

Early Math, Literacy, and Fine Motor Skills Impact Children's School Readiness and Later Academic Achievement:

*A Research Summary in Support of
Really Good Stuff's Original Kindergarten
Readiness Supplementary Materials*



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Abstract

Researchers, policymakers, early childhood teachers, and parents believe that early education can provide young children with the skills they need to be ready for kindergarten and to succeed later in school. But what do experts say are the key skills that children need in order to achieve kindergarten readiness? And what best practices should preschool teachers use to support children in acquiring these skills?

This research summary reviews recent expert findings from the field of early childhood education regarding the types of skills that significantly impact a child’s school—or kindergarten—readiness, plus it investigates research-based best practices and explains how Really Good Stuff original school-readiness products support research-based instruction. In particular, this paper focuses on the importance and impact of developing (1) math, (2) literacy, and (3) fine motor skills as a predictor for later kindergarten and school success.

Introduction

The earliest years of a child’s education—from birth through 3rd grade—set the foundation upon which future learning is built (Education Commission of the States [ECS], 2013). “Interest in early education as a major influence on school readiness has steadily increased in recent years” (Strickland & Schickendanz 2009).

Early childhood programs and policies that promote academic skills have been gaining popularity among politicians and researchers (Duncan et al. 2007). For example, President Barack Obama challenged states to raise the quality of their early learning programs to “ensure that children are better prepared for success by the time they enter kindergarten” (remarks to Hispanic chamber of commerce, 2009). President Obama also said, “In states that make it a priority to educate our youngest children...studies show students grow up more likely to read and do math at grade level, graduate high school, hold a job, form more stable families of their own” (“President Barack Obama’s state of the union address—as prepared for delivery,” 2013).

In recent years, state policymakers have emphasized the need to improve children’s reading [and literacy] skills early on because a lack in this essential skill is a strong predictor of low student performance and increased high school dropout rates. While the emphasis on reading proficiency [and literacy skills] is critical, research shows that the development of mathematics skills early on may be an even greater predictor of later school success. Early knowledge of math not only predicts later success in math, but also predicts later reading achievement even better than early reading skills (ECS, 2013).

Assessing for Kindergarten Readiness

Readiness testing is common (Ackerman & Barnett, 2005) and math and literacy acquisition predominantly feature at the top of the list of skills children are most regularly assessed for when determining kindergarten readiness. For example, the first six categories of the updated version of the Bracken Basic Concept Scale, originally published in 1984, comprise the School Readiness Composite. All six assess math or literacy skills (colors, letters, numbers/counting, sizes, comparisons, shapes) (Bracken, 2008).

While there are many other equally important skills that children need in order to be ready for kindergarten (e.g., social emotional), research continuously fingers literacy and math skills development as the hallmark for future academic achievement. In fact, the widely accepted Common Core State Standards (K–12) chose to focus on literacy and math skills because proficiency in these skills helps students build skill sets that are used in other subjects (National Governors Association Center for Best Practices [NGACBP], Council of Chief State School Officers [CCSSO], 2010).

Fine motor skills are arguably equally important to school readiness since they directly support both math and literacy development, as exemplified by a 2010 study conducted by the National Center for Research on Early Childhood Education (NCRECE). The study examined three ground-breaking international, longitudinal data sets from a 2007 study into long-term indicators of kindergarteners' school success—skills known to strongly and consistently predict later achievement in math and reading during school years. The data sets included information on children from birth to kindergarten entry, following the children through fifth grade. NCRECE researchers re-examined these data sets and found that fine motor skills—above all others—were a strong and consistent predictor of later achievement (NCRECE, 2010).

This paper is divided into three sections:

- Math Skills
- Literacy Skills, and
- Fine Motor Skills.

Each section identifies essential concepts and skills attributed to school readiness, research-based practices associated with teaching these skills, and insight into how Really Good Stuff original school-readiness products help support best practices for promoting school-readiness in the classroom.

Math Skills

Recent research links pre-K math skills and knowledge with school success and achievement down the line (e.g., in fifth or eighth grade). In an interview about the finding of his 2007 study (Duncan et al.), Greg Duncan stated that “early math skills in 5-year-olds are the single greatest predictor of later achievement” (Coulson, 2016). This study, *School Readiness and Later Achievement*, used unprecedented scope; researchers estimated a carefully specified set of models with data from six large-scale longitudinal studies to explore links between three key elements of school readiness—school-entry academic, attention, and socioemotional skills—and later school reading and math achievement. Across all 6 studies, the results show that early math skills are the strongest predictors of later achievement in school.

Another study (Watts, Duncan, Siegler, & Davis-Kean, 2014) came to a similar, yet surprising conclusion: Although the predictive ability of early math on later math achievement was not surprising, the consistent and high magnitude of the relationship between growth in early math skills and adolescent achievement was not expected. Researchers found that school entry math skills and early growth in math ability was consistently predictive of later achievement through age 15.

More surprising, is that early math also predicts later reading achievement even better than early reading skills (Duncan et al., 2007). In 2013, ECS (citing multiple sources) reported that “research shows that doing more mathematics increases

oral language abilities, even when measured during the following school year. These include vocabulary, inference, independence, and grammatical complexity (Sarama et. al.). Given the importance of mathematics to academic success in all subjects (Sadler & Tai, 2007), all children need a robust knowledge of mathematics in their earliest years.”

What math skills are key for school readiness?

With the tremendous amount of material available on this topic, the answers to this question can vary slightly, as listed below, but generally point to the following categories and skills:

- **Counting and Cardinality** • number sense • number names and sequence (ordinal numbers) • identify and associate written numbers (to 5) • begin to write numbers.
- **Geometry** • identify, describe, compare, and compose shapes • spatial sense; explore the positions of objects in space
- **Operations and Algebraic Thinking** • understand adding to (addition) and taking away from (subtraction) • compare sets and quantities • identify, create, and repeat simple patterns
- **Measurement and Data** • measure objects by various attributes use standard and non-standard measurement • compare attributes • match, sort, and categorize objects by color, shape, size, to understand similar and different characteristics

(Head Start, US Department of Health & Human Services, & Administration for Children & Families, 2015; NGACBP & CCSSO, 2010)

In a study appropriately titled “What specific preschool math skills predict later math achievement?” (Nguyen et al., 2015) researchers analyzed previously collected data that measured the impact of early mathematics intervention on a sample of 1,375 preschool children. The results indicated that counting and cardinality are by far the strongest predictors of later math achievement, followed by operations and algebraic thinking, geometry, and measurement and data skills.

Head Start, historically and fundamentally connected to the school-readiness movement, recently updated its Learning Outcomes Framework (2015) that “is grounded in a comprehensive body of research regarding what young children should know and be able to do during these formative years... [to] prepare them to be school ready.” The key skills, identified as subdomains of Mathematics Development, are: counting and cardinality, operations and algebraic thinking, measurement, and geometry and spatial sense.

The National Council of Teachers of Math (NCTM, 2006) recommends that preschool teachers emphasize the following three focal points and their related connections for mathematics in prekindergarten: number and operations, geometry, and measurement. Connections to these topics include data analysis and algebra.

Finally, the widely accepted Common Core State Standards for Kindergarten (NGACBP, CCSSO, 2010) categorizes the math skills children are expected to learn in Kindergarten as follows: counting and cardinality, operations and algebraic thinking, measurement and data, and geometry. Logically, it follows that, at a national level, we expect children in pre-K to learn precursory and related math skills so that they are prepared for kindergarten mathematics.

Best practices for teaching math and how Really Good Stuff supports these practices

When teaching math, many experts stress the importance of providing children with a variety of tools and materials—such as manipulatives (e.g., counters, cubes, and pattern blocks)—based upon age-appropriate themes. NCTM (2000) emphasizes “the importance of providing students with opportunities to use multiple mathematical tools to discuss and solve mathematics problems” (Jung & Conderman, 2013).

Math helps children make sense of the world around them. According to the National Association for the Education of Young Children (NAEYC) (citing other sources in its joint position statement with NCTM, 2010) “Because young children’s experiences fundamentally shape their attitude toward mathematics, an engaging and encouraging climate for children’s early encounters with mathematics is important (NCTM, 2000). It is vital for young children to develop confidence in their ability to understand and use mathematics—in other words, to see mathematics as within their reach. In addition, positive experiences with using mathematics to solve problems help children to develop dispositions such as curiosity, imagination, flexibility, inventiveness, and persistence that contribute to their future success in and out of school (Clements & Conference Working Group, 2004).” When teachers routinely provide authentic mathematics instruction, effectively use math manipulatives, and create an environment where children freely communicate mathematics ideas, children see mathematics as engaging, meaningful, and an important part of their everyday lives (Jung & Conderman, 2013).

In a joint position statement (2010), NAEYC and NCTM advised that high-quality math education for 3- to 6-year-old children should:

- Enhance their natural interest in mathematics and their disposition to use it to make sense of the world.
- Build on their experience and knowledge.
- Provide ample time, materials, and teacher support for children to engage in play that allows them to explore and manipulate mathematical ideas.
- Utilize an assortment of appropriate experiences and teaching strategies to actively introduce mathematical concepts, methods, and language.

Studies into good teaching practices often identify intentionality as a predominant characteristic of successful teachers (Jung & Conderman, 2013). “Intentional teachers plan and teach with knowledge and purpose and employ instructional strategies likely to help children learn” (NCTM, 2000 as cited by Jung & Conderman, 2013). “Intentional teaching can also be serendipitous—taking advantage of the many unexpected opportunities” that arise in early childhood classrooms (NAEYC, 2011). When teachers routinely present important mathematics concepts, provide authentic mathematics instruction, effectively use math manipulatives, and create an environment where children freely communicated mathematics ideas, children see mathematics as engaging, meaningful, and an important part of their everyday lives (Jung & Conderman, 2013).

Researchers widely agree that manipulatives are a vital tool for teaching math to young children. “Kindergarteners who used manipulatives for solving math tasks significantly outperformed peers who did not use manipulatives” (Tournaki & Kerekes, 2008). Creating a rich math and manipulatives learning center and using these math tools and strategies in other areas of the classroom promote a richer learning environment (Pecaski McLennan, 2014).

Really Good Stuff designed more than fifty different math activities, activity packs, and tools that support research-based, intentional math instruction. Utilizing age-appropriate themes, Really Good Stuff original math products promote discussion and problem-solving in small group, one-on-one, and individually guided tasks. As part of a math center, the variety and scope of the products enables choice-making and encourages play.

– **Counting and Cardinality**

Counting and Cardinality incorporates the following: number sense, number names and sequence (ordinal numbers); identification and association of written numbers (to 5); and writing numbers. Number sense is “the ability to understand the quantity of a set and the name associated with that quantity... The role of number sense in mathematical learning is sometimes compared with the role of phonemic awareness in reading... Strong number sense developed in the early years is a key building block of learning arithmetic in the primary grades, as it connects counting to quantities, solidifies and refines the understanding of more and less, and helps children estimate quantities and measurements (The Early Math Collaborative [TEMC]—Erikson Institute, 2014). Subitizing, an aspect of number sense, is the ability to look at a small set of items and know the number of items without counting them (e.g., how you instantly know the number rolled on a die without counting the pips).

Researchers recommend that instructors teach counting and cardinality using a developmental progression. This involves providing children with opportunities to subitize small collections, practice counting, compare quantities, and use numerals (Frye et al., 2013).

Really Good Stuff created products that support research-based instruction for teaching counting and cardinality to prepare them for kindergarten with activities that help children learn and practice:

- creating a numbers through 10 journal
- subitizing: identify and match numbers in small sets
- numerals: identify numbers, numbers in sequence
- counting: clip and check, count and record, count manipulatives, matching numerals to sets
- writing numbers: trace and write numerals and number names to 10, number journal, count to write, form numbers using play dough

– **Geometry**

To prepare children for kindergarten, pre-K geometry should teach children to identify, describe, compare, and compose shape and to develop spatial sense and explore the positions of objects in space. Research-based instruction uses a developmental progression to teach children to recognize and compare shapes (US DoE, 2013). Teachers introduce and label a wide variety of shapes that are in different positions, invite children to construct and talk about shapes, encourage children to make pictures or models of familiar shapes using different materials (NAEYC, 2010), compose/ decompose shapes, and begin to attend to congruence and symmetry (NCTM, 2006).

Really Good Stuff created products that support research-based instruction for teaching geometry to prepare them for kindergarten with activities that help children learn and practice:

- creating a shapes journal

- trace simple and complex shapes
- congruence and lines of symmetry
- recreate of shapes using play dough
- identify, match, and name shapes

Operations and Algebraic Thinking

The following operations and algebraic thinking skills are integral to school-readiness: understanding simple addition and subtraction and identifying; comparing sets and quantities; and creating, and repeating simple patterns. Teaching practices that promote these skills include modeling, sorting, and separating sets of objects, comparing sets of objects, and explore how sets change when adding or subtracting objects.

Really Good Stuff created products that support research-based instruction for teaching operations and algebraic thinking to prepare them for kindergarten with activities that help children learn and practice:

- investigate numbers and sets using counters and other manipulatives
- explore quantities and number relationships using ten-frames mats
- create, identify, and repeat patterns
- compare and match quantities and sets of numbers

– Measurement and Data

Developing measurement and data concepts are critical to a child’s school-readiness and include the ability to match, sort, and categorize objects by color, shape and size; understand similar and different characteristics, compare attributes; and measure objects and their attributes using standards and non-standard forms of measurement. “The intersection between language development and mathematical thinking is a central issue in terms of understanding measurement” because “expressing relationships between things is much more complex than naming concrete items or actions” (TEMC—Erikson Institute, 2014). Citing several sources, Horm et. al. (2016) explains that categorization is one way that very young children organize and recall information and make connections. Toddlers use details like color, shape, and texture when sorting or categorizing.

Best teaching practices support children in developing measurement and data skills by teaching them to “recognize and compare shapes, identify and create patterns, make direct comparisons using measurement tools, and collect and organize information” (National Center for Education Evaluation and Regional Assistance & What Works Clearinghouse, 2014). Really Good Stuff created the following research-based products to support such instruction:

- identifying and matching colors
- sorting by attributes
- measuring using standard units (cubes and ruler)
- measuring using non-standard units
- identifying, creating, and reproducing patterns

Literacy Skills

The years from birth–5 years are a critical time for children’s development and learning. Research confirms that patterns of learning in preschool are closely linked to later achievement: children who develop more skills in the preschool years perform better in the primary grades. The development of early skills appears to be particularly important in the area of literacy. Providing young children with the critical precursor skills to reading can offer a path to improving overall achievement (Eunice Kennedy Shriver National Institute of Child Health and Human Development, NIH, & DHHS, 2010).

Literacy skills play an essential role in school readiness. The National Council for Teachers of English (NCTE) together with the International Reading Council (IRA) developed their Standards for the English Language Arts for grades K–12 based on the assumption “that literacy growth begins before children enter school as they experience and experiment with literacy activities” (“NCTE/IRA Standards for the English language arts,” 2016).

What literacy skills are key for school readiness?

Extensive research in the area of literacy development points to the following skills as predictors of early literacy success:

- **Alphabet Knowledge and Concepts of Print** • identify letters of the alphabet and the sounds they make • understand the purposes and rules for using print
- **Phonological Awareness** • “ability to hear, identify, and manipulate the individual sounds (phonemes) in spoken words” (Strickland & Schickedanz, 2009)
- **Writing** • write or draw for a variety of purposes • write first name • interest in copying words or using invented spelling

(Head Start, US Department of Health & Human Services, & Administration for Children & Families, 2015; NGACBP & CCSSO, 2010; National Early Literacy Panel [NELP], 2009, Snow, Burns, & Griffen, 1998)

As children move from preschool into kindergarten and the primary grades, instruction focused on phonemic awareness, letter recognition, segmenting words into sounds, and decoding printed text will support later reading competence (NAEYC & IRA, 2009). It is impossible to learn to read without these skills because English is an alphabetic that uses an alphabet to represent speech sounds and meaning in its written form (Barone & Mallette, 2013).

Early literacy skills have a clear and consistently strong relationship with later conventional literacy skills. The strongest and most consistent predictors of later literacy development are alphabet knowledge, phonological awareness, recognition of letters and objects, and writing letters (Eunice Kennedy Shriver National Institute of Child Health and Human Development, NIH, & DHHS, 2010). Early writing and concepts of print are closely related skills (Strickland & Schickedanz, 2009). Young children’s understanding of concepts of print has scientifically based research support as a predictor of early literacy success (NELP, 2008; Snow et al, 1998).

Best practices for teaching literacy and how Really Good Stuff supports these practices

Observational and intervention studies suggest that individualized literacy instruction, matched to each child’s skill level, is the most effective type of instruction. Evidence from a growing body of research indicates that small-group or one-on-one instruction helps children learn literacy skills more quickly (Neuman & Dickonson; NELP, 2009). Really Good Stuff original literacy materials support this construct since the materials enable children to make choices and work at their own pace. Really Good Stuff’s literacy materials are designed for use during center time, allowing teachers to offer one-

on-one support, or during small group instruction.

Alphabet Knowledge and Concepts of Print

Skills related to alphabet knowledge and concepts of print include the ability to identify letters of the alphabet and the sounds they make and to understand the purposes and rules for using print. Alphabet knowledge means knowing names of the letter and the sounds associated with them (NELP, 2009) and that print carries meaning and is the written form of speech. Competency in this area provides the basis and vocabulary that enables children to learn to read (Neuman & Dickinson eds., 2011). Teaching practices that help children develop concepts of print include modeling writing and using print for various purposes, providing opportunities to write and draw independently (Strickland & Schickedanz, 2009), and labeling key areas of the classroom as well as furniture and other physical aspects like doors or windows (NELP, 2009).

Best teaching practices that help prepare children for kindergarten by teaching alphabet knowledge and concepts of print include explicit instruction in the alphabet, matching upper-case to lower-case letters, and activities that teach children to write the letters of their names (Barone & Mallette eds., 2013). Providing opportunities to learn letter names, use letter manipulatives, explore and make alphabet books, and identify initial sounds/letter in words. (Strickland & Schickedanz, 2009). The Really Good Stuff literacy materials that support these practices are interactive and include:

- tracing and writing letters
- classroom and name labels
- creating letters using play dough
- matching letters
- building words through matching
- bring a letter to life bags
- alphabet posters and signs with upper- and lowercase letters
- alphabet “glasses”
- alphabet puzzles
- left-to-right reading instruction (with puppet)
- upper- and lowercase letter tiles
- class names poster

– Phonological Awareness

Phonological awareness is made up of a number of related skills that clarify the sound structures of oral language such as syllables, alliteration, rhymes, phonemic awareness, and onset and rime. Phonemic awareness is the ability to identify all the phenomes, or sounds, that make up a word (e.g. the sounds each letter makes in the word cat; c-a-t). Onset and rime is the ability to separate the first sound of a word from the rest of the word, as in /t/ /op/ or /ch/ /at/. Like alphabet knowledge, phonological awareness must be explicitly taught since most children won't pick it up naturally by themselves (Barone & Mallette, 2013). Phonological awareness is highly predictive of later literacy success since children "...come to understand that words are made up of small sound units (phonemes) and that these units can be manipulated to form different words. By engaging in language and word play, children learn to recognize patterns among words and use this knowledge to read and build words (Brown, 2014).

Research-based practices for teaching phonological awareness include identifying and making rhymes; dividing sentences into words; dividing words into syllables; segmenting and blending onsets and rimes; identifying initial, middle, and final phonemes in spoken words; and segmenting or blending individual phonemes in spoken words (Brown, 2014). The following Really Good Stuff literacy materials were designed to support best practices for teaching phonological awareness:

- matching words that rhyme
- short and long vowel activity posters
- bring a letter to life bags
- alphabet sound posters
- rhyming posters featuring rebuses and nursery rhymes

– Writing

Providing and supporting children with numerous writing experiences have more opportunities to learn foundational literacy skills that promote school readiness since “reading and writing are two sides of the same coin” (Barone & Mallette, 2014). Learning to write is a process that, in its early stages, refers to marks a toddler makes on a page. As writing progresses, children learn to use writing utensils more deliberately, moving towards drawing pictures and creating letters and words.

Experts widely agree that teachers should create a classroom writing center and provide daily opportunities for children to practice writing letters, tracing words, drawing pictures, and writing their names (NELP, 2009). The following Really Good Stuff literacy products can be used in writing centers and enable quality writing experiences:

- jumbo pencils for small hands
- dry-erase trace mats and writing sets
- dry-erase classroom labels
- dry erase here-to-there tracing sets

Fine Motor Skills

While not specifically academic in nature, scientific research reveals that children’s fine motor skill development prior to elementary school greatly impact a child’s academic future (Carlson, 2013). A 2010 study by Grissmer et. al. found that fine motor skills were a strong predictor of a child’s later math, reading, and science achievement. The results of this research underscore the role of fine motor skill development in school or kindergarten readiness (NCRECE, 2010).

Why are fine motor skills predictive of achievement? Curby & Carlson (2014) offer two explanations in answer to this question. The first is that much of the brain’s development relies on “experience-dependent learning.” Certain portions of the brain process both motor information and cognitive tasks simultaneously. Stronger motor skills help strengthen the neural connections that support other academic tasks. The second is that strong, early fine motor skills directly benefit children in the classroom when they engage in activities such as writing and drawing.

Carlson (2013) summarizes research from several sources to define and describe the connections between fine motor skills and neurological development: “Fine motor skills are broadly defined as the manual dexterity involved in

coordinating muscle movements in the fingers (Essa, Young, & Lehne, 1998), and primarily rely on the prefrontal cortex (PFC) and cerebellum (Diamond, 2000). This includes the basic control of small muscle movements, which govern such abilities as finger dexterity, motor sequencing, and fine motor speed and accuracy (Davis & Matthews, 2010). Fine motor skills often also involve the incorporation of visual stimuli from the environment (Korkman, Kirk, & Kemp, 2007). Whenever children grip a pencil, tie their shoes, or write their names, they are relying on their fine motor skills.”

What fine motor skills are key for school readiness?

The answer to this question is simple: the fine motor skills that will enable children to do the types of tasks expected from them in school, such as writing, cutting, gluing, and painting. But what do children need to master in order to do these tasks? The following list identifies the fine motor skills children need to develop to enable them to do expected classroom activities and to succeed in school:

- **Hand-Eye Coordination** • use visual input to guide movement of the hand to carry out tasks such as doing puzzles or stringing beads
- **Pincer Grip** • grip something by pressing the index finger (or index and middle finger) to the thumb on one hand • grasp and manipulate tools for writing, cutting, drawing, and painting
- **Muscle Coordination** • complete tasks using coordinated muscle movements, such as buttoning or pouring

Fine motor skills in general are often measured using drawing, copying, and block-building tasks, which capture the various ways that fine motor skills may come into play in a classroom setting (Carleson, 2013). School-age children spend more than half of their day involved in fine motor activities such as handwriting and manipulative tasks with school materials or tools such as cutting or pasting (Pagani & Messier, 2012). Best teaching practices provide children with numerous and daily opportunities to practice and develop fine motor skills. Activities that strengthen fine motor skills include working with play dough, using writing implements, cutting, tracing, and squeezing. Really Good Stuff supports these practices with the following materials:

- activity sets in which children form shapes or letters using play dough
- clothespin activity sets
- writing, drawing, and tracing activity sets
- jumbo pencils
- interlocking cubes

Conclusion

The role of early childhood education in school-readiness has garnered the attention of researchers and policymakers alike. A strong body of growing evidence points to math, literacy, and fine motor skills as essential skills that children need to develop in preschool since early mastery of these skills is highly predictive of future academic performance. Most experts agree that best teaching practices support children in developing these foundational skills.

To support early educators in preparing young children to enter kindergarten, Really Good Stuff created high quality, research-based products and activities that directly foster math, literacy, and fine motor skill development. This document clarifies the reasoning and practices for teaching these skill sets and describes how Really Good Stuff’s original products supports this instruction in the classroom.

References

- Barone, D. M., & Mallette, M. H. (Eds.). (2013). *Best practices in early literacy instruction* [Kindle]. Retrieved from Amazon.com (Barone & Mallette, 2013)
- Brown, C. S. (2014). Language and literacy development in the early years: Foundational skills that support emergent readers. *Language and Literacy Spectrum*, 24(Spring), 35–49.
- Carlson, A. G. (2013). *Kindergarten fine motor skills and executive function: Two non-academic predictors of academic achievement* (Dissertation). George Mason University, Fairfax, VA.
- Coulson, A. (2016). *Digital 1-2-3s make math sense for preschool kids*. Retrieved July 11, 2016, from <http://blog.mindresearch.org/blog/bid/330842/Digital-1-2-3s-Make-Math-Sense-for-Preschool-Kids>
- Curby, T. W., & Carlson, A. G. (2014, February 05). *Fine motor skills and academic achievement*. Retrieved July 12, 2016, from Psychology Today, <https://www.psychologytoday.com/blog/psyched/201402/fine-motor-skills-and-academic-achievement>
- Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., ... Japel, C. (2007). School readiness and later achievement. *Developmental Psychology*, 43(6), 1428–1446. doi:10.1037/0012-1649.43.6.1428
- Education Commission of the States. (2013). Math in the early years, a strong predictor for later school success. *The Progress of Education Reform*, 14(5), 1–7. Retrieved from <http://www.ecs.org/clearinghouse/01/09/46/10946.pdf>
- Eunice Kennedy Shriver National Institute of Child Health and Human Development, NIH, & DHHS. (2010). *Early beginnings: Early literacy knowledge and instruction (A guide for early childhood administrators & professional development providers)*. Retrieved from <https://www.nichd.nih.gov/publications/pubs/documents/NELPEarlyBeginnings09.pdf>
- Frye, D., Baroody, A. J., Burchinal, M., Carver, S. M., Jordan, N. C., & McDowell, J. (2013). *Teaching math to young children: A practice guide* (NCEE 2014-4005). Washington, DC: National Center for Education Evaluation and Regional Assistance (NCEE), Institute of Education Sciences, U.S. Department of Education. Retrieved from the NCEE website: <http://whatworks.ed.gov>
- Head Start, US Department of Health and Human Services & Administration for Children and Families. (2015). *Head Start early learning outcomes framework: Ages birth to five*. Retrieved from <https://eclkc.ohs.acf.hhs.gov/hslc/hs/sr/approach/pdf/ohs-framework.pdf>
- Horm, D., Norris, D., Perry, D., Chazan-Cohen, R., & Halle, T. (2016). *Developmental foundations of school readiness for infants and toddlers, a research to practice report*, OPRE Report # 2016-07, Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.
- Jung, M., & Conderman, G. (2013). Intentional mathematics teaching in early childhood classrooms. *Childhood Education*, 89(3), 173–177.
- National Association for the Education of Young Children & International Reading Association. (2009). *Where we stand on learning to read and write*. Retrieved from <http://www.naeyc.org/files/naeyc/file/positions/WWSSLearningToReadAndWriteEnglish.pdf>
- National Association for the Education of Young Children (2010). *Early childhood mathematics: promoting good beginnings: A joint position statement of the National Association for the Education of Young Children and the National Council of Teachers of Mathematics*. Adopted in 2002. Updated in 2010. Retrieved from <https://www.naeyc.org/files/naeyc/file/positions/psmath.pdf>
- National Association for the Education of Young Children. (2011, February 17). *Q&A with the author of The Intentional Teacher*. Retrieved July 12, 2016, from <http://www.naeyc.org/event/intentional-teacher>
- National Center for Education Evaluation and Regional Assistance & What Works Clearinghouse. (2014). *5 evidence-based recommendations for teaching math to young children*. Retrieved from <http://files.eric.ed.gov/fulltext/ED544754.pdf>

- National Center for Research on Early Childhood Education (2010). Increasing knowledge in early childhood. *In Focus*, 1(5). Retrieved from http://curry.virginia.edu/uploads/resourceLibrary/NCRECEInFocus_V1_I5_School_Readiness_Array_of_Skills.pdf
- National Council of Teachers of English / International Reading Association (2012). *Standards for the English language arts*. Retrieved July 12, 2016, from NCTM, <http://www.ncte.org/standards/ncte-ira>
- National Council of Teachers of Mathematics (2000). Principles and standards for school mathematics. Reston, VA: Author.
- National Council of Teachers of Mathematics. (2006). *Curriculum focal points for prekindergarten through grade 8 mathematics: A quest for coherence*. Reston, VA: Author. Retrieved from <https://www2.bc.edu/solomon-friedberg/mt190/nctm-focal-points.pdf>
- National Early Literacy Panel. (2009). *Developing early literacy. Report of the National Early Literacy Panel. A scientific synthesis of early literacy development and implications for intervention*. Jessup, MD: National Institute for Literacy. Retrieved from <http://lincs.ed.gov/publications/pdf/NELPReport09.pdf>
- National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). *Common Core State Standards: Math*. Retrieved from <http://www.corestandards.org/Math/>
- Neuman, S. B., & Dickinson, David K. (Eds.). (2011). *Handbook of early literacy research* [Kindle]. Retrieved from Amazon.com
- Nguyen, T., Watts, T. W., Duncan, G. J., Clements, D. H., Sarama, J., Wolfe, C. B., & Spitler, M. E. (2015). *What specific preschool math skills predict later math achievement?* Retrieved from <http://files.eric.ed.gov/fulltext/ED562484.pdf>
- Obama, B. (2009). *Remarks of the President to the United States Hispanic Chamber of Commerce: The White House Office of the Press Secretary March 10, 2009*. Retrieved from <https://www.whitehouse.gov/the-press-office/remarks-president-united-states-hispanic-chamber-commerce>
- Pagani, L. S., & Messier, S. (2012). Links between Motor Skills and Indicators of School Readiness at Kindergarten Entry in Urban Disadvantaged Children. *Journal of Educational and Developmental Psychology*, 2(1), 95–107. Retrieved from <http://www.ccsenet.org/journal/index.php/jedp/article/viewFile/16607/11074>
- President Barack Obama’s State of the Union Address—as prepared for delivery. (2013, February 12). Retrieved from <https://www.whitehouse.gov/the-press-office/2013/02/12/president-barack-obamas-state-union-address-prepared-deliver>
- Snow, C. E., Burns, M. S., & Griffin, P. (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.
- Strickland, D. S., & Schickedanz, J. A. (2009). *Learning about print in preschool: Working with letters, words, and beginning links with phonemic awareness* (2nd ed.). United States: International Reading Association.
- The Early Math Collaborative—Erikson Institute. (2014). *Big ideas of early mathematics teachers of young children need to know* [Kindle]. Retrieved from Amazon.com
- Pecaski McLennan, D. (2014). Making math meaningful for young children. *Teaching Young Children*, 8(1), 20–22. Retrieved from <http://www.naeyc.org/tyc/article/making-math-meaningful>
- Tournaki, N. Bae, S.Y., & Kerekes, J. (2008) Rekenrek: A manipulative used to teach addition and subtraction to student with learning disabilities. *Learning Disabilities: A Contemporary Journal*, 6(2), 41–59.
- Watts, T. W., Duncan, G. J., Siegler, R. S., & Davis-Kean, P. E. (2014). *The Groove of Growth: How Early Gains in Math Ability Influence Adolescent Achievement*. Retrieved from <https://www.sree.org/conferences/2014s/program/downloads/abstracts/1157.pdf>