Preschool Predictors of Academic Achievement in Five Kindergarten Readiness Domains:  
*Oral Language & Literacy, Math, Science, Social-Emotional Development & Approaches to Learning*
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
      Skill: Emotion Knowledge ........................................................................................................ 14
      Skill: Emotion Regulation .......................................................................................................... 15
Subdomain: Social Interaction........................................................................................................16
  Predictor: Ability to Maintain Positive Relationships with Peers......................................16
  Predictor: Teacher-Child Relationship Quality...............................................................17
  Predictor: Parent-Child Relationship Quality......................................................................18

Approaches to Learning........................................................................................................20
  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, 2002) 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

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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

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>Number of words (productive &amp; receptive)</td>
<td>Phonological Awareness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sentence complexity (syntax)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Story/Expository comprehension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early reading proficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fewer problem behaviors</td>
</tr>
</tbody>
</table>


### Skill: Conversation

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversation</td>
<td>Amount of displaced (decontextualized) talk</td>
<td>Vocabulary Early reading proficiency Abstract Reasoning</td>
</tr>
</tbody>
</table>


### Skill: Sentence Complexity

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sentence Complexity</td>
<td>Correct word order</td>
<td>Early reading proficiency</td>
</tr>
<tr>
<td></td>
<td>Diversity in complexity</td>
<td></td>
</tr>
</tbody>
</table>


### Skill: Narrative & Exposition

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrative/Exposition</td>
<td>Retell Comprehension</td>
<td>Vocabulary Early reading proficiency</td>
</tr>
</tbody>
</table>


**Skill: Phonological Awareness**

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phonological Awareness</td>
<td>Ability to rhyme</td>
<td>Alphabet knowledge</td>
</tr>
<tr>
<td></td>
<td>Alliteration fluency</td>
<td>Ability to segment words</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spelling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early reading proficiency</td>
</tr>
</tbody>
</table>


Skill: Letter Names

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter Names</td>
<td>Letter name fluency</td>
<td>Early reading proficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early writing proficiency</td>
</tr>
</tbody>
</table>


Skill: Letter Sounds

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter Sounds</td>
<td>Letter sound fluency</td>
<td>Early reading proficiency</td>
</tr>
</tbody>
</table>


**Skill: Concepts About Print**

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concepts About Print</td>
<td>Book and text knowledge</td>
<td>Later reading comprehension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spelling</td>
</tr>
</tbody>
</table>


**Skill: Manual Writing**

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Writing</td>
<td>Ability to use a writing instrument</td>
<td>Fine Motor skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Later reading proficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Later math proficiency</td>
</tr>
</tbody>
</table>


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)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinality</td>
<td>Numeral recognition</td>
<td>Math proficiency</td>
</tr>
<tr>
<td></td>
<td>Count list frequency</td>
<td>Operations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Math problem-solving</td>
</tr>
<tr>
<td></td>
<td></td>
<td>K-science proficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early Reading skills</td>
</tr>
</tbody>
</table>


### Skill: Relative Size (Number)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative size (number)</td>
<td>Ability to visually discriminate</td>
<td>Math proficiency</td>
</tr>
</tbody>
</table>


### Skill: Mental Rotation (Space)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental rotation</td>
<td>Ability to rotate objects</td>
<td>Math proficiency</td>
</tr>
</tbody>
</table>


### Skill: Shape (Space)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape (space)</td>
<td>Shape recognition</td>
<td>Math proficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early Reading skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science proficiency</td>
</tr>
</tbody>
</table>


### Skill: Algebra (Pattern Recognition)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pattern recognition (algebra)</td>
<td>Ability to identify patterns</td>
<td>Math proficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Early Reading skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science proficiency</td>
</tr>
</tbody>
</table>


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

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Method</td>
<td>Size of scientific vocabulary (unique words)</td>
<td>K-science Proficiency Understanding of scientific concepts</td>
</tr>
</tbody>
</table>


Predictor: Amount of Exposure

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific Method</td>
<td>Amount of exposure (earlier is better)</td>
<td>K-science Proficiency Achievement in formal science instruction</td>
</tr>
</tbody>
</table>


**Predictor: Amount of Knowledge**

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Knowledge</td>
<td>Amount of knowledge</td>
<td>K-science Proficiency</td>
</tr>
</tbody>
</table>


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

<table>
<thead>
<tr>
<th>Subdomain</th>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional Development</td>
<td>Emotion knowledge</td>
<td>Understanding of self and other emotions</td>
<td>Later academic achievement</td>
</tr>
</tbody>
</table>


### Skill: Emotion Regulation

<table>
<thead>
<tr>
<th>Subdomain</th>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional</td>
<td>Emotion regulation</td>
<td>Ability to &quot;appropriately&quot; regulate emotions</td>
<td>Later academic achievement</td>
</tr>
</tbody>
</table>


**Subdomain: Social Interaction**

**Predictor: Ability to Maintain Positive Relationships with Peers**

<table>
<thead>
<tr>
<th>Subdomain</th>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Interaction</td>
<td>Develop &amp; maintain relationships with others</td>
<td>Ability to maintain positive relationships with peers</td>
<td>Math proficiency, Early reading skills</td>
</tr>
</tbody>
</table>


## Predictor: Teacher-Child Relationship Quality

<table>
<thead>
<tr>
<th>Subdomain</th>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Interaction</td>
<td>Develop &amp; maintain relationships with others</td>
<td>Teacher-child relationship quality</td>
<td>Math proficiency</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Early reading skills</td>
</tr>
</tbody>
</table>


**Predictor: Parent-Child Relationship Quality**

<table>
<thead>
<tr>
<th>Subdomain</th>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social Interaction</td>
<td>Develop &amp; maintain relationships with others</td>
<td>Parent-child relationship quality</td>
<td>Math proficiency Early reading skills Approaches to learning Positive classroom behaviors</td>
</tr>
</tbody>
</table>


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

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistence</td>
<td>Ability to stay on task/topic</td>
<td>Later academic success (math, science, reading)</td>
</tr>
</tbody>
</table>


Skill: Attention

<table>
<thead>
<tr>
<th>Skill</th>
<th>Predictor</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
<td>Ability to stay on task/topic</td>
<td>Later academic success (math, science, reading)</td>
</tr>
</tbody>
</table>


