**Section 26.135 Curriculum: Mathematics Standards**

Each teacher holding an early childhood education endorsement shall possess the knowledge and skills articulated in this Section.

a) Foundational Mathematical Knowledge

1) Mathematical Proficiency

The effective early childhood teacher:

A) understands conceptually the mathematical content taught during preschool to grade 2 as well as the content taught in grades 3 to 8; can explain and apply mathematical concepts and procedures; and can make connections to everyday mathematical applications or real-world analogies necessary to translate formal mathematical content into meaningful instruction that children can understand and learn;

B) understands the mathematical procedures taught during the early childhood years and just beyond, including the skills to link procedural knowledge to conceptual understanding so each step in a procedure can be explained or a procedure can be readily adapted to solve a novel problem; and

C) possesses affective capacities, including a productive disposition with positive beliefs about mathematics (e.g., nearly everyone is capable of understanding at an elementary level) and the confidence to tackle challenging problems and teach mathematics.

2) Children's Mathematical Development

The effective early childhood teacher:

A) understands how children develop mathematical proficiency from birth to age 8 and what conditions foster or impede this development;

B) understands how informal mathematical knowledge based on everyday experiences develops and provides a basis for understanding and learning formal mathematics (i.e., school-taught and largely symbolic) during the early childhood years and beyond; and

C) understands the developmental progressions of key early childhood concepts and skills.

b) Pedagogical Knowledge

1) Best Practices

The effective early childhood teacher:

A) understands the importance of using a variety of teaching techniques (including regular instruction that specifically targets mathematics, integrated instruction, and unstructured and structured play) and how to systematically and intentionally engage children with developmentally appropriate and worthwhile mathematical activities, materials and ideas; take advantage of spontaneous learning moments; structure the classroom environment to elicit self-directed mathematical engagement; and choose and use games to serve as the basis for intentional, spontaneous or self-directed learning;

B) understands the importance of using instructional activities and materials or manipulatives thoughtfully and how these are used to transmit key concepts and skills;

C) understands the importance of focusing on the learning of both skills and concepts that is meaningful;

D) understands the importance of engaging children in the processes of mathematical inquiry (problem-solving, reasoning, conjecturing and communicating/justifying or "talking math") and how to do so effectively;

E) understands the importance of fostering a positive disposition and how to do so effectively (e.g., encouraging children to do as much for themselves as possible), including how to prevent or remedy math anxiety; and

F) understands the importance of using assessment on an ongoing basis in planning and evaluating instruction, targeting student needs and evaluating student progress.

2) Psychological Development

The effective early childhood teacher:

A) understands the importance of building on what children already know, so that instruction is meaningful (e.g., how to relate or connect formal terms and procedures to children's informal knowledge);

B) understands the importance of using developmental progressions effectively in assessing developmental readiness (e.g., identifying whether developmental prerequisites for an instructional goal have been acquired), planning developmentally appropriate instruction and determining the next instruction, step, or a remedial plan;

C) understands the importance of the limitations of children's informal knowledge and how developmentally inappropriate instruction can cause misconceptions or other learning difficulties, as well as how to address common learning pitfalls; and

D) understands the importance of the progression in children's thinking from concrete (relatively specific and context-bound) to abstract (relatively general and context free), including the need to help children "mathematize" situations (going beyond appearances to consider underlying commonalities or patterns).

c) Standards

1) Counting and Cardinality

The effective early childhood teacher:

A) understands that subitizing (i.e., immediately and reliably recognizing the total number of items in small collections of items and labeling the total with an appropriate number word) is the basis for a learning trajectory of verbal-based number, counting and arithmetic concepts and skills;

B) understands the requirements, components, and principles of meaningful object counting (i.e., stable order principle, one-for-one principle, cardinality principle, and abstraction principle);

C) understands key, more advanced verbal and object counting skills on the learning trajectory for counting and cardinality and knows how these skills are logically and developmentally related;

D) understands how children's ability to make verbal-based magnitude comparisons develops, including the mathematical ideas this entails;

E) understands why written numbers (numerals) are valuable tools (e.g., can serve as a memory aid; make written calculations with large numbers easier or even possible) and how to promote the meaningful learning of numeral reading and writing to 10; and

F) understands the role of estimation (e.g., useful when exact answers are not possible or an approximate answer is sufficient) and why children resist estimating answers (e.g., fear of being wrong, obsession with the correct answer as reinforced by the guess-and-check).

2) Operations and Algebraic Thinking

The effective early childhood teacher:

A) understands the specific addition and subtraction concepts and skills children need to learn in early childhood;

B) understands the formal meaning of relational symbols and how these symbols are or can be interpreted by children; and

C) understands the specific multiplication and division concepts and skills children need to learn in early childhood.

3) Numbers and Operations in Base Ten

The effective early childhood teacher:

A) understands, can identify, and can apply the fundamental concepts of grouping and place-value that underlie the Hindu-Arabic numeral system and operations with multi-digit numbers;

B) understands the application of place value, the properties of operations, and the relation between addition and subtraction to adding and subtracting multi-digit numbers up to 1,000, including demonstrating and explaining renaming (carrying and borrowing) algorithms with base-ten blocks; and

C) understands the application of place value and properties of operations to multiply one-digit whole numbers and multiples of 10 up to 90 (e.g., 9 x 80), including demonstrating and explaining how the meaning of multiplication can be demonstrated with base-ten blocks.

4) Numbers and Operations: Fractions

The effective early childhood teacher:

A) understands, and can explain, two common meanings of fraction notation in terms of the conceptual basis for fractions (equal partitioning) using the informal analogy of "fair" sharing;

B) understands, and can justify, equivalent fractions in terms of the informal analogy of "fair" sharing; and

C) understands, and can justify, fraction comparisons in terms of the informal analogy of "fair" sharing.

5) Measurement and Data

The effective early childhood teacher:

A) understands the general principles of measurement (e.g., object attributes, direct and indirect comparisons, unit value);

B) explicitly understands purposes of and procedures for measurements (e.g., length, time, currency, volume) commonly used in everyday life, including how to derive formulas for area and perimeter; and

C) understands the role of data, data analysis, and data representations (e.g., graphs, tables) in solving problems, raising or addressing issues or questions (e.g., scientific, social, economic or political), and informing others about the importance of involving participants in collecting and analyzing their own data.

6) Geometry

The effective early childhood teacher:

A) understands the van Hiele developmental levels of geometric thinking and demonstrates achievement of at least Level 2 (i.e., Level 0, visual; Level 1, analysis; Level 2, informal reasoning or abstraction; Level 3, deduction; and Level 4, rigor);

B) understands how the "big ideas" of composition and decomposition and equal partitioning apply to geometry and the developmental trajectory children follow in becoming competent composers and decomposers;

C) understands basic geometric concepts, such as angle, parallel, and perpendicular, and can describe these ideas in terms of an informal analogy (e.g., an angle is the "amount of turn");

D) understands and can summarize and illustrate the cognitive developmental progression from visual to descriptive to analytic to abstract characterizations of shapes; uses this progression to understand children's thinking;

E) understands the importance of precision in describing and reasoning about spatial locations and relationships, including descriptive power of prepositions (and their imprecise mapping among languages and dialects) and mathematically precise tools, such as measurements, grids, and the coordinate plane;

F) understands that spatial relationships can be manipulated mentally and that point of view affects both experiences and representations of spatial relationships; and

G) describes the connections (relationships) between geometric properties and arithmetic and algebraic properties, and adapts a problem in one domain to be solved in the other domain.

(Source: Amended at 45 Ill. Reg. 14807, effective November 10, 2021)