



Indiana Content Standards for Educators

Elementary Mathematics Specialist

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The Elementary Mathematics Specialist standards reflect current research on effective teaching and learning of mathematics. The standards define knowledge, skills, and dispositions that Elementary Mathematics Specialists must possess to produce greater levels of mathematical success for all students, while also serving as teacher leaders, bringing significant improvement to student achievement and teacher effectiveness.

The standards provide a basis for professional preparation in mathematical content, pedagogy, and leadership. However, the standards should not be viewed as ends in themselves; rather, they provide clarity for building leaders about the actions they are expected to take in order to drive student achievement and teacher effectiveness outcomes.

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Standard 1: Mathematical Content

Elementary mathematics specialists must know and understand deeply the mathematics of elementary school, the progressions of mathematics topics across several grade levels, as well as how mathematics concepts and skills develop prior to kindergarten and through middle school. Additionally, elementary mathematics specialists must not only understand mathematics for themselves, but also know how understanding is developed in both students and adults.

Standard 2: Mathematical Processes

Elementary mathematics specialists must use mathematical practices such as precision in language, construction and comparison of mathematical representations, conjecturing, problem solving, reasoning, and proving within the context of the P-8 mathematics content. Additionally, they must create opportunities for learners of all ages to develop these mathematical practices.

Standard 3: Learners and Learning

Elementary mathematics specialists are expected to have a foundation in pedagogical content knowledge and mathematical processes, applying to both students and educators-as-learners. Elementary mathematics specialists must foster positive mathematics dispositions and understand how multiple identities shape teachers and students as mathematics learners, presenting learning opportunities that connect to learners' lived experiences.

Standard 4: Teaching

Elementary mathematics specialists are expected to utilize equitable, evidence-based teaching strategies that validate one's knowledge and experiences as mathematics learners, applying to both students and educators-as-learners.

Standard 5: Curriculum and Assessment

Elementary mathematics specialists are expected to understand curriculum (e.g. academic standards, instructional materials, processes, experiences) and equitable assessment practices, choosing learning tasks that reflect the multiple identities of learners.

Standard 6: Leadership Knowledge and Skills

Elementary mathematics specialists take on collegial, non-evaluative leadership roles within their schools and districts. They must have a broad view of the many aspects and resources needed to support and facilitate effective instruction and professional growth. They act professionally to assure that all students have equitable access to opportunities to learn important mathematics.

Elementary Mathematics Specialist Educator Standards

Standard 1: Mathematical Content

Elementary mathematics specialists must know and understand deeply the mathematics of elementary school, the progressions of mathematics topics across several grade levels, and how mathematics concepts and skills develop prior to kindergarten and through middle school. Additionally, elementary mathematics specialists must not only understand mathematics for themselves, but also know how understanding is developed in both students and adults in the following domains:

1.1 Number and Operations

- 1.1.1 Pre-number concepts: Understand and apply non-quantified comparisons (less than, more than, the same), containment (e.g., 5 contains 3), 1-to-1 correspondence, cardinality, meaningful counting, and ordinality.
- 1.1.2 Understand and utilize a comprehensive repertoire of interpretations (i.e., joining and separating, part-whole relationships, additive and multiplicative comparisons, partitive and quotative division), representations, and properties of the four operations of arithmetic.
- 1.1.3 Place value: Understand and apply the structure of place-value notation in general and base-10 notation in particular; how place-value notations (both standard and exponential form) are used to efficiently represent quantities; use of these notations to order numbers, estimate, and represent order of magnitude (e.g., using scientific notation).
- 1.1.4 Understand and apply multi-digit arithmetic, including informal reasoning, visual representations, mental math, non-standard algorithms, and the way that each might be connected; standard algorithms must be drawn from and connected to other techniques/representations and understood on a conceptual basis.
- 1.1.5 Basic number systems: Understand and apply whole numbers, integers, non-negative rational numbers, rational numbers, and real numbers; relationships among them, and locations of numbers in each system on the number line; conceptual understanding of standard and non-standard algorithms; what is involved in extending operations from each system (e.g., whole numbers) to larger systems (e.g., rational numbers).
- 1.1.6 Multiplicative arithmetic: Factors, factorization, multiples, primes, prime factorization, composite numbers, least common multiple, and greatest common factor.

1.2 Proportional Reasoning

- 1.2.1 Represent and reason about how quantities vary together in a proportional relationship, using tables, double number lines, tape diagrams, and other

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models.

- 1.2.2 Distinguish proportional relationships from other relationships, such as additive relationships and inversely proportional relationships.
- 1.2.3 Use unit rates to solve problems and to formulate equations for proportional relationships.
- 1.2.4 Recognize that unit rates make connections with prior learning by connecting ratios to fractions.
- 1.2.5 Connect the concept of proportional relationship to linear relationships.

1.3 Algebra and Functions

- 1.3.1 Axioms: Recognize commutativity, associativity, and distributivity, and 0 and 1 as identity elements in the basic number systems; understand how these may be used in computations and to deduce the correctness of algorithms. Understand the relationships that exist among addition, subtraction, multiplication and division; the need for order-of-operations conventions.
- 1.3.2 Algebraic notation, equations, and inequalities: Understand meanings for and the use of variables, equal sign, and inequality symbols; the process of substituting particular numbers into variable expressions; the solution set of algebraic equations and inequalities; transformations of equations that do not change the solution set; solutions of systems of linear equations.
- 1.3.3 Model mathematical problems, both contextualized and decontextualized, using algebraic equations and inequalities.
- 1.3.4 Understand the concept of a function as defining one variable uniquely in terms of another. Identify functions to model various relationships, including constant, linear, exponential and quadratic. Produce and interpret representations and partial representations of functions (e.g., equation, graph, table, or verbal description). Utilize functional language such as independent and dependent variables, domain (inputs), and range (outputs).

1.4 Geometry and Measurement

- 1.4.1 Visualization: Understand that geometric objects are pictured on a 2-dimensional page; for 3-dimensional objects this requires perspective or projection renderings. Develop mathematical, spatial, and drawing skills to produce and interpret 2- and 3-dimensional representations.
- 1.4.2 Composition and decomposition: Understand that a geometric figure can be assembled by joining together various component figures. Conversely, understand that a geometric figure may be decomposed into pieces (for

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example decomposing a polygon into an assemblage of triangles).

1.4.3 Congruence and similarity: Understand that congruence is the basic concept of geometric "sameness." Similarity has to do with rescaling: Understand that two figures are similar if one of them is congruent to a rescaling of the other. For example, all circles are similar, as are all squares and all isosceles right triangles.

1.4.4 Geometric measurement: Understand measurement as a way of attaching a numerical quantity to a geometric figure. Doing this involves choosing a standard or non-standard unit, and then the measurement is a ratio of the given geometric figure to the unit (how many copies of the unit does it take to compose the given figure?). It follows that if a geometric figure is decomposed, then its measure is the sum of the measures of its components. Changing the unit has the effect of multiplying all measurements by a constant (relating the two units), for example, relating feet to inches, or square centimeters to square meters.

1.4.5 Identify basic geometric figures and relationships in each dimension.
Dimension 1: Line segments, rays, parallel and perpendicular
Dimension 2: Polygons, circles;
Dimension 3: Polyhedral solids, cylinders, cones, spheres.
Use parts (e.g., vertex, edge, face) and properties (e.g., regularity, symmetry) of these figures to classify them.

1.4.6 Develop and use formulas for measurement of 2- and 3-dimensional figures (e.g., area, surface area, volume, and perimeter).

1.4.7 Plane coordinates: Understand how they are introduced, and how they support algebraic expression of geometric objects and relationships. Reciprocally, understand how they afford geometric interpretation of algebraic relations.

1.4.8 Transformations: Understand and apply reflections, rotations, translations, dilations, glide reflections; composition of transformations; symmetry and its expression in terms of transformation (e.g., reflection through a line of symmetry); develop and express congruence and similarity in terms of transformations.

1.4.9 Axiomatic reasoning and proof: Make and prove conjectures about geometric shapes and relations.

1.5 Data Analysis and Probability

1.5.1 Understand and use the statistical investigative process of posing questions, collecting data, analyzing data, and interpreting results.

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- 1.5.2 Understand the nature and uses of data to gain insight into and measure variation: Differentiate between statistical and non-statistical questions.
- 1.5.3 Distinguish between categorical and numerical data. Classify numerical data as either discrete or continuous.
- 1.5.4 Create appropriate types of representations of univariate and bivariate data, with and without technology, and critique the benefits and limitations of different representations. Determine numerical summaries of data (e.g., relative frequencies for categorical data; measures of shape, center, and spread for numerical data).
- 1.5.5 Understand basic concepts of probability and ways to represent them; make judgments under conditions of uncertainty; measure likelihood; become familiar with the concept of randomness; and understand the relationship between experimental and theoretical probability.
- 1.5.6 Conclusions: Understand which representations best support communication of inferences from data, use probability models when appropriate, and account for variability. Understand how the notion of randomness and the methodology of selecting a sample from the population contribute to the limits of generalizability.
- 1.5.7 Understand that statistics and data are non-neutral and designed to serve a particular interest. Analyze the possibilities for whose interest might be served and how the representations might be misleading.

Standard 2: Mathematical Processes

Elementary mathematics specialists must use mathematical practices such as precision in language, construction and comparison of mathematical representations, conjecturing, problem solving, reasoning, and proving within the context of the P-8 mathematics content. Additionally, they must create opportunities for learners of all ages to develop these mathematical practices:

- 2.1** Make sense of problems and persevere in solving them, attending to precision.
- 2.2** Reason abstractly and quantitatively and create explanations by constructing viable arguments and critiquing the reasoning of others.
- 2.3** Model with mathematics and use appropriate tools strategically.
- 2.4** Look for and make use of mathematical structure and look for and express regularity in repeated reasoning.

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Standard 3: Learners and Learning

Elementary mathematics specialists are expected to have a foundation in pedagogical content knowledge and mathematical processes, applying to both students and educators-as-learners. Elementary mathematics specialists must foster positive mathematics dispositions and understand how multiple identities shape teachers and students as mathematics learners, presenting learning opportunities that connect to learners' lived experiences:

- 3.1 Engage learners in rich mathematical tasks that help to develop mathematical proficiency as characterized by the integration and balance of conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition
- 3.2 Organize and deliver instruction that is developmentally appropriate and responsive to individual learners, acknowledging cultural and linguistic differences.
- 3.3 Draw on student's mathematical strengths to create inclusive, social learning contexts that engage all learners in discussions and mathematical explorations among all members of the learning community in order to motivate and extend learning opportunities, connecting to lived experiences.
- 3.4 Cultivate positive mathematical identities and promote positive dispositions toward mathematics, mathematics teaching and learning; demonstrate and encourage equitable and ethical treatment of students and have high expectations for all students.
- 3.5 Understand the roles of power, privilege, and oppression in the history of mathematics education and be equipped to question existing educational systems that produce inequitable learning experiences and outcomes for students.

Standard 4: Teaching

Elementary mathematics specialists are expected to utilize equitable, evidence-based teaching strategies that validate one's knowledge and experiences as mathematics learners, applying to both students and educators-as-learners.

- 4.1 Design, select and/or adapt worthwhile mathematics tasks and sequences of examples that support a particular learning goal.
- 4.2 Support the learning of appropriate technical language associated with mathematics, attending to both mathematical integrity and usability by all learners.
- 4.3 Construct and evaluate multiple representations of mathematical

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ideas or processes, establish correspondences between representations, and understand the purpose and value of doing so.

- 4.4 Facilitate meaningful mathematics discourse by posing purposeful questions, using and connecting mathematical representations, eliciting and using evidence of learners' thinking, and supporting productive struggle in learning mathematics.
- 4.5 Develop learners' abilities to give clear and coherent public mathematical communications in a classroom setting.
- 4.6 Model effective problem solving and mathematical practices--questioning, representing, communicating, conjecturing, making connections, reasoning and proving, self-monitoring--and cultivate the development of such practices in learners.
- 4.7 Use various instructional tools, purposefully, in ways that are mathematically and pedagogically grounded.
- 4.8 Elicit and use evidence of learners' mathematical thinking.
- 4.9 Develop skillful and flexible use of different instructional formats--whole group, small group, partner, and individual--in support of learning goals.
- 4.10 Understand and support the equitable learning of mathematics by embracing and incorporating diversities of the classroom and school--cultural, racial, ethnic, ability, linguistic, gender, socioeconomic, developmental, etc.; utilize this knowledge to motivate and extend learning opportunities.
- 4.11 Provide learners with opportunities to communicate and make connections between mathematics and other content areas, everyday life, and the workplace.

Standard 5: Curriculum and Assessment

Elementary mathematics specialists are expected to understand curriculum (e.g. academic standards, instructional materials, processes, experiences) and equitable assessment practices, choosing learning tasks that reflect the multiple identities of learners.

- 5.1 Understand the connections between mathematical concepts (P-8) as well as the developmental progressions within these mathematical concepts.
- 5.2 Use knowledge of the P-8 content to sequence activities and design instructional tasks in order to establish appropriate benchmarks in grades K-6.
- 5.3 Use multiple strategies (e.g., asking probing questions, listening to learners) to assess mathematical knowledge and to understand thinking processes.

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- 5.4 Determine the suitability of mathematics curricula and teaching materials (e.g., curricular resources, technology, manipulatives) to select, use, and adapt those materials appropriately for particular learning goals.
- 5.5 Evaluate state and national standards, curricular materials, and assessment tools in order to identify gaps in alignment and recommend appropriate adjustments.
- 5.6 Know the different formats, purposes, uses, and limitations of various types of assessment of student learning in order to choose, design, and/or adapt assessment tasks.
- 5.7 Use the formative assessment cycle (administer a formative assessment task, analyze responses to the task, and design and reteach lessons based on this analysis) in order to inform teaching and benefit learning.
- 5.8 Analyze formative and summative assessment results and make appropriate interpretations; communicate results to appropriate and varied audiences.

Standard 6: Leadership Knowledge and Skills

Elementary mathematics specialists take on collegial, non-evaluative leadership roles within their schools and districts. They must have a broad view of the many aspects and resources needed to support and facilitate effective instruction and professional growth. They act professionally to assure that all students have equitable access to opportunities to learn important mathematics:

- 6.1 Take an active role in their own professional growth by participating in evidence-based professional development experiences that directly relate to ambitious and equitable teaching and learning of mathematics and to their development as a mathematics instructional leader.
- 6.2 Engage in and facilitate continuous and collaborative learning that draws upon research in mathematics education to:
 - 6.2.1 Inform practice, make decisions, manage conflict, and promote meaningful change.
 - 6.2.2 Enhance learning opportunities for all students' and teachers' mathematical knowledge development.
 - 6.2.3 Involve teachers, school and district administrators, other school professionals, families, community members, and other stakeholders in discussions about curriculum, teaching, learning, and assessment.
 - 6.2.4 Advance the development in themselves and others as reflective practitioners as they utilize group processes to collaboratively solve problems.
- 6.3 Plan, develop, implement, and evaluate professional development

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programs at the school and/or district level:

- 6.3.1 Use - and assist teachers in using - resources from professional mathematics education organizations, teacher/leader discussion groups, teacher networks, print, digital, and virtual resources/collections.
- 6.3.2 Support teachers in systematically reflecting and learning from practice through one-on-one observation, coaching cycle, video analysis, and/or lesson study.
- 6.4** Evaluate educational structures and policies that affect students' equitable access to advancement in high quality mathematics learning:
 - 6.4.1 Evaluate the alignment of mathematics curriculum standards, curricular resources, and required assessments and make recommendations for addressing learning and achievement gaps.
 - 6.4.2 Collaborate with school-based professionals to develop ambitious and equitable instruction for all students.
 - 6.4.3 Advocate for the rights and/or needs of all students to secure resources and promote advancement as needed.
- 6.5** Use mathematics-focused instructional leadership skills to improve mathematics programs at the school and district levels:
 - 6.5.1 Serve as coach/mentor/content facilitator – providing feedback to colleagues to strengthen practice and improve student learning.
 - 6.5.2 Develop equitable and accessible classroom- or school-level learning environments.
 - 6.5.3 Build relationships with teachers, administrators and the community.
 - 6.5.4 Collaborate to create a shared vision and develop an action plan for school improvement.
 - 6.5.5 Establish and maintain learning communities.
 - 6.5.6 Partner with school-based professionals to improve each student's achievement.
 - 6.5.7 Mentor new and experienced teachers to better serve students.
- 6.6** Select from a repertoire of methods to communicate professionally about students, curriculum, instruction, and assessment to educational constituents—parents and other caregivers, school administrators, and school boards.

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