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Preparing Young Children for School

Educator's Practice Guide

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Introduction to Preparing Young Children for School

The education children receive in preschool can prepare them to benefit from the learning opportunities they will encounter in elementary school.[1] Children who learn social-emotional and executive function skills in preschool, for example, may be better able to maintain positive relationships, follow directions, exhibit self-control, and learn to deal more successfully with problem situations.[2] Similarly, children who are exposed to and have opportunities to use early mathematics and literacy skills in preschool may gain a deeper foundational understanding of mathematics, language, letters, sounds, and print material.[3] By learning social-emotional, executive function, mathematics, and literacy skills in preschool, children are likely to be better prepared for the higher expectations and more formal curriculum in elementary school.[4]

For the purposes of this guide, preschool education covers the schooling that takes place the year or two before children enter kindergarten—years often referred to as preschool, prekindergarten, or pre-K. Preschool programs include private preschools and government-funded programs like district preschools and Head Start, as well as daycare settings with a formal curriculum serving children who will enter kindergarten within the following year or two.

Ensuring that all children are well prepared for elementary school is a priority for parents, caregivers, guardians, and policy makers.[5] To address this priority, the What Works Clearinghouse™ (WWC), in conjunction with an expert panel, distilled recent contemporary research into seven easily comprehensible and practical recommendations for preschool educators to use to help prepare children for school.

Recommendations 1 and **2** focus on practices to improve children's social-emotional and executive function skills. **Recommendations 3** and **4** focus on practices for helping children understand foundational topics in mathematics. **Recommendations 5, 6,** and **7** focus on ways to improve children's vocabulary, letter knowledge, print recognition, and comprehension.

See the **Glossary** for a full list of key terms used in this guide and their definitions. These terms are underlined and hyperlinked to the glossary when first introduced in the guide.

Overarching Themes

Across these seven recommendations, the expert panel addressed five overarching themes that are central to providing instruction in preschool. The themes are:

- **The importance of intentional instruction**

  The panel believes preschool instruction should be focused, deliberate, and purposeful in directly addressing the specific learning objectives of the lesson. Teachers should set up lessons to include conversations and activities to intentionally help children learn a skill

For the purposes of this guide, a preschool teacher refers to any adult who helps children learn, such as a lead or assistant teacher, paraeducator, parent, or volunteer.

or concept, as well as ample repetition and review to clarify and support learning of both newly learned and previously learned skills and topics. Intentional instruction also includes repeated opportunities for children to practice what they are learning. Teachers can provide specific praise to highlight and reinforce the desired behavior, skill, or understanding children demonstrate as they practice what they learned.

- **The importance of interaction and conversation**

  The panel believes that interaction plays a pivotal role in children's learning. Supportive interactions between teachers and children that are essential for this age need to be prioritized.[6] Children learn more from conversing with the teacher than from listening to teachers talk for extended periods. The panel suggests giving children multiple opportunities to engage in group or one-on-one multi-turn conversations. During these conversations, children can be encouraged to talk about the skills and concepts they are learning in a back-and-forth conversation with the teacher and/or other children. Teachers can also lead interactive activities, such as playing games, singing songs, and reading books, to engage children in learning. These activities should be relevant to and supportive of a wide variety of cultural backgrounds and social experiences.

  Developmentally appropriate instruction for children ages 3–5 involves hands-on activities that keep them engaged. Requiring children to sit still for more than 10–15 minutes, to listen to an adult talking for an extended period, or to complete a worksheet are not appropriate expectations for children ages 3–5. To maintain children's engagement, choose hands-on instructional activities, keep verbal instructions short, and allow children many opportunities to contribute to conversations.

- **The importance of lessons building sequentially**

  The panel believes that each area of learning—social-emotional, executive function, mathematics, and literacy—should proceed in a sequential manner, deliberately and systematically building skills and knowledge. New learning should proceed in a sequenced order, from easy to more difficult skills and concepts, and be based on knowledge of young children's natural development. Teaching of new concepts and skills should build on what children know, adding more challenge as children learn and leading toward skills/knowledge that will help children succeed in kindergarten.

  The panel recommends choosing an evidence-based program or curriculum developed by content experts that follows a sequence of topics in social-emotional, executive function, mathematics, and literacy.[7] Following a sequential program or curriculum, rather than piecing together a variety of activities, can help ensure that learning is being addressed in a developmentally appropriate way.

- **The importance of scheduling time for intentional learning**

  The panel recommends developing a schedule in which intentional instruction time is devoted on a consistent basis to social-emotional learning, executive function, mathematics, and literacy. Note that the amount of time spent on these areas of instruction will vary depending on the length of the preschool day.

  The panel emphasizes that each of these intentional instruction times should fit into the daily routine and accompany the learning opportunities that occur throughout the day. Intentional instructional

time can, for example, be embedded into large-group and small-group activities. Large-group instructional activities can be used to provide a brief explanation or demonstration but should be quickly accompanied by hands-on, engaging activities.

Small groups are an excellent way for teachers to provide individualized intentional instruction and support children while they practice using what they are learning.

Small-group instructional time can be difficult with only one teacher, but it can be successful if teachers are strategic about how to set up their classroom environment. Center activities can be coupled with intentional instructional time, so the rest of the class is engaged in practice opportunities while the teacher works with a small group of children.

The panel suggests training children to appropriately participate in center activities as well as how to move from center to center. It may take several days or even weeks for children to learn what is expected of them during small-group and center activities.[8]

- **The importance of recognizing everyone's backgrounds and experiences**

  The panel recognizes that children come from a wide variety of cultural, racial, and linguistic backgrounds and have different social experiences. The panel believes that preschools should reflect and value the cultural, racial, and linguistic backgrounds of the children, teachers, and community, and provide opportunities for children to learn about various cultures in meaningful ways.

  To make learning more relevant, engaging, and interesting for all children, the panel suggests using culturally responsive practices.[9] The work of incorporating these practices into current materials or curricula may need to be done in collaboration with a curriculum or preschool director. Teachers can consider the following ways of engaging with young children from diverse backgrounds:

  - Learn about the children, their families, and their communities and use this knowledge to adapt teaching, materials, and classroom setup.
  - Ensure classroom teaching materials, such as posters, books, toys, and songs reflect the diversity of the children in the classroom so that children see someone who looks like them.
  - Seek out books that include characters with whom children and their families share identities; ensure that the characters in the books are presented in authentic and positive ways.
  - Encourage children and families to bring their traditions and culturally important experiences to school to share.
  - Display real pictures of the teachers, children, their families, and their communities.
  - Include meaningful, engaging activities from various communities and cultures in the classroom community such as food, music, literature, and celebrations.
  - Read books about different cultures, traditions, countries, and regions of the world.
  - Interact with children in a way that delivers positive messages about their self-identity.
  - Place children in diverse, heterogeneous groups, including, for example, children from homes with differing primary or home languages, income levels, or cultural backgrounds.

Who might find this guide useful

This guide is designed for educators working in preschool classrooms or for those personnel supervising teachers and overseeing educational practices for preschool programs. These educators are referred to as "teachers" in this guide. This guide is also for center and program directors and educational coordinators, as well as district or state personnel involved in adopting curricula for preschool programs. Parents, caregivers, and guardians can also use this guide to understand which features of preschool education might be helpful for preparing children for school.

This guide can be used to guide instructional practices and curriculum decisions. However, teachers may need additional professional development to implement these practices or a new curriculum effectively. The panel suggests that personnel supervising teachers and overseeing preschool programs provide teachers with professional development in social-emotional learning, executive function, mathematics, and literacy development. The type, amount, and frequency of professional development necessary will vary depending on the prior training of teachers, teacher turnover, and the needs of the children enrolled in the program. For example, in preschools with higher turnover of teachers, professional development may need to occur more frequently.

Using evidence to develop the recommendations

A panel of experts was formed to develop this practice guide. The panel includes experts in preschool research and practitioners who deliver or oversee delivery of preschool programs. The expert panel identified seven recommendations based on the available evidence. **Box I.1** describes the process for determining the evidence.

Box I.1. Process for determining evidence for recommendations

A systematic literature search was conducted to identify potentially relevant studies. Studies identified in the search were screened and reviewed to determine if they meet WWC standards. Studies that meet standards were used to inform and provide evidence for the recommendations.

Although some panel members authored articles or interventions that appear in the studies used as evidence for this guide, none of the panel members were involved in evaluating the quality of those studies.

Additional details on the study search and review process are available in **Appendix B**.

The studies that provide the evidence for the recommended practices were conducted in a variety of settings and included children from racially and ethnically diverse families. Most of the studies were conducted in Head Start and government-funded programs and included children who are at risk of low performance in school. Many studies included children from low-income families and some studies included children who are dual language learners. The panel used their expertise to extend these recommendations to all forms of preschool to help all children be prepared for school, including those children who do not have the option of public preschool.

Though the studies that provide evidence for the recommendations in this guide took place in preschools before the COVID-19 pandemic began, the panel believes the recommendations derived from these studies remain generalizable to various preschool settings and circumstances.

Each recommendation includes instructional practices and a short summary of the research evidence that supports the recommendation. **Box I.2** describes the levels of evidence and **Table I.1** shows the seven recommendations and the panel's determination of the strength of evidence.

Box I.2. Levels of evidence

Strong: There is consistent evidence that meets WWC standards and indicates that the practices improve outcomes for a diverse child population.

Moderate: There is some evidence meeting WWC standards that the practices improve child outcomes, but there may be ambiguity about whether that improvement is the direct result of the practices or whether the findings can be replicated a diverse population of children.

Minimal: Evidence may not meet WWC standards or may exhibit inconsistencies, but the panel determined that the recommendation must be included, and the practices are based on strong theory, are new and have not yet been studied, or are difficult to study with a rigorous research design.

More detailed information can be found in **Appendix A** and **Appendix C**.

Table I.1. Recommendations and corresponding levels of evidence

Practice recommendation	Level of evidence		
	Minimal	Moderate	Strong
1. Regularly provide intentional, engaging instruction and practice focused on social-emotional skills.			✓
2. Strengthen children's executive function skills using specific games and activities.		✓	
3. Provide intentional instruction to build children's understanding of mathematical ideas and skills.			✓
4. Engage children in conversations about mathematical ideas and support them in using mathematical language.		✓	
5. Intentionally plan activities to build children's vocabulary and language.			✓
6. Build children's knowledge of letters and sounds.			✓
7. Use shared book reading to develop children's language, knowledge of print features, and knowledge of the world.			✓

How to use this practice guide

The panel suggests that teachers use the recommended practices to help prepare young children for school. Readers are encouraged to use the practice guide to enhance existing curricula or to select a curriculum that intentionally teaches children in the areas of social-emotional learning, executive function, mathematics, and literacy.

- **Recommendation:** This guide includes details about each of the recommended practices and a summary of the evidence supporting the recommendations. **Appendix C** contains a detailed rationale for the level of evidence with supporting details from individual studies.
- **How to carry out the recommendation:** The steps outline guidance on how to implement the recommended practices. This guidance is informed by the studies that support the recommendations in concert with the panel's expertise and knowledge of preschool education. Examples are included to give the reader ideas for how to implement the recommended practices. Examples are not intended to endorse specific products for purchase.
- **Potential obstacles and the panel's advice:** The panel offers suggestions for addressing potential challenges to implementation.

Recommendation 1: Regularly provide intentional, engaging instruction and practice focused on social-emotional skills

Developing social-emotional skills is critical for school readiness for all children.[10] For example, when children enter kindergarten, they will be expected to ask for help, take turns, be kind, and interact with others in a positive way. Instruction in social-emotional skills will help children learn how to share, cooperate, and maintain positive relationships with friends; identify and regulate emotions; and deal with problematic social situations.[11] By focusing on social-emotional skills in preschool, children will be better prepared for the kindergarten setting which has higher expectations and more formal curriculum.[12]

The recommendation presents steps for systematically strengthening children's social-emotional skills. The steps describe selecting a social-emotional curriculum and regularly using lessons from the curriculum in an engaging way. The steps also provide guidance on how to provide frequent opportunities for children to practice social-emotional learning with adult support at school and at home.

The WWC and the expert panel assigned a strong level of evidence to this recommendation based on five studies of the effectiveness of practices to teach social-emotional skills. All five studies meet WWC standards without reservations. See **Appendix C** for a detailed rationale for the Level of Evidence for **Recommendation 1**.

How to carry out the recommendation

1. Follow a curriculum that promotes incremental social-emotional learning

Determine whether the existing curriculum or curriculum supplement covers social-emotional learning systematically. The curriculum should have a scope and sequence and address instruction in social-emotional skills in an incremental manner.[13] If the curriculum in place is theme-based and does not sequentially build social-emotional skills, then consider supplementing that curriculum with an evidence-based program that systematically teaches these skills. **Resource 1.1** lists resources that can help teachers find, select, and learn about evidence-based curricula for social-emotional development.

Start at a point in the sequence that is appropriate for the ages and developmental needs of the children in the classroom. Some children are just starting to learn to express their feelings and interact and cooperate with other children in structured settings. Their social-emotional learning should begin with basic ideas, like identifying emotions, cooperating with others, or sharing space and toys.[14]

Resource 1.1. Sources for locating evidence-based curricula for social-emotional development

1. **Collaborative for Academic, Social, and Emotional Learning (CASEL)**
2. **Blueprints for Healthy Youth Development**
3. **What Works Clearinghouse**

Some children possess limited language, so teaching about emotions can start with four basic feelings–happy, sad, mad, and scared. Once children can identify these basic feelings and are more experienced in social interactions, they can learn to identify when they feel more complicated emotions, such as frustrated, excited, jealous, disappointed, and tired. If children in the class have a variety of starting points or needs, it may be beneficial to provide some tailored small-group instruction to children needing additional support.[15]

Consider cultural differences in the ways children learn to express and regulate their emotions. For example, in some cultures, children may not commonly hear adults or their peers talk about being happy, sad, angry, or frustrated. Some children may find identifying or naming their emotions difficult or uncomfortable. Teachers can help by modeling how to talk about feelings and providing opportunities for children to try talking about their feelings at their own pace and in their own way. When children can talk about their feelings, they may be better able to handle interactions in the classroom successfully, and respond to activities that are exciting, frustrating, or disappointing for them rather than acting impulsively.

2. Intentionally devote time to teaching social-emotional skills in an engaging way

Just as time is set aside for intentional instruction on literacy and mathematics, set aside 10-20 minutes to teach social-emotional skills 1-2 times per week.[16] Then offer time throughout the week to practice the skills.

Consider your classroom schedule and select a time when children would be most receptive to social-emotional learning.[17] For example, plan a brief introductory lesson at the beginning of the week, such as during circle time on a Monday, and follow up with activities (see Steps 3 and 4) the rest of the week to reinforce the newly learned concept or skill.[18] **Example 1.1** provides a sample set of weekly lessons.

Example 1.1. Sample plan for using activities from the curriculum each day

Monday	Introduce children to the concept of deep breathing to calm down when they feel upset. Use conversations and role-plays to show how to take a deep breath to calm down when feeling mad or frustrated. Talk about the way it feels inside and how people look when they feel mad versus calm.
Tuesday	Read a story about getting mad and getting into trouble, such as *When Sophie Gets Angry,* by Molly Bang, or *I Was So Mad,* by Mercer Mayer. Talk about what the characters could have done to calm down when they felt mad. Let children practice looking mad like the characters and taking a deep breath to feel calm.
Wednesday	Let children draw a picture showing their mad feelings and their calm feelings. Ask children to talk about what made them feel mad and how they calmed down.
Thursday	Set up an obstacle course with some physical challenges. Let children choose how to move between the challenge stations. For children with limited mobility, consider challenges with low or adaptive obstacles. Then have children practice taking a deep breath to calm down when they reach each station, so they are ready to try the challenge.
Friday	Read another story that involves a character getting mad or frustrated. Let the children talk about how the characters could have calmed down. Role-play a new ending that shows how the characters could take a deep breath to calm down.

Reinforce throughout the week

- Try to model the process of taking a deep breath to calm down 2–3 times per day.
- Find 2–3 times during the day when the whole class can practice taking a deep breath to calm down, such as morning circle or a transition time, like coming inside from outdoors.
- Watch for children who take a deep breath and praise those children specifically for that behavior.
- Remind children to take a deep breath to calm down when they are starting to get visibly excited or upset.

Teach a new social-emotional lesson in a brief and engaging way to capture children's attention. For instance, rather than simply telling children about how to be kind, use teaching methods like short stories, puppet shows, photographs, or brief role-plays to illustrate acts of kindness.[19] These teaching methods can help make an abstract idea more concrete for the children. For example, the teacher can read a book where a character engages in an act of kindness, such as helping a friend who slipped and fell in the rain. The teacher can also show children acts of kindness with a puppet show with stuffed animals or by modeling kindness with another adult.

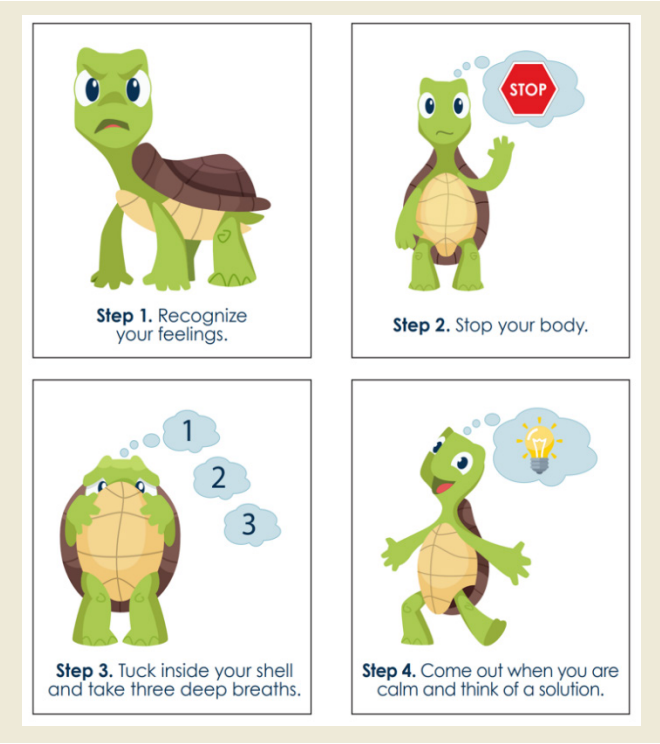
Stories, puppet shows, photographs, or brief role-plays expose children to many different experiences and interactions. This is likely to help children see how they will use their new skills when they find themselves in similar situations. In **Example 1.2**, the teacher uses a turtle puppet and poster to show children how to use the turtle technique to calm down when they are feeling upset.

Example 1.2. Using puppets and visual aids to introduce a social-emotional skill

Children are seated in circle time. The teacher has a turtle puppet in a box and displays a poster of the turtle technique steps.

Teacher: *Today we're going to learn what to do when we are feeling upset. Sometimes we get angry or mad. If this happens for the turtle, there are some really helpful ways to calm down! Should we ask the turtle to teach us how to calm down when we are upset? Turtle, what do you do when you are upset?*

The teacher puts the turtle puppet on one hand to present the puppet to the children. The teacher makes the turtle's arms cross and look visibly upset by shaking and pounding the floor.



Teacher (as the puppet): *I want to go down the slide, but my friend is already on the slide. I am upset. The first thing I do is name my feelings—I'm feeling angry! Next, I think to myself "stop" so I can stop my angry body movements.*

The teacher stops the puppet's angry body movements.

Teacher (as the puppet): *After I stop my angry body movements, I tuck inside my shell and take three deep breaths.*

The teacher tucks the puppet's head and body down.

Teacher (as the puppet): *1, 2, 3…*

The teacher untucks the turtle's body.

Teacher (as the puppet): *Wow, I feel so much better! Now I feel ready to think of a way to fix my problem. I could probably just wait my turn until my friend is done on the slide, and then I can go!*

Teacher: *Thank you for teaching us about how you calm yourself down, turtle! Children, this poster helps us remember what to do next time we need to calm down.*

The teacher then walks through the four steps on the poster with the children again, modeling and asking the children to practice the steps at the same time.

Source: The activity details and poster for the Turtle Technique are freely available through the **National Center for Pyramid Model Innovations (NCPMI)** Teaching Tools for Young Children.

Provide children with vocabulary and phrases they can use to manage their feelings and communicate with others.[20] For example, using role-play or puppets, the teacher can show how to communicate kindness by saying, "I am sorry you fell down. Are you okay?" and offering a helping hand to someone who fell. Engage children in focused conversations by asking questions such as: What was the kind act? How do you know it was kind? How did the person receiving kindness feel? How did the person giving kindness feel?

3. Plan staged activities for children to practice social-emotional skills

Social-emotional learning takes place through repeated exposure and practice.[21] Prepare staged activities that will provide structured opportunities for children to practice what they are learning, rather than waiting for learning opportunities that naturally occur during play time.[22]

Learning social-emotional skills is like learning to ride a bike: Listening to instructions on how to ride a bike does not help one learn to ride. Learning how to ride a bike requires ample practice to master the skill.

This will reinforce understanding of newly learned skills and allow for review of previously learned skills. For example, after showing children how to initiate play with a friend, the teacher stages an activity to provide practice in initiating play in a controlled setting. The teacher forms pairs, and each child in the pair goes through the steps they have learned to initiate play.[23]

Carefully plan and script staged activities in advance.[24] In **Example 1.3** below, the teacher stages an activity to practice and reinforce a previously taught lesson. The staged activity includes reviewing how children can ask a teacher for help, providing children with an opportunity to practice asking for help, and a summary to reinforce the skill.

Reinforce children's learning by providing them with feedback during the staged activities to help them recognize when they are correctly using their new social-emotional skills.[25] Some children are likely to need more practice and support than others. Keep practicing and reinforcing as needed to help these children with their social-emotional learning.

Example 1.3. Staging activities to repeatedly practice and reinforce a skill

1. Review: Role-play with another adult

The teacher first role-plays a situation with another adult, where they show that they are unable to open an activity bag. The teacher thinks aloud, saying, "I can't open this activity bag. I feel *frustrated* and *I need help*." The teacher then looks at the other adult and says, "Can you please help me open this bag?" The adult helps open the bag and hands it back to the teacher. The teacher says, "Thank you."

2. Review: Role-play with one child

The teacher then picks a child to help and selects a string from the bag and says, "I would like to tie this string on my wrist to remind me to share my feelings and ask for help today when I feel frustrated. But it is hard for me to tie a string on my wrist myself." Trying to do it, the teacher turns to the child helper and says, "I feel frustrated. Can you please help me tie this string on my wrist?" If the child has any trouble tying the string, the teacher can say: "I see you feel frustrated too. Who can you ask for help?" After receiving help, the teacher says, "Thank you for helping me."

3. Practice: Additional opportunities for all children

The teacher then lets each of the children choose a string and practice sharing their feelings. The teacher encourages each child to tie a reminder string on their wrist and ask for help if they need it. Other practice activities can involve requesting help for tying their shoelaces, putting on their coats, or picking up heavy objects.

4. Reinforce: Summary of lesson's takeaway

The teacher ends the lesson by summarizing the key points, saying, "Remember, when we are not able to do something on our own, we may feel frustrated. It is okay to feel frustrated. We just have to ask for help and wait."

4. Take advantage of naturally occurring situations to reinforce and review social-emotional skills

The preschool day offers many opportunities to practice skills when children are emotional or interacting with others, such as snack time, waiting to use the bathroom, free play, or transitioning from one activity to another. Use these opportunities to review, practice, and reinforce the target skills. In **Example 1.4**, a teacher helps a child apologize for an accident during free play.

Target social-emotional skills can include:

- Identifying and understanding one's feelings
- Accurately reading and comprehending emotional states in others
- Managing strong emotions and their expression in a constructive manner
- Regulating one's behavior
- Developing empathy for others
- Establishing and sustaining relationships

Source: **Illinois Early Learning and Developmental Standards**

Remind children prior to an activity about what they have learned, including how to manage emotions and interact with others.[26] For example, as children line up to wash their hands, review what the children learned about taking turns and waiting patiently without pushing or cutting the line. Help children remember that they learned that counting could help with waiting.[27] Show them by counting to three out loud.

Monitor and reinforce children when the desired actions or words are seen.[28] For example, a teacher looks around for one or two children waiting patiently for the slide and says, "I noticed Sita and Georgie waiting to take their turn. I saw Sita counting to three to help with the wait."

Example 1.4. Using an accident or mistake to reinforce a social-emotional skill

The teacher sees Ryan trip and accidentally knock over blocks Joe was using to build a tower. Joe starts to protest, yelling at Ryan. The teacher squats down between the two boys. In a calm voice, the teacher says, "I see that we have a problem to solve. Let's take a deep breath first and calm down."

The teacher takes a deep breath along with the children and says, "Now, that helped me feel calmer. Joe, can you tell Ryan what the problem is and how you feel?" The teacher lets Joe talk, restating as needed to clarify.

The teacher asks the children if they have a solution for helping each other feel better. Both children shrug and look away.

The teacher says, "Sometimes we do things that make our friends sad. If that happens, we can say 'I'm sorry' to make them feel better. Ryan, could you tell Joe that you are sorry?" The teacher coaches Ryan through the apology and encourages Joe to forgive Ryan by accepting the apology.

Then the teacher asks, "Do you have any idea about how we can solve this problem?" If needed, the teacher prompts Ryan to help Joe rebuild again and Joe to accept this offer.

Encourage children to look for and recognize the desired behavior in others.[29] Consider teaching children a hand signal, such as a thumbs up, and prompting them by saying, "If you see a friend waiting patiently to take their turn, you can give them a thumbs up! You can also say to your friend, 'Thank you for waiting!'"

Some situations may be too emotionally charged for children; they may not be ready to listen and talk when they are so upset. In these circumstances, it may be more beneficial to wait and have a brief conversation the next day. This can lead to additional practice and review.

5. Inform parents, caregivers, and guardians about the social-emotional skills children are learning so skills can be practiced and reinforced at home

Send a brief note or email to parents, caregivers, and guardians informing them of the social-emotional skill that children are learning.[30] Provide guidance in the note on what parents, caregivers, and guardians could do and say to help their children develop their social-emotional skills.[31] When possible, translate letters into the primary language spoken by the parents, caregivers, and guardians. The panel encourages teachers to consider differences in how families socialize their children and think about the social-emotional skills children are learning at school.

The panel recommends including in the note the specific language or vocabulary that corresponds to the social-emotional skill. For example, if the target skill is *taking turns*, the teacher could highlight the language to use while playing a simple board game, by saying, "It is my turn now, you have to wait," and "It is your turn now, I have to wait." **Example 1.5** depicts a sample note.

Example 1.5. Sample note to parents, caregivers, and guardians

Dear Families,

Children are learning all about feelings this week, including how to name their feelings! Help your child learn more about naming four basic feelings—happy, sad, mad, and scared. Children are learning to say:

I am feeling _____ because _____.

Thank you for your help encouraging your child to name their feelings at home!

Sincerely,

Your Child's Teacher

Teachers may also include in the note simple, easy-to-follow activities that parents, caregivers, and guardians can do with their children to review and reinforce the social-emotional skill, such as reading a book, counting breaths, singing a song, playing a board game, or engaging in an activity that illustrates a target social-emotional skill.[32] Parents, caregivers, and guardians will be more inclined to carry out the activities if they are easy to incorporate into their daily lives, do not require much money or preparation time, and do not take too much time to carry out.[33] Consider sending simple materials home with children to support the activities, like a box of emotion flashcards or images of a character referenced in a book or song.[34] **Example 1.6** gives examples of activities that teachers can recommend to parents, caregivers, and guardians to strengthen children's social-emotional skills.

Example 1.6. Activities to suggest in take-home letters

Children are learning to…	Children will practice this by…
Cooperate/work together	Helping to pick up toys; working together to prepare a meal
Cope with strong emotions	Taking a deep breath or counting breaths to calm down; counting to three to calm down; putting feelings into words
Compromise	Organizing an area of the house together, such as the child's bedroom or play area
Share	Sharing a snack with another family member
Play fairly, take turns, be a gracious winner/loser	Playing a board game as a family; taking turns with siblings for preferred activities, such as choosing which book to read first

Potential obstacles and the panel's advice

OBSTACLE: *I don't see why I need to devote time to social-emotional learning with the whole class. It seems like a waste of time when only three children in my class are disruptive, do not comply, and throw tantrums. The others are well-behaved.*

PANEL'S ADVICE: All children can benefit from practicing social-emotional skills, even those who are well-behaved. Children need to practice and discuss social-emotional skills many times, so they are prepared to use those skills in different situations, including when they enter kindergarten. Additionally, some children hold their emotions inside and do not express when they are upset. Although they may not be as disruptive, those children still need support in learning how to express and manage their feelings.

OBSTACLE: *Some children have behavior that is difficult to manage, and I don't know how to change that.*

PANEL'S ADVICE: Children with more challenging behaviors may need more support with these skills than others.[35] Some children may be disruptive in the classroom with physical or verbal aggression while others may show withdrawn or anxious behaviors. For some children, preschool may be their first exposure to teachers, other adults, or a more formal school or care setting. Others might have experienced trauma or grief. Because of this, children may be at different social-emotional development levels, and some children may need more support in learning how to get along with others and regulate their emotions.[36] Consult with other teachers or administrators about what approach to take to teach social-emotional skills to children who need more support.

OBSTACLE: *I don't know how I will find time to devote to social-emotional learning.*

PANEL'S ADVICE: Blend brief social-emotional learning activities with instruction on other topics, such as literacy, art, and music.[37] For example, intentionally address literacy and social-emotional skills by reading a book that includes social-emotional skills. Similarly, combine social-emotional learning with music by singing a song about social-emotional skills, such as The Calm-Down Song, The Waiting Song, or The Fair Ways to Play Song.[38] During an art lesson, distribute a limited number of crayons for the children to share. This will provide children with practice in both art and problem-solving.

OBSTACLE: *I am using positive classroom management and discipline techniques. Why do I need to promote social-emotional learning separately from those techniques?*

PANEL'S ADVICE: Using positive classroom management and discipline techniques is one important way to support children's social-emotional learning.[39] This includes stating clear expectations for desired behaviors, setting up regular routines to support children during transitions, using specific praise to notice and reinforce desired behaviors, and redirecting children's behavior when needed.[40] Teachers who use these strategies regularly see increases in positive classroom interactions and fewer behavior problems.[41]

However, teachers can take children's skills a step further by intentionally teaching children about social-emotional skills and offering them opportunities to practice their social-emotional skills. Such instruction and practice will help children manage their own behavior rather than relying on external controls for their behavior, such as teacher's use of classroom management and discipline techniques.[42]

Recommendation 2: Strengthen children's executive function skills using specific games and activities

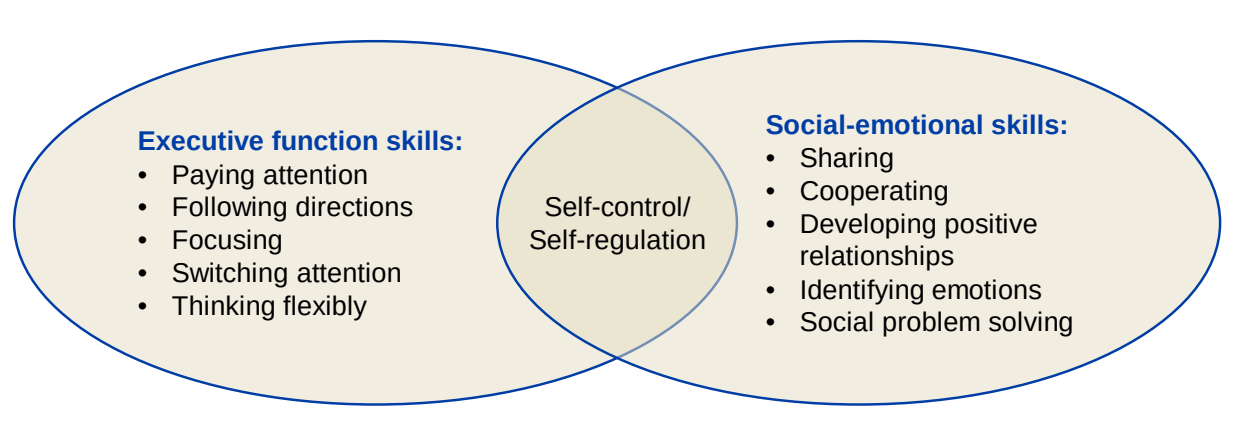
Executive function skills include paying attention, following directions, thinking flexibly, and exhibiting self-control and self-regulation. Developing executive function skills prepares children for challenges they will face when solving problems, remembering instructions, and learning in school.[43] These skills can also help children manage interpersonal conflicts and other emotional situations.[44] For example, when children can think flexibly and shift their attention to consider different aspects of a social situation, they are better able to solve the problem they are facing.[45]

While executive function skills and social-emotional skills are related and often develop together, they are different from one another. **Figure 2.1** shows relationships between executive function skills and social-emotional skills and how they overlap to play a role in children's self-control and self-regulation. These skills work together to help children manage their feelings, thoughts, and behavior.

This recommendation discusses how teachers can plan games and activities to create opportunities for children to build executive function skills. The steps in this recommendation describe the types of games teachers can use and provide guidance on how to transition into these types of activities. The steps also suggest how teachers can make the games more challenging over time and incorporate other activities throughout the day.

The WWC and the expert panel assigned a moderate level of evidence to this recommendation based on four studies of the effectiveness of the use of executive function activities. All four of the studies meet WWC standards without reservations. See **Appendix C** for a detailed rationale for the Level of Evidence for **Recommendation 2**.

Figure 2.1. Relationship between executive function skills and social-emotional skills



How to carry out the recommendation

1. Use intentionally designed games to build children's executive function skills

Use games that are intentionally designed to encourage children to listen to, remember, and follow directions; think flexibly; and exhibit self-control.

- Games that have multiple steps or instructions will help children listen to, remember, and follow directions.
- Games that require children to connect their actions to a visual, oral, or musical cue from the teacher will require children to think quickly and flexibly.
- Games where only certain children, such as children wearing something blue, respond to the teacher's directions at one time will encourage children to calmly wait for their turn.

Playing a game that builds executive function typically lasts about 10-20 minutes.[46] This includes some time to prepare children to play the game and debrief afterward. Practice games multiple times per week. The first time a game is played, choose a single set of instructions that match the children's skill level. Other times the game is played, instructions can be different. **Example 2.1** illustrates games teachers can use to build children's ability to follow directions, think flexibly, and control their impulses.

Example 2.1. Games to practice following directions, thinking flexibly, and controlling impulses

Game	Description
Red Light, Purple Light	*Red Light, Purple Light* is a variation of the game *Red Light, Green Light* often played in schools. During *Red Light, Purple Light*, the teacher tells children which action to do when a color or shape is presented. For example, the teacher could stand at one end of the room and hold up different colors of construction paper circles. The teacher tells the children to stand at the other end of the room and to walk closer when a red circle is up and stop when a purple circle is up. Alternatively, the children can clap when a blue circle is up and hop when an orange circle is up.
The Freeze Game	During *The Freeze Game*, the teacher plays music and provides a set of instructions that encourage children to dance. For example, the instructions could be to dance slowly to slow songs and quickly to fast songs. Tell children to stop when the music stops. Teachers can choose music that the children already enjoy or that comes from the different cultural backgrounds of the children in the classroom.
Drumbeats	In the *Drumbeats* game, the teacher has children move in different ways based on the beat of the drum. Teachers can choose different actions for the children to take, like clapping, stomping, walking quickly, walking slowly, crawling, or hopping. For example, teachers may have children walk quickly to fast drumming, walk slowly to slow drumming, and freeze when the drumming stops.
Which Way? Brain Builder	For the *Which Way? Brain Builder*, the teacher stands at the front of the room with the children standing or seated with space to move around. The teacher tells the children to watch which way the teacher's arms point and make their own arms point the same way. The teacher points both of their arms in the same direction: up, down, left, or right. After the children match the teacher's arm movements, the teacher changes arm positions. Alternatively, the teacher can use a verbal prompt or picture of an arrow instead of an arm motion to show the direction.

Source: Committee for Children, 2013; McClelland et al., 2019; Schmitt et al., 2015: Upshur et al., 2017.

Use a consistent, predictable routine to carry out the game.[47] A routine can help children be calm, focused, and ready to play the game.[48] Circle time may be a good opportunity to introduce a consistent routine for setting up and playing executive function games.[49] A routine should have between three and five steps, with the game included as one of the steps.[50] For example, the first step could be a greeting or song to welcome everyone. Children can clap to the beat of the song, sit in a special spot, hold hands, or dance during this step. The second step could be to introduce the game or activity. The third step could be to have children play the game.

The last step in the routine could be a reflection, another song, or other closing ritual after the game is played. For example, prompt children to reflect on their experience playing the game.[51] Ask them what they liked about the game, how they think the game went, and what they learned. If the game is about taking turns, ask children how the game relates to stopping to think before blurting out an answer.[52]

Resource 2.1 provides a list of resources to use to find additional games and activities to build executive function skills.

Resource 2.1. Sources for activities and games to build executive function skills

- **Center on the Developing Child at Harvard University** Activities Guide
- **Development and Research in Early Math Education (DREME) Network** Math Activity

2. Challenge children by increasing the complexity of games and activities over time

Once children become comfortable with a game and have mastered the initial set of rules, make the game more challenging to help their executive function skills develop further. Increasing the challenge will also help children stay interested and motivated to play the game. Consider changing the game in one of the following ways.

- **Adding more rules to the game.** Creating more rules for a game will make it more challenging for children and require them to use their executive function skills to play the game successfully. For example, for the *Red Light, Purple Light* game described above in **Example 2.1**, add additional colors to the game, like orange or green, and require children to follow different rules when those colors are called.[53] Another option is to add shapes to the game that are not circles, such as purple and orange squares or triangles. This requires children to distinguish between the circles and other shapes to determine when to stop and when to go.
- **Giving less guidance about how to play the game.** Another option is to give less guidance or fewer instructions over time.[54] Teachers may initially provide children with detailed instructions on how to play the game and frequently remind children of the rules. Over time, teachers may give less guidance and fewer reminders to challenge children to remember how they previously played the game.
- **Increasing the speed with which the game is played.** As children get more comfortable with the game, consider speeding up the cues. For example, alternate between the colors in the *Red Light, Purple Light* game, the type of songs in the *Freeze Game,* or the beats in the *Drumbeats* game more quickly, the more the game is played.
- **Changing the rules for the game.** Consider changing the rules of the game periodically. This will prompt children to adapt to new rules. Change the rules for a game by asking children to do the opposite of what they have been doing or add new rules to the game. For example, for the *Red Light, Purple Light* game, reverse the instructions, so children walk forward for the purple circle and stop for the red circle. For the *Freeze Game*, ask children to dance quickly to slow songs and slowly to fast songs. For the *Drumbeats* game, children can walk slowly to quick beats and walk quickly to slow beats. In **Example 2.2**, the teacher switches the rules.

Example 2.2. Game where rules are changed

The teacher uses a dog puppet and a cat puppet to lead children in a game. The teacher asks the children to follow the commands of the dog puppet and ignore the commands of the cat puppet. The teacher uses "nice" and "mean" voices to help children remember which puppet to obey. To make the game more challenging, the teacher switches the rules, so children have to listen to the commands of the cat puppet and ignore the commands of the dog puppet.

Source: Zelazo et al., 2018.

- **Changing the roles that children play in a game.** At first, teachers may lead a game and give children instructions to follow. Then, as children become more familiar with the game, teachers can select a child to lead the game and have them give directions for the rest of the children to follow.[55] In **Example 2.3**, a child goes from being a follower to a leader in a game of *Simon Says*.

Example 2.3. Game where children go from being a follower to being a leader

The teacher begins a game of *Simon Says* and gives commands that children follow. After a few commands, the teacher selects a child to act as Simon and give the commands. The teacher picks a different child to lead the game each day so that all children eventually can be a follower and a leader in the game.

Consider the ages and developmental level of the children in the classroom when changing a game. Younger children may only be able to play one game with one rule, while older children may be ready to play more complex games with multiple rules. Support children during a game and adjust the level of complexity just enough so children are engaged, but not discouraged.[56]

When making a game more complex, encourage children to notice what is making the game more difficult.[57] Ask them what they need to do now that the game has changed.[58] This can help children learn to pause, step back, and act deliberately when faced with a challenging situation or problem to solve.[59]

3. Embed executive function activities in literacy, math, art, or other parts of the day

Provide ongoing practice in using executive function skills by creating opportunities for children to think flexibly, follow directions, problem-solve, or exercise self-control throughout the day.[60] Executive function activities prompt children to plan and problem-solve.[61] During these activities, reinforce and praise children when they exhibit executive function skills, such as waiting their turn, paying attention, remembering instructions, or exercising self-control by raising their hand before blurting out an answer.[62] **Example 2.4** suggests ways in which teachers can embed this practice in other activities while outside, during literacy and mathematics instruction, or during arts and crafts.

Example 2.4. Executive function activities to do during literacy, mathematics, and arts and crafts

Skill being practiced	When to practice	How to practice
Following directions	Outside play time	Play *Simon Says*. In *Simon Says*, one person is the leader and calls out actions to the classroom. If the leader says, "Simon says" before the action, then the class follows the action, such as "Simon says stand on one foot." If the leader says an action without saying "Simon says" first, then the class does not follow the action. If a child follows an action and the leader did not say "Simon says" first, then that child is out of the game.
Remembering multiple items in a list	During literacy instruction	Read a book with repetitive information like *The Very Hungry Caterpillar,* by Eric Carle, and prompt children to remember what the caterpillar already ate.
Planning, problem-solving	During mathematics instruction	Give children a project that involves multiple steps to complete and gets more complex at each step. Have children use blocks to build different types and sizes of towers. Have them start by building a tower three blocks high using blocks of the same size. Gradually make the towers taller and use differently sized blocks. For example, the next tower could be five blocks high and use large blocks on the bottom and small blocks on top.
Following directions, taking turns	During arts and crafts	Assign children to small groups. Have them take turns completing a multi-step activity. For example, to make a picture of a snowman, have each child cut out a piece of a snowman and then have the children take turns pasting their pieces onto a poster in the right order.

Provide additional opportunities for practice beyond games and activities. Ask children to engage in "think time" before raising their hand or to show nonverbal agreement by nodding their head or a thumbs up when another child or the teacher is giving an answer to practice self-control.[63] Randomly call on children in group activities to bring children back to focus. Reinforce and praise children paying attention but sitting quietly.[64]

Potential obstacles and the panel's advice

OBSTACLE: *Isn't executive function just a part of social-emotional learning? I don't understand why I need separate activities to teach each skill.*

PANEL'S ADVICE: Executive function and social-emotional skills are different, but they work together to help children control their thoughts, feelings, and behavior. Even though these skills often develop together, the activities used to build each of these skills are distinct, and they look different for children of different ages. The panel recommends approaching social-emotional instruction and executive function activities separately to ensure that learning objectives are clearly defined. Approaching social-emotional instruction and executive function activities separately ensures that children are not overwhelmed with too many new concepts in a short time.

OBSTACLE: *I tried increasing the complexity of the games we play in the classroom, but the children became confused.*

PANEL'S ADVICE: Make changes in small increments.[65] Avoid making a game too difficult too quickly because children can become overwhelmed when games have too many rules or activities are too complex. If children feel confused, step back and simplify the game or activity. Children may need more practice with a simpler game before they are ready to move on to more complex rules or instructions. It might also help to display the steps of the game or activity with pictures on a poster. Additionally, don't let games or activities go on for much longer than 10-20 minutes because children may lose interest. Shorten longer games and adapt them to what children *can* do before challenging them with a longer or more complicated version of the game.

Recommendation 3: Provide intentional instruction to build children's understanding of mathematical ideas and skills

From an early age, children's natural curiosity may help them develop some informal intuitions about mathematics.[66] However, children also benefit from more intentional activities and conversations designed to help them actively make sense of mathematics and develop a deeper understanding of mathematical ideas and skills.[67] Children who develop these deeper understandings in preschool are better prepared to learn from the more formal mathematics instruction that they will encounter in kindergarten and beyond.[68]

While preschools often help children develop reading-related skills by devoting time to literacy instruction every day, preschool instruction in mathematics is less frequent and shorter, often only covering topics like counting and naming shapes.[69] The panel recommends intentionally planning lessons that will help children develop understandings beyond these basic mathematical skills. This means planning a specific time nearly every day to focus on more formal mathematical skills in numeracy, geometry, measurement, and patterning.[70]

Basic mathematical skills include counting, naming shapes, and creating patterns.

The steps in this recommendation guide teachers on how to provide small-group mathematics instruction, what to teach by extending instruction beyond basic mathematical skills, and how to provide instruction on mathematical topics in an incremental and sequential manner.

The WWC and the expert panel assigned a strong level of evidence to this recommendation based on 15 studies of the effectiveness of the use of intentional mathematics instruction. Thirteen of the studies meet WWC standards without reservations, and two studies meet WWC standards with reservations. See **Appendix C** for a detailed rationale for the Level of Evidence for **Recommendation 3**.

How to carry out the recommendation

1. Provide small-group instruction to build children's foundational understanding of mathematics

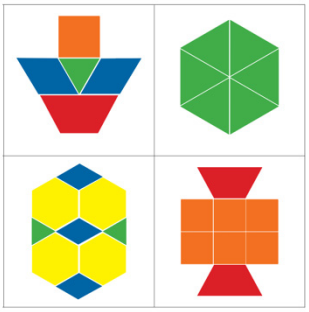
The panel recommends working with a small group of children to provide intentional mathematics instruction, while the other children are engaged in activities at other centers or with a co-teacher or aide. When teaching small groups, teachers can hear from all children multiple times. Teachers can engage children in multi-turn conversations and tailor instruction to meet children's needs.

Dedicate at least 15–20 minutes nearly every day to small-group mathematics instruction.[71] Plan lessons that will intentionally help children learn a foundational mathematical idea or skill, rather than waiting for mathematical topics to occur naturally during the day.

Start by engaging in a brief conversation about the target mathematical idea or skill. Follow up with an engaging, interactive hands-on activity that has been chosen intentionally to help children apply that new idea or skill.[72] Demonstrate how to carry out the activity before having children engage in it.

In **Example 3.1**, the teacher provides a hands-on activity where children use pattern blocks to put several shapes together to create a design. This activity is intended to build children's knowledge of shape and space.

Example 3.1. Children use pattern blocks to copy designs



The teacher creates a design with pattern blocks and asks the children to take a moment to observe the design carefully. The teacher asks students to name the shapes and describe their characteristics.

The teacher leaves the original design visible and asks the children to use pattern blocks to copy the design.

The teacher then asks the children to check their design by asking, "Does your design look the same as mine?" Afterward, the teacher can create new designs for the children to copy.

Example 3.2 showcases another engaging activity. In this example, children play a number-path game that the teacher created to provide practice in counting and number recognition. In a number-path game, children move an object a certain number of spaces along a number path. Playing number-path games can support children in learning important counting strategies such as counting on from a number other than one. For example, start counting from 7 instead of starting at 1.

In this example, children know how to count to 10, so the game includes 10 spaces. For children who know how to count to 20, the game can include 20 spaces. This game can be easily created using markers on a sheet of paper. Teachers can provide children with a game spinner or a set of dice. Depending on children's skill level, the spinner or dice can include only +1 and −1 or can include +2 and −2. It can also be played by drawing a number path with chalk or outlining one with tape on the ground for children to walk on.

Example 3.2. Children play a number-path game to practice counting and number recognition

Each child takes a turn to play. It is Asha's turn. Asha's block is on number 3.

Asha spins a spinner to see how many spaces to move. The spinner lands on number 2.

Asha takes the block, which is on 3, and "counts on" from 3. Asha counts, "4, 5" while moving the block 2 spaces and places it on 5.

Source: Game adapted from Ramani and Siegler, 2011. Photo provided by the Ben and Maxine Miller Child Development Laboratory School at Purdue University.

Adapt activities based on children's knowledge and experience.[73] In **Example 3.1**, for children who can easily compose the figure, the teacher can provide more complex designs to form with the blocks. Similarly, when teaching about *more* and *fewer*, the teacher can provide less experienced children with sets of objects to compare that clearly have different quantities, such as a set of 10 crayons and a set of 2 crayons. Children who are more experienced can compare sets of objects that have similar quantities, such as a set of 6 crayons and a set of 7 crayons.

Also select materials that can be tailored to children's knowledge and experience. If children are learning to measure, for example, choose materials that allow them to measure up to a number they can count. Children who are just learning to count to 5 can be asked to measure items in the classroom that are up to 5 cubes long or 5 squares of paper long. Children who can count to 20 can measure with larger numbers of cubes or paper squares.

Be sure to engage children in multi-turn conversations about the target mathematical ideas or skills throughout the lesson. Ask children to share their thinking about the activity and their learning.[74] Respond to each child to reinforce the mathematics they are explaining. Ask questions that encourage children to respond with more than one-word answers. See **Recommendation 4** for guidance on supporting children's understanding of mathematical ideas through questions that encourage more detailed answers.

Repeat activities several times to provide children with plenty of practice in applying the new idea or skill. Provide specific feedback as children begin to understand how to do the activity. When children apply an idea or skill accurately, tell them what specifically they did right, such as "You counted from 1 to 5 correctly!"

Provide prompts or hints to guide children when they have difficulty with the activity. For instance, in **Example 3.1**, the teacher can provide more support to less experienced children by providing a hint to get the children started. The teacher could place a block such as the green triangle and ask the child, "What can we place below the green triangle?" Some children may also need a review of earlier foundational mathematical ideas, such as the name of shapes or how to count smaller amounts.

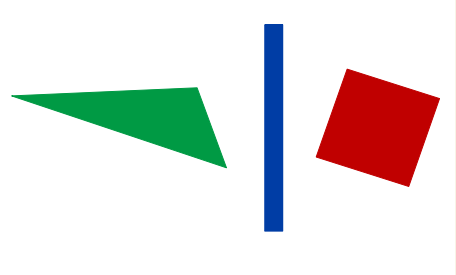
2. Extend mathematics instruction beyond basic skills to include more advanced mathematical ideas

Most preschools focus on verbal counting, shape naming, and numeral identification.[75] However, mathematics instruction at this age should extend beyond these basic topics to include more advanced mathematical ideas.[76] Below are some advanced mathematical ideas that children in preschool would benefit from learning:

- **Characteristics of shapes**: When children are easily able to recognize and name basic shapes, prompt them to describe the characteristics of shapes such as the sides, curves, and angles.[77] Ask them questions such as "How do you know this is a rectangle?"

  The panel also recommends having children identify and discuss less typical shapes and include shapes in different orientations than the children are used to seeing. For example, have children work with a long and narrow rectangle, a triangle with unequal sides, or a square that is shown at an angle. **Figure 3.1** provides examples of less typical shapes.

Figure 3.1. Less typical shapes



- **Measurement:** Include instruction on measurement during mathematical activities.[78] For example, set up a measurement scavenger hunt. After demonstrating for children how to measure objects using classroom items, such as interlocking counting cubes, ask children to find objects based on *clues about the object* and the *length of the object*. For example, "Can you find something you use to paint that is 6 cubes long?" When children no longer need clues about the object, ask the children to find objects based only on the length, such as "Can you find something that is 4 cubes long?"
- **Subitizing**: Provide opportunities for children to practice subitizing.[79] Subitizing is the ability to see a small number of objects and instantly know how many are in the group without counting.[80] Subitizing can be practiced with many different materials, including crackers at snack time, beads during art time, and other items readily available, like paper clips. Consider using dice or playing cards to provide children with opportunities to subitize numbers of dots or other shapes. For example, children can roll a die and quickly say the number of dots on a side.
- **Number relationships**: Teach children about number relationships, which can help them represent a quantity in multiple ways.[81] When children understand number relationships, they can think of the quantity of 4 as a set of 3 and 1 or as 2 sets of 2. Consider using a ten-frame or a number rack such as a rekenrek to help children to visualize quantities.[82] **Example 3.3** shows how a teacher introduces a rekenrek to show children how to make the quantity of 5 in more than one way.

Example 3.3. Teacher introduces a rekenrek to show different arrangements of five beads

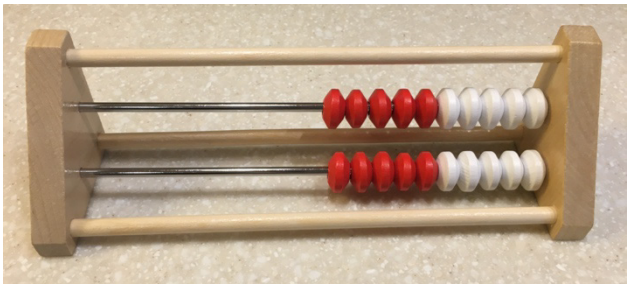
Teacher: *This is a rekenrek. Can you say "rekenrek?"*

Children: *Rekenrek.*

Teacher: *Look at the rekenrek. You can touch it.*

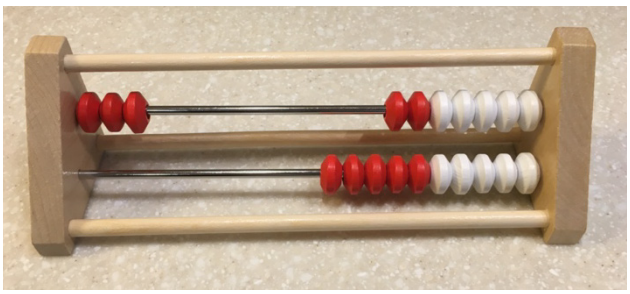
Children explore the rekenrek.

Teacher: *A rekenrek can help you get very good at counting. We always start with the beads on this side. (Points to right side). Can you put the rekenrek in the starting position with all the beads over here? (Points to right side.)*



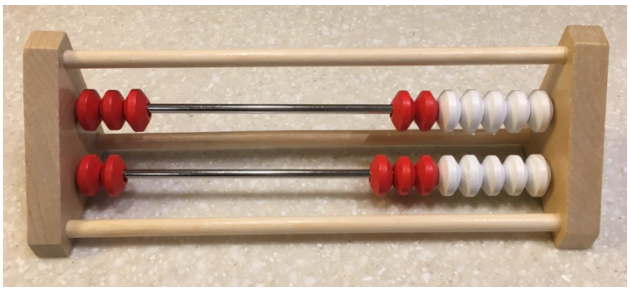
Children put all the beads on the right side.

Teacher: *Okay, now we are going to show numbers on the rekenrek. First, can you show 3 on the top row by moving them over here? (Points to the left side.)*



Children move 3 beads from the right to the left in the top row.

Teacher: *Now, can you show 2 on the bottom row by moving them over here? (Points to the left side.)*



Children move 2 beads to the left on the bottom row.

Continued on next page…

Example 3.3. Teacher introduces a rekenrek to show different arrangements of five beads *(continued)*

Teacher: *Okay! Now, if we have 3 on the top (points to the top row) and 2 on the bottom (points to the bottom row), how many beads are there altogether?*

Children: *Five!*

Teacher: *So, 3 and 2 make 5! What other two numbers can make 5? Let's find out! Let's put the rekenrek back in the starting position.*

Children move all beads to the right side.

Teacher: *Can you show 4 on the top row?*

Children move 4 beads from the right to the left in the top row.

Teacher: *Can you show 1 on the bottom row?*

Children move 1 bead from the right to the left in the bottom row.

Teacher: *Okay! Now, if we have 4 on the top* (points to the top row) *and 1 on the bottom* (points to the bottom row)*, how many beads are there altogether?*

Children: *Five!*

Teacher: *So, 4 and 1 make 5* (points to the left side)*, and 3 and 2 also make 5. You can make 5 in different ways!*

After introducing the rekenrek, the teacher asks pairs of children to work together with rekenreks to show different arrangements of 4 and 6 beads. The teacher asks questions to encourage children to explain how they know the arrangement shows the correct number of beads. The children and teacher engage in a multi-turn conversation about number relationships.

3. Build children's mathematical knowledge and skills in an incremental and sequential manner

Children's knowledge of mathematical ideas and skills builds incrementally over time, following typical natural developmental progressions.[83] The panel recommends using a curriculum that develops skills in an incremental way aligned to these progressions.[84] If the curriculum being used is theme-based and does not develop early skills sequentially, consider adopting a curriculum supplement that follows children's developmental progressions such as one that uses early mathematics learning trajectories to provide an intentional sequence of mathematics instruction and activities.

What is a developmental progression?

Developmental progressions in mathematics are the order in which mathematical skills and understanding typically develop. For example, children learn to recognize and name shapes before they are able to combine or separate shapes to form new ones.

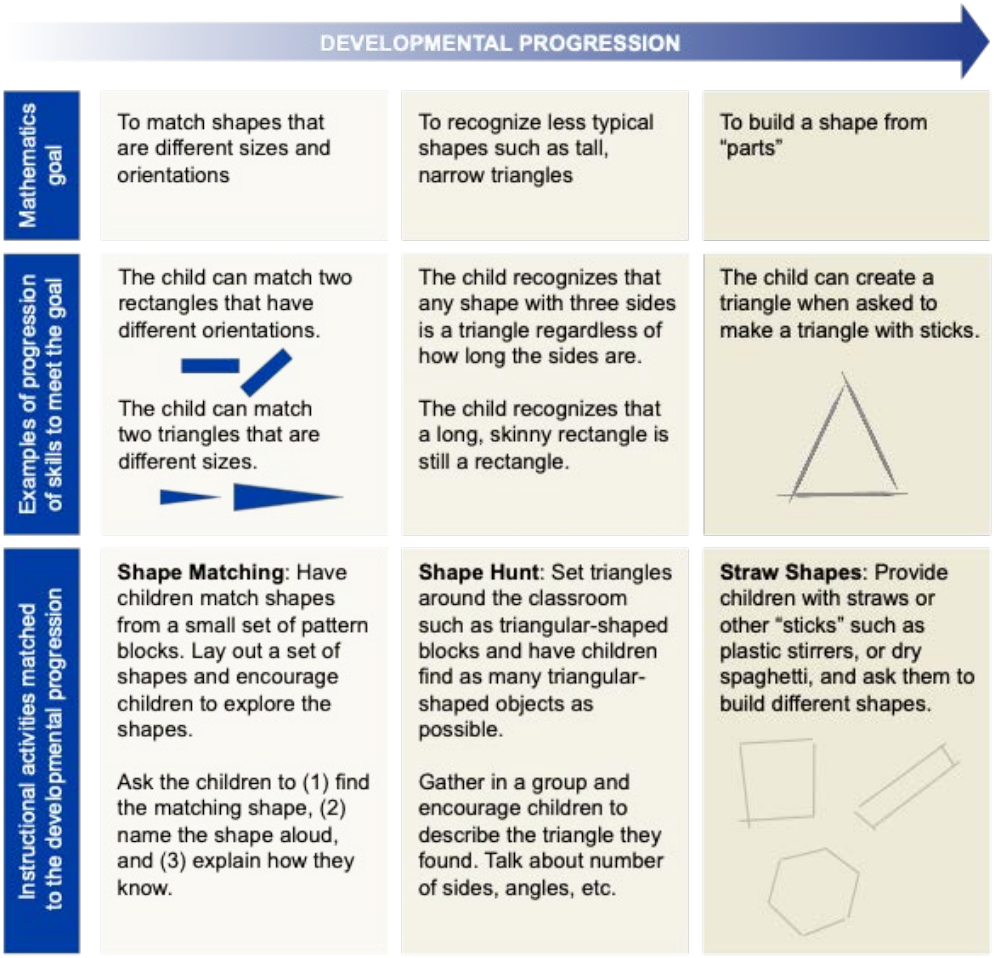
Learning trajectories link instructional activities to specific points in developmental progressions.[85] Teachers can use learning trajectories to decide which instructional

For additional guidance on how to use developmental progressions for teaching mathematical ideas and skills, see ***Early Childhood Math: Number and Operations*** by Regional Educational Laboratory Central.

activities to do with children and in what order. Consider teaching children to recognize atypical shapes such as a long, skinny triangle, or a slanty, oblique triangle. The teacher can begin by first making sure the children can recognize and name typical-looking triangles with activities such as shape matching. During a shape matching activity, children find two matching shapes in a set of pattern blocks and name the shape. Once the children can recognize and name shapes, the teacher can introduce activities that help children recognize less typical shapes, such as shape hunt with triangles that are both typical and atypical hidden around the classroom.

Figure 3.2 depicts an expanded example of a learning trajectory for learning about shapes. This learning trajectory outlines mathematics goals, an example of a progression of skills toward meeting the goals, and the instructional activities teachers can have children participate in to help them build the knowledge and skills children need to be ready for the next goal.

Figure 3.2. A partial learning trajectory for learning about shapes



Sources: Adapted from Learning and Teaching with Learning Trajectories, Clements and Sarama, 2017/2019.

To figure out where children are in their developmental progression, observe children during mathematics lessons and during conversations about mathematics. Note what the children know well and what they are still working on. Record observations about children's knowledge to refer back to and guide decisions about which activities to use next. **Example 3.4** provides an example of an observation sheet a teacher can create to help keep track of children's skill development. The skills are ordered down the left side of the page following the developmental progression for building skills related to number knowledge.

Example 3.4. Teacher-made observation sheet of selected skills related to number knowledge

Skill	Task	Date	Observation	Level of understanding
MATHEMATICS				
Number knowledge				
Using cardinality to show that the last number counted indicates "how many"	Have the child count a small set of items and ask the child to report "how many" items there are after counting.	*Nov. 22*	*I asked Miguel to count out a set of five beans I put in a cup. Then I asked Miguel, "How many beans are there?" and Miguel responded by saying "Five beans!"*	(Got it) Getting it Not yet
Subitizing to five	Show the child a small set of items, then hide the items before the child can count them. Ask the child to recognize how many items there are without counting.	*Feb. 10*	*First, I showed 1 dot and then quickly covered it. I asked Daiyu to hold up how many fingers corresponded to the number of dots on the plate. Then I showed 2 dots, covered them quickly, and asked Daiyu the same question. I repeated the process with 3, 4, 5 dots. Daiyu could subitize up to 3 but had a hard time with 4 and 5 dots.*	Got it (Getting it) Not yet
Understanding the concept of "one more"	Have the child count a small set of items. Then hide the items and ask the child to say how many "one more" will be without recounting a group of items.	*March 8*	*I showed 5 dots to Aamir and asked Aamir to count them. Then I covered the dots and asked Aamir to add one more without uncovering and recounting the dots. Aamir got it right after several attempts with different numbers.*	Got it (Getting it) Not yet

Source: Adapted from Center for Early Learning, Early Learning Matters (ELM) Curriculum, 2018.

Potential obstacles and the panel's advice

OBSTACLE: *The children can't sit still and listen when I try to explain a mathematical idea or have them complete worksheets.*

PANEL'S ADVICE: Developmentally appropriate instruction for children ages 3-5 involves activities that keep them engaged. Requiring children to sit still for more than 10-15 minutes, to listen to an adult talking for an extended period, or to complete a worksheet are not appropriate expectations for children ages 3-5. To maintain children's engagement, choose hands-on instructional activities, keep verbal instructions short, and allow children many opportunities to contribute to conversations.

OBSTACLE: *I like to include a mathematics center activity for the other children to do when I am working with a small group, but the children at the center get distracted or bored quickly.*

PANEL'S ADVICE: Children may appear bored or distracted when they do not understand how to engage with the materials in a center activity. When creating a mathematics center, make center activities hands-on and engaging and make sure to model for children how to engage with the materials. Teachers can introduce and model how to use the center materials during circle time, or individually as children are exploring the center activity.

Teachers can also move learning centers to different areas and change learning center materials every few days or each week to maintain children's interest. Learning centers can be set up anywhere in the classroom, such as a tallying station on the classroom door, buckets of different materials to count on the playground, magnetic shape tiles on a table, or using relevant mathematical materials in the art or dramatic play areas.

OBSTACLE: *We spend much of our circle time in the morning working on the calendar as our mathematics activity. There is not much time left for other math activities.*

PANEL'S ADVICE: Calendar time is important for learning days of the week, months of the year, weather, and holidays, but it does not teach the fundamental mathematical ideas that are developmentally appropriate for children.[86] The panel recommends replacing or supplementing calendar time with developmentally appropriate, intentional mathematics instruction.

OBSTACLE: *We teach mathematics daily to the whole class. I get frustrated because some children can count very high, and others struggle to count to 5. I don't want to keep boring some of the more experienced children while frustrating those with less counting experience.*

PANEL'S ADVICE: Brief whole-class activities can be used to introduce the mathematical ideas or skills that the children will be learning about. However, these whole-class activities should be paired with small-group activities intended to provide children with opportunities to apply the mathematical idea or skill. Instruction during small groups can include support for children who are struggling to learn a new idea or skill, and additional, more challenging practice for children who have more experience with the idea or skill.

Recommendation 4: Engage children in conversations about mathematical ideas and support them in using mathematical language

Young children encounter many situations throughout the day that involve mathematics—[87]while they play games, enjoy snack time, or learn to share. Teachers can help children notice and talk about the mathematics around them. Children can learn to talk about mathematical ideas and skills like *adding* and *subtracting*, how shapes have features like *sides* and *angles*, or whether the class has *too many* or just *enough* granola bars for everyone at snack time.

Mathematical language plays an important role in young children's learning of mathematics.[88] When children understand and practice using mathematical language, they are better prepared to learn from mathematics instruction and engage in conversations that include mathematics.[89]

Mathematical language is the language used to talk about mathematical ideas and skills.

To effectively learn mathematical ideas and skills, children need many opportunities to hear and use mathematical language.[90] This recommendation presents steps for providing opportunities for children to hear, learn, and use mathematical language. The steps in this recommendation will guide teachers on how to explain the meaning of mathematical language, conduct a math-focused shared book reading, and engage children in conversations about mathematics.

The WWC and the expert panel assigned a moderate level of evidence to this recommendation based on five studies of the effectiveness of teaching and using mathematical language. Three of the studies meet WWC standards without reservations, and two studies meet WWC standards with reservations. See **Appendix C** for a detailed rationale for the Level of Evidence for **Recommendation 4**.

How to carry out the recommendation

1. Introduce and explain the meaning of mathematical language during intentional mathematics instruction

The panel recommends introducing and explaining mathematical language during intentional, small-group mathematics instruction (see **Recommendation 3** for more information on intentional mathematics instruction). Some curricula may provide a glossary of mathematical words and phrases to teach and use. If a curriculum does not provide a list, identify mathematical words and phrases related to the focus of the intentional mathematics instruction that are common and appropriate for 3-5-year-olds. **Table 4.1** provides a list of some common mathematical words and their primary topic areas.

Table 4.1. List of some common mathematical words and their primary topic areas

Mathematics topic area	Words
Numeracy	amount, most, many, least, more, a lot, less, fewer, fewest, equal, add, combine, subtract, first, second, third, last, same, similar, different
Geometry	triangle, circle, square, rectangle, rhombus, trapezoid, hexagon, point, round, straight, diagonal, flat, line, corner, angle
Measurement	longer, shorter, wide, narrow, distance, measure, length, half
Patterns	pattern, repeat, continue, extend, alternate, guess, predict, match, order, sequence
Note: This list is not comprehensive. It contains only a sample of mathematical words that can be taught in preschool.	

The panel recommends starting with simpler words, such as *long* and *short,* and gradually introducing more complex words with similar or contrasting meanings, such as *longer* or *narrow*.[91] For example, once children understand the word *less*, the teacher can introduce a related word by saying, "Look, this person has the *least*; that means they have *less* than all the others," when contrasting more than two amounts.

Explain the meaning of the words and phrases using words children already know and provide concrete examples to explain their meanings.[92] For example, when explaining what the word *equal* means regarding quantities, display two equal numbers of objects for the children and say, "These two groups of blocks are equal; that means they have the *same amount*. Each group has three blocks." When discussing the idea of *more* and *less*, show a container filled to the top with water to demonstrate the idea of *more* and show a same-sized container of water with only a small amount to show the idea of *less*.

Gestures can also be used to help children understand mathematical language. For example, when counting *side lengths* on a shape block, the teacher can run their finger along the side of the shape while counting "Onnneee *side*..., twoooooo *sides*..." to show the child that the entire segment is the side.

2. Conduct a math-focused shared book reading activity several times each week

Math-focused shared book readings–sometimes called interactive read-alouds–can be used to broaden children's mathematical language.[93] Shared book readings provide opportunities for children to hear new mathematical language and engage in conversations about the mathematical ideas or skills.

Choose age-appropriate books that are likely to be interesting and that include important mathematical content.[94] The panel recommends ensuring that the text and illustrations accurately depict the mathematical idea or skill children are learning or reviewing. Be sure, for example, that books accurately name shapes. A book may inaccurately refer to a tilted square as a *diamond* or refer to a slice of pizza as a *triangle* when the pizza slice does not accurately represent a triangle. **Table 4.2** suggests ways to choose books that will support development of mathematical language by different topic areas.

Shared book reading is when teachers and children look at a book together, and the teacher reads the book aloud and asks children to participate, by either retelling or connecting to parts of the story, asking questions, or answering questions. Interactions and conversations around books can take place in large and small groups.[a]

[a] Pentimonti et al., 2012.

Table 4.2. Suggestions for choosing a book for math-focused shared book reading

Mathematics topic area	Suggestions	Examples of books
Numeracy	• Choose books with pictures that are clear and easy for children to see. • Find books that provide opportunities for mathematical ideas like counting, adding, or taking away.	• *Anno's Counting Book*, by Mitsumasa Anno • *Mouse Count*, by Ellen Walsh • *Zero is the Leaves on the Tree,* by Betsy Franco
Geometry	• Find books that show different shapes in many ways, such as in the environment.	• *Mouse Shapes,* by Ellen Walsh • *Round is a Tortilla,* by Roseanne Thong • *The Greedy Triangle,* by Marilyn Burns
Measurement	• Look for books that depict measurement tools, such as rulers, or use measurement terms, such as feet, inches, heavy, or light. • Find books that include images that can be measured.	• *Balancing Act,* by Ellen Walsh • *Inch by Inch,* by Leo Lionni • *Who Eats First?,* by Ae-hae Yoon
Patterns	• Look for books that show patterns.	• *Anno's Magic Seeds,* by Mitsumasa Anno • *Two of Everything,* by Lily Toy Hong • *Mr. Noisy's Book of Patterns,* by Rozanne Williams

Source: Adapted from the **DREME Project**.

Before reading to children, the panel recommends taking time to read the book and get comfortable with the story. Identify words and phrases to emphasize, and questions to stimulate conversation about the mathematics in the book.[95] Use sticky notes or note cards to mark when to pause to discuss relevant mathematical language or engage the children in conversations about the mathematical content. Note any questions that might prompt children to think about the mathematics and respond using the words and phrases they are learning.[96] **Example 4.1** provides suggestions for how to talk about mathematical content in a book.

Example 4.1. Suggestions for how to talk about mathematical ideas in a book

Numeracy:

- "Wow, there are so *many* frogs on this page! I don't know if I can count them all. Can you help me count them?"
- "Do you think there are *fewer* cars on this page? Or *fewer* trains? Let's count and see!"
- "The mouse ate *one more* cookie! How many did the mouse eat *altogether*?"

Geometry:

- Notice the shapes and ask children to describe their attributes.
- Ask children how they know a shape is a triangle, etc.

Measurement:

- Notice that one thing on a page is bigger or smaller than another: "The green dinosaur is *taller* than the red dinosaur. The red dinosaur is *shorter*."

Patterns:

- Notice that there is a pattern in the numbering of the pages in a book. Say, "We are on page 4. What number do you think is on the next page?" "What is the *pattern*?" "Each page is *one more*!"
- Notice that there is a pattern in a picture. Say, "I see a *pattern* here that uses red-red-yellow-yellow-red-red-yellow-yellow. What color would come next if the pattern continued?"
- Notice and think aloud about the pattern: "Oh! I think I see a pattern here"; then ask the children "Do you see a pattern? What pattern do you see?" Continue the conversation by asking, "If the pattern continues, what might come next?"

The panel recommends reading the same book 3–5 different times during separate math-focused shared book readings. During the first reading of a book, ask simple questions. Then ask more complex questions during later readings.[97] For example, during the first reading of a book with shapes in it, talk about the shape names. Say, "Oh! This looks like a shape; I wonder what shape this is…" Encourage children to answer with the names of shapes. Help children recognize the shapes and make sure they are familiar with the shape names. During the second reading, ask questions such as, "How did you know this shape was a square?" During the third reading, ask more advanced questions like, "If you put two of these triangles together, what shape might it make?"

After each shared book reading session, talk with children about the mathematical ideas or skills and language they learned. Ask questions that encourage children to discuss mathematical ideas or skills in

connection to their lives.[98] For example, *Ten Friends* by Bruce Goldstone discusses inviting friends to tea in groups of numbers that add up to 10, such as nine bears and one forest ranger. After reading the book, ask children, "Which friends would you invite to tea?" Listen closely to children's comments and expand on their responses.[99] For example, if children say they would invite "dogs and cats" to tea, follow up by asking, "If you invited two dogs and seven cats, how many friends would come to tea?"

3. Engage children in conversations about the mathematical ideas and language they are learning throughout the day

Take advantage of natural opportunities to encourage children to talk about the mathematics they are learning. Teachers can do this by engaging children in conversations about the mathematics throughout the day.[100] The panel recommends finding ways to use new mathematical language many times during conversations to provide children with multiple opportunities to hear and review the words and phrases. For example, if the children are setting the table for lunch, the teacher can say, "This napkin is folded into a triangle! How do we know this is a triangle?" Or, if a child is collecting sticks during free play time outside, the teacher can say, "You found some sticks. Can you count them?" If the child says, "one, two, three, four," the teacher can follow the counting with, "Four! You counted to four! That means you have four sticks."

Ask questions that will encourage more than one-word answers to encourage children to think and talk about the mathematics. Ask questions during mathematics activities and prompt conversations that encourage children to verbalize their thinking and provide more details.[101] **Example 4.2** provides examples of questions that will encourage children to provide more detailed answers.

Example 4.2. Questions that encourage more detailed answers

1. How do you know this is a rectangle?
2. Which tower is taller (or longer)? How do you know?
3. Why do you think this tower is tall and this one is short?
4. How can you tell that this pile of leaves is bigger?
5. How many crackers do you think will fit in the bowl? How could we find out?
6. Which pile of blocks has more? How do you know?
7. How could we share this so that everyone has the same amount?
8. Are these two pieces the same shape or different shapes? How do you know?

As children answer these complex mathematical questions and engage in mathematical conversations, the panel recommends prompting children to use mathematical words and phrases in their responses. If children respond without using mathematical language, model how to answer the question using mathematical language. Complex questions can take children some time to think about. If a child is not responding right away during a mathematical conversation, make sure they have had extra time to think, and then repeat or rephrase the question. **Example 4.3** demonstrates how a teacher might support a child in using mathematical language during conversation.

For additional guidance on how to use mathematical questioning strategies, see ***Early Childhood Math Questioning Strategies*** by Regional Educational Laboratory Central.

Example 4.3. Teacher prompts child to use mathematical language

The teacher places several large shape cutouts around the playground for a "shape hunt" during outdoor play time. A child finds and identifies a triangle.

Teacher: *How do you know this shape is a triangle?*

Mischa: *It has three.*

Teacher: *Three what?*

Mischa: *It has three sides.*

Teacher: *Yes, a triangle has three sides and three angles. Let's count how many angles this triangle has.* (Teacher and child point and count together). *One, two, three! Tell, me how many?*

Mischa: *Three.*

Teacher: *Yes, three angles. Can you say, "three angles"?*

Mischa: *Three angles.*

Potential obstacles and the panel's advice

OBSTACLE: *I have a hard time incorporating mathematical language in my conversations with children. It's just not part of my everyday language.*

PANEL'S ADVICE: It will take practice to notice and help children to notice the mathematics in the world around them. Begin by trying to focus on some specific, selected language each day. Start small, perhaps by trying to refer to things with numbers and locations. For example, instead of saying "Put your shoes next to your cot for naptime," say, "Put your *two* shoes next to your cot." Or, you can say, "Almost everyone is here today. Amar and Alicia are not here yet...that means *two* friends are not here."

Over time add different topics, such as how to think about mathematics. For example, "I am trying to give everyone the *same number* of crackers for snack time. I want everyone to have an *equal* number of crackers." Try one word a week to incorporate in conversations with children. Add the word to the letters

sent home with children to encourage parents, caregivers, and guardians to use the word with their children.

OBSTACLE: *Many children in my class are dual language learners. How can I help them understand the mathematical words and phrases?*

PANEL'S ADVICE: To help children understand and learn to use mathematical words and phrases, it is helpful to connect the words and phrases with something children can see. The panel recommends using the words or phrases children are learning several times during activities that allow children to "see" the mathematics. For example, while teaching children the word *equal*, the teacher or children can physically move objects into separate piles, ensuring that the piles have an equal amount. As children develop an understanding of *equal* with piles of objects, children can examine pictures of objects and determine which pictures illustrate an equal amount. The panel recommends using multi-turn conversations during these activities to give children many opportunities to hear and use the mathematical language they are learning. Teachers can prompt children who forget the word or have a difficult time pronouncing the word.

OBSTACLE: *When we talk about math, children forget to use the mathematical language they are learning.*

PANEL'S ADVICE: It may take time for children to add words to their repertoire. Many children need to hear the words frequently before they understand them and can use them. Be sure to use the words repeatedly and remind children how they are pronounced and used in conversation. It may also be helpful to prompt children to restate their thinking using one of the words they are learning. **Example 4.3** suggests ideas about how to prompt and support children's use of mathematical language.

Recommendation 5: Intentionally plan activities to build children's vocabulary and language

The vocabulary children develop when they are 3, 4, and 5 years old plays a pivotal role in their later language and reading development, and subsequent academic success.[102] Learning new words and their meanings helps children understand new information they come across, which helps them learn more words.[103] In this way, vocabulary development is cumulative.[104]

Most state standards suggest that, by the end of preschool, children should be learning new words; be able to describe people, places, and things using adjectives; and exhibit understanding of which words fit into common categories, like food and clothing.[105] Through intentional and incidental exposure to vocabulary over time, preschools can support children in meeting these standards.[106]

The key to vocabulary development in preschool is repeated exposure and opportunities to use new words in a variety of contexts and conversations around themes interesting to children.[107] The panel recommends providing children with many opportunities to hear and use vocabulary words over time, such as through shared book reading, activities and games, and engagement in conversations.[108] The steps in this recommendation outline how to choose words, introduce new vocabulary, and reinforce and encourage use of the new vocabulary throughout the day.

The WWC and the expert panel assigned a strong level of evidence to this recommendation based on 14 studies of the effectiveness of vocabulary instruction. Ten of the studies meet WWC standards without reservations, and four studies meet WWC standards with reservations. See **Appendix C** for a detailed rationale for the Level of Evidence for **Recommendation 5.**

How to carry out the recommendation

1. Choose 3–5 unique words to focus on each week and include review of those words in other weeks

The panel suggests choosing 3–5 words to teach each week that are likely to be unknown to most of the children in class.[109] For children who are unfamiliar with the words, a simple explanation of their meaning will be helpful for understanding the words and context. For children who are familiar with the words, instruction in their meaning may help children learn nuances of the words, such as what they mean in different contexts. Look for words that will be useful to know because the words occur frequently in books, conversations, or other academic contexts, even words that seem advanced, such as *illustrator*, *author*, *title*, *discuss*, and *similar*. Be sure to include bolded technical vocabulary that appears in informational books that teachers read to the children.

Informational books, also referred to as expository books, inform the reader about a specific topic and include accurate facts. Informational books often include new and interesting language, vocabulary, and content. Some technical words may be bolded.

It can be helpful to choose a group of words that relate to a topic or belong in a category (that is, words that share similar properties).[110] Learning words in categories allows children to learn more words

efficiently and quickly.[111] When possible, choose a topic that the children have expressed interest in, like transportation, caring for Earth, characteristics of plants, or the five senses. Working with words around a topic helps build in repetition of the words in different contexts. For example, if children express interest in learning about dolphins and are unfamiliar with ocean life, choose words like *fin*, *beak*, *tail*, and *flipper*. As the class learns and talks about dolphins, children will have multiple opportunities to hear and use these terms during shared book reading, in conversations during activities, when viewing images of dolphins placed around the classroom, or while playing with dolphin figurines during center activities.

Gradually increase the complexity of words throughout the year.[112] At the beginning of the year, choose words that are easy to depict in pictures or are easy to demonstrate.[113] Words that are depictable in pictures or easy to demonstrate can include a mix of spatial prepositions, concrete nouns and verbs, and descriptor words (adjectives and adverbs).[114] Over time, add in abstract language that is harder to depict in pictures, including abstract nouns and verbs, prepositions, glue words, or other words typically used in school that are not easy to visualize, such as *also*, *because*, *correct*, or *familiar*.

Glue words, also referred to as high-frequency words, are some of the most common and essential words in the English language. They are the foundation of academic language and are often difficult to depict in pictures. When children don't know the meaning of glue words, sentences can be difficult to understand. Some common glue words include *in, on, the, was, for, that, said, a, if, of, to, there, will, be, what, get, go, like, think, some, new, make, much, every, should, just, and, is, this, from, with, have, an, by, it, asked*.

2. Introduce the words and their meanings

Spend time directly discussing the word and what it means.[115] Begin by explaining the meaning of the vocabulary word. Conversations about new vocabulary words can take place during shared book reading[116] or during other parts of the day,[117] such as during whole-class gatherings, small-group time, or free play. Explain the meaning of the new word using words children already know.[118] For example, when you *sprint*, you run fast for a short time, *create* means to make something, and *umbrella* is something you hold up above you to keep your body dry when it is raining. Some words have more than one meaning. For words with multiple meanings, explain the various meanings and then explain which meaning relates to the book or scenario. For example, "*Park* can mean to put your car somewhere for a little while, and a *park* can also mean an outdoor place where everyone can have fun. In this book, the park is a place everyone in the neighborhood goes to play, walk, or sit."

If using a book to introduce words,[119] choose books that include the vocabulary word in text and possibly in a picture as well. Consider pausing briefly before the word is read to give children an opportunity to predict what the word might be, or after the word is read to give children an opportunity to reflect on the word's meaning.[120] Repeat the word or ask the children to say the word to draw attention to it. For example, the teacher reads aloud a sentence with a new word, such as, "He is wearing his favorite *fedora*" while pointing to the illustration, and then immediately prompts the children to repeat the word. The teacher asks, "What was he wearing?"[121] After the children say "fedora," the teacher says, "A fedora is a fancy hat that has a brim, like a cowboy hat. A brim is the part that goes out all around. See this part of

the hat, that's the brim. The brim on the fedora is smaller and it is sometimes curved upwards in the back."

Point to the relevant picture.[122] If the book doesn't have a picture that specifically depicts the word, then use a picture card, toy/figurine, flannel board, or model/prop that depicts the word.[123] Present a simple meaning that relates to what is happening in the book.[124] Do so briefly to preserve the continuity of the story.[125] In later book readings and experiences in which the word relates, pause to engage children in a conversation about the word and provide additional practice with its meaning. **Table 5.1** provides examples of activities that can be used to provide additional practice in clarifying the meaning of the word.

Table 5.1. Practices to expand the meaning of vocabulary words and examples of each practice

Ways to expand the meaning of words	Example
Act out the word or use a gesture to clarify the meaning of the word.[126] Model the action or gesture and then have children practice doing the action or gesture. Consider using the word in a different context from the book.	When explaining the meaning of rummaging for a toy, mime rummaging with your hands.[127] Then say, "Let's pretend we're rummaging around to look for a toy."[128] If the book talks about donning slippers, demonstrate the motion of putting on slippers[129] and ask children to pretend to put on their slippers. Or use the word in a different context, such as, "Today I donned my new jacket [demonstrate the motion of donning a jacket]. I put on my new jacket."[130]
Provide a synonym or an example of the vocabulary word. It can also be helpful to provide an example of a word that is a category and an example of a word that does not fit in the category.[131]	The teacher sits silently one moment, pretends to be loud the next, and asks children about the difference or asks children to identify when the teacher is being silent or not silent. When discussing the word insect, the teacher provides an example, grasshopper, and explains that a bear is not an insect.
Show a short video clip to provide some background information to help make the meaning of the word concrete.[132] Choose a video that clearly depicts the word and is less than 3 minutes long. Plan questions to ask about the video to ensure that children engage with the topic.	Show a short clip about a desert or jungle or about an object with which children may not be familiar, like a yacht.

Ask children to share something related to the word or think about when they experienced the word. Children need to use the word to retain knowledge of its meaning.[133] Ensure that all children have an opportunity to think about the word and relate it to something they know or have experienced. This practice will help children connect the word and its meaning to what they already know and help them remember the word in other contexts. Respond to each child and expand their wording to include the meaning of the word or how the word applies to what was said. **Example 5.1** depicts an exchange between a teacher and a child around the word *silent*.

Example 5.1. A teacher and child discuss the word *silent*

Teacher: *"Can you think of a time you were silent?"*

Sam: *"I was silent when I was sleeping."*

Teacher: *"You said you were silent when you were sleeping. That means that when you were sleeping, you were so quiet you were not making ANY noise!"*

When the words come up in other book readings or other scenarios during the day, gradually increase the demands on children to contribute what they remember about the meaning of the word, giving children multiple turns to engage in the conversation.[134] **Example 5.2** is a vignette that describes how a teacher discussed a word and increased demands on children to remember the word.

Example 5.2. Teacher teaches a word and gradually asks children to do more with the word

The first time the word *fierce* appeared in a book, the teacher stops briefly to explain the meaning of the word in the context of the book and then continues to read.

The second time the word *fierce* appeared, the teacher stops reading a story about a tiger to discuss the word *fierce*. The teacher asks the children whether they know what *fierce* means. Children share that they know that some animals are fierce. One child adds that the *Tyrannosaurus rex* is fierce.

The teacher responds by saying, "Yes, some animals and dinosaurs are fierce. *Fierce* means strong and dangerous." The teacher points to a picture of a scowling animal and uses a growly scary voice.

The teacher asks children to make a fierce face that might scare someone and says, "Everyone looks so scary!"

The next day the teacher reads a book about a *Tyrannosaurus rex* and then directs the children in acting out what happens in the book. The teacher reminds the children that these dinosaurs are fierce. The teacher asks the children, "Who remembers what *fierce* means?" One child says, "Scary." The teacher responds, "That's right. So, when you are a *Tyrannosaurus rex*, you should act fierce."

Later in a small group, the teacher asks children to sort pictures of animal faces into piles of scared faces and fierce faces.

Source: Toub et al., 2018.

3. Choose activities and materials that will offer children opportunities to practice using the target vocabulary words

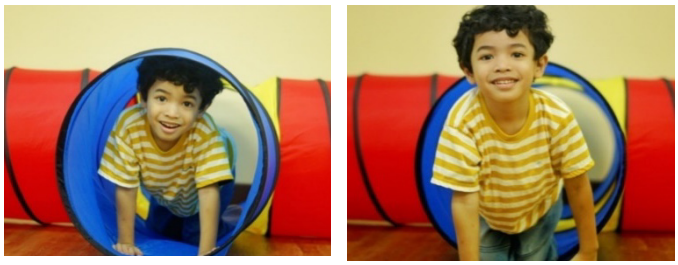
Children need multiple opportunities to think about and practice the words they are learning.[135] Children can develop a deeper understanding of the words they are learning and their meanings when they interact with materials that represent the new words and when they have opportunities to use the words in play and conversation.[136]

Set up opportunities for the words to come up in children's play.[137] Bring out materials that portray or connect to target words or set up scenarios for children to act out the words when appropriate. For example, if the vocabulary words being taught focus on marine life, the teacher can put out marine stuffed animals, art materials for children to create pictures of marine life, or dress-up materials and a marine scene that would allow children to pretend to be marine animals.

Consider leading children in acting out the word, possibly using figurines, puppets, or other props.[138] Tell children what the scenario is and which word they will be portraying. For example, when providing opportunities to use the word *silent*, teachers could help children pretend the play structure is a jungle and ask children to pretend to be silent when they walk through the jungle, so they don't wake up a sleeping tiger. When singing a song about the seasons, for example, ask children to act out the types of activities they would do in the winter, spring, summer, and fall.[139]

If reenacting a story read during shared book reading that includes the word children are learning, tell children which story they are re-enacting and which role each child will play.[140] For example, when providing opportunities for children to learn the word *emerging* that appeared in a story about a dragon hatching from an egg, assign children roles and ask them to act out what happened in the story, either by giving them specific steps to act out or letting them remember the story line on their own. When the children pretend to emerge out of an egg using a tunnel, remind children that *emerging* means to come out of something, and the dragon is emerging from the egg or tunnel in this case. **Figure 5.1** depicts images of a child doing this activity.

Figure 5.1. A child acting out a word



If the children do not initially demonstrate the word accurately, guide them toward the meaning of the word.[141] For example, if the child curls up inside the egg, showing the opposite of *emerging* from the egg, say, "The baby dragon was IN the egg. Can you show me how the dragon came OUT of the egg?" Immediately and specifically point out what children did or said correctly. For example, when the child shows *emerging* from the egg, say, "The dragon emerged! Great job showing how the dragon emerged from, or came out of, the egg!"

As children interact with the activities and materials, look for ways to incorporate conversation about the target vocabulary.[142] Ask questions that encourage children to use the words they are learning when they answer, such as "What part of the animal did you paint purple?" or "You look like you were swimming. What does your animal use to swim?" It may be helpful to prompt children to use the words, such as pointing to the flipper and saying, "We learned about that part of the animal. I wonder who remembers what it is called?" Gradually ask more questions that allow children opportunities to answer with more words, such as "How do dolphins use their tails to swim?" "How do you move around?" "What about when you are in water, how do you move around in water?"[143] When possible, extend the conversation about the vocabulary word by asking children follow-up questions, such as "What else can emerge?" or "What have you emerged from today?"

4. Engage in interactive conversations with children to reinforce or solidify understanding of vocabulary words

Learning words primarily takes place when children hear and use the words frequently and in different contexts over time.[144] Look for ways throughout the day to reintroduce the target vocabulary words into conversations with children to provide additional opportunities for children to hear and use the words. Use questions strategically to prompt children to respond using the words they have learned.[145]

For example, if children are pretending to be a family of rabbits on the playground, notice when they come out of their den and use *emerge* to describe what is happening or prompt children to use the word to explain what they are playing. Be sure to regularly bring words that were taught previously back into conversations. The goal is to keep bringing up words throughout the year that children are learning, not just during the week when they are the focus of instruction.

In addition to reintroducing the target vocabulary words into conversations, add additional words into conversations when appropriate. Do not feel limited to the 3–5 words that are the target words for the week. Exposure to other words that come up in natural ways throughout the day, week, or months can also contribute to children's vocabulary development. Choose words that are relevant to the children, their lives, cultural backgrounds, and what is happening during the preschool day. For example, when children exclaim that they saw an airplane fly overhead, say, "Oh wow, that airplane is so high in the sky." Pause for children to comment on your observation and say, "I wonder how the airplane got up there. Who can tell me what the plane had to do to get up there?" Listen to children's answers. Explain that airplanes have powerful engines and provide a simple explanation of the meaning of *powerful* and *engine*.

Potential obstacles and the panel's advice

OBSTACLE: *I was told to teach only vocabulary words that appear in books or to look for books that include the vocabulary words I want to teach.*

PANEL'S ADVICE*:* Discussing vocabulary in a book is one way to teach vocabulary. It is not necessary to only choose books related to the vocabulary you are teaching. Vocabulary can also be introduced in other ways, such as using and defining descriptive words in response to something a child has said. For

example, if the child says, "I have a truck," respond with "You have a *big, red* truck. Is it *heavy*? Or *light*?" Let the child respond and then provide a simple explanation of *heavy* and an example of something that is heavy and something that is not. Ask the child to think about what else is heavy.

It is also important to replace nonspecific or inaccurate vocabulary with words that are more precise. For example, when a child refers to something vaguely, such as "I want the red one" or "I want that thing," teach the words about the item the child is already focused on. For example, "Oh, you want the *red marker*. The marker is something we draw with. The red marker is not being used so you can color with it."

OBSTACLE: *I don't know how to choose vocabulary words my children don't know.*

PANEL'S ADVICE*:* Through conversations, children may reveal what interests them. There may be vocabulary related to those interests that might help them better understand the topic. Think of synonyms for words related to topics the children have shown interest in. For example, if a group of children has been very interested in animals and pretending to be bears, tigers, and snakes during play, the teacher could introduce terms such as *boa constrictor*, *jaguar*, *panther*, *panda bear/grizzly bear*, or the verbs that relate to those animals, like *slither*, *growl*, *hiss*, *leap*, *sprint*.

Remember to introduce and discuss abstract words, such as *kindness*, *memory,* and *options*. Consider referencing lists of words children should learn.[146] It is also beneficial to reinforce words that children already know. This will ensure that these words become part of the vocabulary they use more regularly.

OBSTACLE: *I am not very comfortable engaging in conversations with children when they play. I want to let them play.*

PANEL'S ADVICE: One way to engage children is to observe something they are doing well, such as, "I really like how hard you are working on filling that pot." Then add in adjectives to expose them to more vocabulary. For example, if a child is filling a pot with mud, say, "I see you filling the big pot with mud." The child might say, "I am making soup." The teacher could talk with the child about the *ingredients* they are including in the soup or how long the soup will need to *boil* before it will be ready to eat. Continue the conversation by saying, for example, "I love soup. When I make soup, I put chicken and carrots in it." Often children will respond with what they put in the soup. If the children don't talk, then ask probing or inferencing questions, such as "What do you think is going to happen next?" "How are these two things alike?" and "What do you think the cook is thinking?"

Recommendation 6: Build children's knowledge of letters and sounds

Exploring and identifying the sounds of language is important for developing literacy.[147] Awareness of the sounds of language, also referred to as phonological awareness, is essential for helping children begin to understand that words are made of sounds, and that when blended, those sounds make words. Children's early knowledge of letters and sounds will help children learn how to read words and may contribute to their development of other literacy skills, like spelling.[148]

Most state standards specify that children need to know some letter names and sounds, and be able to recognize sounds at the beginning and end of words and words that rhyme, before entering kindergarten.[149] Preschool teachers can help children begin to understand the often-complex relationship between sounds and letters. Teachers can help children learn to listen for sounds and connect them to the letters they see. With practice and repetition, children will be able to recognize many letters and identify some of the sounds those letters make.[150]

This recommendation provides four steps for building children's early understanding of letters and the sounds they make. The first step helps children understand that words are made up of different sounds. The next two steps introduce the letters and their sounds and intentionally plan time for children to practice their letter knowledge. The final step involves finding ways for children and teachers to discuss letters and sounds in words throughout the day.

The WWC and the expert panel assigned a strong level of evidence to this recommendation based on nine studies of the effectiveness of instruction on letters and their sounds. The nine studies meet WWC standards without reservations. See **Appendix C** for a detailed rationale for the Level of Evidence for **Recommendation 6**.

How to carry out the recommendation

1. Initially focus on listening for sounds in words

Children may need an introduction to the idea that words are made up of different sounds. Teachers can help children listen for different sounds in words.[151] The panel believes awareness of the smaller sounds in words can set the stage for learning that letters have different sounds and that blending the sounds letters make is reading.

Point out words are made up of sounds like /b/ and -ike in bike and /b/ and -all in ball.[152] Explain that some words start with the same sound, such as /l/ in leg, leaf, little, and long, and some words have the same last sound, such as /t/ in part, sit, and boot.

Explain that when words share the same blended end sound, they rhyme. For example, point out that the words *coat*, *boat*, and *moat* all end in the blended sound *-oat*. Say other words, some with the same blended end sounds such as *end*, *mend*, and *send*, and some with different blended end sounds such as *coat*, *milk*, and *jump*. Ask children to give a thumbs up when the word rhymes. Ask children if they can

think of any other words with the same blended end sound. Encourage children to list words that rhyme, even made-up silly words. For example, after saying the blended end sound in the word *can* is *-an*, ask children what other words end with those blended sounds. Gradually increase the difficulty of the sounds, such as asking children to make up silly words that rhyme with *apple*, like *mapple*, *kapple*, *bapple*, *zapple*.

Tell children to listen for words that share the same beginning or end sound in a song, book, or poem with an alliteration or with words that rhyme.[153] Ask the children what sounds the same in the words they heard. Choose poems, songs, or books that grab children's attention and will keep them engaged so that they can hear when the sound comes up. This might include a silly book or song that uses the sounds of words in a fun way or that incorporates physical movements or sounds, like standing or clapping when they hear words that end with *-at*. Some songs and books have associated videos that lead children in the movements.

Dialects are forms of language that are unique to a specific region or group of people. In some dialects, for example, the end sounds in words are often dropped. Children who speak with one of these dialects will need more exposure to the end sounds to learn them. For these children, it is important to begin phonological awareness instruction by focusing on sounds at the beginning and in the middle of words.

Continue to point out sounds in words or to ask children what sounds they hear, when the opportunity arises. Periodically include previously introduced sounds for review. For example:

- Ask children to make up words that rhyme as they are playing on the playground or building with blocks.
- Play "I spy" by asking pairs of children to work together to find something in the yard that starts with the /t/ sound.
- While the children are standing in line, say some words and ask children to jump when the words start with the /p/ sound and clap when they hear words that start with the /f/ sound.

2. Intentionally introduce a new letter and its sound

Introduce letters and the sounds they make. Start with letters and sounds children are familiar with and add on other letters and sounds from there.[154] This might include letters in children's names or in words they see around the classroom or in words in books that interest the children. For example, if children's names are Tim, Tessa, and Toby, teach the letter "T." The panel suggests choosing one letter and sound to focus on each week, in addition to pointing out letters in print in other parts of the classroom, as explained in Step 4 below. Include discussion of previously learned letters and their sounds to help children learn to discriminate between the letters.

When introducing a letter, clearly explain the letter name and the sound the letter makes. For example, "This is the letter 'B,' and the sound it makes is /b/." For letters that have more than one sound, explain that some letters make more than one sound, and tell children the sounds. For example, "Some letters make more than one sound. This is the letter 'C,' and it makes the sound /s/ like in the words *city* and

cent. It also makes the sound /k/ like in the words *cat* and *cookie*," while pointing to the letter in the words written on the board, in a book, or on an alphabet chart.

Upper- and lowercase letters can be taught simultaneously, within a book, on a letter card, or in a puzzle. When pointing out the case, use the terms "uppercase" or "capital" and "lowercase." When teachers refer to the letters as big or little, children can get confused between letters that appear larger or smaller and the case of the letters.

Share additional words children are familiar with that start with the target letter. Share some words that begin with the sounds and some that do not. Ask children to identify which words start with the sound by showing a thumbs up.

Show children how to write the target letter. When possible, include geometric terms to describe the shape to offer children another opportunity to hear mathematical language (see **Recommendation 4** for more information about using mathematical language). For example, when showing children how to write a capital "A," a teacher can say, "I draw a diagonal line from top to bottom going one way and another diagonal line going from top to bottom the other way so they meet at the top. Then I draw a straight line across the middle."

Intentionally plan time during small-group or center activities or during shared book reading to introduce the target letter and the sound it makes.[155] For example, a center can be a table with objects that begin with the letter "B," such as blocks, balls, ballerinas, brooms, and bags. As children play with these items, encourage children to think about and say the sound they all begin with. Show children the letter "B" and explain that all the objects start with the /b/ sound.

Another example is using an alphabet box to introduce a new letter. Put objects that begin with the target letter in the box. Say the name of each object in the box or ask children to look at the objects in the box and guess which letter all the objects start with. Then discuss the letter, its symbol, and its sound. As children learn the letters, consider including some objects that start with a different letter than they previously learned, such as including a car in a box of objects that begin with "B." Consider including photographs, clothing, foods, musical instruments, pieces of art, or other artifacts that represent children's cultural background and are familiar to the children.

Strengthen children's association with new letters by connecting the letter to a memorable experience that starts with the same letter. The panel suggests that this connection may help the children remember a word that starts with the letter and thus the sound the letter makes. For example, when talking about the letter "F" and /f/ sound, have children paint a fish and make a fish print. Later when asking children to think about the sound an "F" makes, remind children that when they were learning about "F," they painted fish and made fish prints. The child may have an easier time remembering what sound "F" makes.

Another example can be done when introducing the letter "A." Tell children "A" makes the short /a/ sound, like in the word *apple*. Ask children to taste a couple different types of apples and vote on which they like best by putting a sticky note with their name on it on a graph. Together, count which apple got

the most votes. Later when recalling what sound an "A" makes, remind children about the apple tasting vote they did earlier. This may help them remember the sound an "A" makes.

3. Use materials and activities that allow children to practice identifying letters and their corresponding sounds

Children need multiple and repeated exposures to letters and the sounds they make.[156] Carefully choose activities and materials that can be used during small-group or whole-class activities or centers throughout the week to provide children with practice identifying and discussing the target letter and sound.

Be sure to include previously learned letters for children to review. Games can be a fun way to review letters that were previously learned. Children will enjoy sharing what they have learned. Children may also enjoy working with a partner or on a team to practice their letters. Consider pairing children or setting up teams for games or other activities that can incorporate multiple children while still allowing multiple opportunities to practice their letter knowledge.

Example 6.1 depicts some materials and activities that provide opportunities to identify and discuss letters.

Example 6.1. Activities that can be used to discuss letters

- Read books that highlight the target letter or words that start with the target letter.
- Set out materials children can use to practice writing letters on paper or in sand or salt; or materials they can use to form letters, like play dough, pipe cleaners, or beans. Children can also build large letters on the floor with blocks. Children might also enjoy forming letters with edible dough that can be baked and eating their letters at snack time.
- Set out objects or toys that begin with a certain letter and ask children to categorize the items by their beginning sound.
- Ask children to look for items that begin with the letter on the playground or during a nature walk.
- Set out letter puzzles or games,[157] such as games matching upper- and lowercase letters, matching letters printed in different fonts, or matching a letter with an object that clearly begins with the letter. Matching games can be made from paper, clothespins, plastic eggs, or paper plates; or drawn on whiteboards or using sidewalk chalk on the concrete.
- Present individual letters on cards, letter tiles, or letter puzzles and ask children to name the letters that appear as quickly as they can.[158]
- Ask children to look around the room and bring items from the classroom to the table that begin with a certain letter.
- Call out words and have pairs of children run to a pile of letters on the floor and look for the letter the word starts with and run back. This will burn off energy and provide practice locating the letters.

Continued on next page…

Example 6.1. Activities that can be used to discuss letters *(continued)*

- Set up an alphabet maze. To get through the maze, children have to find items that begin with the letter and avoid paths that contain items that begin with other letters.
- Set out 4–5 letter shapes and ask children to sort them into groups of similar letters.
- Write children's names multiple times in different areas on a large piece of paper. Ask children to circle their name every time it appears.
- Write multiple letters on a large piece of paper. Ask children to circle every time the target letter or letters appear.

4. Include print throughout the classroom to provide additional opportunities to discuss letters and their sounds

Making print a regular part of the classroom will not only help familiarize children with letters, but also provide multiple opportunities for teachers to discuss letters and the sounds they make.[159] When children show interest in print, conversations about letters may take place between children or between teachers and children. Use print throughout the classroom to discuss the target letter or any other letters throughout the day. Talk to children about the letter in the print and the sound the letter makes in the word they see.

Use labels throughout the classroom. Consider beginning the school year creating classroom labels with the children. Introduce the word and the letters in that word and then have the children help place the labels. Label parts of the classrooms where certain toys reside on the shelf or with what supplies belong in certain bins or drawers. Label activity centers, like the quiet area/library, writing center, building area, or the dramatic play center. Other labels can be placed on objects, such as the door, shelf, table, and chair. Post the labels where children can see them. These labels offer opportunities to discuss the letters and their sounds while writing on the labels and as children notice them throughout the day. As the school year progresses and children begin to learn letters, ask children to help write new labels.

Write out the daily schedule. Consider working with children to write out words that describe the activities for the day during morning group time.[160] Talk about what the class will be focusing on or doing during the day. Write the words as children watch. Talk about specific letters while writing and the sounds they make. These words can simply be important parts of the activity, not a detailed description. For example, write “book” or “story” for shared book reading time, “cafe” or “veterinarian” for the dramatic play center, and “clay” or “paint” for an art center.

Use children’s names throughout the classroom, such as on labels for their cubbies or name cards to show where to sit. Model how to find a name. For example, “Your name is Tom! The first sound I hear is /t/. That sounds like the letter 'T.' The letter 'T' says /t/. I see a ‘T’ looks like this.” Point to the letter on the alphabet chart. “Oh, here is your name card. I know because it starts with the letter ‘T'!” The teacher could slowly sound out the rest of the name as well to differentiate Tom from other name tags that start with “T.” Also consider asking children to find and trace their names as they arrive to “sign in.” As

children learn letters throughout the year, children might practice writing more letters in their name on their own when they sign in. Once children can write their first names, consider asking them to practice their last names.

Bring print materials into dramatic play. For example, after reading a book about a restaurant, help children make menus and take orders. Provide papers and pencils so they can write the menus and the orders. After reading a book about mail carriers, provide papers or cards and pencils so children can send each other mail. Use a cardboard box to make a blue mailbox. As children write orders or mail, discuss the letters they would use to compose the words they want to write.

Books provide an easy way to talk to children about letters and the sounds they make in words. Consider discussing any letters in the book that might interest the children, even if the letter is not the target letter for the week. Set up a reading library or quiet space for children to explore print independently. Include books with the letters the children have learned, including the book used to introduce a letter. Also include a variety of reading materials children can read on their own, such as books on topics the class is focusing on, and books with labels children know, like pictures of children with their names or pictures of toys they have in their classroom with their names. Include any books made by children, like a dictated book about a class field trip or a classroom dictionary of new words. As children look through the books during centers or free play, look for ways to discuss the letters with children. For example, when looking at a page with an illustration of a shop, the teacher can say, "Look at the sign in the window of that shop. I see letters on it. Which letters do you see?" Together the children and teacher can identify the letters and the sounds they make, and the teacher can slowly sound out the words.

Potential obstacles and the panel's advice

OBSTACLE: *I don't know what letters or sounds to teach, when to move on, or when to backtrack and spend more time on a letter or sound.*

PANEL'S ADVICE: The panel believes that being aware of which letters and sounds children know will help teachers identify whether children are ready to learn new letters and sounds and which children will need more time or support to grasp a letter. Checking what a child knows does not need to take long. A couple of minutes interacting with each child should be enough. Set aside time each week to discuss letters and their sounds with each child. Keep track of each child's letter knowledge by jotting down what they grasped and what they need to work on.

Children's knowledge of letters and the sounds may vary quite a bit.[161] Grouping children with similar levels of letter knowledge into small groups can be very helpful.

OBSTACLE: *My children don't seem very excited about letters/sounds.*

PANEL'S ADVICE: It can be helpful to link the letter to the children in some way. Talk to children about what letter or sound they will be learning about and tell them the letter or sound is in their name or something they are wearing, might have done, or might know about. It can be helpful to greet them as they enter and talk about the letter or sound to get them excited at the start of the day. For example,

"Welcome, Sasha. I am so excited you are here. We are going to be talking about the letter 'S' sound today. You have an 'S' in your name that makes the /s/ sound. Ss-asha. I can't wait to talk about the letter 'S' with you."

Plan activities that will engage children. For example, at the end of free play or center time, ask the children to bring something they worked with during that time. Once all children have an object, ask them, "Who has something that starts with a /b/ sound?" and continue with other sounds. Another example is to encourage children to look around the room and think of alliterations to describe their classroom, such as *purple paper*, *tall table*, and *bouncy ball*. It is also helpful to read silly or engaging books with alliterations or rhymes, such as *Silly Sally,* by Audrey Wood, or *Jake Bakes Cakes: A Silly Rhyming Children's Picture Book,* by Gerald Hawksley.

Recommendation 7: Use shared book reading to develop children's language, knowledge of print features, and knowledge of the world

Shared book reading involves the teacher reading a book and encouraging children to be actively engaged in responding to the book as it is read.[162] These interactions around books can be used to build knowledge about the social and natural world and to teach many components of literacy, such as vocabulary, print features including letters, and phonological awareness.[163]

The panel recommends reading books to children multiple times a day, using either the same book or different books and doing at least one shared book reading a day.[164] This recommendation focuses on how to use shared book reading time to teach literacy concepts effectively. The first two steps detail how to prepare for reading. The last three steps provide more guidance on how to carry out the reading with young children.

The WWC and the expert panel assigned a strong level of evidence to this recommendation based on 17 studies of the effectiveness of the use of shared book reading. Eleven of the studies meet WWC standards without reservations, and six studies meet WWC standards with reservations. See **Appendix C** for a detailed rationale for the Level of Evidence for **Recommendation 7.**

How to carry out the recommendation

1. Select a variety of informational and narrative books that are appropriate for 3-, 4-, and 5-year-olds

Choose books that touch on topics of interest to children or that relate to something they may have experienced, such as books about making friends with a new child who just moved to their block or playing make-believe. Ensure that children regularly see people like themselves in the books that are read, as well as people from other cultures. This helps children connect to the book and identify with the characters.[165] When children connect with the reading, they will enjoy the reading more and be motivated to seek out books, either at school or at home.[166] Children may also be more motivated to take time to understand books.[167]

Informational books are nonfiction or expository books that inform the reader about a specific topic and include accurate facts.

Narrative books are written accounts of a connected series of events. They can include both fiction, such as novels and short stories, as well as nonfiction, such as memoirs, biographies, and news stories.

Choose books that align with the focus of the literacy lesson for the day or week.[168] Books with print features like changes in font sizes, styles, or colors; speech bubbles; tables of contents; or indexes would be interesting to discuss when focusing on parts of print.[169] When focusing on teaching vocabulary, choose books in which target words are depicted in pictures or are mentioned multiple times. This ensures repeated exposure to the words children are learning.[170]

Reading books offers a natural way to point out the names of letters and the sounds they make.[171] Choose books that include words with the target letter (see **Recommendation 6** for more information) or books

that have interesting or large print, so children will focus on the letters depicted. For example, a book with an alliteration of words that begin with the /b/ sound may be a good choice for teaching the letter "B." Also consider alphabet books that present one familiar word beginning with the target letter on each page.[172]

Consider choosing informational books that cover topics relevant to the material in narrative books.[173] Read the narrative books and informational books on the same topic in succession, to reinforce learning about the topic. For example, before reading a narrative book where a monkey is the main character, read an informational book about monkeys or their natural habitats. **Box 7.1** explains why including informational books is important.

Box 7.1. Importance of informational books

Informational books, sometimes called nonfiction, are books that teach about a topic and include accurate facts. While stories can spark children's imagination and stimulate their curiosity, informational books can often answer questions children have, especially when the books are chosen based on children's interests or experiences. The factual content and realistic photos or illustrations found in informational books often prompt children to ask more questions and engage in conversations about the topic. Informational books can also help children solve problems or learn to accomplish tasks, such as tending to a garden or a pet.

Informational books can help build children's knowledge of the natural world and social world and help prepare them for understanding new information. For example, reading a book about what happens at a routine doctor checkup can help children learn about staying healthy, a book about what people eat in different cultures can help children learn about foods and people, and a book about what happens when a seed is planted can help children learn how plants grow.

Reading informational books also exposes children to new and interesting language, vocabulary, and content, as well as higher-order thinking. Informational books have interesting print features, such as bolded words, labels, indexes, and tables of contents.

Some children, especially children who otherwise are not interested in books, may prefer informational books. Finding ways to make books appealing to children who are uninterested is important for reducing the gap that can occur in early reading between children who enjoy books and those who do not.

2. Prior to the lesson, plan the purpose for reading the book and determine when to discuss certain topics with children

Children can learn more from the books when they are read multiple times.[174] When a teacher reads the same book 2-4 times, children will become familiar with the content, and might "read" to themselves or others.[175] Reading books multiple times also allows teachers opportunities to review topics that were taught during the previous readings of the books.

Plan a different focus for each time a book is read, including some review of previously covered topics. Review the book ahead of time to determine what to focus on for each reading. **Examples 7.1** and **7.2** present two possible scenarios for different focuses for each reading of a book.

Example 7.1. Three readings of the same book for different purposes

Time 1: Read the entire book so children can hear the whole story or all the content.

Time 2: Point out and discuss vocabulary, letters, and other interesting parts of print, such as the table of contents.

Time 3: Review some letters and vocabulary and engage in a conversation or an activity based on the topic of the book.

Example 7.2. Four readings of the same book for different purposes

Time 1: Show children the book. Discuss the cover page and pictures on each page before reading the book.

Time 2: Point out and discuss vocabulary words and engage in activities around the vocabulary.

Time 3: Review vocabulary. Discuss a letter and the content in the book.

Time 4: Discuss what is happening in the book or ask children to retell what the book was about.

Use the focus of each reading to determine when to discuss vocabulary; print features like font changes, speech bubbles, or letters; or questions or prompts related to the content of the book. For example, if the focus will be on features of print, plan to show children how the table of contents works and ask children to help choose which section to read or discuss how books are read from front to back and print is read from left to right.[176]

The focus of the reading can be discussed before, during, or after shared book reading. For example, ask children to look at the cover and listen to the title, and then predict what the book is going to be about before reading. Then during reading, lead a conversation about words that are depicted in the pictures in the book, and after reading engage children in a conversation about what happened in the story or why it happened.

It can be helpful to write what to point out or what to ask on sticky notes and place them on the stopping points in the book.[177] Use the sticky notes as a reminder of when to stop. Build in time for children to comment on the book. Consider planning to stop at least three times during reading to ask questions to make certain children understand what is happening in the book or why it is happening.[178]

Stopping points are places teachers have chosen in a book to pause reading aloud to discuss something or ask a question about the book.

Ensure that the stopping points during reading are spread out enough so as not to interfere with the children's understanding of the book.[179] Frequent interruptions can impact comprehension, and children may have difficulty understanding what the book is about. Also consider the length of time

children can focus on and discuss a book. If there are too many stopping points, save some for another reading of the same book.

3. Prepare children for listening to and discussing the content of the book before reading the book aloud

When children know something about the topic of the book, they can accurately connect the information in the book to something they know, have heard about, or have experienced.[180] For example, knowing something about apartment buildings can help a child connect their knowledge to understand a book about living in the city. Knowing something about the many states of water can help a child understand a book about weather events, such as ice storms, rain, and fog. Knowing about the topic of the book may make it easier for children to understand and retain the information in the book.[181]

Start by asking children what they already know about the topic of the book. Discuss connections between what they know and what the book is about. Invite children to share their thoughts on the topic. For example, ask children, "What can you tell me about…," "Tell me what you know about…," "What happens when…," or "What would happen if…." Respond to each child by connecting what they said to the topic of the book.

Listen to what children share to decide whether they have enough knowledge about the topic to understand and connect with the book. When children do not have enough knowledge, present information that might help familiarize them with the topic and engage in a multi-turn conversation to prepare children to better understand what the book is about. This can be done by:

- Facilitating activities that allow children to work with the topic, such as an activity that lets children explore their sense of touch or smell and discussing what they noticed before reading about the five senses;
- Reading and discussing a simpler book, such as a short story about a family preparing for a hurricane before reading an informational book about hurricanes;
- Acting out a scenario or word related to the topic, such as using figurines to show a man purchasing soap at a checkout counter at a grocery store;[182]
- Showing pictures and discussing different parts of the pictures that relate to the story, such as showing pictures of the inside of an airport and discussing the different things people do at the airport before reading a book on the same topic; or
- Presenting a short video clip (less than 3 minutes) that introduces the content in the book, such as a video clip about insects before reading a book about grasshoppers.

4. Engage in conversations with the children while reading the book

While reading, stop periodically at the stopping points determined in Step 2 to encourage children to actively engage with the book.[183] Use the stopping points aligned to the focus of that reading, such as times to stop to discuss a word, a letter, or an interesting picture.

Ask questions that encourage multi-word answers and multi-turn conversations.[184] Start with simple questions and increase the complexity of questions over time.[185] Sequence questions from relatively simple questions about the things pictured in the book, such as what just happened to the character or what something does.

If children can answer those questions, begin asking increasingly complex questions that encourage children to describe relationships between things pictured in the book,[186] such as, "How did Soji feel when Kai did that?" or "What happens when the blades of the fan spin?" If children have difficulty answering these questions, ask guiding questions again or give them hints about the pictures in the book to help them answer the questions.

If children can answer the increasingly complex questions without difficulty, begin asking questions that require them to think a little more.[187] Teachers can ask children questions that encourage them to use vocabulary words or to make connections about what happened in the book or what they have experienced,[188] such as questions that ask why a character did something, what the character might be feeling, what might happen next, or what experiences the children have that are similar.

Example 7.3 outlines questions that increase in complexity over time. Consider increasing the complexity for each reading of the same book if children can answer the simpler questions.

Ask children to justify their answers. For example, say, "What makes you think that?" or "What did you hear in the story that helped you know that?" Encourage children to point to the pictures that help them answer the question.

Remember to ask children if they have any questions about the book. When children have a question about the book, walk them through looking back in the book to find the answer. Looking through a book for an answer helps show children that books can be more than entertaining; they can be a source of information as well. Another option is to model having a question about the book and showing children how to revisit a section of the book to find the answer.

Example 7.3. Questions that increase in complexity

Questions that can be answered by looking at the pictures:

- What happened when they woke up?
- What did they see?
- What does the button do?

Questions that can be answered by making connections between the pictures or parts of the book:

- How did Vera know that Thomas was pulling the rope?
- What happens to the tadpole's legs when they start growing?

Questions that can be answered by connecting what children know to what happened in the book:

- How do you think they would feel if they won the prize?
- What does it mean to "pack their bags"?

5. Align literacy activities with the focus of the shared book reading

Interactive small-group activities provide children opportunities to use or rehearse what they learned from the book.[189] This can enhance language and vocabulary development, letter knowledge, and understanding of the topic, with greater potential for children to be able to use what they learned in other settings.

When the focus of the reading is vocabulary words, set up activities like those described in **Recommendation 5**. When the focus is letters, set up activities like those described in **Recommendation 6**.

When the focus is discussing the content of the book, set up activities related to understanding the story or the information presented in the book. Consider setting out materials related to the science or social studies topic in an informational book. For example, set up a veterinary office in the dramatic play center after reading an informational book about what happens when pets are sick. Children might use medical equipment to take care of stuffed animals. Another option is to set up an experiment where children touch ice with gloves made of different materials, such as latex, cotton, leather, and synthetic fur, to determine which keeps them warmest, after reading about animals that live in the Arctic. **Figure 7.1** depicts materials for an activity to experience how different types of gloves and mittens protect against the cold.

Figure 7.1. Materials for an activity on cold weather

Consider using puppets, figurines, or role-play to act out a story.[190] This will help children "see" and think about what happened in the book.[191] Present the roles children can act out from the story and ask who wants to play each role. Allow children to act out what happened or move the puppets or figurines around to show what happened. Encourage children to say what the character said. Say, for example, "Do you remember what Danny said to the dolphin?"

If children need help remembering the book, give them hints. It might also be helpful to model acting out certain scenes if children do not understand what happened. **Figure 7.2** depicts an activity where children acted out a book about animals in a zoo. The children moved the figurines around to show what the animals did. When the children were stuck, the teacher reminded them using prompts and guiding questions.

Figure 7.2. Animal figurines for an activity

After reading a book multiple times, leave the book in the classroom library or at a center aligned with the content of the book. This allows children to look through the book independently and say what they remember about the story. Encourage children to talk about the pictures in the book and "tell the story" if they are interested.[192]

Potential obstacles and the panel's advice

OBSTACLE: *Some of my children can't answer questions about the book.*

PANEL'S ADVICE*:* Some children may have limited experience answering "*wh-*" questions and will need intentional instruction in what they mean and how to answer them.[193] *Wh-*" questions begin with *what*, *why*, *where*, *when*, and *who*. In some cultures, questions are usually asked when someone has made a mistake or has misbehaved, so the children may have a negative feeling about answering questions.[194] Teachers may need to explain that they are asking questions to learn what the children are thinking, not because they are unhappy with the children. It might be helpful to point to the picture or character the question is about and let children point to the picture when answering.

When necessary, prepare children to answer "*wh-*" questions about the book. Explain each type of question and how it might be answered. For example, explain that for a *where* question, the answer is usually a place. Consider modeling how to answer different questions by talking through how to answer them.

Set up small groups or pairs to practice these questions before asking a child to answer in front of the whole class. For example, ask children to find something they like in the classroom to share with a peer. Ask the children to describe the item to their peer. Then have one child ask the other child "*wh-*" questions about the item. Listen to the children as they practice asking and answering the questions and provide additional explanation when children show they do not understand the questions. Offer specific and immediate praise when they ask or answer the questions well. After some practice, children may feel comfortable asking and answering questions with a small group or whole class.

OBSTACLE: *My children don't seem to understand what I read to them.*

PANEL'S ADVICE*:* If children are not understanding books about a particular topic, the panel suggests spending more time on the topic with a child one-on-one or with a small group of children. If the whole class is not understanding the topic, the panel suggests finding a simpler book on the topic or planning other activities on the topic that can help clarify the topic for the entire group, such as acting out a story with puppets to help children see what happened in the book or creating a solar system in the classroom when trying to understand a book about the solar system. It might also be useful to break the book into smaller portions, such as a single page, and discuss each portion before moving on to the next one.

If children are not understanding multiple books that are read aloud, it might be helpful to work with them on comprehension monitoring.[195] Present short 2-3-sentence stories with illustrations and ask children whether the stories make sense. Present some stories that are silly and inconsistent such as an illustration of a child drawing with a stick of gum and say, "Sid wants to draw a picture. Sid used a stick of gum." Also show some that clearly make sense, such as an illustration of a child and a cat and say, "Pat has a pet cat. The cat likes to sit on Pat's lap." After presenting each illustration and short story, ask children if the story makes sense and to explain their answer. Through practice, children will be better able to identify whether they are understanding what they hear and be able to tell the teacher when they need additional explanation.[196]

OBSTACLE: *My children have such a hard time sitting through an entire book.*

PANEL'S ADVICE*:* Children's prior experiences may not prepare them well for listening to and discussing books. Some children may have listened to books being read regularly and have had conversations about the content of books, while others may have very limited experience listening to or talking about books.[197] The panel believes some children may need to build their ability to sit still and listen to the book being read.

Engaging children during reading can be helpful. For groups of children who are not ready to sit for shared book reading, start with short, interesting stories with pictures. Create voices for characters in the story or use movement to help tell the story. Include movement the children can do if possible. When necessary, allow children to draw or manipulate something in their hands while listening.[198] Consider reading while children are eating a snack or lunch or at other times when they are sitting still but their hands are busy. Gradually read for a little longer each week, until children can sit attentively and participate in shared book reading for 10-12 minutes.

Long books can be difficult for young children. Try picking a shorter chunk for one shared book reading, and possibly picking the book up again at another shared book reading that day or the next day. For example, use the table of contents in an informational book to have children help choose a section to read.

OBSTACLE: *I can't find any books that depict people like the children in my classroom. The books don't include experiences relevant to their lives.*

PANEL'S ADVICE*:* Children need to see people like themselves in the books used in the classroom.[199] Books can reflect their race or ethnicity, culture, where they live, or familiar experiences. If the classroom library does not include books that represent the children and their experiences, it may be helpful to visit the local library to find a wider variety of books. Also consider creating a simple book by printing pictures that reflect the children, the local community, or relevant experiences and adding a short sentence to describe each picture.

Glossary

A

Abstract noun is a person, place, or thing that cannot be experienced with the five senses, such as luck, anger, or freedom.

Academic language refers to the language children are expected to learn to be successful in school. This language is not usually common in informal conversations outside of school. It is primarily the words used in instruction and texts used in school.

Adjective is a word used to describe the attributes of a noun, such as *red* wagon, *warm* weather, or *stunning* view.

Adverb is a word that modifies or describes a verb (he runs *slowly*), an adjective (*very* difficult), another adverb (spoke *too rapidly*). An adverb can also modify a sentence (*Luckily*, I caught the last bus home).

Alliteration is repetition of the first sound or letter in two or more words. For example, Pam plants pretty pink poppies.

B

Basic mathematical skills refers to skills that form the basis for learning advanced mathematics. This can include counting, naming shapes, and creating patterns.

Beginning sound refers to the first sound in a word.

C

Cardinality is understanding of how many items are in a set and the number name for that quantity of items.

Center activities refers to organized activities with an educational focus that encourages children to engage in hands-on learning in a specific area of the classroom. The classroom may be organized to have several centers that children rotate through during a specific time block of the school day.

Circle time refers to a time during the school day when children gather to participate in a discussion or group activity led by the teacher.

Comprehension monitoring refers to children thinking about whether they are understanding what was read.

Concrete nouns refer to persons, places, or things that can be experienced with the five senses, such as a teacher, a park, or a toy truck.

Counting on refers to a process of counting up from a number other than one.

Culturally responsive practices refer to methods of teaching that value children's cultural, racial, and linguistic backgrounds and incorporate their cultures into instruction and the learning environment in meaningful ways.

D

Descriptor words are adjectives and adverbs used to describe or identify the attributes of a noun or verb.

Developmental progressions refer to the order in which development of skills and understanding of concepts build on each other as children develop knowledge.

Dialect is a form of a language that is unique to a specific region or group of people.

Discipline techniques are approaches used to teach children which behaviors are appropriate and which are not.

Dramatic play is a form of play during which children pretend to take on the roles, actions, or speech of someone else.

Dual language learners are children who are learning both English and another language. These children often come from homes where languages other than English are spoken.

E

End sound refers to the sound or letter at the end of a word.

Evidence-based refers to an approach to education that emphasizes the application of findings from the best available current research.[200]

Executive function skills are a set of skills that help one organize plans and execute them, as well as organize and regulate oneself. Executive function skills include self-control, following directions, and planning.

F

Free play is a form of play in which children choose what they do. There are typically no specific learning objectives with free play.

G

Glue words are words that are essential for understanding a sentence. They are some of the most common and essential words in the English language and are often difficult to depict in pictures: for example, *with*, *an*, *that*, *there*, or *the*. They are also referred to as high-frequency words.

H

Hands-on refers to using a wide range of physical objects and two-dimensional representations that children can move, assemble, stack, and arrange as they learn something new.

High-frequency words are words that appear most often in printed text.

Higher-order thinking refers to a type of thinking that requires more cognitive processing, such as critical thinking and problem solving. Higher-order thinking is useful more generally to analyze, evaluate, connect, and understand more complex information.

I

Informational books refers to nonfiction texts that inform the reader about the natural or social world. Also referred to as an expository texts.

Intentional instruction refers to instruction that is focused, deliberate, and purposeful in directly addressing the learning objectives of the lesson.

Interactive read-aloud refers to a practice where the teacher reads a book aloud and asks children to participate, by either telling parts of the story or answering questions.

Interlocking counting cubes are small cubes that connect to each other, often referred to as Unifix® cubes.

L

Learning trajectories refer to a sequence of learning activities that are aligned with the typical progression of how children learn mathematics.

M

Mathematical language is the language used to talk about mathematical ideas, such as quantity and geometric shapes, such as numbers, add, circle, or square.

Multi-turn conversations are conversations during which children are encouraged to talk about what they are thinking or learning in a back-and-forth manner with the teacher.

N

Narrative book is a book about a connected series of events; includes both fiction (e.g., novels, short stories) and nonfiction (e.g., memoirs, biographies, news stories).

Natural world refers to all of the things existing in nature that are not made or caused by people, such as animals, plants, and other phenomena.

Nonfiction refers to stories or text written about facts, real events, and real people.

Number rack is an instrument that consists of rows of movable, colored beads. An abacus and a rekenrek are types of number racks.

Number recognition is the ability to visually recognize and name numbers.

Number relationships refer to how quantities can be represented in multiple, flexible ways.

Number-path game is a number-based game using a path of spaces with increasing numbers in each. These games can be used to teach number recognition, counting, magnitude, and foundations of addition and subtraction. Number paths are also a precursor for children to understand number lines.

P

Phonological awareness is the awareness of the sounds of language.

Positive classroom management is an approach to supporting and working with children to create a classroom environment that is conducive to learning.

Preschool education refers to the schooling that takes place the year or two before children enter kindergarten—years often referred to as preschool, prekindergarten, or pre-K. Preschool programs include private preschools and government-funded programs like district-run preschools and Head Start, as well as home day care settings with a formal curriculum serving children who will enter kindergarten within the following year or two.

Print refers to text that appears, for example, in books and on labels.

Print features refer to the use of images or words to explain something in the text, such as the index, table of contents, glossary, bolded words, headings, subheadings, illustrations, photographs, and diagrams.

Problematic social situations are situations that have a negative impact on the children or teachers involved, usually involving an interaction or behavior that needs to be addressed.

R

Rekenrek is a tool, related to an abacus, used to help children visualize numbers and number relationships, typically consisting of two rows of beads, each with five white beads and five red beads.

Rhyme refers to words with a similar end sound, such as *me*, *be*, *see*, or blended sounds, such as *run*, *fun*, *sun*.

S

Self-control is the ability to inhibit impulsive emotions or behaviors.

Self-regulation is the ability to reduce the intensity and frequency of impulsive emotions or behaviors.

Shape hunt is an activity where children look for and identify objects or pictures that resemble different shapes.

Shared book reading is a form of reading in which the teacher reads a book aloud and asks children to participate, by either saying parts of the story or answering questions.

Small-group activities refer to a form of teaching in which the teacher works with a small group of children to achieve a learning goal.

Social world refers to topics relating to community or human society.

Social-emotional learning is the process of developing friendship skills, self-regulation, and self-awareness.

Social-emotional skills refer to the ability to share and cooperate with friends, to identify and regulate emotions, and to deal with problematic social situations.

Spatial prepositions are words that describe the location or change of location of something, such as *at*, *in*, *on*.

Speech bubbles are graphic balloons used to denote speech or thoughts of a character in a story.

Staged activities are intentionally planned activities that provide structured opportunities for children to practice what they are learning.

Stopping points refer to predetermined places to pause reading aloud to discuss something in the book or ask a question about the book.

Subitizing is the ability to see a small number of objects and instantly know how many are in the group without counting.

Synonym is a word or phrase that has the same meaning as another word or phrase.

T

Target letter is the letter a teacher selects for instruction.

Target skills are the skills a teacher selects for instruction.

Target vocabulary are the word(s) a teacher selects for instruction.

Teacher refers to any adult who helps children learn, such as a lead or assistant teacher, paraeducator, parent, or volunteer.

Ten-frame refers to a graphic tool depicting 10 boxes in two rows and five columns.

Theme-based refers to a way of teaching that covers topics that are connected by or integrated into themes.

Think aloud refers to expressing one's thoughts aloud to help children understand how to think about a topic.

Thinking flexibly is a type of executive function skill in which children are able to shift their attention to consider different aspects of an issue. Thinking flexibly enables them to respond more constructively to interpersonal or learning problems.

V

Verbs are words used to describe an action, such as *run* or *talk*, or state of being, such as *is*, *am*, *be*.

W

Whole-class activities are activities led by a teacher that involve the whole class of children.

Appendix A: Postscript from the Institute of Education Sciences

What is a Practice Guide?

The What Works Clearinghouse (WWC) within the Institute of Education Sciences (IES) publishes practice guides to share expert recommendations addressing a key educational challenge. Each recommendation in the practice guides is explicitly connected to supporting evidence from studies that meet WWC standards.

How are Practice Guides developed?

To produce a practice guide, the WWC first selects a topic based on the needs of the field. Next, working with a WWC contractor, the WWC selects a panel chair who is a national expert on the topic and panelists to co-author the guide. Panelists are selected based on their expertise in the field and the belief that they can work together to develop relevant, evidence-based recommendations. Panels include at least two current educators who are actively working in the field.

The WWC contractor conducts a systematic literature search and consults with the panel to identify relevant research studies. These studies are then reviewed using the WWC standards to assess each study's internal validity.[201] The WWC contractor works with the panel to synthesize the studies that meet WWC standards into recommendations and to draft the practice guide.

The practice guide is then peer-reviewed. This review is independent of the panel and the federal and contractor staff who supported the development of the guide. A critical task of the peer reviewers is to determine whether the evidence cited in support of each recommendation is up to date and to verify that studies of similar or better quality with contradictory results have not been overlooked. Peer reviewers also evaluate whether the level of evidence assigned to each recommendation is appropriate. The WWC contractor revises the guide to address concerns identified by the external peer reviewers and IES.

In addition to the peer-review of the practice guide, the Statistics, Website, and Training (SWAT) team conducts an independent review of the evidence to ensure that the findings are valid and accurate. As part of this peer-review process, all studies that meet standards and the meta-analysis for each recommendation are checked and verified.

Levels of evidence for What Works Clearinghouse Practice Guides

The level of evidence represents the quality and quantity of existing research supporting each recommendation. The panel assigns each recommendation one of the following three levels of evidence: strong evidence, moderate evidence, or minimal evidence.

A *strong* level of evidence rating refers to evidence from two or more well-designed, well-implemented experimental studies that the recommended practices improve relevant outcomes for the population of children relevant to the practice guide. In other words, this level of evidence indicates that there is strong causal and generalizable evidence to support the panel's recommendation.

A *moderate* level of evidence rating refers either to evidence from well-designed, well-implemented, quasi-experimental design studies; studies where the sample does not represent the population of children relevant to the practice guide; or only one well-designed, well-implemented experimental study. In other words, this level of evidence indicates that the relevant research may not be generalizable or that the WWC has some reservations about the quality of the research for causal inferences because of the study design or implementation.

A *minimal* level of evidence rating suggests that the panel cannot point to a body of evidence that demonstrates the practice's positive and statistically significant effects on child outcomes. In some cases, this simply means that the recommended practice would be difficult to study using an experimental or quasi-experimental research design; in other cases, it means that researchers have not yet studied this practice, or that there is a lack of evidence or conflicting evidence about its effectiveness. A minimal evidence rating does not indicate that the panel views the recommendation as any less important than other recommendations with strong or moderate evidence ratings.

To determine these evidence ratings, the WWC contractor first conducts a careful review of the studies supporting each recommendation. For each recommendation, the WWC contractor and the panel examine the entire evidence base, taking into account the following considerations:

- The extent of evidence meeting WWC standards.
- The weighted mean effect size from the fixed-effects meta-analysis for each relevant outcome domain, including its sign and statistical significance.[202]
- How well the studies represent the range of participants, settings, and outcomes relevant to the recommendation.
- Whether findings from the studies can be attributed to the recommended practice.
- The panel's confidence in the effectiveness of the recommended practice.

The WWC contractor and the panel determine the level of evidence rating for a recommendation based on each of the criteria in **Table A.1**. For a recommendation to get a strong rating, the research must be rated strong on each criterion. If at least one criterion receives a rating of moderate and none receives a rating of minimal, then the level of evidence for the recommendation is determined to be moderate. If one or more criteria receive a rating of minimal, then the level of evidence for the recommendation is determined to be minimal.

Table A.1. IES levels of evidence for What Works Clearinghouse practice guides

Criterion	STRONG Evidence base	MODERATE Evidence base	MINIMAL Evidence base
Extent of evidence	For each key outcome domain, the research includes two or more studies that meet WWC standards, and the studies include more than one setting and a sample of more than 350 individuals.	For each key outcome domain, the research includes only one study that meets WWC standards, or more than one study meets WWC standards but the studies either include only one setting or a sample of fewer than 350 individuals.	For each key outcome domain, the research does not include at least one study that meets WWC standards.
Effects on relevant outcomes[a]	For at least half of the key outcome domains[b] with findings meeting WWC standards, the following conditions are met: • The mean effect from a fixed-effects meta-analysis[c] is statistically significant and positive; AND • More than 50.0 percent of the fixed-effects meta-analytic weight comes from studies that Meet WWC Standards Without Reservations. The mean effect from a fixed-effects meta-analysis is not statistically significant and negative for any outcome domain relevant for the recommendation.	For at least half of the key outcome domains with findings meeting WWC standards, the following conditions are met: • The mean effect from a fixed-effects meta-analysis is statistically significant and positive; AND • More than 50.0 percent of the fixed-effects meta-analytic weight comes from studies that Meet WWC Standards with Reservations. Contradictory evidence from a fixed-effects meta-analysis that is statistically significant and negative is considered with regard to relevance to the scope of the recommendation.	For at least half of the key outcome domains with findings meeting WWC standards, one of the following conditions is met: • The mean effect from a fixed-effects meta-analysis is NOT statistically significant and positive, OR • No studies meet WWC standards.
Relevance to scope	The research has direct relevance to scope—relevant settings, populations, comparisons, and outcomes evaluated.	Relevance to scope may vary. At least some research is directly relevant to scope.	No research relevant to the scope of the recommendation could be located.

Criterion	STRONG Evidence base	MODERATE Evidence base	MINIMAL Evidence base
Relationship between the evidence and the recommendation	The recommendation is directly tested in the studies, or the recommendation is a major component of the interventions evaluated in at least half of the studies.	The recommendation is directly tested, or the recommendation is a major component of the interventions evaluated in less than half of the studies.	The recommendation is not tested in the studies, and the panel provides references to one or more peer-reviewed publications that expound theories that support the recommendation.
Panel confidence	Panel has a high degree of confidence that a given practice is effective.	Panel may not be confident about whether the research has effectively controlled for other explanations or whether the practice would be effective in most or all contexts.	In the panel's opinion, the recommendation must be addressed as part of the practice guide; however, the panel cannot point to a body of research that rises to the level of moderate or strong.
Role of expert opinion	Not applicable.	Not applicable.	The recommendation reflects expert opinion based on reasonable extrapolations of research.

[a] Outcome domains relevant to the scope of the practice guide are defined by the protocol.

[b] Key outcome domains are those that are most relevant to each specific recommendation.

[c] If the finding in the relevant outcome domain is from only a single study, then the effect size from that study takes the place of the mean effect from a fixed-effects meta-analysis.

A final note about WWC Practice Guides

Expert panels try to build a consensus, forging statements that all panel members endorse. Practice guides do more than find common ground; they create a list of actionable recommendations. Where research clearly shows which practices are effective, the panelists use this evidence to guide their recommendations. However, in some cases, the research does not provide a clear indication of what works. In these cases, the panelists' interpretation of the existing, but incomplete, evidence plays an important role in developing the recommendations.

Appendix B: Methods and Processes for Developing This Practice Guide

Phase 1: Selecting the panel; establishing a review protocol

Expert Panel. The WWC established an 11-member expert panel to advise on the development of this practice guide. The panel consisted of early childhood researchers in the areas of early literacy, language, mathematics, social-emotional learning, and self-regulation and practitioners with experience in implementing school readiness interventions with children between the ages of 3 years and 5 years.

Practice Guide Review Protocol. The WWC contractor worked with the panel to develop the practice guide review protocol, available at **https://ies.ed.gov/ncee/wwc/Document/1296**, which states the practice guide's purpose and scope. The protocol guided the literature search and review effort.

The time frame for the literature search was 15 years, from January 1, 2005 to July 31, 2020.[203] The eligible sample included children between the ages of 3 years and 5 years who have not yet enrolled in kindergarten and have not been identified as having disabilities. Eligible study designs included randomized controlled trials, quasi-experimental studies, and regression discontinuity designs. Studies had to focus on early literacy, language, mathematics, social-emotional learning, or self-regulation to be eligible for review. Studies that focused exclusively on technology, parent/caregiver/guardian training, or professional development were excluded, as they are beyond the scope of this guide. Only outcomes that fit into one of six outcome domains addressing aspects of school readiness were eligible for inclusion. The six domains are:

1. Reading and literacy related
2. Language
3. Mathematics
4. Social-emotional learning
5. Self-regulation
6. General knowledge

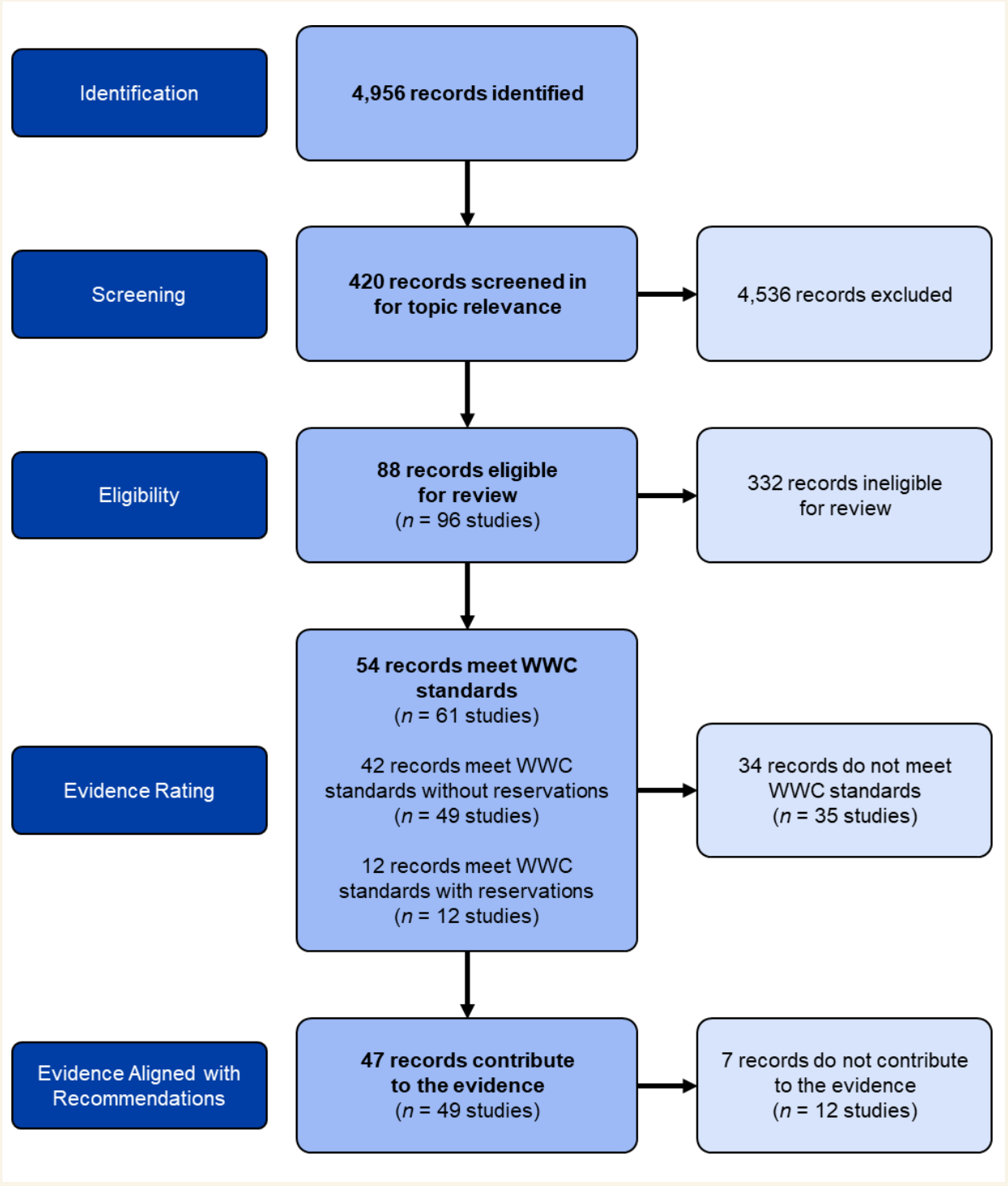
For additional details, the protocol is available on the What Works Clearinghouse website.

Phase 2: Literature search and review

A targeted yet comprehensive search of the public ERIC search engine (**https://eric.ed.gov**) was conducted using *preschool education* as the search term as well as a descriptor. The search was limited to exclude dissertations and studies conducted outside the United States.[204] In addition, a search of the Science Direct database was conducted for research articles using the terms *preschool education* and *early childhood education*. Panel members also recommended studies that could potentially contribute to the guide.

A total of 4,956 records were identified and screened using a multi-stage screening process to determine whether they met the eligibility criteria described above. All 4,956 records were screened by multiple trained WWC contract staff who worked independently to determine if a record should be included or excluded based on the eligibility criteria specified in the protocol. Disagreements between screeners were settled in discussion with the review team leadership. This screening process produced 88 eligible records. Some of the eligible records included more than one study (i.e., more than one experimental comparison). The WWC review team selected one or more studies from these records for review based on their relevance to the practice guide. Thus, from the 88 eligible records, a total of 96 studies were reviewed using **WWC 4.1 group design and regression discontinuity design standards**. In this practice guide, each experimental comparison is being referred to as a study and has a unique WWC study review. See **Figure B.1** for the number of records that went through the screening and eligibility processes, and the number of records and studies that were reviewed with the corresponding WWC evidence ratings.

Figure B.1. Studies identified, screened, and reviewed for this practice guide



Phase 3: Generating the recommendations

The WWC contractor conducted a detailed examination of the 49 studies that meet WWC standards to identify instructional practices that played a role in each intervention. Multiple researchers from the WWC contractor team examined each study and developed coding categories to capture key instructional practices in the interventions. These coding categories were developed in an iterative manner and refined as needed to ensure consistency in coding. Topics for recommendations were generated through discussion with the expert panel using themes identified during the coding process. The panel identified seven recommendations based on the topics and evidence presented by the 49 studies that meet WWC standards. The panel then suggested steps for carrying out the recommendations, guided by the evidence base.

Phase 4: Drafting the Practice Guide

The WWC contractor worked with the panel to further expand and clarify each recommendation and delineate how to implement each recommendation. The team then used an iterative process to draft the recommendations, soliciting feedback from the panel and revising as needed at each stage. The WWC contractor compiled the level of evidence for each recommendation and drafted the technical appendices. The practice guide underwent several rounds of review, including an IES external peer review (as described in **Appendix A**).

Appendix C: Rationale for Evidence Ratings

Conducting reviews of eligible studies

WWC-certified staff reviewed 96 studies from 88 records to assess the quality of evidence supporting education programs and practices using WWC standards and procedures, version 4.1.[205] Of these 96 studies, 61 studies meet WWC standards. Of these 61 studies, 49 studies provide the evidence for the recommendations in this practice guide.[206] The references section lists all 88 records and delineates the studies that provided supporting evidence for the recommendations, as well as the studies that were reviewed but did not provide supporting evidence. The WWC's summary of each of the 96 studies reviewed for this practice guide are available on the WWC website at https://ies.ed.gov/ncee/wwc/ReviewedStudies/ForPracticeGuide/30.

Determining relevance to recommendations

The WWC contractor mapped the 49 studies in the evidence base to one or more of the seven recommendations. Thirty-one studies provide evidence for one recommendation.[207] Eighteen studies provide evidence for more than one recommendation, as the interventions in these studies include more than one practice (or component) for improving child outcomes.[208] For example, one multi-component intervention might include vocabulary instruction (**Recommendation 5**), identifying letters and sounds (**Recommendation 6**), and shared book reading (**Recommendation 7**), and thus be used as evidence for three recommendations in this guide. It was not possible to identify whether a singular component or a combination of components within a multi-component intervention produced an effect. Thus, the calculated effect sizes reflect the effect of each full intervention.

The WWC contractor and panel determined which instructional components were likely to cause an effect based on their prominence in the intervention program investigated in each study that meets WWC standards. Then, each study was assigned to the evidence base for a recommendation based on its relevant instructional components. **Table C.1** presents the mapping between each study and the seven recommendations.

Table C.1. Mapping between studies and recommendations

Scope	Recommendations						
	1	2	3	4	5	6	7
	Social-emotional learning	Executive function	Mathematical ideas and skills	Mathematical language	Vocabulary and language	Letters and sounds	Shared book reading
Assel et al. (2007) ***Doors to Discovery*™ vs. business as usual**					✓	✓	✓
Biazak et al. (2010) **Activity-based listening vs. listening to a story**							✓
Bierman et al. (2008) ***Head Start Research-Based, Developmentally Informed* program vs. business as usual (*Creative Curriculum*® or *HighScope*©)**	✓						
Blewitt et al. (2009) **Scaffolding questions during book reading vs. asking either low- or high-demand questions during book reading**					✓		✓
Clements and Sarama (2008) ***Building Blocks*™ vs. business as usual (*Creative Curriculum*)**			✓	✓			
Clements et al. (2011) ***Building Blocks* vs. business as usual (*Where Bright Futures Begin* or *Opening the World of Learning*™)**			✓	✓			
Clements et al. (2019) **Learning trajectories-based instruction vs. instruction at children's target level without scaffolding**			✓				
Collins (2010) **Rich explanation reading vs. business as usual (story reading without rich explanation)**					✓		✓
DeFlorio et al. (2019) ***Pre-K Mathematics* vs. business as usual (*Creative Curriculum*)**			✓				
Dickinson, Collins, et al. (2019) **Book reading plus play vs. book reading only**					✓		✓
Farver et al. (2009) ***Literacy Express* in English only vs. business as usual (*HighScope*)**					✓	✓	✓

	Recommendations						
	1	2	3	4	5	6	7
Feil et al. (2009) ***Positive Behavioral Interventions and Supports* (*PBIS*) vs. business as usual**	✓						
Flook et al. (2015) ***Kindness Curriculum* vs. business as usual**	✓						
Gunter et al. (2012) ***Strong Start Pre-K* vs. business as usual**	✓						
Jung et al. (2013) ***Building Blocks* software, with rekenrek and ten-frame activities vs. business as usual (*Mathematics: The Creative Curriculum Approach*)**			✓	✓			
Justice et al. (2010) **High-dose print referencing vs. book reading without a focus on print referencing**							✓
Kim and Phillips (2016) **Comprehension monitoring vs. business as usual (*Creative Curriculum* or *Houghton Mifflin Pre-K*)**							✓
Klein et al. (2008) ***Pre-K Mathematics* and *DLM Express*® math software vs. business as usual (*Creative Curriculum* or *HighScope*)**			✓				
Mages (2018) ***Theatre-in-Education* program vs. business as usual (*Head Start*)**					✓		✓
McCarty et al. (2018) ***Blueprint for Early Literacy*© vs. business as usual (*Creative Curriculum*)**							✓
McClelland et al. (2019) ***Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual (*Creative Curriculum*)**		✓					
Neuman and Dwyer (2011) ***World of Words*© vs. business as usual (*HighScope*)**					✓		✓
Neuman et al. (2015) ***World of Words* vs. business as usual (*HighScope*)**					✓		✓
Nicolopoulou et al. (2015) **Storytelling and story-acting vs. business as usual (*Creative Curriculum*)**							✓

	Recommendations						
	1	2	3	4	5	6	7
Ostrov et al. (2009) ***Early Childhood Friendship Project* vs. business as usual**	✓						
Penuel et al. (2012) **Media-rich early literacy supplement vs. media-rich science supplement**					✓	✓	✓
Piasta and Wagner (2010b) **Letter names and sounds instruction vs. numbers instruction**						✓	
Preschool Curriculum Evaluation Research Consortium (2008) ***Doors to Discovery* vs. business as usual**					✓		
Preschool Curriculum Evaluation Research Consortium (2008) ***Let's Begin with the Letter People*® vs. business as usual**						✓	
Preschool Curriculum Evaluation Research Consortium (2008) ***Literacy Express* vs. business as usual (*HighScope*)**					✓	✓	✓
Purpura et al. (2017) **Mathematical language storybook intervention vs. business as usual (*Creative Curriculum*)**			✓	✓			
Ramani and Siegler (2008) **Number board games vs. color board games**			✓				
Ramani and Siegler (2011) **Linear board game vs. numerical activities**			✓				
Read et al. (2019) **Story reading with pauses before target words or story reading with pauses after target words vs. story reading without pauses**					✓		
Roberts et al. (2018) **Experimental letter names and sounds instruction vs. typical letter names and sounds instruction**						✓	
Roberts et al. (2019) **Decontextualized letter names and sounds instruction vs. contextualized letter names and sounds instruction**						✓	
Rosenfeld et al. (2019) ***PBS KIDS Transmedia Math Supplement* vs. business as usual**			✓	✓			
Scalise et al. (2018) **Numerical magnitude comparison vs. numerical matching card game**			✓				

	Recommendations						
	1	2	3	4	5	6	7
Schmitt et al. (2015) **Self-regulation intervention vs. business as usual**		✓					
Siegler and Ramani (2008) **Number board games vs. color board games**			✓				
Siegler and Ramani (2009) **Linear board game vs. numerical activities**			✓				
Thomas et al. (2018) ***Pre-K Mathematics* vs. business as usual**			✓				
Toub et al. (2018) **Guided play or directed play vs. free play**					✓		✓
Ukrainetz et al. (2011) **Syllable tasks or multiple phoneme tasks vs. first phoneme tasks**						✓	
Upshur et al. (2017) ***Second Step® Social-Emotional Skills for Early Learning* vs. business as usual (*Creative Curriculum*)**	✓	✓					
Wakabayashi et al. (2020) ***Numbers Plus® Preschool Mathematics* vs. business as usual (*HighScope*)**			✓				
Wasik and Hindman (2020) ***Story Talk* book reading with "story maps" vs. book reading without "story maps"**					✓		✓
Yazejian and Peisner-Feinberg (2009) **Music and movement intervention that supports language skills vs. business as usual**					✓		
Zelazo et al. (2018) **Mindfulness and reflection training vs. business as usual (regular classroom activities or *Second Step Social-Emotional Skills for Early Learning*)**		✓					

Determining relevant outcomes

To simplify and focus the synthesis of evidence, the WWC contractor worked with the panel to identify which outcome domains were relevant for each recommendation. The panel and WWC contractor considered only the findings in the predetermined relevant domains when determining the level of evidence for each recommendation. The panel deemed the general knowledge domain not relevant to any recommendation. Only findings in relevant domains are presented in this appendix. The relevant domains for each recommendation are listed in Table C.2.

Table C.2. Relevant domains for each recommendation

Outcome domains	Recommendations						
	1	2	3	4	5	6	7
	Social-emotional learning	Executive function	Mathematical ideas and skills	Mathematical language	Vocabulary and language	Letters and sounds	Shared book reading
Language					✓		✓
Mathematics			✓	✓			
Reading and literacy related					✓	✓	✓
Self-regulation		✓					
Social-emotional learning	✓						

Estimating fixed-effects meta-analytic effect sizes

As discussed in Appendix A, the determination of the level of evidence for each recommendation relied on the extent of the evidence from the supporting studies. To synthesize the evidence across studies for each recommendation, two analysts from the WWC contractor team independently calculated a weighted fixed-effects meta-analytic mean effect size for each relevant outcome domain in which at least two studies had findings, using procedures stated in the *WWC Procedures Handbook, Version 4.1.*[209] In addition, the WWC Statistics, Website, and Training (SWAT) team conducted an independent review of the meta-analytic data to ensure that the findings are valid and accurate.

To calculate the meta-analytic effect size, studies were weighted by the inverse of the variance of each study's effect size. Thus, studies that tested an intervention with large numbers of children received more weight than studies with small numbers of children. The statistical significance of each effect size for each outcome domain was calculated using a z test. For additional information on this process, see Appendix H of the *WWC Procedures Handbook, Version 4.1.*

To ensure that the resulting effect sizes were statistically independent, the analysis included only studies with non-overlapping samples from each record.[210] If a record had two relevant studies with non-

overlapping samples, both were included in the analysis. In the case of overlapping samples across relevant studies, only the study most relevant to the recommendation was included in the meta-analysis.

For consistency, the meta-analysis for each domain is based on effect sizes from outcomes measured closest to the end of the intervention. All other outcomes (follow-up measures, subscales of main findings, and measures for eligible subgroups of linguistically diverse students) were not included in the meta-analysis and instead are presented as supplemental evidence at the corresponding study pages on the WWC website. The meta-analytic mean effect sizes for each outcome domain and recommendation are listed in **Tables C.4**, **C.6**, **C.8**, **C.10**, **C.12**, **C.14**, and **C.16**.

Recommendation 1: Regularly provide intentional, engaging instruction and practice focused on social-emotional skills

Rationale for a strong level of evidence

The WWC and the expert panel assigned **Recommendation 1** a strong level of evidence based on six studies.[211] All six studies meet WWC group design standards without reservations because they were randomized controlled trials with low sample attrition.

There were findings in one relevant outcome domain for this recommendation (**Table C.3**). This domain had a statistically significant, positive meta-analytic effect size: measures of social-emotional learning ($g = 0.18$, $p < .05$).

Table C.3. Domain-level effect size across the six studies supporting Recommendation 1

Domain	Number of studies (*k*)	Effect size [a]	95% confidence interval	*p* value	Percentage of weight from studies that meet WWC standards without reservations
Social-emotional learning	6	**0.18**	[0.03–0.34]	< .05	100.00

Note: The effect size was calculated using a fixed-effects meta-analytic effect size across studies. *k* = number of studies with at least one outcome in the relevant domain that contributed to the meta-analytic effect size.
[a] Statistically significant findings are bolded.

In the studies supporting this recommendation, the interventions were closely aligned with the practices outlined in the recommendation. The panel assigned a strong level of evidence to this recommendation. This rating was supported by the strength of the evidence according to the following criteria:

- **Extent of evidence.** The study samples collectively included 1,570 children and at least 27 schools and centers across multiple states.
- **Effects on relevant outcomes.** The outcome domain (measures of social-emotional learning) had an effect size that was positive and statistically significant, with 100 percent of the meta-analytic weight from studies that meet WWC standards without reservations. This domain represented the only relevant outcome domain for this recommendation.
- **Relevance to scope.** The evidence included samples of children ages 3-5, examined instructional practices delivered in preschool settings, and measured outcomes in relevant domains. For the six studies supporting this recommendation, instruction ranged from 5 weeks to 1 school year in duration. Three studies delivered instruction over a range of 5-12 weeks,[212] while the remaining three studies delivered instruction over a range of 28 weeks to 1 year.[213] Four studies delivered instruction once or twice per week,[214] while two studies delivered instruction 5 times per week.[215] Two studies delivered lessons lasting between 20 and 30 minutes in duration,[216] while the remaining four studies did not report lesson duration.[217]

- **Relationship between the evidence and the recommendation.** In more than half of the studies, the recommendation or the how-to steps were a major component of the interventions evaluated. Instruction in these studies focused on building children's social-emotional skills through instruction, practice, and review. The instructional practices included:
  - Using a social-emotional curriculum that follows an appropriate scope and sequence for this age group.
  - Allocating time to intentionally focus on social-emotional learning.
  - Briefly introducing the focus of social-emotional lessons using engaging teaching methods, like short stories, puppet shows, photographs, or brief role-plays.
  - Creating opportunities to review and reinforce those lessons through specifically designed activities.
  - Taking advantage of teachable moments that happen throughout the day, such as during snack time or free play, to practice, reinforce, and review social-emotional skills.
  - Extending learning by sharing with parents, caregivers, and guardians which social-emotional skills children are working on during the day.

Supplemental findings for Recommendation 1

Supplemental findings (follow-up measures and subscales of main findings) for two studies are available at the corresponding study pages on the WWC website:

- Flook et al. (2015) [***Kindness Curriculum* vs. business as usual**], and
- Gunter et al. (2012) [***Strong Start Pre-K* vs. business as usual**].

Table C.4. Studies providing evidence for Recommendation 1: Regularly provide intentional, engaging instruction and practice focused on social-emotional skills

Recommendation 1: Social-emotional learning			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Bierman et al. (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Head Start Research-Based, Developmentally Informed* program vs. business as usual (*Creative Curriculum* or *HighScope*)** **Participants:** 343 4-year-old children • Race/Ethnicity: ▪ 25% Black ▪ 17% Hispanic ▪ 58% White • Dual language learners: ▪ Not reported • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 44 Head Start classrooms in Pennsylvania	**Duration:** One lesson and extension activity per week, 33 lessons total **Content:** Social-emotional skills: prosocial friendship skills, emotional understanding and emotional expression, self-control, and problem-solving skills including interpersonal negotiation and conflict resolution skills **Relevance to recommendation:** Instruction followed a curriculum that included brief introductions of the social-emotional focus of the lessons. Activities provided opportunities for children to practice newly learned skills. Teachers also reviewed and reinforced skills throughout the day. Information was provided to parents, caregivers, and guardians for at-home reinforcement.	**Social-emotional learning: 0.26**
Feil et al. (2009) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Positive Behavioral Interventions and Supports* (*PBIS*) vs. business as usual** **Participants:** 263 3–4-year-old children • Race/Ethnicity: ▪ 31% Hispanic ▪ 73% White • Dual language learners: ▪ Not reported • Family income level: ▪ Not reported **Setting:** 13 Head Start centers in 33 classrooms in Oregon	**Duration:** 5 days per week, 1 year **Content:** Social and behavioral skills **Relevance to recommendation:** Instruction included brief introductions of the social-emotional focus of the lessons. Activities provided opportunities for children to practice newly learned skills. Teachers also reviewed and reinforced skills throughout the day.	**Social-emotional learning:** 0.17

Recommendation 1: Social-emotional learning			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Flook et al. (2015) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Kindness Curriculum* vs. business as usual** **Participants:** 66 children with a mean age of 4.67 years • Race/Ethnicity: ▪ 10% Asian/Pacific Islander ▪ 6% Black ▪ 12% Hispanic ▪ 59% White ▪ 13% Other • Dual language learners: ▪ Not reported • Family income level: ▪ 37.9% of children are considered socioeconomically disadvantaged. **Setting:** 7 classrooms in 6 elementary schools in 1 school district in the midwestern region of the United States	**Duration:** 20–30-minute lessons, 2 times per week, 12 weeks **Content:** Mindfulness-based prosocial skills: focus, attention, regulating emotion, and kindness practices (e.g., empathy, gratitude, sharing) **Relevance to recommendation:** Instruction followed a curriculum that included brief introductions of the social-emotional focus of the lessons. Activities provided opportunities for children to practice newly learned skills. Information was provided to parents, caregivers, and guardians for at-home reinforcement.	**Social-emotional learning:** 0.43
Gunter et al. (2012) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Strong Start Pre-K* vs. business as usual** **Participants:** 84 children • Race/Ethnicity: ▪ 2% Black ▪ 67% Hispanic ▪ 1% Native American ▪ 26% White ▪ 4% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 1 Title I preschool in Utah	**Duration:** 10 lessons total **Content:** Social and emotional competence **Relevance to recommendation:** Instruction followed a curriculum that included brief introductions of the social-emotional focus of the lessons. Activities provided opportunities for children to practice newly learned skills. Information was provided to parents, caregivers, and guardians for at-home reinforcement.	**Social-emotional learning:** 0.28

Recommendation 1: Social-emotional learning			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Ostrov et al. (2009) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Early Childhood Friendship Project* vs. business as usual** **Participants:** 403 3–5-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ Not reported • Family income level: ▪ Sample is socioeconomically diverse. **Setting:** 18 classrooms in 3 public schools and 4 community-based centers in the northeastern region of the United States	**Duration:** 20–30-minute lessons, 6 weeks **Content:** Prosocial behavioral skills for addressing relational and physical aggression **Relevance to recommendation:** Instruction followed a curriculum that included brief introductions of the social-emotional focus of the lessons. Activities provided opportunities for children to practice newly learned skills.	**Social-emotional learning:** 0.22
Upshur et al. (2017) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Second Step Social-Emotional Skills for Early Learning* vs. business as usual (*Creative Curriculum*)** **Participants:** 411 children with a mean age of 4.45 years • Race/Ethnicity: ▪ 2% Asian ▪ 26% Black ▪ 39% Hispanic ▪ 47% White ▪ 4% Other • Dual language learners: ▪ None • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 31 classrooms in community-based preschools and Head Start centers	**Duration:** 5 times per week, 28 weeks **Content:** Social-emotional competence and self-regulation **Relevance to recommendation:** Instruction followed a curriculum that included brief introductions of the social-emotional focus of the lessons. Daily activities provided opportunities for children to practice newly learned skills. Teachers also reviewed and reinforced skills throughout the day. Information was provided to parents, caregivers, and guardians for at-home reinforcement.	**Social-emotional learning:** 0.04

Note: Race and ethnicity categories under the *Participants* heading in each row may not add to 100 percent due to rounding and/or non-mutually exclusive categories of race and ethnicity; some studies did not report this information.

[a] Statistically significant findings are bolded.

Recommendation 2: Strengthen children's executive function skills using specific games and activities

Rationale for a moderate level of evidence

The WWC and the expert panel assigned **Recommendation 2** a moderate level of evidence based on four studies.[218] Three studies meet WWC group design standards without reservations because they were randomized controlled trials with low sample attrition.[219] One study meets WWC group standards with reservations because it was a randomized controlled trial with high individual-level nonresponse, but provided evidence of effects on individuals by satisfying the baseline equivalence requirement for the individuals in the analytic intervention and comparison groups.[220]

There were findings in one relevant outcome domain for this recommendation (**Table C.5**). This domain had a statistically significant, positive meta-analytic effect size: measures of self-regulation ($g = 0.17$, $p < .01$).

Table C.5. Domain-level effect sizes across the four studies supporting Recommendation 2

Domain	Number of studies (*k*)	Effect size [a]	95% confidence interval	*p* value	Percentage of weight from studies that meet WWC standards without reservations
Self-regulation	4	**0.17**	[0.04–0.30]	< .01	43.92

Note: The effect size was calculated using a fixed-effects meta-analytic effect size across studies. *k* = number of studies with at least one outcome in the relevant domain that contributed to the meta-analytic effect size.
[a] Statistically significant findings are bolded.

In the studies supporting this recommendation, the interventions were closely aligned with the practices outlined in the recommendation. The panel assigned a moderate level of evidence to this recommendation. This rating was supported by the strength of the evidence according to the following criteria:

- **Extent of evidence.** The study samples collectively included 968 children and at least 20 schools and centers across multiple states.
- **Effects on relevant outcomes.** The outcome domain (measures of self-regulation) had an effect size that was positive and statistically significant, with 56.08 percent of the meta-analytic weight from studies that meet WWC standards with reservations. This domain represented the only relevant outcome domain for this recommendation.
- **Relevance to scope.** The evidence included samples of children ages 3-5, examined instructional practices delivered in preschool settings, and measured outcomes in relevant domains. For the four studies supporting this recommendation, instruction ranged from 6-28 weeks in duration. Three studies delivered instruction over a range of 6-8 weeks,[221] while the remaining study delivered

instruction for 28 weeks.[222] Two studies delivered instruction 2 times per week,[223] while the remaining two studies delivered 5 lessons per week.[224] Three studies delivered lessons lasting between 15 and 30 minutes in duration,[225] while the remaining study did not report lesson duration.[226]

- **Relationship between the evidence and the recommendation.** In more than half of the studies, the recommendation or the how-to steps were a major component of the interventions evaluated. These studies focused on strengthening children's executive function skills through activities and games that challenge children to focus their attention and follow specific directions. The instructional practices included:
  - Leading specially designed games that require children to listen, remember and follow directions, think flexibly, and exhibit self-control.
  - Making the games more challenging over time by adding more rules, changing the rules, or changing the roles children play in the games.
  - Providing opportunities to practice using executive function skills in different content areas, such as literacy, mathematics, art, or other activities throughout the day.
  - Using predictable routines to transition into an activity.
  - Asking children to reflect on their experience playing a game.

Supplemental findings for Recommendation 2

Supplemental findings (follow-up measures) for one study are available at the corresponding study page on the WWC website:

- Zelazo et al. (2018) [**Mindfulness and reflection training vs. business as usual (regular classroom activities or *Second Step Social-Emotional Skills for Early Learning*)**].

Table C.6. Studies providing evidence for Recommendation 2: Strengthen children's executive function skills using specific games and activities

Recommendation 2: Executive function			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
McClelland et al. (2019) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual (*Creative Curriculum*)** **Participants:** 157 3–5-year-old children • Race/Ethnicity: ▪ 7% Asian/Pacific Islander ▪ 6% Black ▪ 58% Hispanic ▪ 26% White ▪ 3% Other • Dual language learners: ▪ 33% • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 13 Head Start classrooms across 9 sites in the Pacific Northwest region of the United States	**Duration:** 15–20-minute lessons, 2 times per week, 8 weeks **Content:** Self-regulation skills: working memory, attentional flexibility, and inhibitory control **Relevance to recommendation:** Instruction included intentionally designed activities that increased in complexity over time to challenge children.	**Self-regulation:** 0.13
Schmitt et al. (2015) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast: Self-regulation intervention vs. business as usual** **Participants:** 276 3–5-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ 33% • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 14 Head Start classrooms across 9 sites in the Pacific Northwest region of the United States	**Duration:** 20–30-minute lessons, 2 times per week, 8 weeks **Content:** Self-regulation skills: working memory, attentional flexibility, and inhibitory control **Relevance to recommendation:** Instruction included intentionally designed activities that increased in complexity over time to challenge children.	**Self-regulation: 0.17**

Recommendation 2: Executive function			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Upshur et al. (2017) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Second Step Social-Emotional Skills for Early Learning* vs. business as usual (*Creative Curriculum*)** **Participants:** 410 children with a mean age of 4.45 years • Race/Ethnicity: ▪ 2% Asian ▪ 26% Black ▪ 39% Hispanic ▪ 47% White ▪ 4% Other • Dual language learners: ▪ None • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 31 classrooms in community-based preschools and Head Start centers	**Duration:** 5 times per week, 28 weeks **Content:** Social-emotional competence and self-regulation **Relevance to recommendation:** Instruction included intentionally designed activities. Skill practice was embedded throughout the day.	**Self-regulation:** 0.24
Zelazo et al. (2018) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Mindfulness and reflection training vs. business as usual (regular classroom activities or *Second Step Social-Emotional Skills for Early Learning*)** **Participants:** 125 3–5-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ 16% • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 1 preschool in Houston, Texas, and 1 preschool in Washington, D.C.	**Duration:** 24-minute lessons, 5 times per week, 6 weeks **Content:** Self-regulation skills: working memory, attentional flexibility, and inhibitory control **Relevance to recommendation:** Instruction included intentionally designed activities that increased in complexity over time to challenge children.	**Self-regulation:** 0.09

Note: Race and ethnicity categories under the *Participants* heading in each row may not add to 100 percent due to rounding and/or non-mutually exclusive categories of race and ethnicity; some studies did not report this information.

[a] Statistically significant findings are bolded.

Recommendation 3: Provide intentional instruction to build children's understanding of mathematical ideas and skills

Rationale for a strong level of evidence

The WWC and the expert panel assigned **Recommendation 3** a strong level of evidence based on 15 studies.[227] Thirteen studies meet WWC group design standards without reservations because they were randomized controlled trials with low sample attrition.[228] Two studies meet WWC group design standards with reservations because they were either quasi-experimental design studies or randomized controlled trials with high sample attrition, but the analytic intervention and comparison groups in each satisfied the baseline equivalence requirement.[229]

There were findings in one relevant outcome domain for this recommendation (**Table C.7**). The domain had a statistically significant, positive meta-analytic effect size: measures of mathematics ($g = 0.34$, $p < .01$).

Table C.7. Domain-level effect sizes across the 15 studies supporting Recommendation 3

Domain	Number of studies (*k*)	Effect size [a]	95% confidence interval	*p* value	Percentage of weight from studies that meet WWC standards without reservations
Mathematics	15	**0.34**	[0.27–0.42]	< .01	95.57

Note: The effect size was calculated using a fixed-effects meta-analytic effect size across studies. *k* = number of studies with at least one outcome in the relevant domain that contributed to the meta-analytic effect size.
[a] Statistically significant findings are bolded.

In the studies supporting this recommendation, the interventions were closely aligned with the practices outlined in the recommendation. The panel assigned a strong level of evidence to this recommendation. This rating was supported by the strength of the evidence according to the following criteria:

- **Extent of evidence.** The study samples collectively included 4,927 children and at least 126 schools and centers across multiple states.
- **Effects on relevant outcomes.** The outcome domain (measures of mathematics) had an effect size that was positive and statistically significant, with 95.57 percent of the meta-analytic weight from studies that meet WWC standards without reservations. This domain represented the only relevant outcome domain for this recommendation.
- **Relevance to scope.** The evidence included samples of children ages 3-5, examined instructional practices delivered in preschool settings, and measured outcomes in relevant domains. For the 15 studies supporting this recommendation, instruction ranged from 2 weeks to 1 school year in duration. Five studies delivered instruction over a range of 2-3 weeks,[230] four studies delivered instruction over a range of 5-12 weeks,[231] and the remaining six studies delivered instruction over a

range of 26 weeks to 1 school year.[232] Eleven studies delivered instruction between 1 and 3 times per week,[233] while the remaining four studies delivered 4 or 5 lessons per week.[234] Twelve studies delivered lessons lasting between 5 and 20 minutes in duration.[235] The remaining three studies did not report lesson duration.[236]

- **Relationship between the evidence and the recommendation.** In more than half of the studies, the recommendation or the how-to steps were a major component of the interventions evaluated. Instruction in these studies focused on various ways to develop children's understanding of fundamental mathematical ideas and skills. The instructional practices included:
  - Providing time dedicated specifically to instruction on mathematics.
  - Delivering instruction to children in small groups, whole groups, and individually.
  - Providing instruction that follows children's natural developmental progression of mathematics learning.
  - Using instructional materials that support learning of early mathematical ideas and skills.
  - Adapting or extending instruction depending on children's experiences and needs.
  - Teaching counting and number recognition as well as more advanced concepts and skills.

Supplemental findings for Recommendation 3

Supplemental findings (follow-up measures) for 1 study are available at the corresponding study page on the WWC website:

- Ramani and Siegler (2008) [**Number board games vs. color board games**].

Table C.8. Studies providing evidence for Recommendation 3: Provide intentional instruction to build children's understanding of mathematical ideas and skills

Recommendation 3: Mathematical ideas and skills			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Clements and Sarama (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Building Blocks* vs. business as usual (*Creative Curriculum*)** **Participants:** 202 4-year-old children • Race/Ethnicity: ▪ 42% Black ▪ 10% Hispanic ▪ 48% White • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 28 classrooms in preschools and Head Start centers in New York	**Duration:** 10–20-minute lessons, 5 days per week, 26 weeks **Content:** Numeric, geometric, measurement, and patterning skills **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities, followed a sequence aligned with children's natural development of mathematics learning, and extended beyond basic skills to include more complex content.	**Mathematics: 1.07**
Clements et al. (2011) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Building Blocks* vs. business as usual (*Where Bright Futures Begin* or *Opening the World of Learning*)** **Participants:** 1,305 3–4-year-old children • Race/Ethnicity: ▪ 4% Asian ▪ 53% Black ▪ 22% Hispanic ▪ 2% Native American ▪ 19% White ▪ 1% Other • Dual language learners: ▪ 14% • Family income level: ▪ 85% of children are eligible for free or reduced-price lunch. **Setting:** 42 elementary schools in 2 school districts	**Duration:** 10–20-minute lessons, 5 days per week, 1 year **Content:** Numeric, quantitative, geometric, and spatial ideas and skills **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities, followed a sequence aligned with children's natural development of mathematics learning, and extended beyond basic skills to include more complex content.	**Mathematics: 0.48**

Recommendation 3: Mathematical ideas and skills			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Clements et al. (2019) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Learning trajectories-based instruction vs. instruction at children's target level without scaffolding** **Participants:** 145 4-year-old children • Race/Ethnicity: ▪ 7% Asian ▪ 14% Black ▪ 12% Hispanic ▪ 3% Indian/Pacific Islander ▪ 58% White ▪ 6% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Not reported **Setting:** 15 pre-K classrooms in 1 school district	**Duration:** 9-minute lessons (on average), 5 weeks, 8 lessons total **Content:** Shape and shape composition **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities, followed a sequence aligned with children's natural development of mathematics learning, and extended beyond basic skills to include more complex content.	**Mathematics: 0.36**
DeFlorio et al. (2019) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: *Pre-K Mathematics* vs. business as usual (*Creative Curriculum*)** **Participants:** 281 children with a mean age of 3.38 years • Race/Ethnicity: ▪ 6% Asian ▪ 18% Black ▪ 58% Hispanic ▪ 5% White ▪ 14% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 27 preschools, 3 Head Start centers, and 1 state pre-K program	**Duration:** 47 lessons, 10 at-home lessons, 1 year **Content:** Counting and numbers, space and geometry, arithmetic, patterns, and measurement **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities, followed a sequence aligned with children's natural development of mathematics learning, and extended beyond basic skills to include more complex content.	**Mathematics: 0.72**

Recommendation 3: Mathematical ideas and skills			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Jung et al. (2013) *Meets WWC standards with reservations*	**Design:** Quasi-experimental Design **Contrast: *Building Blocks* software, with rekenrek and ten-frame activities vs. business as usual (*Mathematics: The Creative Curriculum Approach*)** **Participants:** 73 3–5-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ Not reported • Family income level: ▪ Sample is socioeconomically diverse. **Setting:** 1 preschool in Chicago, Illinois	**Duration:** 5–10-minute lessons, 4 times per week, 1 additional computer activity per week, 12 weeks **Content:** Subitizing (i.e., instantly recognizing "how many" in a set), part-whole relationships, and more-and-less relationships **Relevance to recommendation:** Instruction extended beyond basic skills to include more complex content.	**Mathematics: 0.28**
Klein et al. (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: *Pre-K Mathematics* and *DLM Express* math software vs. business as usual (*Creative Curriculum* or *HighScope*)** **Participants:** 278 3–4-year-old children • Race/Ethnicity: ▪ 4% Asian ▪ 53% Black ▪ 22% Hispanic ▪ 22% White ▪ 4% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 40 Head Start and state-funded classrooms in San Francisco, California, and Buffalo, New York	**Duration:** 20-minute lessons, 2 times per week, 58 lessons total **Content:** Counting and numbers, understanding arithmetic operations, spatial sense and geometry, patterns, measurement and data, and logical reasoning **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities, followed a sequence aligned with children's natural development of mathematics learning, and extended beyond basic skills to include more complex content.	**Mathematics: 0.51**

Recommendation 3: Mathematical ideas and skills			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Purpura et al. (2017) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast: Mathematical language storybook intervention vs. business as usual (*Creative Curriculum*)** **Participants:** 39 3–5-year-old children • Race/Ethnicity: ▪ 13% Black ▪ 31% Hispanic ▪ 31% White ▪ 26% Other • Dual language learners: ▪ 36% • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 4 Head Start centers	**Duration:** 15–20-minute lessons, 2–3 times per week, 8 weeks **Content:** Quantitative and spatial language **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities and extended beyond basic skills to include more complex content.	**Mathematics: 0.37**
Ramani and Siegler (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Number board games vs. color board games** **Participants:** 124 4–5-year-old children • Race/Ethnicity: ▪ 52% Black ▪ 42% White ▪ 6% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 10 Head Start centers in Allegheny County, Pennsylvania	**Duration:** 15–20-minute lessons, 2 weeks, 4 lessons total **Content:** Numerical magnitude comparison, number line estimation, counting, and numerical identification **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities.	**Mathematics: 0.88**

Recommendation 3: Mathematical ideas and skills			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Ramani and Siegler (2011) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Linear board game vs. numerical activities** **Participants:** 59 3–4-year-old children • Race/Ethnicity: ▪ 78% White ▪ 22% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Children are from middle- to upper-middle-income backgrounds. **Setting:** 6 preschools, 3 of which are affiliated with universities	**Duration:** 15–20-minute lessons, 3 weeks, 4 lessons total **Content:** Numerical magnitude and number line estimation **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities.	**Mathematics: 0.30**
Rosenfeld et al. (2019) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: *PBS KIDS Transmedia Math Supplement* vs. business as usual** **Participants:** 550 4–5-year-old children • Race/Ethnicity: ▪ 19% Asian ▪ 11% Black ▪ 45% Hispanic ▪ 2% White ▪ 23% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 57 Head Start and public preschool classrooms in New York, New York, and San Francisco, California	**Duration:** 4 times per week, 10 weeks total **Content:** Counting, subitizing, recognizing numerals, patterning, composing, and representing shapes **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities, followed a sequence aligned with children's natural development of mathematics learning, and extended beyond basic skills to include more complex content.	**Mathematics: 0.19**

Recommendation 3: Mathematical ideas and skills			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Scalise et al. (2018) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Numerical magnitude comparison vs. numerical matching card game** **Participants:** 46 3–5-year-old children • Race/Ethnicity: ▪ 9% Asian ▪ 57% Black ▪ 17% White ▪ 17% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 4 Head Start centers in the mid-Atlantic region of the United States	**Duration:** 15–20-minute lessons, 3 weeks, 6 lessons total **Content:** Numerical magnitude comparison **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities.	**Mathematics:** 0.30
Siegler and Ramani (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Number board games vs. color board games** **Participants:** 36 4–5-year-old children • Race/Ethnicity: ▪ 58% Black ▪ 42% White • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 1 Head Start program and 3 childcare centers	**Duration:** 15–20-minute lessons, 2 weeks, 4 lessons total **Content:** Numerical magnitude comparison, number line estimation, counting, and numerical identification **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities.	**Mathematics: 1.02**

Recommendation 3: Mathematical ideas and skills			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Siegler and Ramani (2009) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Linear board game vs. numerical activities** **Participants:** 59 4–5-year-old children • Race/Ethnicity: ▪ 34% Black ▪ 61% White ▪ 5% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 7 Head Start classrooms and 2 childcare centers	**Duration:** 15–20-minute lessons, 3 weeks, 4 lessons total **Content:** Numerical magnitude and number line estimation **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities.	**Mathematics:** 0.61
Thomas et al. (2018) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: *Pre-K Mathematics* vs. business as usual** **Participants:** 1,313 children with a mean age of 4.4 years • Race/Ethnicity: ▪ 2% Asian ▪ 6% Black ▪ 75% Hispanic ▪ 13% White ▪ 4% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 140 pre-K classrooms in California and North Carolina	**Duration:** 47 lessons, 10 at-home lessons, 1 year **Content:** Numbers, operations, geometry, pattern knowledge, and measurement **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities, followed a sequence aligned with children's natural development of mathematics learning, and extended beyond basic skills to include more complex content.	**Mathematics: 0.27**

Recommendation 3: Mathematical ideas and skills			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Wakabayashi et al. (2020) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Numbers Plus Preschool Mathematics* vs. business as usual (*HighScope*)** **Participants:** 417 children with a mean age of 4.3 years • Race/Ethnicity: ▪ 3% Asian ▪ 22% Black ▪ 1% Hispanic ▪ 66% White ▪ 9% Multiracial • Dual language learners: ▪ Not reported • Family income level: ▪ Sample is socioeconomically diverse. **Setting:** 22 schools and Head Start centers in Michigan, Maine, and Ohio	**Duration:** 2 times per week, 1 year **Content:** Number sense, operations, geometry, and measurement **Relevance to recommendation:** Instruction devoted time to small-group mathematics activities, followed a sequence aligned with children's natural development of mathematics learning, and extended beyond basic skills to include more complex content.	**Mathematics:** 0.06

Note: Race and ethnicity categories under the *Participants* heading in each row may not add to 100 percent due to rounding and/or non-mutually exclusive categories of race and ethnicity; some studies did not report this information.

[a] Statistically significant findings are bolded.

Recommendation 4: Engage children in conversations about mathematical ideas and support them in using mathematical language

Rationale for a moderate level of evidence

The WWC and the expert panel assigned **Recommendation 4** a moderate level of evidence based on five studies.[237] Three studies meet WWC group design standards without reservations because they were randomized controlled trials with low sample attrition.[238] Two studies meet WWC group design standards with reservations because they were either quasi-experimental design studies or randomized controlled trials with high sample attrition, but the analytic intervention and comparison groups in each satisfied the baseline equivalence requirement.[239]

There were findings in one relevant outcome domain for this recommendation (**Table C.9**). The domain had a statistically significant, positive meta-analytic effect size: measures of mathematics ($g = 0.29$, $p < .01$).

Table C.9. Domain-level effect sizes across the five studies supporting Recommendation 4

Domain	Number of studies (*k*)	Effect size [a]	95% confidence interval	*p* value	Percentage of weight from studies that meet WWC standards without reservations
Mathematics	5	**0.29**	[0.18–0.39]	< .01	91.68

Note: The effect size was calculated using a fixed-effects meta-analytic effect size across studies. *k* = number of studies with at least one outcome in the relevant domain that contributed to the meta-analytic effect size.
[a] Statistically significant findings are bolded.

In the studies supporting this recommendation, the interventions were closely aligned with the practices outlined in the recommendation. The panel assigned a moderate level of evidence to this recommendation. This rating was supported by the strength of the evidence according to the following criteria:

- **Extent of evidence.** The study samples collectively included 2,169 children and at least 47 schools and centers across multiple states.
- **Effects on relevant outcomes.** The outcome domain (measures of mathematics) had an effect size that was positive and statistically significant, with 91.68 percent of the meta-analytic weight from studies that meet WWC standards without reservations. This domain represented the only relevant outcome domain for this recommendation.
- **Relevance to scope.** The evidence included samples of children ages 3–5, examined instructional practices delivered in preschool settings, and measured outcomes in relevant domains. For the five

studies supporting this recommendation, instruction ranged from 8 weeks to 1 school year in duration. Three studies delivered instruction over a range of 8-12 weeks,[240] and the remaining two studies delivered instruction over a range of 26 weeks to 1 school year.[241] One study delivered 2-3 lessons per week,[242] while the remaining four studies delivered instruction 4 or 5 times per week.[243] Four studies delivered lessons lasting between 5 and 20 minutes in duration.[244] The remaining study did not report lesson duration.[245]

- **Relationship between the evidence and the recommendation.** In less than half of the studies, the recommendation or the how-to steps were a major component of the interventions evaluated. Instruction in these studies focused on various ways to support children in learning and using mathematical language. The instructional practices included:
  - Introducing the words and phrases used in the language of early mathematics.
  - Providing multiple opportunities for children to hear mathematical language.
  - Encouraging children to talk about the mathematics they are learning.
  - Teaching mathematical language during math-focused shared booked reading.

Table C.10. Studies providing evidence for Recommendation 4: Engage children in conversations about mathematical ideas and support them in using mathematical language

Recommendation 4: Mathematical language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Clements and Sarama (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Building Blocks* vs. business as usual (*Creative Curriculum*)** **Participants:** 202 4-year-old children • Race/Ethnicity: ▪ 42% Black ▪ 10% Hispanic ▪ 48% White • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 28 classrooms in preschools and Head Start centers in New York	**Duration:** 10–20-minute lessons, 5 days per week, 26 weeks **Content:** Numeric, geometric, measurement, and patterning skills **Relevance to recommendation:** Instruction emphasized engaging children in conversation about the mathematical ideas they were learning.	**Mathematics: 1.07**
Clements et al. (2011) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Building Blocks* vs. business as usual (*Where Bright Futures Begin* or *Opening the World of Learning*)** **Participants:** 1,305 3–4-year-old children • Race/Ethnicity: ▪ 4% Asian ▪ 53% Black ▪ 22% Hispanic ▪ 2% Native American ▪ 19% White ▪ 1% Other • Dual language learners: ▪ 14% • Family income level: ▪ 85% of children are eligible for free or reduced-price lunch. **Setting:** 42 elementary schools in 2 school districts	**Duration:** 10–20-minute lessons, 5 days per week, 1 year **Content:** Numeric, quantitative, geometric, and spatial ideas and skills **Relevance to recommendation:** Instruction emphasized engaging children in conversation about the mathematical ideas they were learning.	**Mathematics: 0.48**

Recommendation 4: Mathematical language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Jung et al. (2013) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Building Blocks* software, with rekenrek and ten-frame activities vs. business as usual (*Mathematics: The Creative Curriculum Approach*)** **Participants:** 73 3–5-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ Not reported • Family income level: ▪ Sample is socioeconomically diverse. **Setting:** 1 preschool in Chicago, Illinois	**Duration:** 5–10-minute lessons, 4 times per week, 1 additional computer activity per week, 12 weeks **Content:** Subitizing (i.e., instantly recognizing "how many" in a set), part-whole relationships, and more-and-less relationships **Relevance to recommendation:** Instruction emphasized engaging children in conversation about the mathematical ideas they were learning.	**Mathematics: 0.28**
Purpura et al. (2017) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast: Mathematical language storybook intervention vs. business as usual (*Creative Curriculum*)** **Participants:** 39 3–5-year-old children • Race/Ethnicity: ▪ 13% Black ▪ 31% Hispanic ▪ 31% White ▪ 26% Other • Dual language learners: ▪ 36% • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 4 Head Start centers	**Duration:** 15–20-minute lessons, 2–3 times per week, 8 weeks **Content:** Quantitative and spatial language **Relevance to recommendation:** Instruction introduced and used mathematics vocabulary and included math-focused, shared book reading.	**Mathematics: 0.37**

Recommendation 4: Mathematical language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Rosenfeld et al. (2019) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***PBS KIDS Transmedia Math Supplement* vs. business as usual** **Participants:** 550 4–5-year-old children • Race/Ethnicity: ▪ 19% Asian ▪ 11% Black ▪ 45% Hispanic ▪ 2% White ▪ 23% Other • Dual language learners: ▪ None • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 57 Head Start and public preschool classrooms in New York, New York, and San Francisco, California	**Duration:** 4 times per week, 10 weeks total **Content:** Counting, subitizing, recognizing numerals, patterning, composing, and representing shapes **Relevance to recommendation:** Instruction included math-focused, shared book reading and emphasized engaging children in conversation about the mathematical ideas they were learning.	**Mathematics: 0.19**

Note: Race and ethnicity categories under the *Participants* heading in each row may not add to 100 percent due to rounding and/or non-mutually exclusive categories of race and ethnicity; some studies did not report this information.

[a] Statistically significant findings are bolded.

Recommendation 5: Intentionally plan activities to build children's vocabulary and language

Rationale for a strong level of evidence

The WWC and the expert panel assigned **Recommendation 5** a strong level of evidence based on 15 studies.[246] Ten studies meet WWC group design standards without reservations because they were randomized controlled trials with low sample attrition.[247] Five studies meet WWC group design standards with reservations because they were either quasi-experimental design studies or compromised randomized controlled trials that provided evidence of effects on individuals by satisfying the baseline equivalence requirement for the individuals in the analytic intervention and comparison groups, or randomized controlled trials with low cluster-level attrition that provided evidence of effects on clusters by demonstrating that the analytic sample of individuals is representative of the clusters.[248]

There were findings in two relevant outcome domains for this recommendation (**Table C.11**). Both domains had statistically significant, positive meta-analytic effect sizes: measures of language ($g = 0.19$, $p < .01$), and measures of reading and literacy related ($g = 0.32$, $p < .01$).

Table C.11. Domain-level effect sizes across the 15 studies supporting Recommendation 5

Domain	Number of studies (*k*)	Effect size [a]	95% confidence interval	*p* value	Percentage of weight from studies that meet WWC standards without reservations
Language	14	**0.19**	[0.12–0.26]	< .01	92.63
Reading and literacy related	5	**0.32**	[0.12–0.53]	< .01	100.00

Note: The effect size was calculated using a fixed-effects meta-analytic effect size across studies. *k* = number of studies with at least one outcome in the relevant domain that contributed to the meta-analytic effect size.
[a] Statistically significant findings are bolded.

In the studies supporting this recommendation, the interventions were closely aligned with the practices outlined in the recommendation. The panel assigned a strong level of evidence to this recommendation. This rating was supported by the strength of the evidence according to the following criteria:

- **Extent of evidence.** The study samples collectively included 2,882 children and at least 60 schools and centers across multiple states.
- **Effects on relevant outcomes.** Both outcome domains (measures of language and measures of reading and literacy related) had effect sizes that were positive and statistically significant, with 92.63 percent and 100.00 percent of the meta-analytic weight from studies that meet WWC standards without reservations, respectively. No outcome domain had negative and statistically significant results.

- **Relevance to scope.** The evidence included samples of children ages 3–5, examined instructional practices delivered in preschool settings, and measured outcomes in relevant domains. For the 15 studies supporting this recommendation, instruction ranged from one 25-minute lesson to 40 weeks in duration. One study delivered instruction for a single lesson,[249] three studies delivered instruction over a range of 2–6 weeks,[250] five studies delivered instruction over a range of 10–20 weeks,[251] and four studies delivered instruction over a range of 21–40 weeks.[252] The remaining two studies did not report duration of instruction.[253] The majority of studies delivered instruction between 4 and 5 times per week, while five studies delivered between 1 and 2 lessons per week.[254] One study did not report number of lessons per week.[255] Nine studies delivered lessons lasting between 12 and 45 minutes in duration.[256] The remaining six studies did not report lesson duration.[257]
- **Relationship between the evidence and the recommendation.** In more than half of the studies, the recommendation or the how-to steps were a major component of the interventions evaluated. Instruction in these studies focused on ways to help children learn new vocabulary words and their meanings. The instructional practices included:
  - Choosing words that are unfamiliar to children but occur frequently in books, conversations, or other academic contexts.
  - Teaching the meaning of words by providing an explanation that is child-friendly.
  - Using an example, picture, gesture, action, or short video clip that further clarifies the meaning of the word.
  - Choosing activities and materials that will reinforce children's understanding of the meaning of words.
  - Encouraging children to use the words in conversations during the day.

Supplemental findings for Recommendation 5

Supplemental findings (measures for eligible subgroups, follow-up measures) for five studies are available at the corresponding study pages on the WWC website:

- Farver et al. (2009) [***Literacy Express* in English only vs. business as usual (*HighScope*)**],
- PCER Consortium (2008) [***Doors to Discovery* vs. business as usual**],
- PCER Consortium (2008) [***Literacy Express* vs. business as usual (*HighScope*)**],
- Toub et al. (2018) [**Guided play or directed play vs. free play**], and
- Wasik and Hindman (2020) [***Story Talk* book reading with "story maps" vs. book reading without "story maps"**].

Table C.12. Studies providing evidence for Recommendation 5: Intentionally plan activities to build children's vocabulary and language

Recommendation 5: Vocabulary and language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Assel et al. (2007) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Doors to Discovery* vs. business as usual** **Participants:** 273 children with a mean age of 4.6 years • Race/Ethnicity: ▪ 21% Black ▪ 42% Hispanic ▪ 29% White ▪ 8% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 41 classrooms from 1 school district and Head Start centers in Houston, Texas	**Duration:** 5 times per week, 26 weeks **Content:** Oral language, phonological awareness, concepts of print, alphabet knowledge, writing, and comprehension **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words, activities to help children use and understand the words, and conversations with children to help reinforce understanding of the words.	**Language:** −0.16 **Reading and literacy related:** −0.10
Blewitt et al. (2009) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** **Scaffolding questions during book reading vs. asking either low- or high-demand questions during book reading** **Participants:** 50 3-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ None • Family income level: ▪ Children are from middle- to upper-middle-income backgrounds. **Setting:** 4 preschools	**Duration:** 4 lessons, 6 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words and conversations with children to help reinforce understanding of the words.	**Language: 0.12**

Recommendation 5: Vocabulary and language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Collins (2010) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast: Rich explanation reading vs. business as usual (story reading without rich explanation)** **Participants:** 69 Portuguese-speaking children with an age range of 4–5-years • Race/Ethnicity: ▪ 4% Black ▪ 96% White • Dual language learners: ▪ 100% • Family income level: ▪ 80% of children are eligible for free or reduced-price lunch. **Setting:** 6 classrooms in 2 public preschools in the northeastern region of the United States	**Duration:** 3 lessons, 1 time per week, 3 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words.	**Language: 1.22**
Dickinson, Collins, et al. (2019) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast: Book reading plus play vs. book reading only** **Participants:** 217 children with a mean age of 4.4 years • Race/Ethnicity: ▪ 42% Black ▪ 32% Hispanic ▪ 15% White ▪ 9% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 10 pre-kindergarten classrooms in Tennessee and 6 Head Start preschool classrooms in Pennsylvania	**Duration:** 12–15-minute lessons, 4 times per week, 12 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words and activities to help children use and understand the words.	**Language:** −0.15

Recommendation 5: Vocabulary and language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Farver et al. (2009) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Literacy Express* in English only vs. business as usual (*HighScope*)** **Participants:** 63 Spanish-speaking children with a mean age of 4.54 years • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ 100% • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 10 classrooms in 1 Head Start center in Los Angeles, California	**Duration:** 20-minute lessons, 4 times per week, 21 weeks **Content:** Dialogic skills, phonological awareness, and print knowledge **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words and conversations with children to help reinforce understanding of the words.	**Language:** 0.40 **Reading and literacy related:** 0.50
Mages (2018) *Meets WWC standards with reservations*	**Design:** Quasi-experimental Design **Contrast:** ***Theatre-in-Education* program vs. business as usual (*Head Start*)** **Participants:** 155 3–5-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ 50% • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 12 Head Start classrooms in New York	**Duration:** 14 lessons, 20 weeks **Content:** Emergent literacy, theory of mind, and imaginative development **Relevance to recommendation:** Instruction included engaging conversations with children to help reinforce understanding of select vocabulary words.	**Language:** 0.00

Recommendation 5: Vocabulary and language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Neuman and Dwyer (2011) *Meets WWC standards with reservations*	**Design:** Quasi-experimental Design **Contrast:** ***World of Words* vs. business as usual (*HighScope*)** **Participants:** 178 children with a mean age of 4.2 years • Race/Ethnicity: ▪ 28% Black ▪ 17% Middle Eastern ▪ 56% White • Dual language learners: ▪ Not reported • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 2 elementary school Head Start programs	**Duration:** 12-minute lessons, 5 times per week, 16 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words, activities to help children use and understand the words, and conversations with children to help reinforce understanding of the words.	**Language: 0.94**
Neuman et al. (2015) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***World of Words* vs. business as usual (*HighScope*)** **Participants:** 143 children with a mean age of 4.3 years • Race/Ethnicity: ▪ 1% Asian ▪ 31% Black ▪ 7% Hispanic ▪ 54% White ▪ 7% Other • Dual language learners: ▪ Not reported • Family income level: ▪ 66% of children are eligible for free or reduced-price lunch. **Setting:** 10 pre-kindergarten classrooms in 5 elementary schools in the northeastern and midwestern regions of the United States	**Duration:** 12–15-minute lessons, 5 times per week, 12 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words and conversations with children to help reinforce understanding of the words.	**Language: 0.37**

Recommendation 5: Vocabulary and language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Penuel et al. (2012) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Media-rich early literacy supplement vs. media-rich science supplement** **Participants:** 396 children with a mean age of 4.7 years • Race/Ethnicity: ▪ 10% Asian/Pacific Islander ▪ 28% Black ▪ 53% Hispanic ▪ 3% Native American ▪ 6% White ▪ 4% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 80 preschool classrooms in New York City, New York, and San Francisco, California	**Duration:** 34-minute lessons, 5 times per week, 10 weeks **Content:** Letter naming, identification of letter sounds, understanding of story and print concepts, and phonological awareness **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words and conversations with children to help reinforce understanding of the words.	**Reading and literacy related: 0.39**
Preschool Curriculum Evaluation Research Consortium (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: *Doors to Discovery* vs. business as usual** **Participants:** 183 children with a mean age of 4.7 years • Race/Ethnicity: ▪ 4% Asian or Pacific Islander ▪ 16% Black ▪ 40% Hispanic ▪ 29% White ▪ 11% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Sample is socioeconomically diverse. **Setting:** 13 Head Start and public pre-kindergarten programs in Houston, Texas	**Duration:** 5 times per week, 26 weeks **Content:** Oral language, phonological awareness, concepts of print, alphabet knowledge and writing, and comprehension **Relevance to recommendation:** Instruction included conversations with children to help reinforce understanding of the words.	**Language:** 0.23 **Reading and literacy related:** 0.12

Recommendation 5: Vocabulary and language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Preschool Curriculum Evaluation Research Consortium (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Literacy Express* vs. business as usual (*HighScope*)** **Participants:** 188 children with a mean age of 4.6 years • Race/Ethnicity: ▪ 61% Black ▪ 2% Hispanic ▪ 34% White • Dual language learners: ▪ Not reported • Family income level: ▪ Not reported **Setting:** 11 public pre-kindergarten schools in Florida	**Duration:** 3–4 times per week **Content:** Vocabulary, oral language, phonological awareness, and print awareness **Relevance to recommendation:** Instruction included simple explanations of vocabulary words.	**Language:** 0.06 **Reading and literacy related:** 0.23
Read et al. (2019) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** **Story reading with pauses before target words or story reading with pauses after target words vs. story reading without pauses** **Participants:** 60 3–5-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ None • Family income level: ▪ Not reported **Setting:** 1 on-campus preschool program for children of faculty and staff at a university	**Duration:** 1 25-minute lesson per participant **Content:** Listening recall skills **Relevance to recommendation:** Instruction included simple explanations of vocabulary words.	**Language:** 0.36

Recommendation 5: Vocabulary and language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Toub et al. (2018) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Guided play or directed play vs. free play** **Participants:** 249 3–5-year-old children • Race/Ethnicity: ▪ 1% Asian ▪ 55% Black ▪ 23% Hispanic ▪ 14% White ▪ 7% Other • Dual language learners: ▪ 15% • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 10 Head Start classrooms in Pennsylvania and 18 pre-kindergarten classrooms in Tennessee	**Duration:** 20-minute lessons, 4 times per week, 2 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words, activities to help children use and understand the words, and conversations with children to help reinforce understanding of the words.	**Language: 0.34**
Wasik and Hindman (2020) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: *Story Talk* book reading with "story maps" vs. book reading without "story maps"** **Participants:** 474 children with a mean age of 4.58 years • Race/Ethnicity: ▪ 83% Black ▪ 9% Hispanic ▪ 8% White • Dual language learners: ▪ 6% • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 35 general education pre-kindergarten classrooms across 15 schools in the northeastern region of the United States	**Duration:** One lesson per day, 30–40 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included simple explanations of select vocabulary words.	**Language: 0.17**

Recommendation 5: Vocabulary and language			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Yazejian and Peisner-Feinberg (2009) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast: Music and movement intervention that supports language skills vs. business as usual** **Participants:** 184 children with a mean age of 4.37 years • Race/Ethnicity: ▪ 63% Black ▪ 9% Hispanic ▪ 19% White ▪ 9% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 6 Head Start centers across 3 sites	**Duration:** 30-minute lesson, 2 times per week, 26 weeks **Content:** Language development, rhyming, expressing language, listening **Relevance to recommendation:** Instruction included activities to help children use and understand the words, and conversations with children to help reinforce understanding of the words.	**Language:** 0.10

Note: Race and ethnicity categories under the *Participants* heading in each row may not add to 100 percent due to rounding and/or non-mutually exclusive categories of race and ethnicity; some studies did not report this information.

[a] Statistically significant findings are bolded.

Recommendation 6: Build children's knowledge of letters and sounds

Rationale for a strong level of evidence

The WWC and the expert panel assigned **Recommendation 6** a strong level of evidence based on nine studies.[258] All nine studies meet WWC group design standards without reservations because they were randomized controlled trials with low sample attrition.[259]

There were findings in one relevant outcome domain for this recommendation (**Table C.13**). The domain had a statistically significant, positive meta-analytic effect size: measures of reading and literacy related ($g = 0.32$, $p < .01$).

Table C.13. Domain-level effect sizes across the nine studies supporting Recommendation 6

Domain	Number of studies (*k*)	Effect size [a]	95% confidence interval	*p* value	Percentage of weight from studies that meet WWC standards without reservations
Reading and literacy related	9	**0.32**	[0.16–0.47]	< .01	100.00

Note: The effect size was calculated using a fixed-effects meta-analytic effect size across studies. *k* = number of studies with at least one outcome in the relevant domain that contributed to the meta-analytic effect size.
[a] Statistically significant findings are bolded.

In the studies supporting this recommendation, the interventions were closely aligned with the practices outlined in the recommendation. The panel assigned a strong level of evidence to this recommendation. This rating was supported by the strength of the evidence according to the following criteria:

- **Extent of evidence.** The study samples collectively included 1,353 children and at least 45 schools and centers across multiple states.
- **Effects on relevant outcomes.** The outcome domain (measures of reading and literacy related) had an effect size that was positive and statistically significant, with 100 percent of the meta-analytic weight from studies that meet WWC standards without reservations. This domain represented the only relevant outcome domain for this recommendation.
- **Relevance to scope.** The evidence included samples of children ages 3-5, examined instructional practices delivered in preschool settings, and measured outcomes in relevant domains. For the nine studies supporting this recommendation, instruction ranged from 4-26 weeks in duration. Five studies delivered instruction over a range of 4-10 weeks,[260] and three studies delivered instruction over a range of 21-26 weeks.[261] The remaining study did not report duration of instruction.[262] The majority of studies delivered instruction between 3 and 5 times per week, while one study delivered

2 lessons per week.[263] Six studies delivered lessons lasting between 10 and 34 minutes.[264] The remaining three studies did not report lesson duration.[265]

- **Relationship between the evidence and the recommendation.** In more than half of the studies, the recommendation or the how-to steps were a major component of the interventions evaluated. Instruction in these studies focused on various ways to support the development of phonological awareness and alphabet knowledge. The instructional practices included:
  - Teaching children to listen for and identify the sounds at the beginning and end of words.
  - Teaching children what rhyme means and listening to songs, poems, and books with rhymes.
  - Teaching children the name, shape, and corresponding sound(s) of letters.
  - Planning activities that will allow children to practice identifying letters and the sounds they make.
  - Placing print throughout the classroom to provide other opportunities to discuss letters with children.

Supplemental findings for Recommendation 6

Supplemental findings (measures for eligible subgroups, follow-up measures) for three studies are available at the corresponding study page on the WWC website:

- Farver et al. (2009) [***Literacy Express* in English only vs. business as usual (*HighScope*)**],
- PCER Consortium (2008) [***Let's Begin with the Letter People* vs. business as usual**], and
- PCER Consortium (2008) [***Literacy Express* vs. business as usual (*HighScope*)**].

Table C.14. Studies providing evidence for Recommendation 6: Build children's knowledge of letters and sounds

Recommendation 6: Letters and sounds			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Assel et al. (2007) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Doors to Discovery* vs. business as usual** **Participants:** 273 children with a mean age of 4.6 years • Race/Ethnicity: ▪ 21% Black ▪ 42% Hispanic ▪ 29% White ▪ 8% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 41 classrooms from 1 school district and Head Start centers in Houston, Texas	**Duration:** 5 times per week, 26 weeks **Content:** Oral language, phonological awareness, concepts of print, alphabet knowledge, writing, and comprehension **Relevance to recommendation:** Instruction focused on sounds in words, letters and the sounds they make, and activities to reinforce knowledge of letters and their sounds. A print-rich environment was used to encourage further discussions of letters and their sounds.	**Reading and literacy related:** −0.10
Farver et al. (2009) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Literacy Express* in English only vs. business as usual (*HighScope*)** **Participants:** 63 Spanish-speaking children with a mean age of 4.54 years • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ 100% • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 10 classrooms in 1 Head Start center in Los Angeles, California	**Duration:** 20-minute lessons, 4 times per week, 21 weeks **Content:** Dialogic skills, phonological awareness, and print knowledge **Relevance to recommendation:** Instruction focused on sounds in words, letters and the sounds they make, and activities to reinforce knowledge of letters and their sounds.	**Reading and literacy related:** 0.50

Recommendation 6: Letters and sounds			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Penuel et al. (2012) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Media-rich early literacy supplement vs. media-rich science supplement** **Participants:** 396 children with a mean age of 4.7 years • Race/Ethnicity: ▪ 10% Asian/Pacific Islander ▪ 28% Black ▪ 53% Hispanic ▪ 3% Native American ▪ 6% White ▪ 4% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 80 preschool classrooms in New York City, New York, and San Francisco, California	**Duration:** 34-minute lessons, 5 times per week, 10 weeks **Content:** Letter naming, identification of letter sounds, understanding of story and print concepts, and phonological awareness **Relevance to recommendation:** Instruction focused on letters and the sounds they make.	**Reading and literacy related: 0.39**
Piasta and Wagner (2010) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Letter names and sounds instruction vs. numbers instruction** **Participants:** 38 3–4-year-old children • Race/Ethnicity: ▪ 14% Black ▪ 72% White ▪ 14% Other • Dual language learners: ▪ None • Family income level: ▪ Not reported **Setting:** 4 private child-care centers in the southeastern region of the United States	**Duration:** 10–15-minute lessons, 3–4 times per week, 8 weeks **Content:** Letter names and sounds **Relevance to recommendation:** Instruction focused on letters and the sounds they make, and activities to reinforce knowledge of letters and their sounds.	**Reading and literacy related:** 0.16

Recommendation 6: Letters and sounds			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Preschool Curriculum Evaluation Research Consortium (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Let's Begin with the Letter People* vs. business as usual** **Participants:** 184 children with a mean age of 4.65 years • Race/Ethnicity: ▪ 5% Asian or Pacific Islander ▪ 13% Black ▪ 45% Hispanic ▪ 29% White ▪ 8% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Sample is socioeconomically diverse. **Setting:** 13 Head Start and public pre-kindergarten programs in Houston, Texas	**Duration:** 5 times per week, 26 weeks **Content:** Oral language, phonological awareness, phonemic awareness, and letter knowledge **Relevance to recommendation:** Instruction focused on letters and the sounds they make, and activities to reinforce knowledge of letters and their sounds.	**Reading and literacy related:** 0.09
Preschool Curriculum Evaluation Research Consortium (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Literacy Express* vs. business as usual (*HighScope*)** **Participants:** 188 children with a mean age of 4.6 years • Race/Ethnicity: ▪ 61% Black ▪ 2% Hispanic ▪ 34% White • Dual language learners: ▪ Not reported • Family income level: ▪ Not reported **Setting:** 17 public pre-kindergarten schools in Florida	**Duration:** 3–4 times per week **Content:** Vocabulary, oral language, phonological awareness, and print awareness **Relevance to recommendation:** Instruction focused on sounds in words.	**Reading and literacy related:** 0.23

Recommendation 6: Letters and sounds			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Roberts et al. (2018) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Experimental letter names and sounds instruction vs. typical letter names and sounds instruction** **Participants:** 45 children with a mean age of 4.15 years • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 6 classrooms in 3 elementary schools in 1 school district in the western region of the United States	**Duration:** 10-minute lessons, 4 times per week, 9 weeks **Content:** Letter names and sounds **Relevance to recommendation:** Instruction focused on letters and the sounds they make, and activities to reinforce knowledge of letters and their sounds.	**Reading and literacy related:** 0.34
Roberts et al. (2019) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Decontextualized letter names and sounds instruction vs. contextualized letter names and sounds instruction** **Participants:** 127 3–4-year-old children • Race Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ 36% • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 5 elementary schools in 1 school district in the western region of the United States	**Duration:** 12–15-minute lessons, 4 times per week, 10 weeks **Content:** Letter names and sounds **Relevance to recommendation:** Instruction focused on letters and the sounds they make, and activities to reinforce knowledge of letters and their sounds.	**Reading and literacy related:** 0.32

Recommendation 6: Letters and sounds			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Ukrainetz et al. (2011) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Syllable tasks or multiple phoneme tasks vs. first phoneme tasks** **Participants:** 39 4–5-year-old children • Race Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ Not reported • Family income level: ▪ Children are from middle-income backgrounds. **Setting:** 2 childcare centers in Laramie, Wyoming	**Duration:** 25–30-minute lessons, 2 times per week, 4 weeks **Content:** Phoneme blending and segmenting **Relevance to recommendation:** Instruction focused on sounds in words and activities to reinforce knowledge of letters and their sounds.	**Reading and literacy related: 0.74**

Note: Race and ethnicity categories under the *Participants* heading in each row may not add to 100 percent due to rounding and/or non-mutually exclusive categories of race and ethnicity; some studies did not report this information.

[a] Statistically significant findings are bolded.

Recommendation 7: Use shared book reading to develop children's language, knowledge of print features, and knowledge of the world

Rationale for a strong level of evidence

The WWC and the expert panel assigned **Recommendation 7** a strong level of evidence based on 17 studies.[266] Eleven studies meet WWC group design standards without reservations because they were randomized controlled trials with low sample attrition.[267] Six studies meet WWC group design standards with reservations because they were either quasi-experimental design studies or compromised randomized controlled trials that provided evidence of effects on individuals by satisfying the baseline equivalence requirement for the individuals in the analytic intervention and comparison groups, or randomized controlled trials with low cluster-level attrition that provided evidence of effects on clusters by demonstrating that the analytic sample of individuals is representative of the clusters.[268]

There were findings in two relevant outcome domains for this recommendation (**Table C.15**). Both domains had statistically significant, positive meta-analytic effect sizes: measures of language ($g = 0.20$, $p < .01$) and measures of reading and literacy related ($g = 0.30$, $p < .01$).

Table C.15. Domain-level effect sizes across the 17 studies supporting Recommendation 7

Domain	Number of studies (*k*)	Effect size [a]	95% confidence interval	*p* value	Percentage of weight from studies that meet WWC standards without reservations
Language	16	**0.20**	[0.13–0.26]	< .01	79.03
Reading and literacy related	5	**0.30**	[0.13–0.48]	< .01	100.00

Note: The effect size was calculated using a fixed-effects meta-analytic effect size across studies. *k* = number of studies with at least one outcome in the relevant domain that contributed to the meta-analytic effect size.
[a] Statistically significant findings are bolded.

In the studies supporting this recommendation, the interventions were closely aligned with the practices outlined in the recommendation. The panel assigned a strong level of evidence to this recommendation. This rating was supported by the strength of the evidence according to the following criteria:

- **Extent of evidence.** The study samples collectively included 4,597 children and at least 79 schools and centers across multiple states.
- **Effects on relevant outcomes.** Both outcome domains (measures of language and measures of reading and literacy related) had effect sizes that were positive and statistically significant, with 79.03 percent and 100 percent of the meta-analytic weight from studies that meet WWC standards without reservations, respectively. No outcome domain had negative and statistically significant results.

- **Relevance to scope.** The evidence included samples of children ages 3–5, examined instructional practices delivered in preschool settings, and measured outcomes in relevant domains. For the 17 studies supporting this recommendation, instruction ranged from 1 lesson to 40 weeks in duration. One study delivered instruction for a single lesson,[269] two studies delivered instruction over a range of 2–3 weeks,[270] six studies delivered instruction over a range of 6–16 weeks,[271] and seven studies delivered instruction over a range of 20–40 weeks.[272] The remaining study did not report duration of instruction.[273] The majority of studies delivered instruction between 3 and 5 times per week, five studies delivered 1–2 lessons per week,[274] and one study did not report number of lessons per week.[275] The majority of studies did not report lesson duration; seven studies delivered lessons lasting between 5 and 34 minutes.[276]
- **Relationship between the evidence and the recommendation.** In more than half of the studies, the recommendation or the how-to steps were a major component of the interventions evaluated. Instruction in these studies focused on using shared book reading to develop children's print knowledge, vocabulary, alphabet knowledge, phonological awareness, and comprehension. The instructional practices included:
  - Selecting developmentally appropriate books that can be used to teach children about the focus of the literacy lesson.
  - Reading books multiple times for different purposes.
  - Engaging children in conversations about interesting print features, vocabulary words, or questions about the content in the book.
  - Acting out scenarios from the book.

Supplemental findings for Recommendation 7

Supplemental findings (follow-up measures, measures for eligible subgroups of linguistically diverse children) for four studies are available at the corresponding study pages on the WWC website:

- Biazak et al. (2010) [**Activity-based listening vs. listening to a story**],
- Farver et al. (2009) [***Literacy Express* in English only vs. business as usual (*HighScope*)**],
- Toub et al. (2018) [**Guided play or directed play vs. free play**], and
- Wasik and Hindman (2020) [***Story Talk* book reading with "story maps" vs. book reading without "story maps"**].

Table C.16. Studies providing evidence for Recommendation 7: Use shared book reading to develop children's language, knowledge of print features, and knowledge of the world

Recommendation 7: Shared book reading			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Assel et al. (2007) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Doors to Discovery* vs. business as usual** **Participants:** 273 children with a mean age of 4.6 years • Race/Ethnicity: ▪ 21% Black ▪ 42% Hispanic ▪ 29% White ▪ 8% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 41 classrooms from 1 school district and Head Start centers in Houston, Texas	**Duration:** 5 times per week, 26 weeks **Content:** Oral language, phonological awareness, concepts of print, alphabet knowledge, writing, and comprehension **Relevance to recommendation:** Instruction included conversations during book reading at predetermined stopping points and activities aligned to the topic of the book to reinforce understanding.	**Language:** −0.16 **Reading and literacy related:** −0.10
Biazak et al. (2010) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Activity-based listening vs. listening to a story** **Participants:** 56 3–5-year-old children • Race/Ethnicity: ▪ 3% American Indian ▪ 5% Asian/Pacific Islander ▪ 1% Black ▪ 30% Hispanic ▪ 31% White ▪ 29% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Not reported **Setting:** 1 university-associated daycare facility in the southwestern region of the United States	**Duration:** One lesson **Content:** Listening and using manipulatives to represent story events **Relevance to recommendation:** Instruction included activities aligned to the topic of the book to reinforce understanding.	**Language: 0.46**

Recommendation 7: Shared book reading			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Blewitt et al. (2009) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Scaffolding questions during book reading vs. asking either low- or high-demand questions during book reading** **Participants:** 50 3-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ None • Family income level: ▪ Children are from middle- to upper-middle-income backgrounds. **Setting:** 4 preschools	**Duration:** 4 lessons, 6 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included conversations during book reading at predetermined stopping points and activities aligned to the topic of the book to reinforce understanding.	**Language: 0.12**
Collins (2010) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast: Rich explanation reading vs. business as usual (story reading without rich explanation)** **Participants:** 69 Portuguese-speaking children with an age range of 4–5-years • Race/Ethnicity: ▪ 4% Black ▪ 96% White • Dual language learners: ▪ 100% • Family income level: ▪ 80% of children are eligible for free or reduced-price lunch. **Setting:** 6 classrooms in 2 public preschools in the northeastern region of the United States	**Duration:** 3 lessons, 1 time per week, 3 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included conversations during book reading at predetermined stopping points. Books were chosen intentionally.	**Language: 1.22**

Recommendation 7: Shared book reading			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Dickinson, Collins, et al. (2019) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast: Book reading plus play vs. book reading only** **Participants:** 217 children with a mean age of 4.4 years • Race/Ethnicity: ▪ 42% Black ▪ 32% Hispanic ▪ 15% White ▪ 9% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 10 pre-kindergarten classrooms in Tennessee and 6 Head Start preschool classrooms in Pennsylvania	**Duration:** 12–15-minute lessons, 4 times per week, 12 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included conversations during book reading at predetermined stopping points and activities aligned to the topic of the book to reinforce understanding. Books were chosen intentionally.	**Language:** −0.15
Farver et al. (2009) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: *Literacy Express* in English only vs. business as usual (*HighScope*)** **Participants:** 63 Spanish-speaking children with a mean age of 4.54 years • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ 100% • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 10 classrooms in 1 Head Start center in Los Angeles, California	**Duration:** 20-minute lessons, 4 times per week, 21 weeks **Content:** Dialogic skills, phonological awareness, and print knowledge **Relevance to recommendation:** Instruction included conversations during book reading and activities aligned to the topic of the book to reinforce understanding. Books were chosen intentionally.	**Language:** 0.40 **Reading and literacy related:** 0.50

Recommendation 7: Shared book reading			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Justice et al. (2010) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: High-dose print referencing vs. book reading without a focus on print referencing** **Participants:** 288 3–4-year-old children • Race/Ethnicity: ▪ 37% Black ▪ 8% Hispanic ▪ 42% White ▪ 13% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 59 classrooms from Head Start centers, Title 1 schools, early childhood special education programs, and fee-supported independent programs in Ohio and Virginia	**Duration:** 4 times per week, 30 weeks, 120 lessons total **Content:** Print knowledge **Relevance to recommendation:** Instruction included conversations during book reading at predetermined stopping points and activities aligned to the topic of the book to reinforce understanding. Books were chosen intentionally.	**Language:** 0.08 **Reading and literacy related:** 0.23
Kim and Phillips (2016) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Comprehension monitoring vs. business as usual (*Creative Curriculum* or *Houghton Mifflin Pre-K*)** **Participants:** 70 children with a mean age of 4.75 years • Race/Ethnicity: ▪ 56% Black ▪ 29% White ▪ 15% Other • Dual language learners: ▪ None • Family income level: ▪ 67–85% of children are eligible for free or reduced-price lunch. **Setting:** 8 pre-kindergarten classrooms in 4 public schools	**Duration:** 5-minute lessons, 4 times per week, 8 weeks **Content:** Listening comprehension **Relevance to recommendation:** Instruction included conversations during book reading.	**Language: 0.58**

Recommendation 7: Shared book reading			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Mages (2018) *Meets WWC standards with reservations*	**Design:** Quasi-experimental Design **Contrast:** ***Theatre-in-Education* program vs. business as usual (*Head Start*)** **Participants:** 155 3–5-year-old children • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ 50% • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 12 Head Start classrooms in New York	**Duration:** 14 lessons, 20 weeks **Content:** Emergent literacy, theory of mind, and imaginative development **Relevance to recommendation:** Instruction included conversations during book reading at predetermined stopping points and activities aligned to the topic of the book to reinforce understanding.	**Language:** 0.00
McCarty et al. (2018) *Meets WWC standards with reservations*	**Design:** Quasi-experimental Design **Contrast:** ***Blueprint for Early Literacy* vs. business as usual (*Creative Curriculum*)** **Participants:** 1,591 children with a mean age of 4.3 years • Race/Ethnicity: ▪ Not reported • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 4 school-based and 18 community-based pre-kindergarten centers in Philadelphia, Pennsylvania	**Duration:** 1 school year **Content:** Literacy skills **Relevance to recommendation:** Instruction included conversations during book reading at predetermined stopping points.	**Language: 0.21**

Recommendation 7: Shared book reading			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Neuman and Dwyer (2011) *Meets WWC standards with reservations*	**Design:** Quasi-experimental Design **Contrast:** ***World of Words* vs. business as usual (*HighScope*)** **Participants:** 178 children with a mean age of 4.2 years • Race/Ethnicity: ▪ 28% Black ▪ 17% Middle Eastern ▪ 56% White • Dual language learners: ▪ Not reported • Family income level: ▪ Children are from families with incomes below the poverty guidelines. **Setting:** 2 elementary school Head Start programs	**Duration:** 12-minute lessons, 5 times per week, 16 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included discussing prior knowledge on a topic and activities aligned to the topic of the book to reinforce understanding. Books were chosen intentionally.	**Language: 0.94**
Neuman et al. (2015) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***World of Words* vs. business as usual (*HighScope*)** **Participants:** 143 children with a mean age of 4.3 years • Race/Ethnicity: ▪ 1% Asian ▪ 31% Black ▪ 7% Hispanic ▪ 54% White ▪ 7% Other • Dual language learners: ▪ None • Family income level: ▪ 66% of children are eligible for free or reduced-price lunch. **Setting:** 10 pre-kindergarten classrooms in 5 elementary schools in the northeastern and midwestern regions of the United States	**Duration:** 12–15-minute lessons, 5 times per week, 12 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included discussing prior knowledge on a topic, conversations during book reading, and activities aligned to the topic of the book to reinforce understanding. Books were chosen intentionally.	**Language: 0.37**

Recommendation 7: Shared book reading			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Nicolopoulou et al. (2015) *Meets WWC standards with reservations*	**Design:** Randomized Controlled Trial **Contrast: Storytelling and story-acting practice vs. business as usual (*Creative Curriculum*)** **Participants:** 137 3–5-year-old children • Race/Ethnicity: ▪ 24% Black ▪ 25% Hispanic ▪ 49% White ▪ 3% Other • Dual language learners: ▪ 8% • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 13 classrooms in 6 preschools in the northeastern region of the United States	**Duration:** 2 times per week, 24 weeks **Content:** Emergent literacy, oral language skills, and social competence **Relevance to recommendation:** Instruction included activities aligned to the topic of the book to reinforce understanding. Books were chosen intentionally.	**Language:** 0.09
Penuel et al. (2012) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Media-rich early literacy supplement vs. media-rich science supplement** **Participants:** 396 children with a mean age of 4.7 years • Race/Ethnicity: ▪ 10% Asian/Pacific Islander ▪ 28% Black ▪ 53% Hispanic ▪ 3% Native American ▪ 6% White ▪ 4% Other • Dual language learners: ▪ Not reported • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 80 preschool classrooms in New York City, New York, and San Francisco, California	**Duration:** 34-minute lessons, 5 times per week, 10 weeks **Content:** Letter naming, identification of letter sounds, understanding of story and print concepts, and phonological awareness **Relevance to recommendation:** Instruction included discussing prior knowledge on a topic and conversations during book reading.	**Reading and literacy related: 0.39**

Recommendation 7: Shared book reading			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Preschool Curriculum Evaluation Research Consortium (2008) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Literacy Express* vs. business as usual (*HighScope*)** **Participants:** 188 children with a mean age of 4.6 years • Race/Ethnicity: ▪ 61% Black ▪ 2% Hispanic ▪ 34% White • Dual language learners: ▪ Not reported • Family income level: ▪ Not reported **Setting:** 17 public pre-kindergarten schools in Florida	**Duration:** 3–4 times per week **Content:** Vocabulary, oral language, phonological awareness, and print awareness **Relevance to recommendation:** Instruction included activities aligned to the topic of the book to reinforce understanding. Books were chosen intentionally.	**Language:** 0.06 **Reading and literacy related:** 0.23
Toub et al. (2018) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast: Guided play or directed play vs. free play** **Participants:** 249 3–5-year-old children • Race/Ethnicity: ▪ 1% Asian ▪ 55% Black ▪ 23% Hispanic ▪ 14% White ▪ 7% Other • Dual language learners: ▪ 15% • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 10 Head Start classrooms in Pennsylvania and 18 pre-kindergarten classrooms in Tennessee	**Duration:** 20-minute lessons, 4 times per week, 2 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included conversations during book reading at predetermined stopping points and activities aligned to the topic of the book to reinforce understanding. Books were chosen intentionally.	**Language: 0.34**

Recommendation 7: Shared book reading			
Study and WWC rating	**Study description**	**Intervention condition description**	**Outcome domain and WWC-calculated effect size [a]**
Wasik and Hindman (2020) *Meets WWC standards without reservations*	**Design:** Randomized Controlled Trial **Contrast:** ***Story Talk* book reading with "story maps" vs. book reading without "story maps"** **Participants:** 474 children with a mean age of 4.58 years • Race/Ethnicity: ▪ 83% Black ▪ 9% Hispanic ▪ 8% White • Dual language learners: ▪ 6% • Family income level: ▪ Majority of children are considered socioeconomically disadvantaged. **Setting:** 35 general education pre-kindergarten classrooms across 15 schools in the northeastern region of the United States	**Duration:** One lesson per day, 30–40 weeks **Content:** Vocabulary **Relevance to recommendation:** Instruction included discussing prior knowledge on a topic, conversations during book reading at predetermined stopping points, and activities aligned to the topic of the book to reinforce understanding.	**Language: 0.17**

Note: Race and ethnicity categories under the *Participants* heading in each row may not add to 100 percent due to rounding and/or non-mutually exclusive categories of race and ethnicity; some studies did not report this information.

[a] Statistically significant findings are bolded.

Appendix D: Meta-Analytic Data

Table D.1 provides domain-level data for each recommendation. Specifically, the table provides the total number of studies (*k*) contributing to the meta-analysis, as well as the domain-level meta-analytic effect size, standard error, and *p* value.

Table D.1. Domain-level effect sizes across the studies supporting all recommendations

Outcome domain	Number of studies (*k*)	Effect size (*g*) [a]	Standard error	*p* value
Recommendation 1: Social-emotional learning				
Social-emotional learning	6	**0.18**	0.08	< .05
Recommendation 2: Executive function				
Self-regulation	4	**0.17**	0.07	< .01
Recommendation 3: Mathematical ideas and skills				
Mathematics	15	**0.34**	0.04	< .01
Recommendation 4: Mathematical language				
Mathematics	5	**0.29**	0.05	< .01
Recommendation 5: Vocabulary and language				
Language	14	**0.19**	0.03	< .01
Reading and literacy related	5	**0.32**	0.10	< .01
Recommendation 6: Letters and sounds				
Reading and literacy related	9	**0.32**	0.08	< .01
Recommendation 7: Shared book reading				
Language	16	**0.20**	0.03	< .01
Reading and literacy related	5	**0.30**	0.09	< .01

Note: All effect sizes were calculated using a fixed-effects meta-analytic effect size across studies. *k* = number of studies with at least one outcome in the relevant domain that contributed to the meta-analytic effect size; *g* = Hedges' *g*.

[a] Statistically significant findings are bolded.

Tables D.2, **D.3**, **D.4**, **D.5**, **D.6**, **D.7**, and **D.8** provide the underlying data for conducting the fixed-effects meta-analyses for Recommendations 1-7. Each table includes the average effect size and standard error for each outcome domain and study.

If a study had multiple main findings contributing to the evidence in the same outcome domain, the average effect size was used. Additional data on the findings and studies reviewed for this practice guide can be extracted from **https://ies.ed.gov/ncee/wwc/studyfindings** when selecting "Preparing Young Children for School" in the Protocol field. The WWC webpages for each study also contain additional information about the study and findings (see **References**).

For each finding, the WWC may use either the effect size reported in the study, if it was calculated in a way that is consistent with the WWC Handbooks, or an effect size calculated by the WWC. For additional information on this process, see Appendix E of the *WWC Procedures Handbook, Version 4.1*.

Table D.2. Data for studies providing evidence for Recommendation 1: Regularly provide intentional, engaging instruction and practice focused on social-emotional skills

Recommendation 1: Social-emotional learning			
Study	**Outcome domain**	**Effect size (*g*)**	**Standard error**
Bierman et al. (2008)	Social-emotional learning	0.26	0.193
Feil et al. (2009)	Social-emotional learning	0.17	0.200
Flook et al. (2015)	Social-emotional learning	0.43	0.369
Gunter et al. (2012)	Social-emotional learning	0.28	0.496
Ostrov et al. (2009)	Social-emotional learning	0.22	0.140
Upshur et al. (2017)	Social-emotional learning	0.04	0.158

Table D.3. Data for studies providing evidence for Recommendation 2: Strengthen children's executive function skills using specific games and activities

Recommendation 2: Executive function			
Study	**Outcome domain**	**Effect size (*g*)**	**Standard error**
McClelland et al. (2019)	Self-regulation	0.13	0.203
Schmitt et al. (2015)	Self-regulation	0.17	0.087
Upshur et al. (2017)	Self-regulation	0.24	0.141
Zelazo et al. (2018)	Self-regulation	0.09	0.186

Table D.4. Data for studies providing evidence for Recommendation 3: Provide intentional instruction to build children's understanding of mathematical ideas and skills

Recommendation 3: Mathematical ideas and skills			
Study	**Outcome domain**	**Effect size (*g*)**	**Standard error**
Clements and Sarama (2008)	Mathematics	1.07	0.218
Clements et al. (2011)	Mathematics	0.48	0.153
Clements et al. (2019)	Mathematics	0.36	0.189
DeFlorio et al. (2019)	Mathematics	0.72	0.178
Jung et al. (2013)	Mathematics	0.28	0.226
Klein et al. (2008)	Mathematics	0.51	0.179
Purpura et al. (2017)	Mathematics	0.37	0.319
Ramani and Siegler (2008)	Mathematics	0.88	0.221
Ramani and Siegler (2011)	Mathematics	0.30	0.189
Rosenfeld et al. (2019)	Mathematics	0.19	0.062
Scalise et al. (2018)	Mathematics	0.30	0.293
Siegler and Ramani (2008)	Mathematics	1.02	0.347
Siegler and Ramani (2009)	Mathematics	0.61	0.357
Thomas et al. (2018)	Mathematics	0.27	0.091
Wakabayashi et al. (2020)	Mathematics	0.06	0.211

Table D.5. Data for studies providing evidence for Recommendation 4: Engage children in conversations about mathematical ideas and support them in using mathematical language

Recommendation 4: Mathematical language			
Study	**Outcome domain**	**Effect size (*g*)**	**Standard error**
Clements and Sarama (2008)	Mathematics	1.07	0.218
Clements et al. (2011)	Mathematics	0.48	0.153
Jung et al. (2013)	Mathematics	0.28	0.226
Purpura et al. (2017)	Mathematics	0.37	0.319
Rosenfeld et al. (2019)	Mathematics	0.19	0.062

Table D.6. Data for studies providing evidence for Recommendation 5: Intentionally plan activities to build children's vocabulary and language

Recommendation 5: Vocabulary and language			
Study	**Outcome domain**	**Effect size (*g*)**	**Standard error**
Assel et al. (2007)	Language	-0.16	0.288
Assel et al. (2007)	Reading & literacy related	-0.10	0.288
Blewitt et al. (2009)	Language	0.12	0.053
Collins (2010)	Language	1.22	0.281
Dickinson, Collins, et al. (2019)	Language	-0.15	0.262
Farver et al. (2009)	Language	0.40	0.251
Farver et al. (2009)	Reading & literacy related	0.50	0.253
Mages (2018)	Language	0.00	0.255
Neuman and Dwyer (2011)	Language	0.94	0.295
Neuman et al. (2015)	Language	0.37	0.163
Penuel et al. (2012)	Reading & literacy related	0.39	0.135
Preschool Curriculum Evaluation Research Consortium (2008) [*Doors to Discovery* vs. business as usual]	Language	0.23	0.518
Preschool Curriculum Evaluation Research Consortium (2008) [*Doors to Discovery* vs. business as usual]	Reading & literacy related	0.12	0.442
Preschool Curriculum Evaluation Research Consortium (2008) [*Literacy Express* vs. business as usual (*HighScope*)]	Language	0.06	0.452
Preschool Curriculum Evaluation Research Consortium (2008) [*Literacy Express* vs. business as usual (*HighScope*)]	Reading & literacy related	0.23	0.459
Read et al. (2019)	Language	0.36	0.273
Toub et al. (2018)	Language	0.34	0.134
Wasik and Hindman (2020)	Language	0.17	0.062
Yazejian & Peisner-Feinberg (2009)	Language	0.10	0.398

Table D.7. Data for studies providing evidence for Recommendation 6: Build children's knowledge of letters and sounds

Recommendation 6: Letters and sounds			
Study	**Outcome domain**	**Effect size (*g*)**	**Standard error**
Assel et al. (2007)	Reading & literacy related	-0.10	0.288
Farver et al. (2009)	Reading & literacy related	0.50	0.253
Penuel et al. (2012)	Reading & literacy related	0.39	0.135
Piasta and Wagner (2010b)	Reading & literacy related	0.16	0.189
Preschool Curriculum Evaluation Research Consortium (2008) [*Let's Begin with the Letter People* vs. business as usual]	Reading & literacy related	0.09	0.446
Preschool Curriculum Evaluation Research Consortium (2008) [*Literacy Express* vs. business as usual (*HighScope*)]	Reading & literacy related	0.23	0.459
Roberts et al. (2018)	Reading & literacy related	0.34	0.300
Roberts et al. (2019)	Reading & literacy related	0.32	0.198
Ukrainetz et al. (2011)	Reading & literacy related	0.74	0.350

Table D.8. Data for studies providing evidence for Recommendation 7: Use shared book reading to develop children's language, knowledge of print features, and knowledge of the world

Recommendation 7: Shared book reading			
Study	**Outcome domain**	**Effect size (*g*)**	**Standard error**
Assel et al. (2007)	Language	-0.16	0.288
Assel et al. (2007)	Reading & literacy related	-0.10	0.288
Biazak et al. (2010)	Language	0.46	0.268
Blewitt et al. (2009)	Language	0.12	0.053
Collins (2010)	Language	1.22	0.281
Dickinson, Collins, et al. (2019)	Language	-0.15	0.262
Farver et al. (2009)	Language	0.40	0.251
Farver et al. (2009)	Reading & literacy related	0.50	0.253
Justice et al. (2010)	Language	0.08	0.158
Justice et al. (2010)	Reading & literacy related	0.23	0.160
Kim and Phillips (2016)	Language	0.58	0.242
Mages (2018)	Language	0.00	0.255
McCarty et al. (2018)	Language	0.21	0.081
Neuman and Dwyer (2011)	Language	0.94	0.295
Neuman et al. (2015)	Language	0.37	0.163
Nicolopoulou et al. (2015)	Language	0.09	0.329
Penuel et al. (2012)	Reading & literacy related	0.39	0.135
Preschool Curriculum Evaluation Research Consortium (2008) [*Literacy Express* vs. business as usual (*HighScope*)]	Language	0.06	0.452
Preschool Curriculum Evaluation Research Consortium (2008) [*Literacy Express* vs. business as usual (*HighScope*)]	Reading & literacy related	0.23	0.459
Toub et al. (2018)	Language	0.34	0.134
Wasik and Hindman (2020)	Language	0.17	0.062

Appendix E: About the Panel and WWC Contractor Staff

Panel

Margaret R. Burchinal, Ph.D. (Panel Chair), is a research professor in the School of Education and Human Development at the University of Virginia. Her research examines the role early childhood education plays in child learning and development. She has served as the lead statistician for landmark early education studies, including the *Abecedarian Project*, National Institute of Child Health and Human Development (NICHD) Study of Early Child and Youth Development, and *Family Life Project*, and for evaluations of major early childhood policy initiatives. She has authored or co-authored over 150 peer-reviewed articles. She has served on review panels for the Maternal and Child Health Bureau, IES, and NICHD; as an associate editor for *Child Development* and *Early Childhood Research Quarterly*; and as a board member for the W.T. Grant Foundation and American Educational Research Association (AERA).

Karen Bierman, Ph.D., is an Evan Pugh University Professor of Psychology and Human Development and Family Studies and director of the Child Study Center at Penn State. Her 40-year research career has focused on social-emotional development and children at risk, with an emphasis on the design and evaluation of school-based and community-focused programs that promote social-emotional competence and school readiness. She has directed several longitudinal studies evaluating the long-term impact of early school-based and family-focused preventive interventions designed to reduce behavior problems (*Fast Track*) and enhance school success (*Head Start REDI*). She has served as an educational advisor to several organizations devoted to improving early education, including Head Start and Sesame Street.

Jorge E. Gonzalez, Ph.D., is a professor and director of the School Psychology program, Department of Psychological, Health, and Learning Sciences at the College of Education at the University of Houston. His research focuses on the causes and correlates of early oral language and literacy difficulties in young children with an emphasis on adult-child interactive reading at the intersection of dual language learning and culture. His scholarship examines Latinx children's home literacy environments, the effects of textual and extratextual teacher-child conversations around shared reading, longitudinal effects of shared reading interventions, and the heterogeneous nature of language and literacy difficulties of at-risk children. He has previously been the lead investigator on an Early Reading First project titled *Accelerating Children's Early Literacy and Language* (*ACELL*), an IES development grant titled *Words of Oral Reading and Language Development* (*WORLD*), and a follow-up IES efficacy grant of the same name, as well as a development grant titled *Families4College*.

Megan M. McClelland, Ph.D., is the Katherine E. Smith Healthy Children and Families Professor and the endowed director at the Hallie E. Ford Center for Healthy Children and Families at Oregon State University. Her research focuses on optimizing children's development, especially as it relates to self-regulation, early learning, and school success. She has received grants from IES, National Institutes of Health (NIH), and private foundations focused on measuring and improving self-regulation and executive function in young children. She has been involved with several national and international projects to

develop measures of self-regulation and improve school success in young children. She serves on national and international boards and committees including the technical review panel for the *Early Childhood Longitudinal Study of the Kindergarten Class of 2023* (ECLS-K: 2023) and is also an advisor to *PBS Kids*.

Kimberly Nelson, M.A., is the executive director of early childhood education at Rockford Public Schools, Rockford, Illinois. A graduate of Northern Illinois University and St. Xavier University, she has a bachelor's degree in Education with endorsements/approvals in early childhood, elementary, and special education and master's degrees in Educational Leadership and Education and Teacher Leadership. Nelson supervises the district's Early Childhood program of more than 2,500 students ages 3–5 as well as the Birth to 3 Home Visiting program, which serves 171 families. As a Barbara Bowman Leadership Fellow of Erikson Institute, Nelson adheres to the foundational principles of quality, access, and equity in all aspects of her work to ensure that young children and their families meet their greatest potential.

Jill Pentimonti, Ph.D., is the director of research advancement and affiliate of the Institute for Educational Initiatives at the University of Notre Dame. Her research interests include language and literacy instruction, early childhood development, intervention research, and quantitative methods. She currently serves as principal investigator on an IES efficacy evaluation study of a targeted shared book reading program in preschool classrooms. Prior IES projects include the development and evaluation of the psychometric qualities of an early childhood classroom observation tool. She has served as a kindergarten teacher in the Chicago Public School system and a pre-kindergarten teacher in Washington, D.C., at an early childhood center for children who are hearing impaired.

David J. Purpura, Ph.D., is an associate professor in the College of Health and Human Sciences at Purdue University. His research focuses on understanding how young children in preschool through Grade 3 learn math and how to identify children at risk for later math difficulties. Currently, he is developing and evaluating interventions using picture books and games to support the early mathematics skills of monolingual English speakers and dual language learners. He is also studying how home factors affect the home numeracy and literacy environment and children's academic skills before they enter preschool.

Jason Sachs, Ph.D., is the executive director of the preschool to second-grade office of Boston Public Schools (BPS), Boston, Massachusetts. Since the inception of the Early Childhood Department, Dr. Sachs has led an effort to deliver a universal high-quality system of early childhood programs for BPS, including the successful implementation of the curriculum for pre-kindergarten to second grade, a professional development system for teachers and principals, the expansion of National Association for the Education of Young Children (NAEYC)-accredited classrooms in Boston, and a comprehensive evaluation system of both classroom quality and child outcomes. Previously, he worked in the Massachusetts Department of Education's Early Learning Services division for six years as a research and policy consultant and was a former board member of NAEYC.

Julie Sarama, Ph.D., is a Distinguished University Professor and the Kennedy Endowed Chair in Innovative Technology at the University of Denver. She conducts research on young children's development of mathematical concepts and competencies, implementation and scale-up of educational reform, professional development models and their influence on student learning, and effects of software environments in mathematics classrooms. Her current research involves development and rigorous evaluation of pre-kindergarten mathematics curricula and professional development in early mathematics. She also designed and programmed over 50 published computer programs, including *Building Blocks* software and her version of Logo and Logo-based software activities (e.g., *Turtle Math*™, which was awarded Technology & Learning Software of the Year award, 1995, in the category "Math").

Elizabeth Schlesinger-Devlin, Ed.D., is the director of the Ben and Maxine Miller Child Development Laboratory School at Purdue University. Her research focuses on curriculum in early childhood and how administrative decisions are made in implementing curriculum, professional development and training related to curriculum, and assessment/evaluation of curriculum. As a practitioner, she taught preschool, kindergarten, and first grade in public and charter schools in Ohio, New Jersey, Colorado, Indiana, and Arizona. She also served as director of an early childhood program within a registered ministry in Indiana. Additionally, she delivers professional development and other training to preservice/in-service teachers and leadership personnel in the Child Development Certification (CDA) credential and the Early Learning Matters (ELM) curriculum and teaches for the Human Development and Family Studies Department.

Julie Washington, Ph.D., is a professor in the School of Education at the University of California, Irvine (UCI). She is a speech-language pathologist and is a Fellow of the American Speech Language Hearing Association. Dr. Washington directs the California Learning Disabilities Research Innovation Hub at UCI. She is also director of the Dialect, Poverty and Academic Success Lab. Her research focuses on the intersection of literacy, language variation, and poverty in African American children from preschool through fifth grade. Her work focuses on understanding the role of cultural dialect in assessment outcomes, identification of reading disabilities in school-aged African American children, and disentangling the relationship between language production and comprehension in development of early reading and language skills for children growing up in poverty. Currently, she is working on the development of assessment protocols for use with high-density dialect speakers that are designed to improve our ability to measure their linguistic competence. This work is funded by the National Institute on Deafness and other Communication Disorders at the NIH.

WWC contractor staff

Madhavi Jayanthi, Ed.D., the research director at Instructional Research Group, served as project director for this practice guide. She also participated in various capacities in developing six other WWC practice guides. She is certified in WWC 4.1 group design and single-case design standards. Jayanthi has served or currently serves as a principal or co-principal investigator on grants funded by the National Center for Education Research; National Center on Education and the Economy; National Science Foundation; and Office of Special Education and Rehabilitation Services, U.S. Department of Education.

Her research interests include examining effective instructional practices in mathematics and reading for struggling learners.

Russell Gersten, Ph.D., the executive director of Instructional Research Group and professor emeritus of educational research at the University of Oregon, served as the principal investigator for this practice guide. He worked with the panel on interpreting major themes in the research and played a role in conceptualizing and writing the guide. Gersten developed the very first WWC practice guide and created the concept of "obstacles" and potential solutions in practice guides. He led, as either the panel chair or principal investigator, teams that developed six subsequent WWC practice guides. He has authored over 160 articles in scholarly journals.

Rebecca Newman-Gonchar, Ph.D., a senior research associate at Instructional Research Group, worked with the panel to craft the literacy recommendations, introduction, and glossary, and guided the development of the other recommendations. She also synthesized and compiled the evidence for the recommendations. She worked with expert panels and contributed to eight other WWC practice guides. She served as a co-principal investigator for three research syntheses on professional development for mathematics teachers, reading interventions for struggling students, and rational number interventions for struggling students. She is certified in WWC 4.1 group design standards.

Sarah Krowka, Ph.D., a research associate at Instructional Research Group, worked with the panel to craft the mathematics recommendations. She also synthesized and compiled the evidence for the recommendations. She is a certified reviewer in WWC 4.1 group design and single-case design standards. She has supported the development of two prior WWC practice guides. She recently co-authored a research synthesis on rational number interventions for struggling students and is currently serving as a co-PI for an IES meta-analysis of mathematics interventions. She is a former early childhood education teacher and center director. Her research interests include the development, evaluation, and translation of intervention research for struggling learners.

Kelly Haymond, M.A., a research associate at Instructional Research Group, served as the evidence lead, providing technical assistance to reviewers and reconcilers, conducting quality assurance checks, and providing oversight for all WWC study reviews for this guide. As a certified WWC reviewer since 2008, Haymond has reviewed group design studies for 10 prior WWC practice guides, three WWC topic area reviews, two REL research digests, and two meta-analyses. She served as the evidence lead for the reading interventions WWC practice guide, overseeing WWC reviews of more than 70 studies, and the deputy evidence coordinator for the WWC practice guide on mathematics interventions. She currently serves as a WWC-SWAT audit reviewer and intervention report peer reviewer, responsible for identifying and summarizing discrepancies in study reviews and intervention reports across WWC topic areas. She is certified in WWC 4.1 group design and regression discontinuity design evidence standards.

Samantha Wavell, B.A., a research associate at Instructional Research Group, conducted the fixed-effects meta-analyses to inform the evidence levels for the recommendations and led the drafting of the technical appendices. She also synthesized and compiled the evidence for the recommendations. She also served as project manager and as a liaison between WWC study reviewers and the WWC's Statistics,

Website, and Training team. She collaborated to address issues raised by reviewers during the process of completing WWC study reviews in the online system. She has also served as the project manager for two prior WWC practice guides. She is certified in WWC 4.1 group design and single-case design standards, and WWC 4.0 regression discontinuity design evidence standards.

Joshua Furgeson, Ph.D., a consultant for Instructional Research Group, served as a senior reviewer and reconciler and conducted quality assurance checks. Furgeson has led the development of four practice guides. He has been certified in WWC standards since 2008 and has conducted trainings in these standards for the WWC. He is certified in WWC 4.1 group design and 4.0 single-case design standards.

Julia Lyskawa, M.P.P., a researcher at Mathematica, served as the project lead for the Mathematica subcontract with IRG and worked with the panel to craft the social-emotional and executive function recommendations. She also synthesized and compiled the evidence for the recommendations. She has worked in various capacities on several WWC practice guides. Lyskawa previously oversaw implementation of the WWC's dissemination strategy for practice guides and other products, created supplemental resources to support each practice guide, and promoted practice guides at conferences and through webinars and social media. She created the concept of practice guide summaries and has written several for numerous practice guides. She is a certified WWC reviewer in WWC 4.1 group design standards.

Emily Rosen, M.P.P., a research analyst at Mathematica, worked with the panel and helped draft the social-emotional and executive function recommendations. She is certified as a WWC reviewer in the WWC 4.1 group design standards. She previously worked as an educator and teaching coach. She taught kindergarten and first grade at a public charter school, and led interventions for small-group reading, mathematics, and writing. She has also worked on other WWC products, including a practice guide summary focused on supporting English language learners. Outside of her work on WWC, she has experience planning and synthesizing information from multiple expert panels and informant interviews.

Acknowledgments

The panel would like to thank the team of WWC-certified reviewers from Instructional Research Group and Mathematica for their contributions to this practice guide. They would also like to thank the following staff from Instructional Research Group: Isabella Boyadjian for assisting with screening and coding studies, collating study information, and managing the project; Jonathan Cohen for his editorial assistance; Joseph Dimino for assisting with the coding of studies and quality assurance of the recommendations; Robin Schumacher for conducting quality assurance of the recommendations; Christopher Tran for coordinating and managing study reviews, and assisting with the literature search and screening of studies; and Amber Wang for assisting with quality assurance checks of the technical appendices and completed reviews.

Appendix F: Disclosure of Potential Conflicts of Interest

Practice guide panels are comprised of nationally recognized experts on the topics about which they are making recommendations. The Institute of Education Sciences (IES) expects the experts to be involved in professional activities that might relate to their work as a panelist. Panel members are asked to disclose these professional activities and institute deliberative processes that encourage critical examination of their views as they relate to the content of the practice guide. Objectivity is further encouraged by the requirement that the panelists ground their recommendations in evidence that is documented in the practice guide. In addition, before all practice guides are published, the guides undergo an independent external peer review focusing on whether the evidence related to the recommendations in the guide has been presented appropriately.

The professional activities reported by each panel that appear to be most closely associated with the panel recommendations are noted below.

Panelists

Peg Burchinal co-authored articles referenced in this practice guide.

Karen Bierman co-authored articles that were reviewed and used for evidence for this practice guide. She led and/or contributed to the development of an intervention program, *Research-Based Developmentally Informed* (*REDI*), examined in some of these articles.

Jorge Gonzalez co-authored articles referenced in this practice guide.

Megan McClelland co-authored articles that were reviewed and used for evidence for this practice guide. She led and/or contributed to the development of an intervention program, *Red Light, Purple Light!*, examined in some of these articles. She is the one of the instructors of the *Red Light, Purple Light: A Self-Regulation Intervention Program* training, which uses a book she co-authored and is commercially available.

Jill Pentimonti co-authored articles referenced in this practice guide.

David Purpura co-authored articles that were reviewed and used as evidence for this practice guide. He led and/or contributed to the development of the interventions examined in some of these articles. He has contributed to other articles referenced in this practice guide.

Julie Sarama co-authored articles that were reviewed and used for evidence for this practice guide. She led and/or contributed to the development of an intervention, *Building Blocks*, examined in some of these articles. She is associated with the **Learning and Teaching with Learning Trajectories [LT]²** website and has contributed to other articles referenced in this practice guide.

Julie Washington co-authored articles referenced in this practice guide.

References

Studies included in the meta-analysis. These studies meet WWC standards and provide the evidence base for the recommendations. Citations include hyperlinks to the WWC study review and the URL for the full-text article in the Education Resources Information Center (ERIC).

Assel, M. A., Landry, S. H., Swank, P. R., & Gunnewig, S. (2007). An evaluation of curriculum, setting, and mentoring on the performance of children enrolled in pre-kindergarten. *Reading and Writing, 20*(5), 463-494. **https://eric.ed.gov/?id=EJ774756 [*Doors to Discovery* vs. business as usual]**.

Biazak, J. E., Marley, S. C., & Levin, J. R. (2010). Does an activity-based learning strategy improve preschool children's memory for narrative passages? *Early Childhood Research Quarterly, 25*(4), 515-526. **https://eric.ed.gov/?id=EJ902065 [Activity-based listening vs. listening to a story]**.

Bierman, K. L., Domitrovich, C. E., Nix, R. L., Gest, S. D., Welsh, J. A., Greenberg, M. T., Blair, C., Nelson, K. E., & Gill, S. (2008). Promoting academic and social-emotional school readiness: The Head Start REDI program. *Child Development, 79*(6), 1802-1817. **https://eric.ed.gov/?id=EJ818718 [*Head Start Research-Based, Developmentally Informed* program vs. business as usual (*Creative Curriculum* or *HighScope*)]**.

Blewitt, P., Rump, K. M., Shealy, S. E., & Cook, S. A. (2009). Shared book reading: When and how questions affect young children's word learning. *Journal of Educational Psychology, 101*(2), 294-304. **https://eric.ed.gov/?id=EJ835037 [Scaffolding questions during book reading vs. asking either low- or high-demand questions during book reading]**.

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 [*Building Blocks* vs. business as usual (*Creative Curriculum*)]**.

Clements, D. H., Sarama, J., Baroody, A. J., Joswick, C., & Wolfe, C. B. (2019). Evaluating the efficacy of a learning trajectory for early shape composition. *American Educational Research Journal, 56*(6), 2509-2530. **https://eric.ed.gov/?id=EJ1234710 [Learning trajectories-based instruction vs. instruction at children's target level without scaffolding]**.

Clements, D. H., Sarama, J., Spitler, M. E., Lange, A. A., & Wolfe, C. B. (2011). Mathematics learned by young children in an intervention based on learning trajectories: A large-scale cluster randomized trial. *Journal for Research in Mathematics Education, 42*(2), 127-166. **https://eric.ed.gov/?id=EJ918252 [*Building Blocks* vs. business as usual (*Where Bright Futures Begin* or *Opening the World of Learning*)]**.

Collins, M. F. (2010). ELL preschoolers' English vocabulary acquisition from storybook reading. *Early Childhood Research Quarterly, 25*(1), 84-97. **https://eric.ed.gov/?id=EJ864528 [Rich explanation reading vs. business as usual (story reading without rich explanation)]**.

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 [*Pre-K Mathematics* vs. business as usual (*Creative Curriculum*)]**.

Dickinson, D. K., Collins, M. F., Nesbitt, K., Toub, T. S., Hassinger-Das, B., Hadley, E. B., Hirsh-Pasek, K., & Golinkoff, R. M. (2019). Effects of teacher-delivered book reading and play on vocabulary learning and self-regulation among low-income preschool children. *Journal of Cognition and Development, 20*(2), 136-164. **https://eric.ed.gov/?id=EJ1219025 [Book reading plus play vs. book reading only]**.

Farver, J. A. M., Lonigan, C. J., & Eppe, S. (2009). Effective early literacy skill development for young Spanish-speaking English language learners: An experimental study of two methods. *Child Development, 80*(3), 703-719. **https://eric.ed.gov/?id=EJ840084 [*Literacy Express* in English only vs. business as usual (*HighScope*)]**.

Feil, E. G., Walker, H., Severson, H., Golly, A., Seeley, J. R., & Small, J. W. (2009). Using positive behavior support procedures in Head Start classrooms to improve school readiness: A group training and behavioral coaching model. *NHSA Dialog, 12*(2), 88-103. **https://eric.ed.gov/?id=EJ865812 [*Positive Behavioral Interventions and Supports* (PBIS) vs. business as usual]**.

Flook, L., Goldberg, S. B., Pinger, L., & Davidson, R. J. (2015). Promoting prosocial behavior and self-regulatory skills in preschool children through a mindfulness-based kindness curriculum. *Developmental Psychology, 51*(1), 44-51. **https://eric.ed.gov/?id=EJ1049597 [*Kindness Curriculum* vs. business as usual]**.

Gunter, L., Caldarella, P., Korth, B. B., & Young, K. R. (2012). Promoting social and emotional learning in preschool students: A study of Strong Start Pre-K. *Early Childhood Education Journal, 40*(3), 151-159. **https://eric.ed.gov/?id=EJ963276 [*Strong Start Pre-K* vs. business as usual]**.

Jung, M., Hartman, P., Smith, T., & Wallace, S. (2013). The effectiveness of teaching number relationships in preschool. *International Journal of Instruction, 6*(1), 165-178. **https://eric.ed.gov/?id=EJ1085361 [*Building Blocks* software, with rekenrek and ten-frame activities vs. business as usual (*Mathematics: The Creative Curriculum Approach*)]**.

Justice, L. M., McGinty, A. S., Piasta, S. B., Kaderavek, J. N., & Fan, X. (2010). Print-focused read-alouds in preschool classrooms: Intervention effectiveness and moderators of child outcomes. *Language, Speech, and Hearing Services in Schools, 41*(4), 504-520. **https://eric.ed.gov/?id=EJ909127 [High-dose print referencing vs. book reading without a focus on print referencing]**.

Kim, Y.-S. G., & Phillips, B. (2016). Five minutes a day to improve comprehension monitoring in oral language contexts. *Topics in Language Disorders, 36*(4), 356-367. **https://eric.ed.gov/?id=ED575735 [Comprehension monitoring vs. business as usual (*Creative Curriculum* or *Houghton Mifflin Pre-K*)]**.

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 [*Pre-K Mathematics* and *DLM Express* math software vs. business as usual (*Creative Curriculum* or *HighScope*)]**.

Mages, W. K. (2018). Does theatre-in-education promote early childhood development?: The effect of drama on language, perspective-taking, and imagination. *Early Childhood Research Quarterly, 45*(4), 224-237. **https://doi.org/10.1016/j.ecresq.2017.12.006 [*Theatre-in-Education* program vs. business as usual (*Head Start*)]**.

McCarty, A., Comly, R., Strouf, K., & Rigsby, M. (2018). *Children's Literacy Initiative's Blueprint for Early Literacy: Year 2 evaluation report*. Research for Action. **https://eric.ed.gov/?id=ED593711 [*Blueprint for Early Literacy* vs. business as usual (*Creative Curriculum*)]**.

McClelland, M. M., Tominey, S. L., Schmitt, S. A., Hatfield, B., Purpura, D., Gonzales, C., & Tracy, A. (2019). Red Light, Purple Light! Results of an intervention to promote school readiness for children from low-income backgrounds. *Frontiers in Psychology, 10*(2365), 1-15. **https://eric.ed.gov/?id=ED599347 [*Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual (*Creative Curriculum*)]**.

Neuman, S. B., & Dwyer, J. (2011). Developing vocabulary and conceptual knowledge for low-income preschoolers: A design experiment. *Journal of Literacy Research, 43*(2), 103-129. **https://eric.ed.gov/?id=EJ950695 [*World of Words* vs. business as usual (*HighScope*)]**.

Neuman, S. B., Pinkham, A., & Kaefer, T. (2015). Supporting vocabulary teaching and learning in prekindergarten: The role of educative curriculum materials. *Early Education and Development, 26*(7), 988-1011. **https://eric.ed.gov/?id=EJ1070888 [*World of Words* vs. business as usual (*HighScope*)]**.

Nicolopoulou, A., Cortina, K. S., Ilgaz, H., Cates, C. B., & de Sá, A. B. (2015). Using a narrative-and play-based activity to promote low-income preschoolers' oral language, emergent literacy, and social competence. *Early Childhood Research Quarterly, 31*, 147-162. **https://doi.org/10.1016/j.ecresq.2015.01.006 [Storytelling and story-acting vs. business as usual (*Creative Curriculum*)]**.

Ostrov, J. M., Massetti, G. M., Stauffacher, K., Godleski, S. A., Hart, K. C., Karch, K. M., Mullins, A. D., & Ries, E. E. (2009). An intervention for relational and physical aggression in early childhood: A preliminary study. *Early Childhood Research Quarterly, 24*(1), 15-28. **https://eric.ed.gov/?id=EJ830312 [*Early Childhood Friendship Project* vs. business as usual]**.

Penuel, W. R., Bates, L., Gallagher, L. P., Pasnik, S., Llorente, C., Townsend, E., Hupert, N., Domínguez, X., & VanderBorght, M. (2012). Supplementing literacy instruction with a media-rich intervention: Results of a randomized controlled trial. *Early Childhood Research Quarterly, 27*(1), 115-127. **https://eric.ed.gov/?id=EJ947504 [Media-rich early literacy supplement vs. media-rich science supplement]**.

Piasta, S. B., & Wagner, R. K. (2010b). Learning letter names and sounds: Effects of instruction, letter type, and phonological processing skill. *Journal of Experimental Child Psychology, 105*(4), 324-344. **https://eric.ed.gov/?id=EJ876203 [Letter names and sounds instruction vs. numbers instruction]**.

Preschool Curriculum Evaluation Research Consortium (2008). *Effects of preschool curriculum programs on school readiness* (NCER 2008-2009). National Center for Education Research, Institute of Education Sciences, U.S. Department of Education, U.S. Government Printing Office. **https://eric.ed.gov/?id=ED502153 [*Doors to Discovery* vs. business as usual; *Let's Begin with the Letter People* vs. business as usual; *Literacy Express* vs. business as usual (*HighScope*)]**.

Purpura, D. J., Napoli, A. R., Wehrspann, E. A., & Gold, Z. S. (2017). Causal connections between mathematical language and mathematical knowledge: A dialogic reading intervention. *Journal of Research on Educational Effectiveness, 10*(1), 116-137. **https://eric.ed.gov/?id=EJ1125420 [Mathematical language storybook intervention vs. business as usual (*Creative Curriculum*)]**.

Ramani, G. B., & Siegler, R. S. (2008). Promoting broad and stable improvements in low-income children's numerical knowledge through playing number board games. *Child Development, 79*(2), 375-394. **https://eric.ed.gov/?id=EJ789398 [Number board games vs. color board games]**.

Ramani, G. B., & Siegler, R. S. (2011). Reducing the gap in numerical knowledge between low-and middle-income preschoolers. *Journal of Applied Developmental Psychology, 32*(3), 146-159. **https://eric.ed.gov/?id=EJ922466 [Linear board game vs. numerical activities]**.

Read, K., Furay, E., & Zylstra, D. (2019). Using strategic pauses during shared reading with preschoolers: Time for prediction is better than time for reflection when learning new words. *First Language, 39*(5), 508-526. **https://eric.ed.gov/?id=EJ1226484 [Story reading with pauses before target words or story reading with pauses after target words vs. story reading without pauses]**.

Roberts, T. A., Vadasy, P. F., & Sanders, E. A. (2018). Preschoolers' alphabet learning: Letter name and sound instruction, cognitive processes, and English proficiency. *Early Childhood Research Quarterly, 44*, 257-274. **https://eric.ed.gov/?id=ED583491 [Experimental letter names and sounds instruction vs. typical letter names and sounds instruction]**.

Roberts, T. A., Vadasy, P. F., & Sanders, E. A. (2019). Preschool instruction in letter names and sounds: Does contextualized or decontextualized instruction matter? *Reading Research Quarterly, 54*(3), 413-437. **https://eric.ed.gov/?id=ED599352 [Decontextualized letter names and sounds instruction vs. contextualized letter names and sounds instruction]**.

Rosenfeld, D., Dominguez, X., Llorente, C., Pasnik, S., Moorthy, S., Hupert, N., Gerard, S., & Vidiksis, R. (2019). A curriculum supplement that integrates transmedia to promote early math learning: A randomized controlled trial of a PBS KIDS intervention. *Early Childhood Research Quarterly, 49*, 241-253. **https://doi.org/10.1016/j.ecresq.2019.07.003 [*PBS KIDS Transmedia Math Supplement* vs. business as usual]**.

Scalise, N. R., Daubert, E. N., & Ramani, G. B. (2018). Narrowing the early mathematics gap: A play-based intervention to promote low-income preschoolers' number skills. *Journal of Numerical Cognition, 3*(3), 559-581. **https://doi.org/10.5964/jnc.v3i3.72** [**Numerical magnitude comparison vs. numerical matching card game**].

Schmitt, S. A., McClelland, M. M., Tominey, S. L., & Acock, A. C. (2015). Strengthening school readiness for Head Start children: Evaluation of a self-regulation intervention. *Early Childhood Research Quarterly, 30*, 20-31. **https://doi.org/10.1016/j.ecresq.2014.08.001** [**Self-regulation intervention vs. business as usual**].

Siegler, R. S., & Ramani, G. B. (2008). Playing linear numerical board games promotes low-income children's numerical development. *Developmental Science, 11*(5), 655-661. **https://eric.ed.gov/?id=EJ849743** [**Number board games vs. color board games**].

Siegler, R. S., & Ramani, G. B. (2009). Playing linear number board games—but not circular ones—improves low-income preschoolers' numerical understanding. *Journal of Educational Psychology, 101*(3), 545-560. **https://eric.ed.gov/?id=EJ861180** [**Linear board game vs. numerical activities**].

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** [***Pre-K Mathematics* vs. business as usual**].

Toub, T. S., Hassinger-Das, B., Nesbitt, K. T., Ilgaz, H., Weisberg, D. S., Hirsh-Pasek, K., Golinkoff, R. M., Nicolopoulou, A., & Dickinson, D. K. (2018). The language of play: Developing preschool vocabulary through play following shared book-reading. *Early Childhood Research Quarterly, 45*, 1-17. **https://doi.org/10.1016/j.ecresq.2018.01.010** [**Guided play or directed play vs. free play**].

Ukrainetz, T. A., Nuspl, J. J., Wilkerson, K., & Beddes, S. R. (2011). The effects of syllable instruction on phonemic awareness in preschoolers. *Early Childhood Research Quarterly, 26*(1), 50-60. **https://eric.ed.gov/?id=EJ906814** [**Syllable tasks or multiple phoneme tasks vs. first phoneme tasks**].

Upshur, C. C., Heyman, M., & Wenz-Gross, M. (2017). Efficacy trial of the Second Step Early Learning (SSEL) curriculum: Preliminary outcomes. *Journal of Applied Developmental Psychology*, *50*, 15-25. **https://eric.ed.gov/?id=ED573440** [***Second Step Social-Emotional Skills for Early Learning* vs. business as usual (*Creative Curriculum*)**].

Wakabayashi, T., Andrade-Adaniya, F., Schweinhart, L. J., Xiang, Z., Marshall, B. A., & Markley, C. A. (2020). The impact of a supplementary preschool mathematics curriculum on children's early mathematics learning. *Early Childhood Research Quarterly, 53*, 329-342. **https://doi.org/10.1016/j.ecresq.2020.04.002** [***Numbers Plus Preschool Mathematics* vs. business as usual (*HighScope*)**].

Wasik, B. A., & Hindman, A. H. (2020). Increasing preschoolers' vocabulary development through a streamlined teacher professional development intervention. *Early Childhood Research Quarterly, 50, Part 1*(1), 101-113. **https://eric.ed.gov/?id=ED611720 [*Story Talk* book reading with "story maps" vs. book reading without "story maps"]**.

Yazejian, N., & Peisner-Feinberg, E. S. (2009). Effects of a preschool music and movement curriculum on children's language skills. *NHSA Dialog, 12*(4), 327-341. **https://eric.ed.gov/?id=EJ865822 [Music and movement intervention that supports language skills vs. business as usual]**.

Zelazo, P. D., Forston, J. L., Masten, A. S., & Carlson, S. M. (2018). Mindfulness plus reflection training: Effects on executive function in early childhood. *Frontiers in Psychology, 9*(208), 1-12. **https://doi.org/10.3389/fpsyg.2018.00208 [Mindfulness and reflection training vs. business as usual (regular classroom activities or *Second Step Social-Emotional Skills for Early Learning*)]**.

Studies not included in the meta-analysis. The studies were reviewed as a potential source of evidence for this practice guide, and they meet WWC standards; however, the panel determined that they were not relevant to any of the recommendations in this practice guide. Citations include hyperlinks to the WWC study review and the URL for the full-text article in ERIC.

Assel, M. A., Landry, S. H., Swank, P. R., & Gunnewig, S. (2007). An evaluation of curriculum, setting, and mentoring on the performance of children enrolled in pre-kindergarten. *Reading and Writing, 20*(5), 463-494. **https://eric.ed.gov/?id=EJ774756 [*Let's Begin with the Letter People* vs. business as usual]**.

Carbonneau, K. J., & Marley, S. C. (2015). Instructional guidance and realism of manipulatives influence preschool children's mathematics learning. *The Journal of Experimental Education, 83*(4), 495-513. **https://eric.ed.gov/?id=EJ1071109 ["Bland" manipulatives vs. "realistic" manipulatives]**.

Curtis, R., Okamoto, Y., & Weckbacher, L. M. (2009). Preschoolers' use of count information to judge relative quantity. *Early Childhood Research Quarterly, 24*(3), 325-336. **https://eric.ed.gov/?id=EJ858278 [Balance-scale tasks with count information vs. balance-scale tasks without count information]**.

Farver, J. A. M., Lonigan, C. J., & Eppe, S. (2009). Effective early literacy skill development for young Spanish-speaking English language learners: An experimental study of two methods. *Child Development, 80*(3), 703-719. **https://eric.ed.gov/?id=EJ840084 [*Literacy Express* in English and Spanish vs. business as usual (*HighScope*)]**.

Fyfe, E. R., McNeil, N. M., & Rittle-Johnson, B. (2015). Easy as ABCABC: Abstract language facilitates performance on a concrete patterning task. *Child Development, 86*(3), 927-935. **https://eric.ed.gov/?id=EJ1060670 [Labeling patterns with abstract labels vs. labeling patterns with concrete labels]**.

Kinzie, M. B., Whittaker, J. V., Williford, A. P., DeCoster, J., McGuire, P., Lee, Y., & Kilday, C. R. (2014). MyTeachingPartner-Math/Science pre-kindergarten curricula and teacher supports: Associations with children's mathematics and science learning. *Early Childhood Research Quarterly, 29*(4), 586-599. **https://eric.ed.gov/?id=ED577452 [*MyTeachingPartner–Math/Science* vs. business as usual (*HighScope*)]**.

Lobo, Y. B., & Winsler, A. (2006). The effects of a creative dance and movement program on the social competence of Head Start preschoolers. *Social Development, 15*(3), 501-519. **https://eric.ed.gov/?id=EJ942189 [Creative dance and movement program vs. play time without music or dance]**.

McClelland, M. M., Tominey, S. L., Schmitt, S. A., Hatfield, B., Purpura, D., Gonzales, C., & Tracy, A. (2019). Red Light, Purple Light! Results of an intervention to promote school readiness for children from low-income backgrounds. *Frontiers in Psychology, 10*(2365), 1-15. **https://eric.ed.gov/?id=ED599347 [*Red Light, Purple Light Circle Time Games* only vs. business as usual (*Creative Curriculum*)]**.

Pasnik, S., & Llorente, C. (2013). *Preschool teachers can use a PBS KIDS Transmedia Curriculum Supplement to support young children's mathematics learning: Results of a randomized controlled trial. Summative evaluation of the CPB-PBS "Ready To Learn Initiative."* Education Development Center, Inc. **https://eric.ed.gov/?id=ED594258 [*PBS KIDS Transmedia Math Supplement* vs. business as usual]**.

Preschool Curriculum Evaluation Research Consortium (2008). *Effects of preschool curriculum programs on school readiness* (NCER 2008-2009). National Center for Education Research, Institute of Education Sciences, U.S. Department of Education, U.S. Government Printing Office. **https://eric.ed.gov/?id=ED502153 [*Language-Focused Curriculum* vs. business as usual]**.

Upshur, C. C., Wenz-Gross, M., Rhoads, C., Heyman, M., Yoo, Y., & Sawosik, G. (2019). A randomized efficacy trial of the Second Step Early Learning (SSEL) curriculum. *Journal of Applied Developmental Psychology, 62*, 145-159. **https://eric.ed.gov/?id=ED593534 [*Second Step Social-Emotional Skills for Early Learning* vs. business as usual (*Creative Curriculum*)]**.

Zelazo, P. D., Forston, J. L., Masten, A. S., & Carlson, S. M. (2018). Mindfulness plus reflection training: Effects on executive function in early childhood. *Frontiers in Psychology, 9*(208), 1-12. **https://doi.org/10.3389/fpsyg.2018.00208 [*Opening the World of Learning Literacy Training* vs. business as usual (regular classroom activities or *Second Step Social-Emotional Skills for Early Learning*)]**.

Studies that did not meet WWC standards. These studies were reviewed for this practice guide but did not meet WWC standards. Therefore, these studies do not contribute to the evidence base for the recommendations. Citations include hyperlinks to the WWC study review and the URL for the full-text article in the ERIC.

Allen, S. F. (2009). A study of a violence prevention program in prekindergarten classrooms. *Children & Schools, 31*(3), 177-187. **https://eric.ed.gov/?id=EJ850051 [*Peacemakers* vs. business as usual]**.

Barnett, W. S., Jung, K., Yarosz, D. J., Thomas, J., Hornbeck, A., Stechuk, R., & Burns, S. (2008). Educational effects of the Tools of the Mind curriculum: A randomized trial. *Early Childhood Research Quarterly, 23*(3), 299-313. **https://eric.ed.gov/?id=EJ807583 [*Tools of the Mind* vs. business as usual]**.

Bernhard, J. K., Cummins, J., Campoy, F. I., Ada, A. F., Winsler, A., & Bleiker, C. (2006). Identity texts and literacy development among preschool English language learners: Enhancing learning opportunities for children at risk for learning disabilities. *Teachers College Record, 108*(11), 2380-2405. **https://eric.ed.gov/?id=EJ746180 [*Early Authors Program* (EAP) vs. business as usual]**.

Bernhard, J. K., Winsler, A., Bleiker, C., Ginieniewicz, J., & Madigan, A. L. (2008). "Read my story!" Using the early authors program to promote early literacy among diverse, urban preschool children in poverty. *Journal of Education for Students Placed at Risk, 13*(1), 76-105. **https://eric.ed.gov/?id=EJ789730 [*Early Authors Program* (EAP) vs. business as usual]**.

Brendefur, J., Strother, S., Thiede, K., Lane, C., & Surges-Prokop, M. J. (2013). A professional development program to improve math skills among preschool children in Head Start. *Early Childhood Education Journal, 41*(3), 187-195. **https://eric.ed.gov/?id=EJ998750 [Mathematics intervention with professional development vs. active control without professional development]**.

Clements, D. H., & Sarama, J. (2007). Effects of a preschool mathematics curriculum: Summative research on the Building Blocks project. *Journal for Research in Mathematics Education, 38*(2), 136-163. **https://eric.ed.gov/?id=EJ757034 [*Building Blocks* vs. business as usual]**.

Clements, D. H., Sarama, J., Layzer, C., Unlu, F., & Fesler, L. (2020). Effects on mathematics and executive function of a mathematics and play intervention versus mathematics alone. *Journal for Research in Mathematics Education, 51*(3), 301-333. **https://eric.ed.gov/?id=EJ1255793 [*Building Blocks* vs. business as usual]**.

Domitrovich, C. E., Cortes, R. C., & Greenberg, M. T. (2007). Improving young children's social and emotional competence: A randomized trial of the preschool "PATHS" curriculum. *The Journal of Primary Prevention, 28*(2), 67-91. **https://doi.org/10.1007/s10935-007-0081-0 [*Preschool Promoting Alternative Thinking Strategies* (PATHS) vs. business as usual]**.

Fantuzzo, J. W., Gadsden, V. L., & McDermott, P. A. (2011). An integrated curriculum to improve mathematics, language, and literacy for Head Start children. *American Educational Research Journal, 48*(3), 763-793. **https://eric.ed.gov/?id=EJ924275 [*Evidence-based Program for Integrated Curricula* (EPIC) vs. *Developmental Learning Materials* (DLM)]**.

Fuhs, M. W., McNeil, N. M., Kelley, K., O'Rear, C., & Villano, M. (2016). The role of non-numerical stimulus features in approximate number system training in preschoolers from low-income homes. *Journal of Cognition and Development, 17*(5), 737-764. **https://eric.ed.gov/?id=EJ1118667 [Approximate number sense acuity activity vs. shared book reading]**.

Gonzalez, J. E., Pollard-Durodola, S., Simmons, D. C., Taylor, A. B., Davis, M. J., Kim, M., & Simmons, L. (2011). Developing low-income preschoolers' social studies and science vocabulary knowledge through content-focused shared book reading. *Journal of Research on Educational Effectiveness, 4*(1), 25-52. **https://eric.ed.gov/?id=EJ911536 [*Words of Oral Reading and Language Development* (WORLD) vs. business as usual]**.

Hamre, B. K., Pianta, R. C., Mashburn, A. J., & Downer, J. T. (2012). Promoting young children's social competence through the preschool PATHS curriculum and MyTeachingPartner professional development resources. *Early Education & Development, 23*(6), 809-832. **https://eric.ed.gov/?id=EJ981550 [*PATHS*-High or *PATHS*-Low vs. business as usual]**.

Izard, C. E., King, K. A., Trentacosta, C. J., Morgan, J. K., Laurenceau, J. P., Krauthamer-Ewing, E. S., & Finlon, K. J. (2008). Accelerating the development of emotion competence in Head Start children: Effects on adaptive and maladaptive behavior. *Development and Psychopathology, 20*(1), 369-397. **https://doi.org/10.1017/S0954579408000175 [Emotion-based prevention program vs. business as usual]**.

Kermani, H., & Aldemir, J. (2015). Preparing children for success: integrating science, math, and technology in early childhood classroom. *Early Child Development and Care, 185*(9), 1504-1527. **https://eric.ed.gov/?id=EJ1068162 [Math, science, and technology curriculum vs. business as usual]**.

Kirk, S. M., & Kirk, E. P. (2016). Sixty minutes of physical activity per day included within preschool academic lessons improves early literacy. *Journal of School Health, 86*(3), 155-163. **https://eric.ed.gov/?id=EJ1089662 [Literacy lessons with physical activity vs. literacy lessons alone]**.

Lewis Presser, A., Clements, M., Ginsburg, H., & Ertle, B. (2015). Big math for little kids: The effectiveness of a preschool and kindergarten mathematics curriculum. *Early Education and Development, 26*(3), 399-426. **https://eric.ed.gov/?id=EJ1053642 [*Big Math for Little Kids* (BMLK) vs. business as usual]**.

Lonigan, C. J., Farver, J. M., Phillips, B. M., & Clancy-Menchetti, J. (2011). Promoting the development of preschool children's emergent literacy skills: A randomized evaluation of a literacy-focused curriculum and two professional development models. *Reading and Writing, 24*(3), 305-337. **https://eric.ed.gov/?id=EJ915825 [*Literacy Express* Preschool Curriculum (Workshop Group) or *Literacy Express* Preschool Curriculum (Mentored Group) vs. business as usual (*HighScope*)]**.

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 [Mathematics or literacy or explicit social-emotional curriculum vs. business as usual]**.

Lowman, J., Stone, L. T., & Guo, J. (2018). Effects of interactive book reading for increasing children's knowledge of instructional verbs. *Communication Disorders Quarterly, 39*(4), 477-489. **https://eric.ed.gov/?id=EJ1184782 [Instructional verb intervention vs. business as usual]**.

Mashburn, A., Justice, L. M., McGinty, A., & Slocum, L. (2016). The impacts of a scalable intervention on the language and literacy development of rural pre-kindergartners. *Applied Developmental Science, 20*(1), 61-78. **https://eric.ed.gov/?id=EJ1086729 [*Read-it-Again*: Traditional (RIA-T) vs. control]**.

Mix, K. S., Sandhofer, C. M., Moore, J. A., & Russell, C. (2012). Acquisition of the cardinal word principle: The role of input. *Early Childhood Research Quarterly, 27*(2), 274-283. **https://eric.ed.gov/?id=EJ958047 [Labeling and counting vs. no training]**.

Morris, P., Mattera, S., Castells, N., Bangser, M., Bierman, K., & Raver, C. C. (2014). *Impact findings from the Head Start CARES demonstration: National evaluation of three approaches to improving preschoolers' social and emotional competence. OPRE Report 2014-44*. Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services. **https://eric.ed.gov/?id=ED546649 [*Tools of the Mind*-Play vs. business as usual; *PATHS* vs. business as usual]**.

Pasnik, S., & Llorente, C. (2012). *2012 preschool pilot study of PBS KIDS Transmedia Mathematics Content: A report to the CPB-PBS "Ready to Learn Initiative."* Education Development Center, Inc. **https://eric.ed.gov/?id=ED543352 [*PBS KIDS Transmedia Math Supplement* vs. mathematics supplement with no transmedia]**.

Pollard-Durodola, S. D., Gonzalez, J. E., Saenz, L., Soares, D., Resendez, N., Kwok, O., Davis, H., & Zhu, L. (2016). The effects of content-related shared book reading on the language development of preschool dual language learners. *Early Childhood Research Quarterly, 36*, 106-121. **https://doi.org/10.1016/j.ecresq.2015.12.004 [*Words of Oral Reading and Language Development* (WORLD) vs. business as usual]**.

Ramaswamy, V., & Bergin, C. (2009). Do reinforcement and induction increase prosocial behavior? Results of a teacher-based intervention in preschools. *Journal of Research in Childhood Education, 23*(4), 527-538. **https://eric.ed.gov/?id=EJ852154** [**Reinforcement and/or induction vs. control**].

Ritblatt, S., Longstreth, S., Hokoda, A., Cannon, B. N., & Weston, J. (2013). Can music enhance school-readiness socioemotional skills? *Journal of Research in Childhood Education, 27*(3), 257-266. **https://doi.org/10.1080/02568543.2013.796333** [**Music Program vs. business as usual (no music program)**].

Ruston, H. P., & Schwanenflugel, P. J. (2010). Effects of a conversation intervention on the expressive vocabulary development of prekindergarten children. *Language, Speech, and Hearing Services in Schools, 41*(3), 303-313. **https://eric.ed.gov/?id=EJ892596** [**Children assigned to a "talking buddy" vs. business as usual**].

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** [***TRIAD* (*Building Blocks/Pre-K Math* plus professional development) vs. business as usual**].

Schmitt, S. A., Korucu, I., Napoli, A. R., Bryant, L. M., & Purpura, D. J. (2018). Using block play to enhance preschool children's mathematics and executive functioning: A randomized controlled trial. *Early Childhood Research Quarterly, 44*, 181-191. **https://doi.org/10.1016/j.ecresq.2018.04.006** [**Semi-structured block play vs. business as usual**].

Spencer, T. D., Petersen, D. B., Slocum, T. A., & Allen, M. M. (2015). Large group narrative intervention in Head Start preschools: Implications for response to intervention. *Journal of Early Childhood Research, 13*(2), 196-217. **https://eric.ed.gov/?id=EJ1064504** [**Narrative instruction vs. non-narrative instruction**].

Thibodeau-Nielsen, R. B., Gilpin, A. T., Nancarrow, A. F., Pierucci, J. M., & Brown, M. M. (2020). Fantastical pretense's effects on executive function in a diverse sample of preschoolers. *Journal of Applied Developmental Psychology, 68*. **https://doi.org/10.1016/j.appdev.2020.101137** [**Fantastical pretense or realistic pretense vs. business as usual**].

Tominey, S. L., & McClelland, M. M. (2011). Red Light, Purple Light: Findings from a randomized trial using circle time games to improve behavioral self-regulation in preschool. *Early Education & Development, 22*(3), 489-519. **https://eric.ed.gov/?id=EJ927309** [***Red Light, Purple Light!* (RLPL) self-regulation playgroup intervention vs. business as usual**].

Williford, A. P., LoCasale-Crouch, J., Whittaker, J. V., DeCoster, J., Hartz, K. A., Carter, L. M., Wolcott, C. S., & Hatfield, B. E. (2017). Changing teacher-child dyadic interactions to improve preschool children's externalizing behaviors. *Child Development, 88*(5), 1544-1553. **https://eric.ed.gov/?id=EJ1153146 [“Banking” one-on-one time with the teacher vs. business as usual]**.

Wood, L., Roach, A. T., Kearney, M. A., & Zabek, F. (2018). Enhancing executive function skills in preschoolers through a mindfulness-based intervention: A randomized, controlled pilot study. *Psychology in the Schools, 55*(6), 644-660. **https://eric.ed.gov/?id=EJ1181817 [*Mini-Mind* vs. control]**.

Additional sources cited. These sources provide other information relevant to the practice guide topic, recommendations, and implementation of the recommended practices.

Arizona Department of Education. (2018). *Arizona early learning standards*. **https://www.azed.gov/sites/default/files/2015/02/Arizona%20Early%20Learning%20Standards_4th%20Edition_2021.pdf**.

Armstrong, A. (2020). *Culturally responsive teaching in early childhood education*. **https://www.edutopia.org/article/culturally-responsive-teaching-early-childhood-education**.

Barner, D., Chow, K., & Yang, S.-J. (2009). Finding one's meaning: A test of the relation between quantifiers and integers in language development. *Cognitive Psychology, 58*(2), 195-219. **https://eric.ed.gov/?id=EJ820337**.

Biemiller, A. (2010). *Words worth teaching: Closing the vocabulary gap*. McGraw-Hill SRA.

Bierman, K. L., & Motamedi, M. (2015). Social-emotional programs for preschool children. In J. Durlak, C. Domitrovich, R. P. Weissberg, T. Gullotta, & P. Goren (Eds.), *The handbook of social and emotional learning: Research and practice* (pp. 135-150). Guilford.

Bishop, R. S. (1990). Mirrors, windows, and sliding glass doors. *Perspectives: Choosing and Using Books for the Classroom, 6*(3), ix-xi.

Blair, C., & Raver, C. C. (2015). School readiness and self-regulation: A developmental psychobiological approach. *Annual Review of Psychology, 66*(1), 711-731. **https://doi.org/10.1146/annurev-psych-010814-015221**.

Brownell, J. O., Chen, J.-Q., Ginet, L., Hynes-Berry, M., Itzkowich, R., Johnson, D., & McCray, J. (2014). *Big ideas of early mathematics. What teachers of young children need to know*. Pearson.

Burchinal, M. R., Magnuson, K. A., Powell, D., & Soliday Hong, S. (2015). Early childcare and education. In R. M. Lerner, M. H. Bornstein, & T. Leventhal (Eds.), *Handbook of child psychology and developmental science* (7th ed., pp. 223-267). Wiley. **https://psycnet.apa.org/record/2015-15587-006**.

Center for Early Learning. (2018). *Early Learning Matters (ELM) Curriculum*. Purdue University. **https://www.purdue.edu/hhs/hdfs/ELM/about.html**.

Center on the Developing Child at Harvard University. (2014). *Enhancing and practicing executive function skills with children from infancy to adolescence*. **https://developingchild.harvard.edu/**.

Center on the Developing Child at Harvard University. (2019). *What is executive function? And how does it relate to child development?* **https://developingchild.harvard.edu/resources/what-is-executive-function-and-how-does-it-relate-to-child-development/**.

Clements, D. H., & Sarama, J. (2014). *Learning and teaching early math: The learning trajectories approach*. Routledge.

Clements, D. H., & Sarama, J. (2017/2019). *Learning and teaching with learning trajectories [LT]2*. Marsico Institute, Morgridge College of Education, University of Denver. **https://www.learningtrajectories.org/**.

Collaborative for Academic, Social, and Emotional Learning (CASEL). (2020). *CASEL'S SEL framework: What are the core competence areas and where are they promoted?* **https://casel.s3.us-east-2.amazonaws.com/CASEL-SEL-Framework-11.2020.pdf**.

Collaborative for Educational Services. (2015). *Massachusetts standards for preschool and kindergarten: Social and emotional learning, and approaches to play and learning*. **https://www.collaborative.org/sites/default/files/SEL.APL-StandardsBooklet.pdf**.

Committee for Children. (2013). *Brain builder activity*. **https://www.cfchildren.org/wp-content/uploads/resources/previous-programs/misc/Brain-Builder-Which-Way.42bc5a72-e08b-4c58-9ba8-4a5434600dc3.pdf**.

Confrey, J., Maloney, A. P., & Corley, A. K. (2014). Learning trajectories: A framework for connecting standards with curriculum. *ZDM Mathematics Education, 46*(5), 719–733. **https://doi.org/10.1007/s11858-014-0598-7**.

Connor, C. M., Morrison, F. J., & Slominski, L. (2006). Preschool instruction and children's emergent literacy growth. *Journal of Educational Psychology, 98*(4), 665–689. **https://eric.ed.gov/?id=EJ746473**.

Copple, C., & Bredekamp, S. (2009). *Developmentally appropriate practice in early childhood programs serving children from birth through age 8*. National Association for the Education of Young Children. **https://eric.ed.gov/?id=ED510265**.

Cross, C. T., Woods, T. A., & Schweingruber, H. (Eds.). (2009). *Mathematics learning in early childhood: Paths toward excellence and equity*. National Academies Press. **https://eric.ed.gov/?id=ED536446**.

Davidson, M. R., Fields, M. K., & Yang, J. (2009). A randomized trial study of a preschool literacy curriculum: The importance of implementation. *Journal of Research on Educational Effectiveness*, *2*(3), 177–208. **https://eric.ed.gov/?id=EJ866975**.

Definitions That Apply to Department Regulations, 34 C.F.R. § 77 (2021). **https://www.ecfr.gov/current/title-34/subtitle-A/part-77**.

Delaware Department of Education. (2010). *Delaware early learning foundations: Preschool for school success*. **https://dieecpd.org/static/uploads/files/elfpreschool9-10.pdf**.

Denham, S. A., & Zinsser, K. M. (2014). Social and emotional learning during early childhood. In Gullotta T. P. & Bloom M. (Eds.), *Encyclopedia of primary prevention and health promotion* (pp. 926-935). Springer. **https://doi.org/10.1007/978-1-4614-5999-6_144**.

Dickinson, D. K., Nesbitt, K. T., Collins, M. F., Hadley, E. B., Newman, K., Rivera, B. L., Ilgez, H., Nicolopoulou, A., Golinkoff, R. M., & Hirsh-Pasek, K. (2019). Teaching for breadth and depth of vocabulary knowledge: Learning from explicit and implicit instruction and the storybook texts. *Early Childhood Research Quarterly, 47*, 341-356. **https://eric.ed.gov/?id=ED606645**.

Dodge, K. A., Bai, Y., Ladd, H. F., & Muschkin, C. G. (2017). Impact of North Carolina's early childhood programs and policies on educational outcomes in elementary school. *Child Development, 88*(3), 996-1014. **https://eric.ed.gov/?id=EJ1140481**.

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology, 43*(6), 1428-1446. **https://eric.ed.gov/?id=EJ779938**.

Early Childhood Learning and Knowledge Center (ECLKC). (2018). *News you can use: Foundations of school readiness: Social emotional development*. **https://eclkc.ohs.acf.hhs.gov/school-readiness/article/news-you-can-use-foundations-school-readiness-social-emotional-development**.

Florida's Division of Early Learning. (2017). *Florida early learning developmental standards and professional competencies*. Florida Department of Education. **http://flbt5.floridaearlylearning.com/standards.html**.

Fox, D. L., & Short, K. G. (2003). *Stories matter: The complexity of cultural authenticity in children's literature*. National Council of Teachers of English. **https://eric.ed.gov/?id=ED480339**.

Gonzalez, J. E., Pollard-Durodola, S., Simmons, D. C., Taylor, A. B., Davis, M. J., Fogarty, M., & Simmons, L. (2014). Enhancing preschool children's vocabulary: Effects of teacher talk before, during and after shared reading. *Early Childhood Research Quarterly, 29*(2), 214-226. **https://doi.org/10.1016/j.ecresq.2013.11.001**.

Hadley, E. B., & Dickinson, D. K. (2020). Measuring young children's word knowledge: A conceptual review. *Journal of Early Childhood Literacy, 20*(2), 223-251. **https://eric.ed.gov/?id=EJ1255130**.

Hamre, B. K., Pianta, R. C., Burchinal, M., Field, S., LoCasale-Crouch, J., Downer, J. T., Howes, C., La Paro, K., & Scott-Little, C. (2012). A course on effective teacher-child interactions: Effects on teacher beliefs, knowledge, and observed practice. *American Educational Research Journal, 49*(1), 88-123. **https://eric.ed.gov/?id=ED544020**.

Hassinger-Das, B., Jordan, N. C., & Dyson, N. (2015). Reading stories to learn math: Mathematics vocabulary instruction for children with early numeracy difficulties. *The Elementary School Journal, 116*(2), 242-264. **https://eric.ed.gov/?id=EJ1084338**.

Hedges, L. V., & Vevea, J. L. (1998). Fixed- and random-effects models in meta-analysis. *Psychological Methods, 3*(4), 486-504. **https://doi.org/10.1037/1082-989X.3.4.486**.

Hemmeter, M. L., Fox, L., & Snyder, P. (2013). A tiered model for promoting social-emotional competence and addressing challenging behavior. In V. Buysee & E. S. Peisner-Feinberg (Eds.), *Handbook of Response to Intervention in early childhood* (pp. 85-101). Paul H. Brookes.

Honey, M. (2019). *Engaging SEL competencies to create a culturally responsive-sustaining classroom*. **https://blog.savvas.com/engaging-sel-competencies-to-create-a-culturally-responsive-sustaining-classroom/**.

Hornburg, C. B., Schmitt, S. A., & Purpura, D. J. (2018). Relations between preschoolers' mathematical language understanding and specific numeracy skills. *Journal of Experimental Child Psychology, 176*, 84-100. **https://doi.org/10.1016/j.jecp.2018.07.005**.

Howes, C., Burchinal, M., Pianta, R., Bryant, D., Early, D., Clifford, R., & Barbarin, O. (2008). Ready to learn? Children's pre-academic achievement in pre-kindergarten programs. *Early Childhood Research Quarterly, 23*(1), 27-50. **https://eric.ed.gov/?id=EJ783140**.

Illinois State Board of Education. (2013). *Illinois early learning and development standards*. **https://www.isbe.net/documents/early_learning_standards.pdf**.

Izard, C. E., Trentacosta, C. J., King, K. A., & Mostow, A. J. (2004). An emotion-based prevention program for Head Start children. *Early Education and Development, 15*(4), 407-422. **https://eric.ed.gov/?id=EJ757470**.

Kaefer, T., Neuman, S. B., & Pinkham, A. M. (2015). Pre-existing background knowledge influences socioeconomic differences in preschoolers' word learning and comprehension. *Reading Psychology, 36*(3), 203-231. **https://eric.ed.gov/?id=EJ1050199**.

Kentucky Governor's Office of Early Childhood. (2020). *Kentucky's early childhood standards*. Commonwealth of Kentucky. **https://kyecac.ky.gov/Documents/kentucky-ec-standards.pdf**.

Keys, T. D., Farkas, G., Burchinal, M. R., Duncan, G. J., Vandell, D. L., Li, W., Ruzek, E. A., & Howes, C. (2013). Preschool center quality and school readiness: Quality effects and variation by demographic and child characteristics. *Child Development, 84*(4), 1171-1190. **https://eric.ed.gov/?id=EJ1014503**.

La Paro, K. M., Hamre, B. K., Locasale-Crouch, J., Pianta, R. C., Bryant, D., Early, D., Clifford, R., Barbarin, O., Howes, C., & Burchinal, M. (2009). Quality in kindergarten classrooms: Observational evidence for the need to increase children's learning opportunities in early education classrooms. *Early Education and Development, 20*(4), 657-692. **https://eric.ed.gov/?id=EJ857263**.

Lonigan, C. J., Purpura, D. J., Wilson, S. B., Walker, P. M., & Clancy-Menchetti, J. (2013). Evaluating the components of an emergent literacy intervention for preschool children at risk for reading difficulties. *Journal of Experimental Child Psychology, 114*(1), 111-130. **https://eric.ed.gov/?id=EJ1006636**.

Ludwig, J., & Miller, D. L. (2007). Does Head Start improve children's life chances? Evidence from a regression discontinuity design. *The Quarterly Journal of Economics, 122*(1), 159-208. **https://doi.org/10.1162/qjec.122.1.159**.

Majsterek, D. J., Shorr, D. N., & Erion, V. L. (2000). Promoting early literacy through rhyme detection activities during Head Start circle-time. *Child Study Journal, 30*(3), 143-151. **https://eric.ed.gov/?id=EJ626919**.

McClelland, M. M., Tominey, S. L., Schmitt, S. A., & Duncan, R. (2017). SEL interventions in early childhood. *The Future of Children, 27*(1), 33-47. **https://eric.ed.gov/?id=ED590403**.

McLeod, A. N., & McDade, H. L. (2011). Preschoolers' incidental learning of novel words during storybook reading. *Communication Disorders Quarterly, 32*(4), 256-266. **https://eric.ed.gov/?id=EJ931492**.

McLeod, B. D., Sutherland, K. S., Martinez, R. G., Conroy, M. A., Snyder, P. A., & Southam-Gerow, M. A. (2017). Identifying common practice elements to improve social, emotional, and behavioral outcomes of young children in early childhood classrooms. *Prevention Science, 18*(2), 204-213. **https://eric.ed.gov/?id=ED583253**.

Mol, S. E., & Bus, A. G. (2011). To read or not to read: A meta-analysis of print exposure from infancy to early adulthood. *Psychological Bulletin, 137*(2), 267-296. **https://eric.ed.gov/?id=EJ933833**.

Morgan, P. L., Farkas, G., & Wu, Q. (2011). Kindergarten children's growth trajectories in reading and mathematics: Who falls increasingly behind? *Journal of Learning Disabilities, 44*(5), 472-488. **https://eric.ed.gov/?id=EJ937710**.

Morgan, P. L., & Meier, C. R. (2008). Dialogic reading's potential to improve children's emergent literacy skills and behavior. *Preventing School Failure: Alternative Education for Children and Youth, 52*(4), 11-16. **https://eric.ed.gov/?id=EJ808351**.

National Early Literacy Panel [NELP]. (2008). *Developing early literacy: Report of the National Early Literacy Panel*. National Institute for Literacy. **https://lincs.ed.gov/publications/pdf/NELPReport09.pdf**.

Neuman, S. B., Newman, E. H., & Dwyer, J. (2011). Educational effects of a vocabulary intervention on preschoolers' word knowledge and conceptual development: A cluster-randomized trial. *Reading Research Quarterly, 46*(3), 249-272. **https://eric.ed.gov/?id=EJ935112**.

O'Connor, R. E., Jenkins, J. R., Leicester, N., & Slocum, T. A. (1993). Teaching phonological awareness to young children with learning disabilities. *Exceptional Children, 59*(6), 532-546. **https://eric.ed.gov/?id=EJ464005**.

Pace, A., Alper, R., Burchinal, M. R., Golinkoff, R. M., & Hirsh-Pasek, K. (2019). Measuring success: Within and cross-domain predictors of academic and social trajectories in elementary school. *Early Childhood Research Quarterly, 46*, 112-125. **https://doi.org/10.1016/j.ecresq.2018.04.001**.

Pentimonti, J. M., Zucker, T. A., & Justice, L. M. (2011). What are preschool teachers reading in their classrooms? *Reading Psychology, 32*(3), 197-236. **https://eric.ed.gov/?id=EJ925049**.

Pentimonti, J. M., Zucker, T. A., Justice, L. M., Petscher, Y., Piasta, S. B., & Kaderavek, J. N. (2012). A standardized tool for assessing the quality of classroom-based shared reading: Systematic Assessment of Book Reading (SABR). *Early Childhood Research Quarterly, 27*(3), 512-528. **https://eric.ed.gov/?id=EJ974443**.

Petscher, Y., Cabel, S. Q., Catts, H. W., Compton, D. L., Foorman, B. R., Hart, S. A., Lonigan, C. J., Phillips, B. M., Schatschneider, C., Steacy, L. M., Terry, N. P., & Wagner, R. K. (2020). How the science of reading informs 21st-century education. *Reading Research Quarterly, 55*, 267-282. **https://eric.ed.gov/?id=EJ1267525**.

Phillips, D., Lipsey, M., Dodge, K. A., Haskins, R., Bassok, D., Burchinal, M. R., & Weiland, C. (2017). *Puzzling it out: The current state of scientific knowledge on pre-kindergarten effects*. Brookings Institution. **https://www.brookings.edu/wp-content/uploads/2017/04/consensus-statement_final.pdf**.

Piasta, S. B., Pelatti, C. Y., & Miller, H. L. (2014). Mathematics and science learning opportunities in preschool classrooms. *Early Education and Development, 25*(4), 445-468. **https://eric.ed.gov/?id=EJ1030886**.

Piasta, S. B., & Wagner, R. K. (2010a). Developing early literacy skills: A meta-analysis of alphabet learning and instruction. *Reading Research Quarterly, 45*(1), 8-38. **https://eric.ed.gov/?id=EJ871738**.

Pickens, J. (2009). Socio-emotional programme promotes positive behaviour in preschoolers. *Child Care in Practice*, *15*(4), 261-278. **https://eric.ed.gov/?id=EJ865183**.

Purpura, D. J., Baroody, A. J., & Lonigan, C. J. (2013). The transition from informal to formal mathematical knowledge: Mediation by numeral knowledge. *Journal of Educational Psychology, 105*(2), 453-464. **https://eric.ed.gov/?id=EJ1007956**.

Purpura, D. J., Schmitt, S. A., Napoli, A. R., Dobbs-Oates, J., King, Y. A., Hornburg, C. B., Westerberg, L., Borriello, G. A., Bryant, L. M., Anaya, L. Y., Kung, M., Litkowski, E., Lin, J., & Rolan, E. (2021). Engaging caregivers and children in picture books: A family-implemented mathematical language intervention. *Journal of Educational Psychology, 113*(7), 1338-1353. **https://eric.ed.gov/?id=EJ1318762**.

Price, C. L., & Steed, E. A. (2016). Culturally responsive strategies to support young children with challenging behavior. *Young Children, 71*(5), 36-43. **https://www.naeyc.org/resources/pubs/yc/nov2016/culturally-responsive-strategies**.

Ramirez, T., Brush, K., Raisch, N., Bailey, R., & Jones, S. M. (2021). Equity in social emotional learning programs: A content analysis for equitable practices in PreK-5 SEL programs. *Frontiers in Education, 6*, 679467. **https://doi.org/10.3389/feduc.2021.679467**.

REL Mid-Atlantic. (2021). *Engaging New Jersey families in learning and development during prekindergarten and kindergarten: Fact sheet*. U.S. Department of Education, Institute of Education Sciences. **https://ies.ed.gov/ncee/edlabs/regions/midatlantic/app/Docs/Infographics/50388_NJDOE_FactSheet_508c.pdf**.

Responsive Classroom. (2013). *Teaching students how to wait*. **https://www.responsiveclassroom.org/teaching-students-how-to-wait/**.

Riccomini, P. J., Smith, G. W., Hughes, E. M., & Fries, K. M. (2015). The language of mathematics: The importance of teaching and learning mathematical vocabulary. *Reading & Writing Quarterly: Overcoming Learning Difficulties, 31*(3), 235-252. **https://eric.ed.gov/?id=EJ1060695**.

Ritchie, S. J., & Bates, T. C. (2013). Enduring links from childhood mathematics and reading achievement to adult socioeconomic status. *Psychological Science, 24*(7), 1301-1308. **https://doi.org/10.1177/0956797612466268**.

Seo, K.-H., & Ginsburg, H. P. (2004). What is developmentally appropriate in early childhood mathematics education? Lessons from new research. In D. H. Clements, J. Sarama, & A.-M. DiBiase (Eds.), *Engaging young children in mathematics: Standards for early childhood mathematics education* (pp. 91-104). Lawrence Erlbaum Associates, Inc.

Simon, M. A. (1995). Reconstructing mathematics pedagogy from a constructivist perspective. *Journal for Research in Mathematics Education, 26*(2), 114-145. **https://eric.ed.gov/?id=EJ504021**.

Steffe, L. P. (2012). On the construction of learning trajectories of children: The case of commensurate fractions. *Mathematical Thinking and Learning, 6*(2), 129-162. **https://eric.ed.gov/?id=EJ683061**.

Tournaki, N., Bae, Y. S., & Kerekes, J. (2008). Rekenrek: A manipulative used to teach addition and subtraction to students with learning disabilities. *Learning Disabilities: A Contemporary Journal, 6*(2), 41-59. **https://eric.ed.gov/?id=EJ804513**.

Vandell, D. L., Burchinal, M., & Pierce, K. M. (2016). Early childcare and adolescent functioning at the end of high school: Results from the NICHD Study of Early Child Care and Youth Development. *Developmental Psychology, 52*(10), 1634-1645. **https://eric.ed.gov/?id=EJ1116022**.

Vanover, S. T. (2020). From circle time to small groups: Meeting children's needs. *Teaching Young Children 13*(4). **https://www.naeyc.org/resources/pubs/tyc/apr2020/circle-time-small-groups**.

Washington, J. A., & Craig, H. K. (2002). Morphosyntactic forms of African American English used by young children and their caregivers. *Applied Psycholinguistics, 23*(2), 209-231. **https://eric.ed.gov/?id=EJ653869**.

Watts, T. W., Duncan, G. J., Siegler, R. S., & Davis-Kean, P. E. (2014). What's past is prologue: Relations between early mathematics knowledge and high school achievement. *Educational Researcher, 43*(7), 352-360. **https://eric.ed.gov/?id=EJ1042755**.

Webster-Stratton, C., Reid, M. J., & Hammond, M. (2001). Preventing conduct problems, promoting social competence: A parent and teacher training partnership in Head Start. *Journal of Clinical Child Psychology, 30*(3), 283-302. **https://doi.org/10.1207/S15374424JCCP3003_2**.

Yeh, S. S. (2003). An evaluation of two approaches for teaching phonemic awareness to children in Head Start. *Early Childhood Research Quarterly, 18*(4), 513-529. **https://eric.ed.gov/?id=EJ778645**.

Yoshikawa, H., Weiland, C., & Brooks-Gunn, J. (2016). When does preschool matter? *The Future of Children, 26*(2), 21-35. **https://eric.ed.gov/?id=EJ1118535**.

Zelazo, P. D., Blair, C. B., & Willoughby, M. T. (2016). *Executive function: Implications for education* (NCER 2017-2000). Institute of Education Sciences, U.S. Department of Education. **https://eric.ed.gov/?id=ED570880**.

Notes

[1] Burchinal et al., 2015; Dodge et al., 2017; Duncan et al., 2007; Howes et al., 2008; Keys et al., 2013; Ludwig & Miller, 2007; Pace et al., 2019; Phillips et al., 2017; Vandell et al., 2016; Yoshikawa et al., 2016.

[2] Bierman et al., 2008; Feil et al., 2009; Flook et al., 2015; Gunter et al., 2012; McClelland et al., 2019; Ostrov et al., 2009; Schmitt et al., 2015; Upshur et al., 2017; Zelazo et al., 2016.

[3] Assel et al., 2007; Biazak et al., 2010; Blewitt et al., 2009; Clements & Sarama, 2008; Clements et al., 2011, 2019; Collins, 2010; Curtis et al., 2009; DeFlorio et al., 2019; Dickinson, Collins, et al., 2019; Farver et al., 2009; Jung et al., 2013; Justice et al., 2010; Kim & Phillips, 2016; Klein et al., 2008; Mages, 2018; McCarty et al., 2018; Neuman & Dwyer, 2011; Neuman et al., 2015; Nicolopoulou et al., 2015; Penuel et al., 2012; Piasta & Wagner, 2010b; PCER Consortium, 2008 (*Doors to Discovery*); PCER Consortium, 2008 (*Let's Begin with the Letter People*); PCER Consortium, 2008 (*Literacy Express*); Purpura et al., 2017; Ramani & Siegler, 2008, 2011; Read et al., 2019; Roberts et al., 2018, 2019; Rosenfeld et al., 2019; Scalise et al., 2018; Siegler & Ramani, 2008, 2009; Thomas et al., 2018; Toub et al., 2018; Ukrainetz et al., 2011; Wakabayashi et al., 2020; Wasik & Hindman, 2020; Yazejian & Peisner-Feinberg, 2009.

[4] Dodge et al., 2017; Duncan et al., 2007; Phillips et al., 2017; Vandell et al., 2016; Yoshikawa et al., 2016.

[5] Ludwig & Miller, 2007; Phillips et al., 2017; Vandell et al., 2016; Yoshikawa et al., 2016.

[6] Hamre, Pianta, et al., 2012.

[7] Electronic Code of Federal Regulations [eCFR], n.d.

[8] Vanover, 2020.

[9] Armstrong, 2020; Honey, 2019; Price & Steed, 2016; Ramirez et al., 2021.

[10] Bierman et al., 2008; Collaborative for Academic, Social, and Emotional Learning (CASEL), 2020; Early Childhood Learning and Knowledge Center (ECLKC), 2018; Flook et al., 2015; Gunter et al., 2012; Ostrov et al., 2009.

[11] Bierman et al., 2008; Feil et al., 2009; Flook et al., 2015; Gunter et al., 2012; Pickens, 2009; Upshur et al., 2017.

[12] Early Childhood Learning and Knowledge Center (ECLKC), 2018.

[13] Bierman et al., 2008; Flook et al., 2015; Gunter et al., 2012; Upshur et al., 2017.

[14] Izard et al., 2004.

[15] Denham & Zinsser, 2014; Hemmeter et al., 2013.

[16] Denham & Zinsser, 2014; Gunter et al., 2012; McClelland et al., 2017; Ostrov et al., 2009.

[17] Bierman et al., 2008; Ostrov et al., 2009.

[18] Bierman et al., 2008; Feil et al., 2009; Flook et al., 2015; Gunter et al., 2012; Ostrov et al., 2009; Upshur et al., 2017.

[19] Bierman et al., 2008; Flook et al., 2015; Gunter et al., 2012; Ostrov et al., 2009; Pickens, 2009; Upshur et al., 2017.

[20] Bierman et al., 2008; Flook et al., 2015; Gunter et al., 2012; Pickens, 2009; Upshur et al., 2017.

[21] Gunter et al., 2012; Ostrov et al., 2009; Upshur et al., 2017.

[22] Flook et al., 2015; Gunter et al., 2012.

[23] Ostrov et al., 2009.

[24] Bierman et al., 2008; Flook et al., 2015; Gunter et al., 2012; Ostrov et al., 2009; Upshur et al., 2017.

[25] Bierman et al., 2008; Ostrov et al., 2009; Upshur et al., 2017.

[26] Flook et al., 2015; Upshur et al., 2017.

[27] Collaborative for Educational Services, 2015; Responsive Classroom, 2013.

[28] Bierman et al., 2008; Ostrov et al., 2009; Upshur et al., 2017.

[29] Ostrov et al., 2009.

[30] Bierman et al., 2008; Gunter et al., 2012; Upshur et al., 2017.

[31] Bierman et al., 2008; Flook et al., 2015; Gunter et al., 2012; REL Mid-Atlantic, 2021.

[32] Bierman et al., 2008; Gunter et al., 2012.

[33] REL Mid-Atlantic, 2021.

[34] Bierman et al., 2008; Gunter et al., 2012; REL Mid-Atlantic, 2021.

[35] Denham & Zinsser, 2014; Hemmeter et al., 2013.

[36] McClelland et al., 2017.

[37] Bierman et al., 2008; Flook et al., 2015; Gunter et al., 2012; Ostrov et al., 2009; Upshur et al., 2017.

[38] Bierman et al., 2008; Flook et al., 2015; Upshur et al., 2017.

[39] Bierman & Motamedi, 2015.

[40] Feil et al., 2009; Webster-Stratton et al., 2001.

[41] McLeod et al., 2017.

[42] Bierman & Motamedi, 2015.

[43] Center on the Developing Child at Harvard University, 2019; McClelland et al., 2019; Schmitt et al., 2015; Zelazo et al., 2016.

[44] Blair & Raver, 2015.

[45] Blair & Raver, 2015.

[46] McClelland et al., 2019; Schmitt et al., 2015; Upshur et al., 2017; Zelazo et al., 2018.

[47] Schmitt et al., 2015; Zelazo et al., 2018.

[48] Schmitt et al., 2015; Zelazo et al., 2018.

[49] McClelland et al., 2019; Schmitt et al., 2015.

[50] Schmitt et al., 2015; Zelazo et al., 2018.

[51] Zelazo et al., 2018.

[52] Zelazo et al., 2018.

[53] McClelland et al., 2019; Schmitt et al., 2015.

[54] McClelland et al., 2019; Schmitt et al., 2015; Zelazo et al., 2018.

[55] McClelland et al., 2019.

[56] Zelazo et al., 2018.

[57] Zelazo et al., 2018.

[58] Zelazo et al., 2018.

[59] Zelazo et al., 2018.

[60] McClelland et al., 2019.

[61] McClelland et al., 2019.

[62] Upshur et al., 2017.

[63] Upshur et al., 2017.

[64] Upshur et al., 2017.

[65] McClelland et al., 2019; Schmitt et al., 2015; Zelazo et al., 2018.

[66] Seo & Ginsberg, 2004.

[67] Clements & Sarama, 2008; Clements et al., 2011, 2019; DeFlorio et al., 2019; Jung et al., 2013; Kinzie et al., 2014; Klein et al., 2008; Purpura et al., 2017; Ramani & Siegler, 2008, 2011; Rosenfeld et al., 2019; Scalise et al., 2018; Siegler & Ramani, 2008, 2009; Thomas et al., 2018.

[68] Duncan et al., 2007; Morgan et al., 2011; Ritchie & Bates, 2013; Watts et al., 2014.

[69] Connor et al., 2006; La Paro et al., 2009; Piasta et al., 2014.

[70] Clements & Sarama, 2008; Clements et al., 2011, 2019; DeFlorio et al., 2019; Jung et al., 2013; Kinzie et al., 2014; Klein et al., 2008; Purpura et al., 2017; Ramani & Siegler, 2008, 2011; Rosenfeld et al., 2019; Scalise et al., 2018; Siegler & Ramani, 2008, 2009; Thomas et al., 2018.

[71] Clements & Sarama, 2008; Clements et al., 2011, 2019; DeFlorio et al., 2019; Kinzie et al., 2014; Klein et al., 2008; Purpura et al., 2017; Rosenfeld et al., 2019; Thomas et al., 2018; Wakabayashi et al., 2020.

[72] Clements & Sarama, 2008; Clements et al., 2011, 2019; DeFlorio et al., 2019; Jung et al., 2013; Kinzie et al., 2014; Klein et al., 2008; Ramani & Siegler, 2008, 2011; Rosenfeld et al., 2019; Scalise et al., 2018; Siegler & Ramani, 2008, 2009; Thomas et al., 2018; Wakabayashi et al., 2020.

[73] Clements & Sarama, 2008; Clements et al., 2011, 2019; Jung et al., 2013; Klein et al., 2008; Thomas et al., 2018.

[74] Clements & Sarama, 2008; Clements et al., 2011; Jung et al., 2013; Rosenfeld et al., 2019.

[75] Piasta et al., 2014.

[76] Clements & Sarama, 2008; Clements et al., 2011, 2019; DeFlorio et al., 2019; Jung et al., 2013; Kinzie et al., 2014; Klein et al., 2008; Purpura et al., 2017; Ramani & Siegler, 2008, 2011; Rosenfeld et al., 2019; Scalise et al., 2018; Siegler & Ramani, 2008, 2009; Thomas et al., 2018; Wakabayashi et al., 2020.

[77] Clements & Sarama, 2008; Clements et al., 2011, 2019; Wakabayashi et al., 2020.

[78] DeFlorio et al., 2019; Klein et al., 2008; Thomas et al., 2018; Wakabayashi et al., 2020.

[79] Clements & Sarama, 2008; Clements et al., 2011; Jung et al., 2013; Rosenfeld et al., 2019.

[80] Brownell et al., 2014.

[81] Clements & Sarama, 2008; Clements et al., 2011; Jung et al., 2013; Wakabayashi et al., 2020.

[82] Jung et al., 2013; Tournaki et al., 2008.

[83] Clements et al., 2019; Purpura et al., 2013.

[84] Clements & Sarama, 2008; Clements et al., 2011; Copple & Bredekamp, 2009.

[85] Clements & Sarama, 2014; Confrey et al., 2014; Simon, 1995; Steffe, 2012.

[86] Cross et al., 2009.

[87] Seo & Ginsburg, 2004.

[88] Barner et al., 2009; Hornburg et al., 2018.

[89] Riccomini et al., 2015.

[90] Hassinger-Das et al., 2015.

[91] Purpura et al., 2021.

[92] Collins, 2010; Dickinson, Collins, et al., 2019; Neuman & Dwyer, 2011; Neuman et al., 2015; Toub et al., 2018.

[93] Purpura et al., 2017; Rosenfeld et al., 2019.

[94] Purpura et al., 2017; Rosenfeld et al., 2019.

[95] Purpura et al., 2017; Rosenfeld et al., 2019.

[96] Purpura et al., 2017.

[97] Purpura et al., 2017.

[98] Purpura et al., 2017.

[99] Purpura et al., 2017.

[100] Clements & Sarama, 2008; Clements et al., 2011.

[101] Clements & Sarama, 2008; Clements et al., 2011; Jung et al., 2013; Purpura et al., 2017; Rosenfeld et al., 2019.

[102] Collins, 2010; Dickinson, Collins, et al., 2019; Farver et al., 2009; Neuman & Dwyer, 2011; Neuman et al., 2015; Toub et al., 2018; Wasik & Hindman, 2020.

[103] Neuman & Dwyer, 2011; Neuman et al., 2015.

[104] Hadley & Dickinson, 2020.

[105] Arizona Department of Education, 2018; Delaware Department of Education, 2010; Illinois State Board of Education, 2013.

[106] Assel et al., 2007; Collins, 2010; Dickinson, Collins, et al., 2019; Dickinson, Nesbitt, et al., 2019; Farver et al., 2009; McLeod & McDade, 2011; Neuman & Dwyer, 2011; Neuman et al., 2015; Read et al., 2019; Toub et al., 2018; Wasik & Hindman, 2020.

[107] Collins, 2010; Wasik & Hindman, 2020.

[108] Collins, 2010.

[109] Dickinson, Collins, et al., 2019; Neuman & Dwyer, 2011; Neuman et al., 2011; Neuman et al., 2015; Pollard-Durodola et al., 2016.

[110] Neuman & Dwyer, 2011; Neuman et al., 2011; Neuman et al., 2015.

[111] Hadley & Dickinson, 2020; Neuman & Dwyer, 2011; Neuman et al., 2015.

[112] Farver et al., 2009.

[113] Pollard-Durodola et al., 2016.

[114] Dickinson, Collins, et al., 2019.

[115] Collins, 2010; Dickinson, Collins, et al., 2019; Neuman & Dwyer, 2011; Neuman et al., 2015; Read et al., 2019; Toub et al., 2018; Wasik & Hindman, 2020.

[116] Collins, 2010; Dickinson, Collins, et al., 2019; Read et al., 2019; Toub et al., 2018; Wasik & Hindman, 2020.

[117] Collins, 2010.

[118] Dickinson, Collins, et al., 2019; Toub et al., 2018.

[119] Collins, 2010; Gonzalez et al., 2014; McLeod & McDade, 2011; Mol & Bus, 2011; Penuel et al., 2012; PCER Consortium (Literacy Express), 2008; Toub et al., 2018; Wasik & Hindman, 2020.

[120] Read et al., 2019.

[121] Read et al., 2019.

[122] Collins, 2010; Dickinson, Collins, et al., 2019; Neuman & Dwyer, 2011; Neuman et al., 2015.

[123] Toub et al., 2018.

[124] Read et al., 2019; Toub et al., 2018.

[125] Collins, 2010.

[126] Collins, 2010; Dickinson, Collins, et al., 2019; Toub et al., 2018.

[127] Dickinson, Collins, et al., 2019.

[128] Toub et al., 2018.

[129] Collins, 2010.

[130] Collins, 2010.

[131] Neuman and Dwyer, 2011; Neuman et al., 2015.

[132] Neuman and Dwyer, 2011; Neuman et al., 2015.

[133] Collins, 2010; Toub et al., 2018.

[134] Blewitt et al., 2009; Toub et al., 2018.

[135] Collins, 2010; Toub et al., 2018.

[136] Toub et al., 2018; Yazejian & Peisner-Feinberg, 2009.

[137] Dickinson, Collins, et al., 2019.

[138] Dickinson, Collins, et al., 2019; Yazejian & Peisner-Feinberg, 2009.

[139] Yazejian & Peisner-Feinberg, 2009.

[140] Toub et al., 2018.

[141] Toub et al., 2018.

[142] Neuman & Dwyer, 2011; Neuman et al., 2015.

[143] Morgan & Meier, 2008; Neuman & Dwyer, 2011; Neuman et al., 2015.

[144] Collins, 2010; Toub et al., 2018.

[145] Morgan & Meier, 2008.

[146] Biemiller, 2010.

[147] Petscher et al., 2020.

[148] Majsterek et al., 2000; O'Connor et al., 1993; Petscher et al., 2020; Piasta & Wagner, 2010a, 2010b; Roberts et al., 2018; Yeh, 2003.

[149] Florida's Division of Early Learning, 2017; Justice et al., 2010; Kentucky Governor's Office of Early Childhood, 2020.

[150] Piasta & Wagner, 2010a, 2010b.

[151] Farver et al., 2009; Yazejian & Peisner-Feinberg, 2009.

[152] Assel et al., 2007; Ukrainetz et al., 2011.

[153] Yazejian & Peisner-Feinberg, 2009.

[154] Roberts et al., 2019.

[155] Davidson et al., 2009; Justice et al., 2010; Roberts et al., 2018, 2019.

[156] Piasta & Wagner, 2010b; Roberts et al., 2018.

[157] Farver et al., 2009; Roberts et al., 2019.

[158] Roberts et al., 2019.

[159] Davidson et al., 2009; Mol & Bus, 2011.

[160] McCarty et al., 2018.

[161] Mol & Bus, 2011.

[162] National Early Literacy Panel [NELP], 2008.

[163] Dickinson, Collins, et al., 2019; Lonigan et al., 2013; McCarty et al., 2018; Pentimonti et al., 2012; Pollard-Durodola et al., 2016; Toub et al., 2018.

[164] Collins, 2010; Dickinson, Collins, et al., 2019; Pentimonti et al., 2011; Read et al., 2019; Wasik & Hindman, 2020.

[165] Bishop, 1990; Fox & Short, 2003.

[166] Bishop, 1990; Fox & Short, 2003.

[167] Bishop, 1990; Fox & Short, 2003.

[168] Assel et al., 2007.

[169] Justice et al., 2010.

[170] Collins, 2010.

[171] Roberts et al., 2018, 2019.

[172] Roberts et al., 2019.

[173] Pollard-Durodola et al., 2016.

[174] Collins, 2010; Dickinson, Collins, et al., 2019; Read et al., 2019; Wasik & Hindman, 2020.

[175] Farver et al., 2009.

[176] Assel et al., 2007; Justice et al., 2010.

[177] Justice et al., 2010.

[178] Dickinson, Collins, et al., 2019; McCarty et al., 2018.

[179] Collins, 2010.

[180] Davidson et al., 2009; Kaefer et al., 2015.

[181] Kaefer et al., 2015.

[182] Biazak et al., 2010.

[183] Assel et al., 2007; Mol & Bus, 2011; Pentimonti et al., 2012; Toub et al., 2018.

[184] Farver et al., 2009; Toub et al., 2018.

[185] Farver et al., 2009; Toub et al., 2018.

[186] Farver et al., 2009.

[187] Blewitt et al., 2009.

[188] Farver et al., 2009.

[189] Dickinson, Collins, et al., 2019.

[190] Toub et al., 2018.

[191] Biazak et al., 2010; Toub et al., 2018.

[192] Farver et al., 2009.

[193] Morgan & Meier, 2008; Washington & Craig, 2002.

[194] Washington & Craig, 2002.

[195] Kim & Phillips, 2016.

[196] Kim & Phillips, 2016.

[197] Mol & Bus, 2011.

[198] Biazak et al., 2010.

[199] Bishop, 1990; Fox & Short, 2003.

[200] Definitions That Apply to Department Regulations, 2021.

[201] Studies were reviewed using the *WWC Standards Handbook, Version 4.1*, available at **https://ies.ed.gov/ncee/wwc/Handbooks** and the version 4.1 practice guide review protocol available at **https://ies.ed.gov/ncee/wwc/Document/1296**.

[202] Following WWC guidelines, improved outcomes are indicated by a positive, statistically significant effect from a meta-analytic effect size calculated separately for each relevant outcome domain. For more information on how the WWC calculates these effect sizes and determines levels of evidence, see the *WWC Standards Handbook, Version 4.1* at **https://ies.ed.gov/ncee/wwc/Handbooks**.

[203] A decision was made in conjunction with the expert panel to include only studies that were published within the last 15 years. The panel felt that recent studies were more relevant to current practices in pre-K, given the highly dynamic and evolving nature of policy and practice in the field of early childhood education.

[204] As with all literature reviews, publication bias could be introduced by the exclusion of dissertations and masters' theses and the tendency toward publication of studies with favorable findings. Additionally, it is possible that relevant studies were excluded due to limitations of the search strategies and the scope of the guide. Including additional studies might change the overall strength of evidence for this guide.

[205] WWC standards and procedures, version 4.1 were followed for reviewing all studies. For two studies (Feil et al., 2009; Ostrov et al., 2009), during the review process, the standard deviations were misclassified as individual-level instead of cluster-level standard deviations. To address this misclassification, a decision was made to employ WWC standards and procedures, version 5.0 adjustment methods for using cluster-level standard deviations to calculate impact estimates. This approach allowed for the inclusion of the largest amount of available evidence. For more information on how the WWC calculates effect sizes and standard errors for cluster-level studies, see Appendix E of the *WWC Standards and Procedures Handbook, Version 5.0* at **https://ies.ed.gov/ncee/wwc/Handbooks**.

[206] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Biazak et al., 2010; Bierman et al., 2008; Blewitt et al., 2009; Clements & Sarama, 2008; Clements et al., 2011, 2019; Collins, 2010; Curtis et al., 2009; DeFlorio et al., 2019; Dickinson, Collins, et al., 2019; Feil et al., 2009; Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Flook et al., 2015; Gunter et al., 2012; Jung et al., 2013; Justice et al., 2010; Kim & Phillips, 2016; Kinzie et al., 2014; Klein et al., 2008; Mages, 2018; McCarty et al., 2018; McClelland et al., 2019 (*Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual [*Creative Curriculum*]); Neuman & Dwyer, 2011; Neuman et al., 2015; Ostrov et al., 2009; Penuel et al., 2012; Piasta & Wagner, 2010b; PCER Consortium, 2008 (*Doors to Discovery*); PCER Consortium, 2008 (*Let's Begin with the Letter People*); PCER Consortium, 2008 (*Literacy Express*); Purpura et al., 2017; Ramani & Siegler, 2008, 2011; Read et al., 2019; Roberts et al., 2018, 2019; Rosenfeld et al., 2019; Scalise et al.,

2018; Schmitt et al., 2015; Siegler & Ramani, 2008, 2009; Thomas et al., 2018; Toub et al., 2018; Ukrainetz et al., 2011; Upshur et al., 2017; Wakabayashi et al., 2020; Wasik & Hindman, 2020; Zelazo et al., 2018 (Mindfulness and reflection training vs. business as usual [regular classroom activities or *Second Step: Social-Emotional Skills for Early Learning*]).

[207] Biazak et al., 2010; Bierman et al., 2008; Clements et al., 2019; Curtis et al., 2009; DeFlorio et al., 2019; Feil et al., 2009; Flook et al., 2015; Gunter et al., 2012; Justice et al., 2010; Kim & Phillips, 2016; Kinzie et al., 2014; Klein et al., 2008; McCarty et al., 2018; McClelland et al., 2019 (*Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual [*Creative Curriculum*]); Ostrov et al., 2009; Piasta & Wagner, 2010b; PCER Consortium, 2008 (*Doors to Discovery*); PCER Consortium, 2008 (*Let's Begin with the Letter People*); Ramani & Siegler, 2008, 2011; Read et al., 2019; Roberts et al., 2018, 2019; Scalise et al., 2018; Schmitt et al., 2015; Siegler & Ramani, 2008, 2009; Thomas et al., 2018; Ukrainetz et al., 2011; Wakabayashi et al., 2020; Zelazo et al., 2018 (Mindfulness and reflection training vs. business as usual [regular classroom activities or *Second Step: Social-Emotional Skills for Early Learning*]).

[208] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Blewitt et al., 2009; Clements & Sarama, 2008; Clements et al., 2011; Collins, 2010; Dickinson, Collins, et al., 2019; Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Jung et al., 2013; Mages, 2018; Neuman & Dwyer, 2011; Neuman et al., 2015; Penuel et al., 2012; PCER Consortium, 2008 (*Literacy Express*); Purpura et al., 2017; Rosenfeld et al., 2019; Toub et al., 2018; Upshur et al., 2017; Wasik & Hindman, 2020.

[209] Hedges & Vevea, 1998.

[210] If effect sizes from studies with overlapping samples are entered into a meta-analysis, participants from experimental conditions that are common across studies will be counted twice, resulting in effect sizes that are statistically dependent. This dependence in a meta-analysis can create a serious threat to the validity of the results.

[211] Bierman et al., 2008; Feil et al., 2009; Flook et al., 2015; Gunter et al., 2012; Ostrov et al., 2009; Upshur et al., 2017.

[212] Flook et al., 2015; Gunter et al., 2012; Ostrov et al., 2009.

[213] Bierman et al., 2008; Feil et al., 2009; Upshur et al., 2017.

[214] Bierman et al., 2008; Flook et al., 2015; Gunter et al., 2012; Ostrov et al., 2009.

[215] Feil et al., 2009; Upshur et al., 2017.

[216] Flook et al., 2015; Ostrov et al., 2009.

[217] Bierman et al., 2008; Feil et al., 2009; Gunter et al., 2012; Upshur et al., 2017.

[218] McClelland et al., 2019 (*Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual [*Creative Curriculum*]); Schmitt et al., 2015; Upshur et al., 2017; Zelazo et al., 2018 (Mindfulness and reflection training vs. business as usual [regular classroom activities or *Second Step: Social-Emotional Skills for Early Learning*]).

[219] McClelland et al., 2019 (*Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual [*Creative Curriculum*]); Upshur et al., 2017; Zelazo et al., 2018 (Mindfulness and reflection training vs. business as usual [regular classroom activities or *Second Step: Social-Emotional Skills for Early Learning*]).

[220] Schmitt et al., 2015.

[221] McClelland et al., 2019 (*Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual [*Creative Curriculum*]); Schmitt et al., 2015; Zelazo et al., 2018 (Mindfulness and reflection training vs. business as usual [regular classroom activities or *Second Step: Social-Emotional Skills for Early Learning*]).

[222] Upshur et al., 2017.

[223] McClelland et al., 2019 (*Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual [*Creative Curriculum*]); Schmitt et al., 2015.

[224] Upshur et al., 2017; Zelazo et al., 2018 (Mindfulness and reflection training vs. business as usual [regular classroom activities or *Second Step: Social-Emotional Skills for Early Learning*]).

[225] McClelland et al., 2019 (*Red Light, Purple Light Circle Time Games* only or *Red Light, Purple Light Circle Time Games* plus math and literacy components vs. business as usual [*Creative Curriculum*]); Schmitt et al., 2015; Zelazo et al., 2018 (Mindfulness and reflection training vs. business as usual [regular classroom activities or *Second Step: Social-Emotional Skills for Early Learning*]).

[226] Upshur et al., 2017.

[227] Clements & Sarama, 2008; Clements et al., 2011, 2019; DeFlorio et al., 2019; Jung et al., 2013; Klein et al., 2008; Purpura et al., 2017; Ramani & Siegler, 2008, 2011; Rosenfeld et al., 2019; Scalise et al., 2018; Siegler & Ramani, 2008, 2009; Thomas et al., 2018; Wakabayashi et al., 2020.

[228] Clements & Sarama, 2008; Clements et al., 2011, 2019; DeFlorio et al., 2019; Klein et al., 2008; Ramani & Siegler, 2008, 2011; Rosenfeld et al., 2019; Scalise et al., 2018; Siegler & Ramani, 2008, 2009; Thomas et al., 2018; Wakabayashi et al., 2020.

[229] Jung et al., 2013; Purpura et al., 2017.

[230] Ramani & Siegler, 2008, 2011; Scalise et al., 2018; Siegler & Ramani, 2008, 2009.

[231] Clements et al., 2019; Jung et al., 2013; Purpura et al., 2017; Rosenfeld et al., 2019.

[232] Clements & Sarama, 2008; Clements et al., 2011; DeFlorio et al., 2019; Klein et al., 2008; Thomas et al., 2018; Wakabayashi et al., 2020.

[233] Clements et al., 2019; DeFlorio et al., 2019; Klein et al., 2008; Purpura et al., 2017; Ramani & Siegler, 2008, 2011; Scalise et al., 2018; Siegler & Ramani, 2008, 2009; Thomas et al., 2018; Wakabayashi et al., 2020.

[234] Clements & Sarama, 2008; Clements et al., 2011; Jung et al., 2013; Rosenfeld et al., 2019.

[235] Clements & Sarama, 2008; Clements et al., 2011, 2019; Jung et al., 2013; Klein et al., 2008; Purpura et al., 2017; Ramani & Siegler, 2008, 2011; Scalise et al., 2018; Siegler & Ramani, 2008, 2009; Thomas et al., 2018.

[236] DeFlorio et al., 2019; Rosenfeld et al., 2019; Thomas et al., 2018.

[237] Clements & Sarama, 2008; Clements et al., 2011; Jung et al., 2013; Purpura et al., 2017; Rosenfeld et al., 2019.

[238] Clements & Sarama, 2008; Clements et al., 2011; Rosenfeld et al., 2019.

[239] Jung et al., 2013; Purpura et al., 2017.

[240] Jung et al., 2013; Purpura et al., 2017; Rosenfeld et al., 2019.

[241] Clements & Sarama, 2008; Clements et al., 2011.

[242] Purpura et al., 2017.

[243] Clements & Sarama, 2008; Clements et al., 2011; Jung et al., 2013; Rosenfeld et al., 2019.

[244] Clements & Sarama, 2008; Clements et al., 2011; Jung et al., 2013; Purpura et al., 2017.

[245] Rosenfeld et al., 2019.

[246] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Blewitt et al., 2009; Collins, 2010; Dickinson, Collins, et al., 2019; Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Mages, 2018; Neuman & Dwyer, 2011; Neuman et al., 2015; Penuel et al., 2012; PCER Consortium, 2008 (*Doors to Discovery*); PCER Consortium, 2008 (*Literacy Express*); Read et al., 2019; Toub et al., 2018; Wasik & Hindman, 2020; Yazejian & Peisner-Feinberg, 2009.

[247] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Blewitt et al., 2009; Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Neuman et al., 2015; Penuel et al., 2012; PCER Consortium, 2008 (*Doors to Discovery*); PCER Consortium, 2008 (*Literacy Express*); Read et al., 2019; Toub et al., 2018; Wasik & Hindman, 2020.

[248] Collins, 2010; Dickinson, Collins, et al., 2019; Mages, 2018; Neuman & Dwyer, 2011; Yazejian & Peisner-Feinberg, 2009.

[249] Read et al., 2019.

[250] Blewitt et al., 2009; Collins, 2010; Toub et al., 2018.

[251] Dickinson, Collins, et al., 2019; Neuman & Dwyer, 2011; Neuman et al., 2015; Penuel et al., 2012.

[252] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Mages, 2018; Wasik & Hindman, 2020; Yazejian & Peisner-Feinberg, 2009.

[253] PCER Consortium, 2008 (*Doors to Discovery*); PCER Consortium, 2008 (*Literacy Express*).

[254] Blewitt et al., 2009; Collins, 2010; Mages, 2018; Read et al., 2019; Yazejian & Peisner-Feinberg, 2009.

[255] PCER Consortium, 2008 (*Doors to Discovery*).

[256] Dickinson, Collins, et al., 2019; Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Mages, 2008; Neuman & Dwyer, 2011; Neuman et al., 2015; Penuel et al., 2012; Read et al., 2019; Toub et al., 2018; Yazejian & Peisner-Feinberg, 2009.

[257] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Blewitt et al., 2009; Collins, 2010; PCER Consortium, 2008 (*Doors to Discovery*); PCER Consortium, 2008 (*Literacy Express*); Wasik & Hindman, 2020.

[258] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Penuel et al., 2012; Piasta & Wagner, 2010b; PCER Consortium, 2008 (*Let's Begin with the Letter People*); PCER Consortium, 2008 (*Literacy Express*); Roberts et al., 2018, 2019; Ukrainetz et al., 2011.

[259] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Penuel et al., 2012; Piasta & Wagner, 2010b; PCER Consortium, 2008 (*Let's Begin with the Letter People*); PCER Consortium, 2008 (*Literacy Express*); Roberts et al., 2018, 2019; Ukrainetz et al., 2011.

[260] Penuel et al., 2012; Piasta & Wagner, 2010b; Roberts et al., 2018, 2019; Ukrainetz et al., 2011.

[261] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); PCER Consortium, 2008 (*Let's Begin with the Letter People*).

[262] PCER Consortium, 2008 (*Literacy Express*).

[263] Ukrainetz et al., 2011.

[264] Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Penuel et al., 2012; Piasta & Wagner, 2010b; Roberts et al., 2018, 2019; Ukrainetz et al., 2011.

[265] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); PCER Consortium, 2008 (*Let's Begin with the Letter People*); PCER Consortium, 2008 (*Literacy Express*).

[266] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Biazak et al., 2010; Blewitt et al., 2009; Collins, 2010; Dickinson, Collins, et al., 2019; Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Justice et al., 2010; Kim & Phillips, 2016; Mages, 2018; McCarty et al., 2018; Neuman & Dwyer, 2011; Neuman et al., 2015; Nicolopoulou et al., 2015; Penuel et al., 2012; PCER Consortium, 2008 (*Literacy Express*); Toub et al., 2018; Wasik & Hindman, 2020.

[267] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Biazak et al., 2010; Blewitt et al., 2009; Farver et al., 2009; Justice et al., 2010; Kim & Phillips, 2016; Neuman et al., 2015; Penuel et al., 2012; PCER Consortium, 2008 (*Literacy Express*); Toub et al., 2018; Wasik & Hindman, 2020.

[268] Collins, 2010; Dickinson, Collins, et al., 2019; Mages, 2018; McCarty et al., 2018; Neuman & Dwyer, 2011; Nicolopoulou et al., 2015.

[269] Biazak et al., 2010.

[270] Collins, 2010; Toub et al., 2018.

[271] Blewitt et al., 2009; Dickinson, Collins, et al., 2019; Kim & Phillips, 2016; Neuman & Dwyer, 2011; Neuman et al., 2015; Penuel et al., 2012.

[272] Assel et al., 2007 (*Doors to Discovery* vs. business as usual); Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Justice et al., 2010; Mages, 2018; McCarty et al., 2018; Nicolopoulou et al., 2015; Wasik & Hindman, 2020.

[273] PCER Consortium, 2008 (*Literacy Express*).

[274] Biazak et al., 2010; Blewitt et al., 2009; Collins, 2010; Mages, 2018; Nicolopoulou et al., 2015.

[275] McCarty et al., 2018.

[276] Dickinson, Collins, et al., 2019; Farver et al., 2009 (*Literacy Express* in English only vs. business as usual [*HighScope*]); Kim & Phillips, 2016; Neuman & Dwyer, 2011; Neuman et al., 2015; Penuel et al., 2012; Toub et al., 2018.