

PREDICTOR REFERENCE LIBRARY

Preschool Predictors of Academic Achievement in Five Kindergarten Readiness Domains:

*Oral Language & Literacy, Math, Science, Social-
Emotional Development & Approaches to Learning*

DECEMBER 2016

PRESENTED TO:



PRESENTED BY:

NORC at the University of Chicago

AUTHORS:

Eileen Graf, Marc W. Hernandez, &
Ryan S. Bingham

NORC

at the UNIVERSITY *of* CHICAGO

Table of Contents

Introduction	1
Background and Purpose.....	1
Oral Language and Literacy	3
Definition.....	3
Skill: Vocabulary	3
Skill: Conversation	4
Skill: Sentence Complexity.....	5
Skill: Narrative & Exposition	5
Skill: Phonological Awareness	6
Skill: Letter Names.....	7
Skill: Letter Sounds.....	7
Skill: Concepts About Print.....	8
Skill: Manual Writing	8
Math	9
Definition.....	9
Skill: Ordinality (Number)	9
Skill: Relative Size (Number)	10
Skill: Mental Rotation (Space)	10
Skill: Shape (Space)	11
Skill: Algebra (Pattern Recognition).....	11
Science	12
Definition.....	12
Predictor: Size of Scientific Vocabulary.....	12
Predictor: Amount of Exposure	12
Predictor: Amount of Knowledge.....	13
Social-Emotional Development	14
Definition.....	14
Subdomain: Emotional Development	14
<i>Skill: Emotion Knowledge</i>	14
<i>Skill: Emotion Regulation</i>	15

Subdomain: Social Interaction.....	16
<i>Predictor: Ability to Maintain Positive Relationships with Peers.....</i>	16
<i>Predictor: Teacher-Child Relationship Quality.....</i>	17
<i>Predictor: Parent-Child Relationship Quality.....</i>	18
Approaches to Learning.....	19
Definition.....	19
Skill: Persistence.....	19
Skill: Attention.....	20

Introduction

Background and Purpose

Three in five children across the United States are not ready for kindergarten. Early development and learning is foundational for later academic success, yet with regard to social-emotional development and skill learning, large numbers of children begin falling behind their peers in early childhood. This gap widens during the preschool years, and, in kindergarten, these children lack a solid developmental and academic skill base to build on. Being unprepared, children experience academic “inequality at the starting gate” (Burkham & Lee, 2002¹) from which they will not recover. This so-called academic achievement gap grows exponentially throughout children’s school tenure, leading to poor educational and life outcomes.

As the scientific evidence base accumulates, the importance of early childhood development and learning is increasingly being recognized by educators and policy makers. What it means to be kindergarten ready is now subject of a greater debate, both at the national and at the state level. However, there is no national standard or consensus across the early learning standards set by all 50 states. The Kenneth Rainin Foundation tasked NORC at the University of Chicago with identifying the domains that were common among all state readiness standards. NORC finds that five large domains emerge: [1] *Oral Language & Literacy*, [2] *Cognition & General Knowledge* [3] *Physical Development, Health & Safety*, [4] *Social-Emotional Development* and [5] *Approaches to Learning*. Of these, [1] and [2] are represented in every state, [3] and [4] are represented in virtually all states, and [5] is a separate domain for slightly more than half of all states. Domain [1] is most clearly defined. The composition of domain [2] differs across states, but is mostly comprised of three sub-domains: math, science and social studies. Domain [4] consists of comparable standards related to physical well-being, health, and motor development as well as safety standards. Domains [3] and [5] are least distinctly defined and delineated, with standards relating to [5] often represented in [3]. This definitional im/precision likely reflects the state of the research base in the domains [3] Social-Emotional Development and [5] Approached to Learning, which is still relatively small compared to the domain [1] Oral Language and Literacy and the subdomain of [2], Math. NORC identified two more areas of interest: *Creative Arts* was elevated to domain status by more than half of all states (others defined it as a sub-domain of [2], or not at all) and *Technology* emerged as a domain to watch.

The actual observable/ measurable standards associated with each one of these domains varied greatly in terms of content and level of detail across all states. The Kenneth Rainin Foundation therefore

¹ Burkham, D.T. & Lee, V.E. (2002). *Inequality at the Starting Gate: Social background differences in achievement as children begin school*. Washington, D.C.: Economic Policy Institute.

commissioned NORC to isolate those kindergarten readiness standards that are associated with the greatest predictive value. That is, within the domains identified above, NORC determined which early skills (i.e., standards) are most predictive of kindergarten readiness and later school success. NORC identified predictors in the following domains and sub-domains: Oral Language & Literacy (domain), Math (sub-domain), Science (sub-domain), Social-Emotional Development (domain) and Approaches to Learning (domain). This document details skills, predictors and predicted outcomes per these domains, together with relevant scientific literature. Each domain is organized at the skill level, except for the sections on Science and Social Interaction (which is a Sub-domain of Social-Emotional Development), where more than one predictor is associated with an individual skill. These two sections are organized at the predictor level.

From the evidence presented here, we conclude that the most promising and cost-effective approach to ensuring kindergarten readiness is to create multi-disciplinary learning opportunities that integrate domains such that various content learning areas (Science, Math) are combined with objectives in Oral Language & Literacy and Social-Emotional Development. This will generate opportunities for children to learn, inquire, collaborate and struggle with expository content. Specifically, it allows for opportunities to use oral language skills, learn precursors to reading and writing; it encourages critical thinking and innovation, and it fosters collaboration among peers.

This review was commissioned by Susan True, Director, Education Strategy & Ventures at the Kenneth Rainin Foundation, and directed by Dr. Marc Hernandez, Director, Early Childhood Research & Practice Collaborative at NORC at the University of Chicago.

Oral Language and Literacy

Definition

The domain describes the ability to listen, speak, read and write. It includes the development of oral language comprehension (listen) and production (speak) as well as the development of literacy, i.e. decoding (reading) and encoding (writing). Specific *oral language skills* include conversation (questions), sentence complexity (syntax), narrative/exposition (fiction/fact), and phonological awareness (rhyming, alliteration, blending, segmenting). Specific *literacy skills* include letter name identification, letter sound correspondence, concepts about print, and manual writing.

Skill: Vocabulary

Skill	Predictor	Predicted Outcome
Vocabulary	Number of words (productive & receptive)	Phonological Awareness Sentence complexity (syntax) Story/Expository comprehension Early reading proficiency Fewer problem behaviors

Dickinson, D. K. & Tabors, P. O. (2001) *Beginning literacy with language: Young children learning at home and school*. Baltimore, MD: Brookes.

Dickinson, D.K., & M.V. Porche (2011). Relation Between Language Experiences in Preschool Classrooms and Children’s Kindergarten and Fourth-Grade Language and Reading Abilities. *Child Development*, 82 (3): 870–86.

Dickinson, D.K., McCabe, A., Anastasopoulos, L., Peisner-Feinberg, E., & Poe, M. (2003). The Comprehensive Language Approach to Early Literacy: The Interrelationships Among Vocabulary, Phonological Sensitivity, and Print Knowledge Among Preschool-aged Children. *The Journal of Educational Psychology*, 95: 465-481.

Lonigan, C.J. (2006). Development, assessment and promotion of preliteracy skills. *Early Education and Development*, 17: 91-114.

Metsala, J. L. (1999). Young children’s phonological awareness and nonword repetition as a function of vocabulary development. *Journal of Educational Psychology*, 91: 3-19.

Morgan, Farkas, Hillemeier, Hammer & Maczuga (2015). 24-Month-Old Children With Larger Oral Vocabularies Display Greater Academic and Behavioral Functioning at Kindergarten Entry. *Child Development*, 86 (5): 1351-1370.

Nation, K. & Snowling, M. J. (2004). Beyond phonological skills: Broader language skills contribute to the development of reading. *Journal of Research in Reading, 27*: 342-356.

Pan, B.A., M.L. Rowe, J.D. Singer, & C.E. Snow (2005). Maternal Correlates of Growth in Toddler Vocabulary Production in Low-Income Families. *Child Development, 76* (4): 763–82.

Roth, F. P., Cooper, D. H., & Speece, D. L. (2002). A longitudinal analysis of the connection between oral language and early reading. *Journal of Educational Research, 95* (5): 259-272.

Rowe, M.L., S.W. Raudenbush, & S. Goldin-Meadow (2012). The Pace of Vocabulary Growth Helps Predict Later Vocabulary Skill. *Child Development, 83* (2): 508–25.

Sénéchal, M., G. Ouellette, & D. Rodney. 2006. The Misunderstood Giant: On the Predictive Role of Early Vocabulary to Future Reading. *Handbook of Early Literacy Research, Volume 2*. Eds. D.K. Dickinson & S.B. Neuman, 173–82. New York: Guilford.

Snow, C. E., Porche, M. V., Tabors, P. O., and Harris, S. R. (2007). *Is literacy enough? Pathways to academic success for adolescents*. Baltimore, MD: Brookes.

Storch, S. A. & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology, 38*: 934-947.

Weizman, Z.O., & C.E. Snow (2001). Lexical Input as Related to Children’s Vocabulary Acquisition: Effects of Sophisticated Exposure and Support for Meaning. *Developmental Psychology, 37* (2): 265–79.

Skill: Conversation

Skill	Predictor	Predicted Outcome
Conversation	Amount of displaced (decontextualized) talk	Vocabulary Early reading proficiency Abstract Reasoning

Beals D. (2001). Eating and reading: links between family conversations with preschoolers and later language and literacy. In: Dickinson DK, Tabors PO, eds. *Beginning Literacy with Language: Young Children Learning at Home and School*. Baltimore, MD: Brookes Publishing: 75–92.

Curenton, S.M., Craig, M.J., & Flanigan, N. (2008). Use of decontextualized talk across story contexts: how oral storytelling and emergent reading can scaffold children’s development. *Early Education and Development, 19*: 161–187.

Demir, O.E., Rowe, M., Heller, G., Goldin-Meadow, S., & Levine, S.L. (2015). Vocabulary, Syntax, and Narrative Development in Typically Developing Children and Children With Early Unilateral Brain Injury: Early Parental Talk About the “There-and-Then” Matters. *Developmental Psychology, 51* (2): 161-175.

Reese E, Leyva D, Sparks A, & Grolnick W. (2010). Maternal elaborative reminiscing increases low-income children’s narrative skills relative to dialogic reading. *Early Education and Development*, 21: 318–342.

Rowe, M.L. (2013). Decontextualized Language Input and Preschoolers’ Vocabulary Development. *Seminars in Speech and Language*, 34: 260–266.

Snow, C. E. (1991). The theoretical basis for the relationships between language and literacy in development. *Journal of Research in Childhood Education*, 6: 5-10.

Snow, C. E., Barnes, W. S., Chandler, J., Goodman, J. F., & Hemphill, L. (1991). *Unfulfilled expectations: Home and school influences on literacy*. Cambridge, MA: Harvard University Press.

Skill: Sentence Complexity

Skill	Predictor	Predicted Outcome
Sentence Complexity	Correct word order Diversity in complexity	Early reading proficiency

Bowey, J.A. (1986). Syntactic awareness and verbal performance from preschool to fifth grade. *Journal of Psycholinguistic Research*, 15: 285-306.

Demont, E., & Gombert, J.E. (1996). Phonological awareness as a predictor of decoding skills and syntactic awareness as a predictor of comprehension skills. *British Journal of Educational Psychology*, 66: 315-332.

Hoff E. (2003). The specificity of environmental influence: socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, 74: 1368–1378.

Huttenlocher, J., Vasilyeva, M, Cymerman, E., & Levine, S. (2002). Language input and child syntax. *Cognitive Psychology*, 45: 337-374.

Muter, V., Hulme, C., Snowling, M. J., & Stevenson, J. (2004). Phonemes, rimes, vocabulary, and grammatical skills as foundations of early reading development: evidence from a longitudinal study. *Developmental Psychology*, 40 (5): 665-8.

Skill: Narrative & Exposition

Skill	Predictor	Predicted Outcome
Narrative/Exposition	Retell Comprehension	Vocabulary Early reading proficiency

Griffin, T. M., Hemphill, L., Camp, L., & Wolf, D. P. (2004). Oral Discourse in the Preschool Years and Later Literacy Skills. *First Language*, 24 (2), 123-147.

Isbell, R., Sobol, J., Lindauer, L., & Lowrance, A. (2004). The effects of Storytelling and Story Reading on the Oral Language Complexity and Story Comprehension of Young Children. *Early Childhood Education Journal*, 32 (3): 157-163.

Kamhi A., & Catts, H.W. (2012). *Language and reading disabilities 3*. Boston, MA: Pearson.
 Kendeou, P., van den Broek, P., White, M. J., & Lynch, J. (2009). Predicting Reading Comprehension in Early Elementary School: The Independent Contributions of Oral Language and Decoding Skills. *Journal of Educational Psychology*, 101: 765-778.

Kendeou, P., van den Broek, P., White, M., & Lynch, J. (2007). Preschool and early elementary comprehension: Skill development and strategy interventions. In: D. S. McNamara (Ed.). *Reading comprehension strategies: Theories, Interventions, and Technologies*, (pp.27-45). Mahwah, NJ: Erlbaum.

Storch, S. A. & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: evidence from a longitudinal structural model. *Developmental Psychology*, 38: 934-947

Skill: Phonological Awareness

Skill	Predictor	Predicted Outcome
Phonological Awareness	Ability to rhyme Alliteration fluency	Alphabet knowledge Ability to segment words Spelling Early reading proficiency

Bryant, P. E., MacLeesan, M., Bradley, L. L., & Crossland, J. (1990). Rhyme and alliteration, phoneme detection, and learning to read. *Developmental Psychology*, 26: 429-438.

Dickinson, D.K., McCabe, A., Anastasopoulos, L., Peisner-Feinberg, E., & Poe, M. (2003). The Comprehensive Language Approach to Early Literacy: The Interrelationships Among Vocabulary, Phonological Sensitivity, and Print Knowledge Among Preschool-aged Children. *The Journal of Educational Psychology*, 95: 465-481.

Lonigan, C.J. (2006). Development, assessment and promotion of preliteracy skills. *Early Education and Development*, 17: 91-114.

Missal, K. N., Reschly, A., Betts, J., McConnell, S., Heistad, D., Pickart, M., et al. (2007). Examination of the Predictive Validity of Preschool Early Literacy Skills. *School Psychology Review*, 36: 433-452.

Snow, C. E., Bums, S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.

Whitehurst, G. J. & Lonigan, C. J. (1998). Child development and emergent literacy. *Child Development*, 69: 848-872.

Skill: Letter Names

Skill	Predictor	Predicted Outcome
Letter Names	Letter name fluency	Early reading proficiency Early writing proficiency

Caravolas, M., Hulme, C., & Snowling, M. J. (2001). The foundations of spelling ability: Evidence from a 3-year longitudinal study. *Journal of Memory and Language, 45*: 751–774.

Duncan, L. G., & Seymour, P.H.K. (2000). Socio-economic differences in foundation level literacy. *British Journal of Psychology, 91*: 145–166.

Gallagher, A., Frith, U., & Snowling, M. J. (2000). Precursors of literacy delay among children at genetic risk of dyslexia. *Journal of Child Psychology and Psychiatry, 41*: 203–213.

Missal, K. N., Reschly, A., Betts, J., McConnell, S., Heistad, D., Pickart, M., et al. (2007). Examination of the Predictive Validity of Preschool Early Literacy Skills. *School Psychology Review, 36*: 433-452.

Piasta, Shayne B.; Petscher, Yaacov; Justice, Laura M. (2012). How many letters should preschoolers in public programs know? The diagnostic efficiency of various preschool letter-naming benchmarks for predicting first-grade literacy achievement. *Journal of Educational Psychology, 104* (4): 945-958.

Skill: Letter Sounds

Skill	Predictor	Predicted Outcome
Letter Sounds	Letter sound fluency	Early reading proficiency

Duncan, L. G., & Seymour, P.H.K. (2000). Socio-economic differences in foundation level literacy. *British Journal of Psychology, 91*: 145–166.

Gallagher, A., Frith, U., & Snowling, M. J. (2000). Precursors of literacy delay among children at genetic risk of dyslexia. *Journal of Child Psychology and Psychiatry, 41*: 203–213.

Missal, K. N., Reschly, A., Betts, J., McConnell, S., Heistad, D., Pickart, M., et al. (2007). Examination of the Predictive Validity of Preschool Early Literacy Skills. *School Psychology Review, 36*: 433-452.

Piasta, Shayne B.; Petscher, Yaacov; Justice, Laura M. (2012). How many letters should preschoolers in public programs know? The diagnostic efficiency of various preschool letter-naming benchmarks for predicting first-grade literacy achievement. *Journal of Educational Psychology, 104* (4): 945-958.

Skill: Concepts About Print

Skill	Predictor	Predicted Outcome
Concepts About Print	Book and text knowledge	Later reading comprehension Spelling

Dickinson, D.K., McCabe, A., Anastasopoulos, L., Peisner-Feinberg, E., & Poe, M. (2003). The Comprehensive Language Approach to Early Literacy: The Interrelationships Among Vocabulary, Phonological Sensitivity, and Print Knowledge Among Preschool-aged Children. *The Journal of Educational Psychology, 95*: 465-481.

Lonigan, C.J. (2006). Development, assessment and promotion of preliteracy skills. *Early Education and Development 17*: 91-114.

Snow, C. E., Bums, S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.

Storch, S. A. & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: evidence from a longitudinal structural model. *Developmental Psychology, 38*: 934-947

Skill: Manual Writing

Skill	Predictor	Predicted Outcome
Manual Writing	Ability to use a writing instrument	Fine Motor skills Later reading proficiency Later math proficiency

Bloodgood, J.W. (1999). Children’s Name Writing and Literacy Acquisition. *Reading Research Quarterly, 34* (3): 342-367.

Grissmer, D., Grimm, K. J., Aiyer, S. M., Murrah, W. M., & Steele, J. S. (2010). Fine motor skills and early comprehension of the world: Two new school readiness indicators. *Developmental Psychology, 46* (5): 1008-1017.

Steffani, S. & Slevester, P.M. (2009). The Relationship of Drawing, Writing, Literacy and Math in Kindergarten Children. *Reading Horizons, 49* (2): 125-142

Math

Definition

Math is a subdomain of the Kindergarten Readiness domain “Cognition and General Knowledge.” Math is comprised of number sense, spatial cognition (geometry), patterns (algebra), and measurement. Specific skills include cardinality, ordinality (counting, one-to-one correspondence, number ID), relative set size, operations, shapes (composition and decomposition), mental rotation, pattern recognition, and linear measurement.

Skill: Ordinality (Number)

Skill	Predictor	Predicted Outcome
Ordinality	Numeral recognition Count list frequency	Math proficiency Operations Math problem-solving K-science proficiency Early Reading skills

Aunio, P. & Niemivirta, M. (2010). Predicting children’s mathematical performance in grade one by early numeracy. *Learning and Individual Differences, 20*: 427–435.

Aunola, K., Leskinen, E., Lerkkanen, M.-K., & Nurmi, J.-E. (2004). Developmental Dynamics of Math Performance From Preschool to Grade 2. *Journal of Educational Psychology, 96* (4): 699-713.

Bartelet, D., Vaessen, A., Blomert, L. & Ansari, D. (2014). What basic number processing measures in kindergarten explain unique variability in first-grade arithmetic proficiency? *Journal of Experimental Child Psychology, 117*: 12–28.

Batchelor, S., Inglis, M., & Gilmore, C. (2015). Spontaneous focusing on numerosity and the arithmetic advantage. *Learning and Instruction, 40*: 79-88.

Geary, D. C. (2011). Cognitive predictors of achievement growth in mathematics: A 5-year longitudinal study. *Developmental Psychology, 47*: 1539–1552.

Hannula, M., & Lehtinen, E. (2005). Spontaneous focusing on numerosity and mathematical skills of young children. *Learning and Instruction, 15* (3): 237-256.

Jordan, N. C., Kaplan, D., Locuniak, M. N. & Ramineni, C. (2007). Predicting first-grade math achievement from developmental number sense trajectories. *Learning Disability Practice, 22*: 36–46.

Krajewski, K., & Schneider, W. (2008). Early development of quantity to number-word linkage as a precursor of mathematical school achievement and mathematical difficulties: Findings from a four-year longitudinal study. *Learning and Instruction, 19* (6): 513-526.

Krajewski, K., & Schneider, W. (2009). Exploring the impact of phonological awareness, visual-spatial working memory, and preschool quantity-number competencies on mathematics achievement in elementary school: Findings from a 3-year longitudinal study. *Journal of Experimental Child Psychology, 103*: 516-531.

McMullen, J., Hannula-Sormunen, M. M., & Lehtinen, E. (2015). Preschool spontaneous focusing on numerosity predicts rational number conceptual knowledge 6 years later. *ZDM Mathematics Education, 47*: 813-824.

Moll, K., Snowling, M., Göbel, S., & Hulme, C. (2015). Early language and executive skills predict variations in number and arithmetic skills in children at family-risk of dyslexia and typically developing controls. *Learning and Instruction, 38*: 53-62.

Östergren, R., & Träff, U. (2013). Early number knowledge and cognitive ability affect early arithmetic ability. *Journal of Experimental Child Psychology, 115* (3): 405-421.

Skill: Relative Size (Number)

Skill	Predictor	Predicted Outcome
Relative size (number)	Ability to visually discriminate	Math proficiency

Bonny, J., & Lourenco, S. (2012). The approximate number system and its relation to early math achievement: Evidence from the preschool years. *Journal of Experimental Child Psychology, 114* (3): 375-388.

Chu, F. W., vanMarle, K., & Geary, D. C. (2013). Quantitative Deficits of Preschool Children at Risk for Mathematical Learning Disability. *Frontiers in Psychology, 4*: 195.

Libertus, M. E., Feigenson, L. and Halberda, J. (2011). Preschool acuity of the approximate number system correlates with school math ability. *Developmental Science, 14*: 1292-1300.

Mazzocco M., Feigenson L., & Halberda J. (2011). Preschoolers’ Precision of the Approximate Number System Predicts Later School Mathematics Performance. *PLoS ONE, 6* (9).

Skill: Mental Rotation (Space)

Skill	Predictor	Predicted Outcome
Mental rotation	Ability to rotate objects	Math proficiency

Gunderson, E. A., Ramirez, G., Beilock, S. L., & Levine, S. C. (2012). The relation between spatial skill and early number knowledge: The role of the linear number line. *Developmental Psychology*, 48 (5): 1229-1241.

Verdine, B. N., Golinkoff, R. M., Hirsh-Pasek, K., Newcombe, N. S., Filipowicz, A. T. and Chang, A. (2014), Deconstructing Building Blocks: Preschoolers' Spatial Assembly Performance Relates to Early Mathematical Skills. *Child Development*, 85: 1062–1076.

Skill: Shape (Space)

Skill	Predictor	Predicted Outcome
Shape (space)	Shape recognition	Math proficiency Early Reading skills Science proficiency

Augustine, E., Jones, S. S., Smith, L. B., & Longfield, E. (2015). Relations among early object recognition skills: Objects and letters. *Journal of Cognition and Development*, 16 (2): 221-235.

Steffani, S. & Slevester, P.M. (2009). The Relationship of Drawing, Writing, Literacy and Math in Kindergarten Children. *Reading Horizons*, 49 (2): 125-142.

Verdine, B., Irwin, C., Golinkoff, R., & Hirsh-Pasek, K. (2014). Contributions executive function and spatial skills to preschool mathematics achievement. *Journal of Experimental Child Psychology*, 126: 37-51.

Skill: Algebra (Pattern Recognition)

Skill	Predictor	Predicted Outcome
Pattern recognition (algebra)	Ability to identify patterns	Math proficiency Early Reading skills Science proficiency

Geary, D. (1994). Children’s mathematical development: Research and practical applications. Washington, DC: American Psychological Association.

Papic, M., & Mulligan, J. (2007). The Growth of Early Mathematical Patterning: An Intervention Study. *Mathematics: Essential Research, Essential Practice*, 2: 591-600.

Papic, M. M., Mulligan, J. T., Highfield, K., McKay-Tempest, J., & Garrett, D. (2015). The impact of a patterns and early algebra program on children’s learning in transition to school in Australian Indigenous communities. In: B. Perry, A. Gervasoni, & A. MacDonald (Eds.), *Mathematics and transition to school: International perspectives*, Chapter 14. NY: Springer.

Science

Definition

Science is a subdomain of the Kindergarten Readiness domain “Cognition and General Knowledge.” Science is comprised of process skills related to the scientific method and content knowledge related to the natural sciences. Specific skills include observing (includes asking questions, generating hypotheses and predicting) and experimentation or testing (includes summarizing or analyzing data and communicating results). The subdomain also includes critical thinking and logic and reasoning and revolves around the content areas earth science (weather, environment, etc.), space science (planets, stars, etc.), physical science (gravity, velocity, etc.), life Science (plants, animals, health, etc.) and measurement and classification.

Predictor: Size of Scientific Vocabulary

Skill	Predictor	Predicted Outcome
Scientific Method	Size of scientific vocabulary (unique words)	K-science Proficiency Understanding of scientific concepts

Conezio, K., & French, L. (2002). Science in the preschool classroom: Capitalizing on children’s fascination with the everyday world to foster language and literacy development. *Young Children*, 57 (5): 12–18.

Spycher, P. (2009). Learning Academic Language through Science in Two Linguistically Diverse Kindergarten Classes. *The Elementary School Journal*, 109 (4): 359–379.

Predictor: Amount of Exposure

Skill	Predictor	Predicted Outcome
Scientific Method	Amount of exposure (earlier is better)	K-science Proficiency Achievement in formal science instruction

Eshach, H., & Fried M. N. (2005). Should science be taught in early childhood? *Journal of Science Education and Technology*, 14 (3): 315-336.

Leibham, Alexander & Johnson (2013). Science Interests in Preschool Boys and Girls: Relations to Later Self-Concept and Science Achievement. *Science Education*, 97 (4): 574-593.

Tao, Y., Oliver, M., & Venville, G. (2012). Long-term outcomes of early childhood science education: Insights from a cross-national comparative case study on conceptual understanding of science. *International Journal of Science and Mathematics Education*, 10 (6): 1269-1302.

Predictor: Amount of Knowledge

Skill	Predictor	Predicted Outcome
Content Knowledge	Amount of knowledge	K-science Proficiency

French, L. (2004). Science as the center of a coherent, integrated early childhood curriculum. *Early Childhood Research Quarterly, 19* (1): 138

Gelman, R. & Brenneman, K. (2004). Science Learning Pathways for young children. *Early Childhood Research Quarterly, 19*: 150–158.

Social-Emotional Development

Definition

Social-Emotional Development is comprised of two subdomains, Emotional Development and Social Interaction. *Emotional Development* refers to children’s ability to regulate their emotions. Specific skills that enable emotion regulation include emotion knowledge, self-awareness, self-confidence, independence & self-direction, flexibility in changing environments, perspective taking and empathy. *Social Interaction* refers to children’s development and maintenance of relationships with others. Specific skills that support positive social interactions include awareness and respect for others, following routines and rules, and a concept of fairness.

Subdomain: Emotional Development

Skill: Emotion Knowledge

Subdomain	Skill	Predictor	Predicted Outcome
Emotional Development	Emotion knowledge	Understanding of self and other emotions	Later academic achievement

Choi, J.Y., Elicker, J., Christ, S.L., & Dobbs-Oates, J. (2014). Predicting growth trajectories in early academic learning: Evidence from growth curve modeling with Head Start children. *Early Childhood Research Quarterly, 36*: 244-258.

Denham, S. A., Bassett, H. H., Way, E., Mincic, M., Zinsser, K., & Graling, K. (2012). Preschoolers’ emotion knowledge: Self-regulatory foundations, and predictions of early school success. *Cognition & Emotion, 26* (4): 667–679.

Denham, S.A., Bassett, H.H., Zinsser, K., & Wyatt, T.M. (2014). How Preschoolers’ Social–Emotional Learning Predicts Their Early School Success: Developing Theory Promoting, Competency-Based Assessments. *Infant and Child Development, 23*: 426–454.

Leerkes, E. M. & Paradise, M. J. & O'Brien, M. & Calkins, S. D. & Lange, G. (2008). Emotion and Cognition Processes in Preschool Children. *Merrill-Palmer Quarterly, 54* (1): 102-124. Wayne State University Press. McWayne, C. M., Fantuzzo, J. W., & McDermott, P. A. (2004). Preschool Competency in Context: An Investigation of the Unique Contribution of Child Competencies to Early Academic Success. *Developmental Psychology, 40* (4): 633-645.

Shields, A., Dickstein, S., Seifer, R., Giusti, L., Dodge Magee, K. & Spritz, B. (2001). Emotional Competence and Early School Adjustment: A Study of Preschoolers at Risk. *Early Education and Development, 12* (1): 73-96.

Torres, M.M., Domitrovich, C.E., & Bierman, K.L. (2015). Preschool interpersonal relationships predict kindergarten achievement: Mediated by gains in emotion knowledge. *Journal of Applied Developmental Psychology, 39*: 44–52.

Skill: Emotion Regulation

Subdomain	Skill	Predictor	Predicted Outcome
Emotional Development	Emotion regulation	Ability to "appropriately" regulate emotions	Later academic achievement

Blair, C., & Diamond, A. (2008). Biological processes in prevention intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology, 20*: 899-911.

Bulotsky-Shearer, R. J. & Fantuzzo, J.W. (2011). Preschool behavior problems in classroom learning situations and literacy outcomes in kindergarten and first grade. *Early Childhood Research Quarterly, 26*: 61–73.

Choi, J.Y., Elicker, J., Christ, S.L., & Dobbs-Oates, J. (2014). Predicting growth trajectories in early academic learning: Evidence from growth curve modeling with Head Start children. *Early Childhood Research Quarterly, 36*: 244-258.

Denham, S. A., Bassett, H. H., Way, E., Mincic, M., Zinsser, K., & Graling, K. (2012). Preschoolers’ emotion knowledge: Self-regulatory foundations, and predictions of early school success. *Cognition & Emotion, 26* (4): 667–679.

Denham, S.A., Bassett, H.H., Zinsser, K., & Wyatt, T.M. (2014). How Preschoolers’ Social–Emotional Learning Predicts Their Early School Success: Developing Theory Promoting, Competency-Based Assessments. *Infant and Child Development, 23*: 426–454.

Howse, R., Calkins, S.D., Anastopoulos, A., Keane, S. & Shelton, T. (2003). Regulatory Contributors to Children’s Kindergarten Achievement. *Early Education and Development, 14*: 101-119.

McWayne, C. & Cheung, K. (2009). A picture of strength: Preschool competencies mediate the effects of early behavior problems on later academic and social adjustment for Head Start children. *Journal of Applied Developmental Psychology, 30*: 273–285.

McWayne, C. M., Fantuzzo, J. W., & McDermott, P. A. (2004). Preschool Competency in Context: An Investigation of the Unique Contribution of Child Competencies to Early Academic Success. *Developmental Psychology, 40* (4): 633-645.

Normandeau, S., & Guay, F. (1998). Preschool behavior and first-grade school achievement: The mediational role of cognitive self-control. *Journal of Educational Psychology, 90* (1): 111-121.

Shields, A., Dickstein, S., Seifer, R., Giusti, L., Dodge Magee, K. & Spritz, B. (2001). Emotional Competence and Early School Adjustment: A Study of Preschoolers at Risk. *Early Education and Development, 12* (1): 73-96.

Subdomain: Social Interaction

Predictor: Ability to Maintain Positive Relationships with Peers

Subdomain	Skill	Predictor	Predicted Outcome
Social Interaction	Develop & maintain relationships with others	Ability to maintain positive relationships with peers	Math proficiency Early reading skills

Bulotsky-Shearer, R. J. & Fantuzzo, J.W. (2011). Preschool behavior problems in classroom learning situations and literacy outcomes in kindergarten and first grade. *Early Childhood Research Quarterly, 26*: 61–73.

Choi, J.Y., Elicker, J., Christ, S.L., & Dobbs-Oates, J. (2014). Predicting growth trajectories in early academic learning: Evidence from growth curve modeling with Head Start children. *Early Childhood Research Quarterly, 36*: 244-258.

Denham, S. A., Bassett, H. H., Way, E., Mincic, M., Zinsser, K., & Graling, K. (2012). Preschoolers’ emotion knowledge: Self-regulatory foundations, and predictions of early school success. *Cognition & Emotion, 26* (4): 667–679.

Denham, S.A., Bassett, H.H., Zinsser, K., & Wyatt, T.M. (2014). How Preschoolers’ Social–Emotional Learning Predicts Their Early School Success: Developing Theory Promoting, Competency-Based Assessments. *Infant and Child Development, 23*: 426–454.

McWayne, C. & Cheung, K. (2009). A picture of strength: Preschool competencies mediate the effects of early behavior problems on later academic and social adjustment for Head Start children. *Journal of Applied Developmental Psychology, 30*: 273–285.

McWayne, C. M., Fantuzzo, J. W., & McDermott, P. A. (2004). Preschool Competency in Context: An Investigation of the Unique Contribution of Child Competencies to Early Academic Success. *Developmental Psychology, 40* (4): 633-645.

Normandeau, S., & Guay, F. (1998). Preschool behavior and first-grade school achievement: The mediational role of cognitive self-control. *Journal of Educational Psychology, 90* (1): 111-121.

Shields, A., Dickstein, S., Seifer, R., Giusti, L., Dodge Magee, K. & Spritz, B. (2001). Emotional Competence and Early School Adjustment: A Study of Preschoolers at Risk. *Early Education and Development, 12* (1): 73-96.

Torres, M.M., Domitrovich, C.E., & Bierman, K.L. (2015). Preschool interpersonal relationships predict kindergarten achievement: Mediated by gains in emotion knowledge. *Journal of Applied Developmental Psychology, 39*: 44–52.

Predictor: Teacher-Child Relationship Quality

Subdomain	Skill	Predictor	Predicted Outcome
Social Interaction	Develop & maintain relationships with others	Teacher-child relationship quality	Math proficiency Early reading skills

Bulotsky-Shearer, R. J. & Fantuzzo, J.W. (2011). Preschool behavior problems in classroom learning situations and literacy outcomes in kindergarten and first grade. *Early Childhood Research Quarterly, 26*: 61–73.

Burchinal, M.R., Peisner-Feinberg, E., Pianta, R., & Howes, C. (2002). Development of Academic Skills from Preschool Through Second Grade: Family and Classroom Predictors of Developmental Trajectories. *Journal of School Psychology, 40* (5):415 – 436.

Choi, J.Y., Elicker, J., Christ, S.L., & Dobbs-Oates, J. (2014). Predicting growth trajectories in early academic learning: Evidence from growth curve modeling with Head Start children. *Early Childhood Research Quarterly, 36*: 244-258.

Denham, S. A., Bassett, H. H., Way, E., Mincic, M., Zinsser, K., & Graling, K. (2012). Preschoolers’ emotion knowledge: Self-regulatory foundations, and predictions of early school success. *Cognition & Emotion, 26* (4): 667–679.

Denham, S.A., Bassett, H.H., Zinsser, K., & Wyatt, T.M. (2014). How Preschoolers’ Social–Emotional Learning Predicts Their Early School Success: Developing Theory Promoting, Competency-Based Assessments. *Infant and Child Development, 23*: 426–454.

Masten, A.S., & Coatsworth, J.D. (1998). The Development of Competence in Favorable and Unfavorable Environments. Lessons From Research on Successful Children. *American Psychologist, 53*, (2): 205-220.

McWayne, C. & Cheung, K. (2009). A picture of strength: Preschool competencies mediate the effects of early behavior problems on later academic and social adjustment for Head Start children. *Journal of Applied Developmental Psychology, 30*: 273–285.

McWayne, C. M., Fantuzzo, J. W., & McDermott, P. A. (2004). Preschool Competency in Context: An Investigation of the Unique Contribution of Child Competencies to Early Academic Success. *Developmental Psychology, 40* (4): 633-645.

Normandeau, S., & Guay, F. (1998). Preschool behavior and first-grade school achievement: The mediational role of cognitive self-control. *Journal of Educational Psychology, 90* (1): 111-121.

Rhoades, B.L., Warren, H.K., Domitrovich, C.E., & Greenberg, M.T. (2011). Examining the link between preschool social–emotional competence and first grade academic achievement: The role of attention skills. *Early Childhood Research Quarterly, 26*: 182–191

Shields, A., Dickstein, S., Seifer, R., Giusti, L., Dodge Magee, K. & Spritz, B. (2001). Emotional Competence and Early School Adjustment: A Study of Preschoolers at Risk. *Early Education and Development, 12* (1): 73-96.

Predictor: Parent-Child Relationship Quality

Subdomain	Skill	Predictor	Predicted Outcome
Social Interaction	Develop & maintain relationships with others	Parent-child relationship quality	Math proficiency Early reading skills Approaches to learning Positive classroom behaviors

Burchinal, M.R., Peisner-Feinberg, E., Pianta, R., & Howes, C. (2002). Development of Academic Skills from Preschool Through Second Grade: Family and Classroom Predictors of Developmental Trajectories. *Journal of School Psychology, 40* (5): 415 – 436.

Choi, J.Y., Elicker, J., Christ, S.L., & Dobbs-Oates, J. (2014). Predicting growth trajectories in early academic learning: Evidence from growth curve modeling with Head Start children. *Early Childhood Research Quarterly, 36*: 244-258.

Fearon, R.P., Bakermans-Kranenburg, M.J., van Ijzendoorn, M.H., Lapsley, A., & Roisman, G.I. (2010). The Significance of Insecure Attachment and Disorganization in the Development of Children’s Externalizing Behavior: A Meta-Analytic Study. *Child Development, 81* (2): 435–456.

Gutman, L.M., Sameroff, A.J., & Cole, R. (2003). Academic Growth Curve Trajectories From 1st Grade to 12th Grade: Effects of Multiple Social Risk Factors and Preschool Child Factors. *Developmental Psychology, 39* (4): 777–790.

Masten, A.S., & Coatsworth, J.D. (1998). The Development of Competence in Favorable and Unfavorable Environments. Lessons From Research on Successful Children. *American Psychologist, 53*, (2): 205-220.

Approaches to Learning

Definition

Approaches to Learning is comprised of the skills and behaviors children use to engage in learning, and is strongly tied to Social-Emotional Development. Specific skills and behaviors include persistence, attention, motivation, curiosity, learning mindsets (incremental vs. entity), and structured learning (goal setting, planning, organizing).

Skill: Persistence

Skill	Predictor	Predicted Outcome
Persistence	Ability to stay on task/topic	Later academic success (math, science, reading)

- Clark, C.A.C., Pritchard, V.E., & Woodward, L.J. (2010). Preschool Executive Functioning Abilities Predict Early Mathematics Achievement. *Developmental Psychology, 46* (5): 1176–1191.
- Friedman, S.L., Scholnick, E.K., Bender, R.H., Vandergrift, N., Spieker, S., Hirsh Pasek, K., Keating, D.P., & Park, Y. (2014). Planning in Middle Childhood: Early Predictors and Later Outcomes. *Child Development, 85* (4): 1446–1460.
- McClelland, M. M., Acock, A. C., Piccinin, A., Rhea, S. A., & Stallings, M. C. (2013). Relations between preschool attention span-persistence and age 25 educational outcomes. *Early Childhood Research Quarterly, 28* (2): 314-324.
- McWayne, C. M., Fantuzzo, J. W., & McDermott, P. A. (2004). Preschool Competency in Context: An Investigation of the Unique Contribution of Child Competencies to Early Academic Success. *Developmental Psychology, 40* (4): 633-645.
- Mokrova, I.L., O’Brien, M., Calkins, S.D., Leerkes, E.M., & Marcovitch, S. (2013). The role of persistence at preschool age in academic skills at kindergarten. *European Journal of Psychology of Education, 28*: 1495–1503
- Mullineaux, P.Y., Dilalla, L.F. (2009). Preschool Pretend Play Behaviors and Early Adolescent Creativity. *Journal of Creative Behavior, 43* (1): 41-57.
- Nelson, B., Martin, R.P., Hodge, S., Havill, V., & Kamphaus, R. (1999). Modeling the prediction of elementary school adjustment from preschool temperament. *Personality and Individual Differences, 26*: 687-700.
- Viterbori, P., Usai, M.C., Traverso, L., & De Franchis, (V. 2015). How preschool executive functioning predicts several aspects of math achievement in Grades 1 and 3: A longitudinal study. *Journal of Experimental Child Psychology, 140*: 38–55.

Skill: Attention

Skill	Predictor	Predicted Outcome
Attention	Ability to stay on task/topic	Later academic success (math, science, reading)

Clements, D.H., Sarama, J., & Germeroth, C. (2015). Learning executive function and early mathematics: Directions of causal relations. *Early Childhood Research Quarterly, 36*: 79–90.

Denham, S. A., Bassett, H. H., Way, E., Mincic, M., Zinsser, K., & Graling, K. (2012). Preschoolers’ emotion knowledge: Self-regulatory foundations, and predictions of early school success. *Cognition & Emotion, 26* (4): 667–679.

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.

Fowler, M.G. & Cross, A.W. (1986). Preschool Risk Factors as Predictors of Early School Performance. *Developmental and Behavioral Pediatrics, 7* (4): 237-241.

Friedman, S.L., Scholnick, E.K., Bender, R.H., Vandergrift, N., Spieker, S., Hirsh Pasek, K., Keating, D.P., & Park, Y. (2014). Planning in Middle Childhood: Early Predictors and Later Outcomes. *Child Development, 85* (4): 1446–1460.

McWayne, C. M., Fantuzzo, J. W., & McDermott, P. A. (2004). Preschool Competency in Context: An Investigation of the Unique Contribution of Child Competencies to Early Academic Success. *Developmental Psychology, 40* (4): 633-645.

Mullineaux, P.Y., Dilalla, L.F. (2009). Preschool Pretend Play Behaviors and Early Adolescent Creativity. *Journal of Creative Behavior, 43* (1): 41-57.

Nelson, B., Martin, R.P., Hodge, S., Havill, V., & Kamphaus, R. (1999). Modeling the prediction of elementary school adjustment from preschool temperament. *Personality and Individual Differences, 26*: 687-700.

Razza, R.A., Martin, A., & Brooks-Gunn, J. (2012). The implications of early attentional regulation for school success among low-income children. *Journal of Applied Developmental Psychology, 33*: 311–319.

Stipek, D. & Valentino, R.A. (2014). Early childhood memory and attention as predictors of academic growth trajectories. *Journal of Educational Psychology, 107* (3): 771-788.