Pre-K Content Blueprint Series

Mathematics

Developing Assessments for All Pre-K Children

September 2025

MEASURES FOR EARLY SUCCESS

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Introduction

The Pre-K Content Blueprints are intended to help assessment developers learn about and design assessment tools that provide more accurate information about young children's early learning and development. Assessment developers can use these blueprints as they embark on content research, concept definition, and product development to ensure that their decision-making is grounded in the needs that are outlined in the *User-Informed Principles*.[1]

The Pre-K Content Blueprints were originally developed in 2022 to guide the work of the project teams that were selected to design novel assessments through the Measures for Early Success Initiative.[2]

How were the Pre-K Content Blueprints developed?

Each Pre-K Content Blueprint was developed through a systematic review of Head Start and select states' early learning standards (using what was publicly available as of early 2022), as well as theoretical and empirical literature on children's development. To benefit all children served by public pre-K programs, the Pre-K Content Blueprints consider a variety of perspectives, experiences, and needs to highlight domain-specific opportunities for assessment design to ensure that all children are given a fair chance to show what they know and can do.[3]

About the Measures for Early Success Initiative

Central to the Measures for Early Success Initiative is the belief that early learning assessments are a powerful tool for understanding young children's strengths and competencies and where they are at in their learning and development.

Data from assessments can provide users with information to:

- help tailor instruction in the classroom,
- support children's learning in key areas that are unique to them,
- provide or recommend additional support for specific children, and
- inform pre-K system-level policies and supports for pre-K programs.

A key objective of the Measures for Early Success Initiative is to create innovative assessments that provide accurate insights into what all children know and can do.

How can this resource be used?

The Measures for Early Success Initiative generated a set of Pre-K Content Blueprints to guide assessment development in the following domains:*

- Language
- Literacy
- Mathematics
- Executive Function

Each Pre-K Content Blueprint has three primary goals:

Describe skills in each domain and how they develop in children from ages 3 to 5.

Place assessment users' perspectives and needs at the center of the design of innovative assessments in each domain.

Provide an overview of existing assessments in each domain and highlight some ways that they advance toward the goals outlined in the *User-Informed Principles*.

*These domains were emphasized in the first phase of the Measures for Early Success Initiative (through 2024) because current direct assessment tools for these domains are most developed.

Pre-K Content Blueprints can be used in conjunction with the following resources that were developed for the Measures for Early Success Initiative:

- The *User-Informed Principles* resource highlights key goals for innovative child assessment solutions with corresponding criteria and target thresholds. It can help assessment developers address challenges in the current assessment landscape by helping them to identify areas where existing solutions do not address users' priorities; possible measurement items or solutions to address these gaps; and important areas or features to design to ensure that assessments are relevant for all pre-K children.

- *Centering User Perspectives in Assessment Design* describes how assessment tools can be designed in more accurate, usable, and useful ways by integrating users' perspectives, strengths, and needs early in the assessment design process.[4] This resource can be used to make progress toward the goals outlined in the *User-Informed Principles*.

- *Pre-K Content Blueprint Series - Technical Manual* describes the process for using federal and state early learning standards to summarize children's skills and developmental trajectories that are presented in the *Pre-K Content Blueprint Series*.[5]

Federal and State Early Learning Standards

Federal and state early learning standards describe the concepts and skills children develop and learn along the developmental continuum from birth until kindergarten entry. The purpose of these early learning standards is to inform the work of those aiming to foster the healthy development and well-being of young children. Early learning standards often represent minimum thresholds for children's development at various ages. Curricular supports, resources, and activities are selected to align with early learning standards. Pre-K programs also use early learning standards to select assessment tools that track children's developmental progression across early learning domains.

For the purposes of capturing children's skills and developmental progression from ages 3 to 5, this Content Blueprint presents definitions and summarizes developmental progressions—generated from the Head Start Early Learning Outcomes Framework (ELOF) and a subset of the early learning standards from the Measures Initiative's advisory states—using publicly available information as of early 2022.

Federal early learning standards reflected in the Pre-K Content Blueprints

The Pre-K Content Blueprints feature early learning standards from the Head Start Early Learning Outcomes Framework (ELOF),[7] which guides federally funded Head Start programs across the country.

States' early learning standards reflected in the Pre-K Content Blueprints

The Measures for Early Success Initiative engaged with pre-K leaders from over 20 states to gather their thoughts and feedback on child assessments.

To create the Pre-K Content Blueprints, the early learning standards from a subset of those states were selected to reflect the variation in the population and geography of the United States as well as different types of publicly funded pre-K systems. The state early learning standards in the Pre-K Content Blueprints came from Alabama, New Mexico, Ohio, Oregon, and Tennessee.* Notably, these states' early learning standards do not represent the early learning standards of all states.

*Oregon's early learning standards largely align with the Head Start ELOF standards. Alabama and Ohio have revised their early learning standards since the Pre-K Content Blueprints were initially researched and developed.

How do skills in the domain develop between the ages of 3 and 5?

This section presents skill definitions and developmental progressions that come from existing research literature and early learning standards in this domain.

How to use: This section can be used as an example of landscaping federal and state early learning standards to inform item development for assessments that measure children's abilities in this domain.

Early Mathematics Subdomains

Each domain is comprised of subdomains, which are groups of related skills. While federal and state early learning standards may label subdomains in different ways (see the right-hand column for examples), the skills in the standards generally align with the following four areas of early mathematics:

■ Numbers

Also includes: Counting and Cardinality, Numbers and Quantity, Number Relationships and Operations

▲ Operations and Algebraic Thinking

Also includes: Sorting, Algebra

◆ Measurement and Data

Also includes: Data Analysis

● Geometry and Spatial Awareness

Also includes: Spatial Sense, Spatial Reasoning, Spatial Relationships

The subdomains and the subsequent skills and indicators reflect those outlined in early learning standards from selected states. When designing their mathematics content, assessment developers are encouraged to use these in conjunction with Learning Trajectories, a website that offers a comprehensive, research-based overview of children's mathematics development across the full set of mathematics subdomains.[12]

Federal and select state subdomains

Head Start Early Learning Outcomes Framework (ELOF)[6] & Oregon[7]

- ■ Counting and Cardinality
- ▲ Operations and Algebraic Thinking
- ◆ Measurement
- ● Geometry and Spatial Sense

Alabama[8]

- ■ Numbers and Quantity
- ▲ Algebraic Thinking
- ◆ Measurement and Data Analysis
- ● Spatial Reasoning and Geometry

New Mexico[9]

- ■ Counting and Cardinality
- ▲ Sorting
- ◆ Measurement and Data
- ● Geometry and Spatial Relationships

Ohio[10]

- ■ Number Relationships and Operations
- ▲ Algebra
- ◆ Measurement and Data
- ● Geometry and Spatial Relationships

Tennessee[11]

- ■ Counting and Cardinality
- ▲ Operations and Algebraic Thinking
- ◆ Measurement and Data
- ● Geometry

Numbers

SKILLS	EMERGING INDICATORS *(36 to 48 months)*	COMPLEX INDICATORS *(by 60 months)*
Knows number names and count sequence, and produces a set of objects	Says or signs some number words in sequence (up to 10[a,e] or up to five),[b,c] starting with one. Counts backwards from three with assistance.[b] Understands that counting words are separate words, such as "one," "two," or "three" as opposed to "onetwothree."[a,e] Counts out one or two objects when asked.[b]	Rote counts verbally or signs to at least 20[a,b,d,e] (or 30)[c,f] by ones. Counts backwards from 10 to zero.[b] Identifies written numerals from zero up to nine[d] or 10.[b,f] Names and identifies a few written numerals with personal significance (for example, the numeral representing the child's age).[c] Counts out a specified number of objects[f] up to 10.[b]
Subitizes	Begins to recognize small quantities of objects (two)[b] in groups without counting.[a,e]	Instantly recognizes, without counting, small quantities of up to five objects and says or signs the number.[a,b,d,e,f]
Understands the relationship between numbers and quantity	Begins to coordinate verbal counting with objects by pointing to or moving objects for small groups of objects laid in a line (one-to-one correspondence).[a,b,c,e] Begins to understand that a written numeral represents a quantity[c] and the last number represents how many objects are in a group (cardinality).[a,e] Uses language to refer to amount and quantity, such as some, more, another, or nothing.	When counting objects, says or signs the number names in order, pairing one number word that corresponds with one object, up to at least 10[a,d,e,f] (or 15[b,c]) objects. Understands that the last number represents how many objects are in a group.[a,b,c,d,e,f] Accurately counts as many as five objects in a scattered configuration. Counts and answers "How many?" questions for approximately 10 objects.[a,e,f] Understands that each successive number name refers to a quantity that is one larger.[a,c,e]

(continued on next page)

a = ELOF (2015); b = Alabama (2020); c = New Mexico (2020); d = Ohio (2012); e = Oregon (2015); f = Tennessee (2018)

Numbers *(cont'd)*

SKILLS	EMERGING INDICATORS *(36 to 48 months)*	COMPLEX INDICATORS *(by 60 months)*
Compares numbers	Begins to accurately count and compare objects that are about the same size and are in small groups with adult assistance.[a,b,e]	Identifies whether the number of objects in one group is more than, less than, or the same as objects in another group[b] for up to at least five[a,e] (or 10)[d] objects. Uses comparative language, such as more or less than or equal to, to compare and describe collections of objects.[f]
Begins to write numbers and make representations	Begins to understand that a written numeral represents a quantity and may draw objects or use informal symbols to represent numbers.[a,e]	Associates a number of objects with a written numeral from zero to five. Recognizes and, with support, writes some numerals up to 10.[a,e] Begins to print the distinctive features of numerals (such as circle, line, diagonal, or crossed lines).[f]
Identifies and uses ordinal numbers	Understands the concept of first.[b] Identifies the first and second objects in a sequence.[a,e]	Identifies and uses numbers related to order or position from first to tenth.[a,e] Identifies more complex ordinals, such as second, third, or next.[b]

a = ELOF (2015); b = Alabama (2020); c = New Mexico (2020); d = Ohio (2012); e = Oregon (2015); f = Tennessee (2018)

Operations and Algebraic Thinking

SKILLS	EMERGING INDICATORS *(36 to 48 months)*	COMPLEX INDICATORS *(by 60 months)*
Understands addition as adding to and subtraction as taking away from	Begins to add and subtract very small collections of objects with adult support.[a,b,e]	Represents addition and subtraction in different ways, such as with fingers, objects, and drawings.[a,e,f] Solves addition and subtraction word problems.[a,e] Adds and subtracts up to five to or from a given number (up to 10 objects).[b] Begins to use counting on from the larger number for addition and counting back from the larger number for subtraction.[a,e] Shows, using concrete objects or drawings, the number needed to make up to five when added to any given number from zero to five.[f]
Explores patterns	Recognizes a simple pattern.[a,b,e] Fills in the missing element of a pattern. Duplicates and extends ABABAB patterns.[a,e] Identifies what comes next in the daily schedule or steps within a daily routine.[b]	Fills in missing elements of simple patterns. Duplicates simple patterns in a different location than demonstrated. Extends patterns.[a,b,d,e] Creates a more complex pattern that includes different attributes.[b,d] Identifies differences in the daily schedule or routine.[b]
Sorts and classifies objects	Matches two similar objects based on one attribute. Sorts objects by one characteristic during child led play. Orders objects according to size or shape.[b] Identifies two objects or pictures that are the same and eliminates those that are different in a group with adult support.[c]	Matches objects according to two or more attributes. Sorts and places objects in a series according to more than one attribute.[b,d] Puts up to 10 objects in order according to an attribute. Demonstrates knowledge that the same set can be sorted in different ways.[b] Determines a classification scheme for a collection of objects that creates a group for every item and makes one or more comments about the classification scheme.[c]

a = ELOF (2015); b = Alabama (2020); c = New Mexico (2020); d = Ohio (2012); e = Oregon (2015); f = Tennessee (2018)

Measurement and Data

SKILLS	EMERGING INDICATORS *(36 to 48 months)*	COMPLEX INDICATORS *(by 60 months)*
Describes objects	Describes an object in the immediate environment by using language or gestures related to size (including length, width, and height).[b,c]	Describes objects using at least two[b,c] measurable attributes (including length, size, capacity, and weight).[c,d,f]
Uses comparative language	Begins to understand that attributes can be compared.[a,e] Increases vocabulary related to size (for example, uses words such as tall and long).[c] Makes simple comparisons about the sizes of two different objects.[b]	Uses comparative language for two or more objects, such as shortest or longest, heavier or lighter, or biggest or smallest.[a,b,d,e,f] Compares or orders up to five[a,e] objects based on their measurable attributes, such as height or weight.[a,b,d,e,f]
Explores measurement using standard and non-standard tools	Pretends to use measurement tools in play.[b]	Measures using the same unit, such as putting together snap cubes to see how tall a book is.[a,e] Uses a variety of techniques with standard and non-standard tools to measure and compare objects.[b,d] Begins to use estimation skills to solve everyday measurement problems.[b]

a = ELOF (2015); b = Alabama (2020); c = New Mexico (2020); d = Ohio (2012); e = Oregon (2015); f = Tennessee (2018)

Geometry and Spatial Awareness

SKILLS	EMERGING INDICATORS *(36 to 48 months)*	COMPLEX INDICATORS *(by 60 months)*
Explores, identifies, compares, describes, and composes two-dimensional shapes	Recognizes and names typical shapes, such as circle, square, and triangle.[a,b,c,e] With adult support, matches some shapes that are different sizes and orientations.[a,c,e] Notices basic shapes in the environment.[b]	Names and describes shapes in terms of length of sides, number of sides, and number of angles,[a,b,d,e,f] regardless of size and orientation.[a,d,e] Analyzes, compares, and sorts two-dimensional shapes and objects in different sizes. Describes their similarities, differences, and other attributes, such as size and shape.[a,c,d,e,f] Creates and builds shapes from components.[a,c,d,e,f] Begins to describe objects in the environment using the names of shapes.[b,f] Completes complex shape puzzles.[b]
Explores, identifies, compares, and describes three-dimensional shapes	Recognizes and names three-dimensional shapes, such as cone and sphere.[b]	Names three-dimensional objects using informal, descriptive vocabulary, such as "cube" for box, "ice cream cone" for cone, and "ball" for sphere.[d] Analyzes, compares, and sorts three-dimensional shapes and objects in different sizes.[a,e] Describes their similarities, differences, and other attributes, such as size and shape.[a,b,e] Begins to explore shapes as two- or three-dimensional.[f]
Develops understanding of spatial relationships	Begins to understand spatial vocabulary,[a,e] such as "under" and "next to."[d] Moves body to show understanding of basic directionality.[a,b,e] Manipulates objects by moving them in different ways and directions. Stacks and builds with objects to create something new.[b]	Visualizes a spatial transformation. Describes the ways in which objects fit together or verbally shares plans about how to fit objects together.[b] Moves body in different ways independently or following directions involving the child's own position in space in response to music or song (for example, "stand up").[a,b,e] Demonstrates understanding of the relative position of objects using terms such as in, on, or under; up or down; inside or outside; above or below, beside or between; in front of or behind; and next to.[a,b,d,e,f]

a = ELOF (2015); b = Alabama (2020); c = New Mexico (2020); d = Ohio (2012); e = Oregon (2015); f = Tennessee (2018)

What are domain-specific opportunities for innovation?

This section provides examples that are specific to the development of assessment tools in this domain.

How to use: This section should be used to reflect on the current state of assessment in this domain and to identify potential opportunities for innovation in this domain. However, these examples are not exhaustive.

Centering User Perspectives in Assessment Design

Given the broad range of families and children served by publicly funded pre-K programs, the *Centering User Perspectives in Assessment Design* resource was created to ensure that the decision-making used to develop and design early learning assessments focuses on the perspectives, challenges, and context of those who will ultimately use the tools in pre-K programs and systems.[4]

Assessment developers are encouraged to use that resource and this Content Blueprint to:

Expand the types of skills that are measured to capture the strengths and capabilities of all children.

Explore how children might demonstrate these skills in different ways.

Innovate approaches to address key user considerations in new assessments in this domain.

Consider the progress of existing tools in this domain—as well as any new tools—in advancing toward the goals outlined in the *User-Informed Principles*.

Review the goals in the *User-Informed Principles*

GOAL 1
Content

GOAL 2
Psychometrics

GOAL 3
Experience

GOAL 4
Usefulness

GOAL 5
Scalability

Examples of Opportunities

The examples on this page can be used to reflect on the current state of mathematics assessments and to identify potential opportunities for innovation in the mathematics domain.

Mathematics assessments often ask children to demonstrate knowledge in ways that do not reflect the contexts in which they learned the skills. For example, sorting tasks often ask children to sort manipulatives, but many children learn sorting by helping with household tasks such as folding laundry and putting away dishes. Through their daily experiences, children bring a wealth of mathematics knowledge to the classroom.[13] Developing more contextually relevant assessments of mathematics skills can provide a better understanding of all children's true mathematics knowledge.

How can assessments allow children to demonstrate mathematics skills in familiar contexts or scenarios?

Existing assessments often prioritize basic mathematics *knowledge* (for example, counting and shape identification) rather than more complex mathematical *thinking* (for example, problem solving, connecting, and reasoning). Scores of basic math knowledge likely reflect variability in children's opportunities with formal mathematics instruction[14] and environmental influences (such as high-quality preschool programs, libraries, or stable housing) rather than children's underlying ability to engage with more complex mathematical concepts.

How can assessments be designed to allow children to demonstrate their mathematical thinking and reasoning?

Examples of Opportunities *(cont'd)*

The examples on this page can be used to reflect on the current state of mathematics assessments and to identify potential opportunities for innovation in the mathematics domain.

What additional opportunities for innovation do you see in the assessment of mathematics?

Mathematics assessments may reflect children's skills in other domains, depending on the prompts given during the assessment. For example, prompts with complex language may result in scores that measure children's receptive language abilities.[15] This may be a concern for children who primarily speak a language other than the language the assessment is administered in, as early mathematics assessments often require an understanding of domain-specific vocabulary (such as, more or less than, or add and subtract).[16]

This highlights the need to design assessments that allow for bilingual administration to ensure that language is not a barrier for children to express their mathematical knowledge. Similarly, tasks that require a large number of different manipulatives or switching between prompt formats may also reflect children's executive functioning skills.

How can assessments be designed to accurately measure children's mathematical skills, rather than primarily measuring their skills in other domains, particularly for emergent bilingual children?[17]

How are skills in the domain currently measured?

This section presents a sample of direct assessments that measure skills in this domain. An overview of each assessment is provided and some ways that each tool is aligned with the *User-Informed Principles* are highlighted.

How to use: This section can be used to understand the current state of assessments in this domain and to identify potential opportunities for innovation and improvements. These tools are elevated as examples—not exemplars—of direct assessments of young children's skills in this domain.

Assessment developers should not try to replicate these tools or copy example prompts or items as most of these tools are primarily used in research environments. Assessment developers should consider the needs of educators, children, and families, and other assessment users when designing their tools.

Bracken Basic Concept Scale 4: Receptive Version (BBCS-4: R)[18]

Subdomain(s) Measured

Geometry and Spatial Awareness; Measurement and Data; Numbers

Age Range

Ages 3 years through 7 years 11 months

Language Version(s)

English; Spanish translation (only generates raw scores and the number correct for each subtest)

Administration

- The BBCS-4:R is administered one-on-one with each child and takes 20 to 40 minutes to complete. The School Readiness Composite—which reflects a subset of math skills and other concepts critical for beginning school—can be generated through a shortened 15 to 20 minute administration.
- Children are asked questions based on a set of images. Children point to the image that best corresponds with the question.
- There are three options for administration:[19]
  - Traditional print version
  - Q-global: this digital version of the stimulus book can be used for in-person and remote administration
  - Q-interactive: two Bluetooth connected iPads are used for administration. The examiner has one iPad, and the child has the other to view and complete the assessment. Q-interactive allows for automatic scoring.
- There are 10 subtests. To generate the School Readiness Composite, only subtests 1 to 6 are used: 1. Colors, 2. Letters, 3. Numbers/Counting, 4. Sizes/Comparisons, 5. Shapes, 6. Self-Social-Awareness, 7. Direction/Position, 8. Texture/Material, 9. Quantity, 10. Time/Sequence

Sample Items[19]

Numbers/Counting

- "Point to the number I say." Examples: 1, 5, 8
- "What is this number?" Examples: 2, 6, 9
- [The child is shown four images: only one image has three flowers.] "Show me three flowers."

Sizes/Comparisons

- [The child is shown four images: the same chair, each with a different sized ball on it. One of the balls is much smaller than the others.] "Show me the little ball."

Shapes

- [The child is shown four images: a rectangle, an octagon, a triangle, and a square.] "Show me which one is round."

Direction/Position

- [The child is shown four images: a child stepping into the water, a child standing next to the water, a child standing in the water, and a child stepping out of the water.] "Show me which child is stepping into the water."

Quantity

- [The child is shown four images of a person standing next to a group of chickens, one photo shows a person with far more chickens than the rest.] "Show me which person has the greatest number of chickens."

Scoring[19]

- The assessment's starting point is established by the child's age. For each item, children are given a 1 (correct response), 0 (incorrect response), or NR (no response). For all subtests, the basal is established with three correct consecutive responses. For subtests 1 to 6, the ceiling is established by three incorrect consecutive responses. For subtests 7 to 10, the ceiling is established by four incorrect consecutive responses.
- Examiners can manually score the assessment or use Q-global when using the print version or Q-global. Once subtest item scores or subtest raw scores are entered into Q-global, a report is generated with the child's:
  - Receptive Total Composite (all subtests)
  - School Readiness Composite standard score (subtests 1 to 6)
  - School Readiness Subtests (SRS) scale score (subtests 1 to 6)
  - Other subtest scaled scores (subtests 7 to 10)
  - Percentile ranks
  - Concept age equivalents
  - Normal curve equivalents
  - Growth scale values
  - Descriptive classifications (very delayed, delayed, average, advanced, very advanced)
- Subtests are not intended to be administered separately nor are subtest scores intended to be interpreted separately.[19]

Alignment with the User-Informed Principles

GOAL 2: Psychometric Strengths

Reliability: The Bracken's normative sample reflects the population of the United States as captured on the American Community Survey.

GOAL 3: Experience Strengths

Educator experience: The Bracken's Q-Global approach allows educators to administer the tool using linked tablets and automatically produces scores.

Research-Based Early Math Assessment (REMA)[20]

Subdomain(s) Measured

Geometry and Spatial Awareness; Measurement and Data; Numbers; Operations and Algebraic Thinking

Age Range

Ages 3 through 8
REMA Brief: preschool-aged children (measures accuracy only, not math processes)

Language Version(s)

English; Spanish

Administration

- The REMA is administered one-on-one with each child in two 20-minute sessions. There are 199 total test items across the following math areas: comparing and ordering, verbal counting, counting and counting strategies, arithmetic, recognition of number and subitizing, composing number, comparing shape, identifying shape, turning shape, representing shape, composing shape, measuring, and patterning.
- During the assessment, the examiner uses a flip chart of images and a range of objects (such as pennies or number cards) to ask children questions aligned with the math Learning Trajectories. Learning Trajectories are based on the developmental progression of math skills in children.[12]

Sample Items[20]

- [Children are given three objects and then two more.] Once provided these manipulatives, the child is asked, "Pretend I give you three candies then I give you two more. How many will you have altogether?"
- "How high can you count? Start at one and keep going!"
- Look. I will put four boxes in this shopping cart. Count with me. 1, 2, 3, 4. 4!" [The assessor lays them in a straight line as they count.] "Now, I'm going to hide some." [The assessor covers the boxes with cloth, then secretly removes and hide two, then removes the cover to show the remaining two.] "How many am I hiding?"

Scoring[20]

- Children must get three consecutive correct answers in a row to establish a floor in each developmental area. The ceiling is established, and the assessment stops, when the child incorrectly answers three consecutive items. Items are ordered by difficulty using Rasch modeling.
- Items are scored as a 0 if the child is incorrect and a 1 if the child is correct.
- Scores are generated by measure developers by applying Item Response Theory (IRT) approaches to raw data. Assessors cannot generate scores themselves. The use of IRT allows for the creation of scores that place students on a common ability scale, supporting the comparison of scores across ages.[21]
- The scoring procedure yields numeracy and geometry scores.
- Beyond assessing correct items, the REMA also evaluates children's approaches to mathematical thinking when observable (for example, the processes of subitizing).[22]

Alignment with the User-Informed Principles

GOAL 1:
Content Strengths

Domain coverage: The content of the REMA is aligned with Learning Trajectories to measure how children's math skills develop over time. The items measure comprehensive information about children's knowledge and thinking across math subdomains.

GOAL 2:
Psychometric Strengths

Reliability: The REMA uses IRT approaches to evaluate the difficulty of items and place children's scores on a continuous scale reflecting mathematical knowledge. This allows for accurate comparisons of children's skills across ages and areas.

Test of Early Mathematics Ability 3 (TEMA-3)[23]

Subdomain(s) Measured

Numbers; Operations and Algebraic Thinking

Age Range

Ages 3 years through 8 years 11 months

Language Version(s)

English

Administration

- The TEMA is administered one-on-one with each child and takes around 40 minutes per child. The TEMA is designed to assess informal and formal math skills. Informal math skills are intuitive or typically acquired during everyday life, such as counting and understanding relative magnitude (for example, three is more than one). Formal math skills are typically learned in the classroom, such as base 10 concepts and adding two-digit numerals.[24]
- Some test items use objects like tokens and blocks to make the assessment more engaging.
- The test has two parallel forms (Form A and Form B), and each form has 72 test items.

Sample Items[23]

- [The child is given 10 tokens.] "One, two, three… now count by yourself."
- [The child is shown a picture of three cats.] "How many cats do you see?"
- [The child is shown a hand, holding up various numbers of fingers.] "Count the fingers for me. Can you show me three fingers?"
- [The child is shown a series of numbers, such as 106, 562, and 280.] "Look at these numbers. What is this number?"
- "I am going to tell you a number and I'd like you to write the number down on this worksheet." [102, 280]
- "Now, I am going to show you some adding problems. I want you to quickly tell me what you think the answer is." [2+2 =?, 6+4=?]
- "Here is a picture of a $100 bill. How many $10 bills are in one $100 bill?"
- "Pretend we are counting '1, 2, 3.' What number comes next? [4] How about this one, '148, 149.' What number comes next?"

Scoring

- The examiner manually scores test items throughout the assessment. Each test item is marked as 0 if the child answers incorrectly and as 1 if the child answers correctly. The assessment starting point is determined by the child's age—all children ages 3, 4, and 5 start with question 1.[25] The basal is established when a child correctly answers five consecutive items. The ceiling is established, and the assessment stops, when a child incorrectly answers five consecutive test items.[26]
- The TEMA does not produce any individual subtest scores for the different areas of math that are being assessed.[24] The following scores are produced:
  - raw scores (number of correct items)
  - standard scores, also called the Math Ability Score (has a mean of 100 points and a standard deviation of 15)
  - percentile ranks
  - age equivalents
  - grade equivalents
- To allow examiners to use scores on the two forms interchangeably, the test authors have incorporated a linear equating procedure. This is particularly useful if teachers are interested in testing children twice throughout the school year since the results are comparable.

Alignment with the User-Informed Principles

GOAL 1: Content Strengths

Developmental and linguistic relevance: The TEMA allows children to demonstrate math skills acquired informally (such as at home) and formally (such as at school).

GOAL 4: Usefulness Strengths

Actionable insights: The test includes "Assessment Probes and Instructional Activities" aligned with areas that are evaluated on the test to encourage educators to support children based on assessment data.

Woodcock Johnson Applied Problems (WJ AP)[27]

Subdomain(s) Measured

Geometry and Spatial Awareness; Measurement and Data; Numbers; Operations and Algebraic Thinking

Age Range

Ages 2 through 90+

Language Version(s)

English; Spanish: Batería IV Aprovechamiento 2: Problemas Aplicados (Battery IV: Achievement 2: Applied Problems)[28]

Administration

- The Woodcock-Johnson Applied Problems (WJ AP) subtest is administered one-on-one with each child and takes approximately 5 to 10 minutes. The WJ AP is a part of a larger assessment battery, the Woodcock Johnson IV Test of Achievement (WJ IV ACH).
- The WJ ACH has two parallel forms, containing all 22 of the subtests.
- To administer, the adult uses a flip chart with pictures to prompt children to answer math-related questions.

Sample Items

- [The child is shown an image of seven cartoon pennies.] "If you have seven pennies and you spend three of them, how many pennies would you have left?"[29]
- [The child is shown an image of a bunny, a cow, and a squirrel.] "How many cows are there?"[29]
- [The child is shown an image of ten different shapes in an array, ranging in color and orientation.] "How many circles are there?"[30]

Scoring[31]

- The assessment is manually scored, and each item is given a score of 0 (incorrect response) or 1 (correct response). The starting point is established by the child's estimated ability or achievement, and general guidelines are provided by grade. For preschoolers, it is recommended to start with the first item. The ceiling is established, and the assessment ends, when a child incorrectly answers five items in a row, or the last item is answered.
- A raw score is generated at the end of the assessment and reflects the total number of correct items. The raw score can be converted into standard scores and percentile ranks, reflecting the child's skills compared with the normed national sample.

Alignment with the User-Informed Principles

GOAL 2: Psychometric Strengths

Comparison: Standard scores and percentile ranks allow for comparisons of children's skills across domains (for example, Applied Problems with Oral Language subtests).

GOAL 3: Experience Strengths

Child experience: The Applied Problems subtest is relatively brief, requiring 5 to 10 minutes per child to assess.

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