

Scientific Research Basis of Early Childhood Emergent Literacy & Math

Research Basis Behind Right on Target Literacy and Math Kits by Hatch

The National Early Literacy Panel Findings

The formation of reading and writing concepts and skills is a process that is dynamic in the earliest stages of children's literacy development¹. The emergent literacy perspective holds that for young children, reading and writing develop hand-in-hand and are strengthened through experiences that encourage meaningful interaction with written and oral language².

Examples are following along in a book as an adult reads aloud or telling a story through a drawing³. By way of being exposed to written language, prekindergarten children come to have an awareness of print, letter naming, and phonemic awareness. Experiences with oral language allow for the development of listening comprehension, vocabulary, and language competence. A thorough review of the emergent literacy literature suggests that early childhood literacy experiences affect successful reading acquisition.

Research findings can inform early childhood classroom instruction in emergent literacy in the following ways⁴: Reading and writing experiences with print facilitate the development of understanding the purpose, conventions, and functions of print; Interacting with others who are modeling language (both oral and written) helps children learn how to pay attention to language and apply what they have learned to literacy situations; Phonological awareness and letter recognition in particular facilitate beginning reading acquisition by assisting children to develop effective word-recognition strategies (e.g., detecting pronunciations and storing associations in memory); and Storybook reading, both the content and the interaction between the teacher and children, has an impact on children's attitudes, knowledge, and strategies toward reading.

The National Early Literacy Panel (NELP)⁵ found strong evidence for the importance of the following skills for later reading and writing success:

- Alphabet knowledge
- Phonological awareness
- Rapid naming tasks involving either naming of letters and digits or naming of objects and colors
- Writing/writing name
- Phonological short-term memory

Key Message: When integrating these findings into early childhood instruction in reading, what is recommended (and what many educators likely already practice), is a balanced approach. Such an approach combines the language-and literature rich activities connected with whole language focused on increasing meaning, understanding, and a positive attitude toward language. With clear and direct instruction around skills needed for the development of fluency, children move more smoothly along to being proficient in reading.

The National Early Literacy Panel Findings

For your convenience, we have summarized the findings for you. The reference and link to the full report follow.

A Scientific Synthesis of Early Literacy Development and Implications for Intervention. Large-scale studies have shown that young children—those entering kindergarten and first grade—vary greatly in their attainment of the early precursor skills that provide the launching pad for later literacy learning (West, Denton, & Germino-Hausken, 2000; West, Denton, & Reaney, 2000). In 1997, the U.S. Congress asked that a review of research be conducted to determine what could be done to improve reading and writing achievement. The resulting Report of the National Reading Panel: Teaching Children to Read (NICHD, 2000) has been influential in helping to guide reading-education policy and practice in the United States. However, that report did not examine the implications of instructional practices used with children from birth through age 5. To address this gap in the knowledge base, the National Early Literacy Panel (NELP) was convened.

Key Findings of the National Early Literacy Panel

- A. Identification of the Domain of Early Literacy Skills. Conventional reading and writing skills that are developed in the years from birth to age 5 have a clear and consistently strong relationship with later conventional literacy skills. Additionally, six areas representing early literacy skills or precursor literacy skills had medium to large predictive relationships with later measures of literacy development. These not only correlated with later literacy as shown by data drawn from multiple studies with large numbers of children but also maintained their predictive power even when the role of other variables, such as IQ or socioeconomic status (SES), were accounted for. These six areas include:
 - **Alphabet Knowledge (AK):** Knowledge of the names and sounds associated with printed letters
 - **Phonological Awareness (PA):** Ability to detect, manipulate, or analyze auditory aspects of spoken language (including the ability to distinguish or segment words, syllables, or phonemes), independent of meaning
 - **Rapid Automatic Naming (RAN) of letters or digits:** The ability to rapidly name a sequence of random letters or digits
RAN of objects or colors: The ability to rapidly name a sequence of repeating random sets of pictures of objects (e.g., “car,” “tree,” “house,” “man”) or colors
 - **Writing or Writing name:** The ability to write letters in isolation on request or to write one’s own name
 - **Phonological Memory:** The ability to remember spoken information for a short period of time
- B. Instructional Practices that Enhance Early Literacy Skills. The panel also set out to identify studies that employed experimental or quasi-experimental methods to determine the effectiveness of instructional strategies, programs, or practices in imparting conventional literacy skills or any of these precursor skills to young children. These included:
 - **Code-focused interventions:** Interventions designed to teach children skills related to cracking the alphabetic code. Most code-focused interventions included PA instruction.

- **Shared-reading interventions:** Interventions involving reading books to children. These interventions included studies of simple shared reading and those that encouraged various forms of reader-child interactions around the material being read.
- **Parent and home programs:** Interventions using parents as agents of intervention. These interventions may have involved teaching parents instructional techniques to use with their children at home to stimulate children's linguistic or cognitive development.
- **Preschool and kindergarten programs:** Studies evaluating any aspect of a preschool or kindergarten program, such as effects of educational programs, curricula, or policies.
- **Language-enhancement interventions:** Studies examining the effectiveness of an instructional effort aimed at improving young children's language development.

The code-focused instructional efforts reported statistically significant and moderate to large effects across a broad spectrum of early literacy outcomes. Code-focused interventions consistently demonstrated positive effects directly on children's conventional literacy skills. Book-sharing interventions produced statistically significant and moderate-sized effects on children's print knowledge and oral language skills, and the home and parent programs yielded statistically significant and moderate to large effects on children's oral language skills and general cognitive abilities. Studies of preschool and kindergarten programs produced significant and moderate to large effects on spelling and reading readiness.

Finally, language-enhancement interventions were successful at increasing children's oral language skills to a large and statistically significant degree. Together, these findings suggest that there are many things that parents and preschools can do to improve the literacy development of their young children and that different approaches influence the development of a different pattern of essential skills. It should be noted that the interventions that produced large and positive effects on children's code-related skills and conventional literacy skills were usually conducted as one-on-one or small-group instructional activities.

These activities tended to be teacher-directed and focused on helping children learn skills by engaging in the use of those skills. Almost all of the code-focused interventions included some form of PA intervention. These PA activities generally required children to detect or manipulate (e.g., delete or blend) small units of sounds in words. Teaching children about the alphabet (e.g., letter names or letter sounds) or simple phonics tasks (e.g., blending letter sounds to make words) seemed to enhance the effects of PA training.

National Early Literacy Panel. (2009). Developing Early Literacy: Report of the National Early Literacy Panel. Washington, DC: National Institute for Literacy. http://www.nap.edu/catalog.php?record_id=12519#toc

Emergent Mathematics Research Basis

During early childhood, children pay attention to dimensions of their environment that are mathematical in nature and make use of a variety of mathematical concepts to make sense of their world. Young children sort, count, find patterns, compare quantities, and move through space. Young children also exhibit a noteworthy capacity to formulate,

represent, and solve simple mathematical problems and to reason and explain their mathematical activities. Wanting to quantify their world through the lens of mathematics appears to come naturally⁷. These activities are the beginnings of foundational skills that will help children successfully learn math in school^{8,9}.

Facilitating preschoolers' engagement with math concepts is encouraged by many researchers and educators through activities that are hands-on¹⁰, natural¹¹, have meaning for children^{12,13}, and come from everyday life¹⁴. Instead of using drill and rote to teach skills, early childhood educators can offer experiences that have much depth and present opportunities that are appropriate in their developmental sequence through play¹⁵.

Some of the key practices the National Council of Teachers of Mathematics¹⁶ and the National Association for the Education of Young Children¹⁷ recommend are:

- Build on children's natural interest, experiences, and knowledge in math;
- Base mathematics curriculum and teaching practices on knowledge of young children's developmental levels;
- Ensure the curriculum follows the sequence of important math concepts;
- Provide for children's full and continued interaction with key math ideas;
- Teach math through a range of strategies, including play; and
- Continually assess.

A landmark study from the National Research Council Committee on Early Childhood Mathematics found that virtually all young children have the capability to learn and become competent in mathematics¹⁸. In fact, well before first grade, children can learn the ideas and skills that support later, more complex mathematics understanding. There is expert consensus that two areas of mathematics are particularly important for young children to learn: (1) number, which includes whole number, operations, and relations, and (2) geometry, spatial thinking, and measurement. However, the study also found that time spent in mathematics instruction is extremely low in early childhood settings.

Putting concepts forward in a developmentally appropriate sequence gives children the opportunity to build on their present understanding and knowledge, and allows them to apply what they have learned. The general order of introducing math concepts in such a developmentally appropriate sequence is presented below¹⁹:

Free exploration of materials (becoming aware of and developing vocabulary for attributes and properties of materials),

- Spatial relationships (vocabulary for position and direction),
- Classification (sorting items into a specified position or set based on attributes),
- Patterning (arranging items in a specific sequence based on attributes),
- One-to-one correspondence (matching items from sets into a one-to-one relationship) and set comparison,
- Ordering (arranging items by an attribute of size), and
- Numeration (understanding the concept of number).

Key Message: Young children are very interested in mathematics and are capable of learning in this area. Unfortunately, in many cases in early childhood settings, children get very little mathematics instruction. The most successful approach is to avoid rote learning however and focus instead on activities that are from the everyday lives of the children.

The National Research Council's Mathematics Learning in Early Childhood Findings

For your convenience, we have summarized the findings for you. The reference and url for the full report follow. A Scientific Synthesis of Early Math Development and Implications for Intervention. Mathematics education has risen to the top of the national policy agenda as part of the need to improve the technical and scientific literacy of the American public. There is particular concern about the chronically low mathematics and science performance of economically disadvantaged students and the lack of diversity in the science and technical workforce. Particularly alarming is that such disparities exist in the earliest years of schooling and even before school entry. Recognizing the increasing importance of mathematics and encouraged by a decade of success in improving early literacy, the Mathematical Sciences Education Board of the Center for Education at the National Research Council established the Committee on Early Childhood Mathematics. The majority of support for this study was provided by the U.S. Department of Health and Human Services, ACF, and Office of Head Start among other sponsors.

Key Findings of the National Research Council

- A. Identification of the Domain of Early Math Skills. The committee found that virtually all young children have the capability to learn and become competent in mathematics. In fact, well before first grade, children can learn the ideas and skills that support later, more complex mathematics understanding. There is expert consensus that two areas of mathematics are particularly important for young children to learn: (1) number, which includes whole number, operations, and relations, and (2) geometry, spatial thinking, and measurement.
- B. Instructional Practices That Enhance Early Math Skills. For most children the potential to learn mathematics in the early years of school is not currently realized. This stems from a lack of opportunities to learn mathematics either in early childhood settings or through everyday experiences in homes and in communities. This is particularly the case for economically disadvantaged children, who start out behind in mathematics and will remain so without extensive, high quality early mathematics instruction. The report informs the field that results from two robust studies indicate that children in state Pre-K programs spend a great deal of time NOT engaged in any type of instructional activity.

The study illustrated that during the preschool day, the average student spent 44% of the time engaged in non-curriculum activities (literacy, mathematics, science, social studies, etc.) What are children doing? In preschool classrooms, much of the time (22%) was spent engaged in routine activities such as transitioning, waiting in line, or washing hands. Pre-K children in the NCEDL studies were exposed to mathematics content in only 6% of the classrooms observations. In the state-funded Pre-K classrooms observed in the NCEDL study, mathematics was often taught in conjunction with art, music, and fine motor activities. The committee thinks that the integration of mathematics with other activities may or may not be effective in supporting children's mathematics knowledge development. In an observational study of New Jersey preschools, it was found to provide little support for children's mathematics skill development and seldom used mathematics terminology (Frede et al., 2007).

Of particular interest, is that over 40% of the classrooms in the study were rated good to excellent quality on the ECERS-R measure of the environmental quality of early childhood programs. Apparently, mathematics teaching and learning is relatively rare even in classrooms that are otherwise judged to be high quality. Many widely used early childhood curricula do not provide sufficient guidance on mathematics pedagogy or content. When early childhood classrooms do have mathematics activities, they are often presented as part of an integrated or

embedded curriculum, in which the teaching of mathematics is secondary to other learning goals. Emerging research indicates, however, that learning experiences in which mathematics is a supplementary activity rather than the primary focus are less effective in promoting children's mathematics learning than experiences in which mathematics is the primary goal.

National Research Council. (2009). Mathematics Learning in Early Childhood: Paths Toward Excellence and Equity. Committee on Early Childhood Mathematics, Christopher T. Cross, Taniesha A. Woods, and Heidi Schweingruber, Editors. Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press. http://www.nap.edu/openbook.php?record_id=12519

Using Right on Target by Hatch to Help Children Achieve Critical Math & Literacy Outcomes

The Right On Target™ Kit is a bridge between current research, specific state and national prekindergarten standards, and classroom implementation. Teachers can feel comfortable knowing the kit will help provide an optimal learning experience to support school readiness.

References

- 1 National Research Council and Institute of Medicine, Board on Children, Youth, and Families, Commission on Behavioral and Social Sciences and Education. *From Neurons to Neighborhoods: The Science of Early Childhood Development*, eds. Shonkoff, J.P. and Phillips, D. Washington, DC: National Academy Press, 2001.
- 2 Sulzby, E., and Teale, W. (1991). "Emergent Literacy," in *Handbook of Reading Research: Vol 2*, eds R. Barr, M. L. Kamil, P. B. Mosenthal, and P. D. Pearson (New York: Longman, 1991), 727-757.
- 3 Hiebert, E. H., and Papierz, J. M. "The Emergent Literacy Construct and Kindergarten and Readiness Books of Basal Reading Series." *Early Childhood Research Quarterly* 5 (1990): 317-334.
- 4 Gunn, B.K., Kameenui, E.J., and Simmons, D.C. *Emergent Literacy: Synthesis of the Research*. Eugene, OR: University of Oregon, National Center to Improve the Tools of Educators, 1995.
- 5 National Early Literacy Panel. *Developing Early Literacy: Report of the National Early Literacy Panel*. Washington, DC: National Institute for Literacy, 2008.
- 6 Honig, B. *Teaching Our Children to Read: The Role of Skills in a Comprehensive Reading Program*. Thousand Oaks, CA: Corwin Press, 1996.
- 7 National Research Council. *Adding It Up: Helping Children Learn Mathematics*. Washington, DC: National Academy Press, 2001.
- 8 National Association for the Education of Young Children and National Council for Teachers of Mathematics. *Early Childhood Mathematics: Promoting Good Beginnings-A Joint Position Statement of NAEYC and NCTM*. Washington, DC: Author, 2002. <http://www.naeyc.org/about/positions/pdf/psmath.pdf>
- 9 National Association for the Education of Young Children. *State Policies that Promote Early Childhood Mathematics*. Washington, DC: Author, 2003. http://www.naeyc.org/ece/critical/pdf/math_survey.pdf
- 10 Hunter, D. "Bringing Math to Life." *Academic Exchange Quarterly* 4 (2000): 25.
- 11 Clements, D. "Mathematics in Preschool." *Teaching Children Mathematics* 7 (2001): 270-78.
- 12 Zanger, V. "Math Storybooks." *Teaching Children Mathematics* 5 (1998): 98-103.
- 13 Moyer, P. "Communicating Mathematically: Children's Literature as a Natural Connection." *The Reading Teacher* 54 (2000): 246-258.
- 14 Kliman, M. "Beyond Helping with Homework: Parents and Children doing Mathematics at Home." *Teaching Children Mathematics* 6 (1999): 140-146.
- 15 Cutler, K.M., D. Gilkerson, S. Parrott, and M.T. Bowne. "Developing Math Games Based on Children's Literature." *Young Children* 58 (2003): 22-27.
- 16 National Council of Teachers of Mathematics. *Principles and Standards for School Mathematics*. Reston, VA: Author,

2000.

17 Bredekamp, S., and Rosegrant, T. Reaching Potentials: Transforming Early Childhood Curriculum and Assessment Vol. 2 . Washington, DC: National Association for the Education of Young Children, 1995.

18 National Research Council. Mathematics Learning in Early Childhood: Paths Toward Excellence and Equity, eds. C.T. Cross, T.A. Woods, and H. Schweingruber. Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press, 2009.
http://www.nap.edu/catalog.php?record_id=12519#toc

19 Schiller, P. Making Math Meaningful and Enjoyable: An Early Childhood Best Practice Brief . Columbus, OH: The Ohio Resource Center, 2008. http://www.ohiorc.org/orc_documents/orc/rec/briefs/0010.pdf