

Introduction to the Middle Grades and High School Teacher Preparation Standards for Mathematics

February 24, 2021



Office of Educator Excellence

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Purpose

To ensure educator preparation providers have access to critical information regarding Teacher Preparations Standards for Mathematics for middle grades (5-9) and high school (7-12) and the implications for programs.

The logo for Michigan's TOP 10 Strategic Education Plan. It features the words "Michigan's" and "Strategic Education Plan" in black. The word "TOP" is in large, bold, blue letters, with the "O" containing a silhouette of a person sitting at a desk. The word "10" is also in large, bold, blue letters. A horizontal orange bar is positioned across the middle of the "TOP" and "10". Below the "TOP" and "10" are several horizontal lines of varying colors (red, green, blue, yellow) and a central graphic element consisting of a blue square with a white circle inside, flanked by horizontal lines.

Michigan's TOP 10 Strategic Education Plan

Vision: Every learner in Michigan's public schools will have an inspiring, engaging, and caring learning environment that fosters creative and critical thinkers who believe in their ability to positively influence Michigan and the world beyond.

Guiding Principles



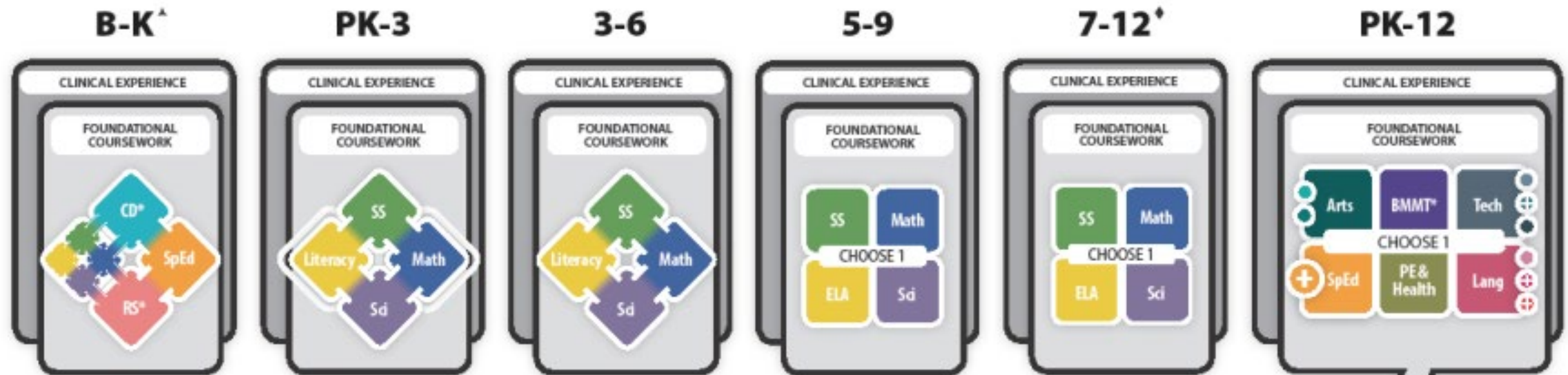
- 1. All students have access to high-quality instruction** regardless of their gender, sexual orientation, ethnicity, race, economic status, native language, or physical, emotional, and cognitive abilities **to close the student achievement and opportunity gaps.**
- 1. All educators are encouraged to be creative and innovative. All educators** are adequately compensated and respected for their professionalism, and have the resources, support, and **training needed to educate students.**
- 1.** All students are encouraged to express their creativity, **have voice** in their own learning, feel connected to their schools, and have authentic, meaningful relationships with educators.
- 1.** All students are **provided every opportunity to achieve** the broadest range of life dreams.
- 1. Families and communities are essential partners** of teachers, support staff, and administrators in the education of students.



Whole Child

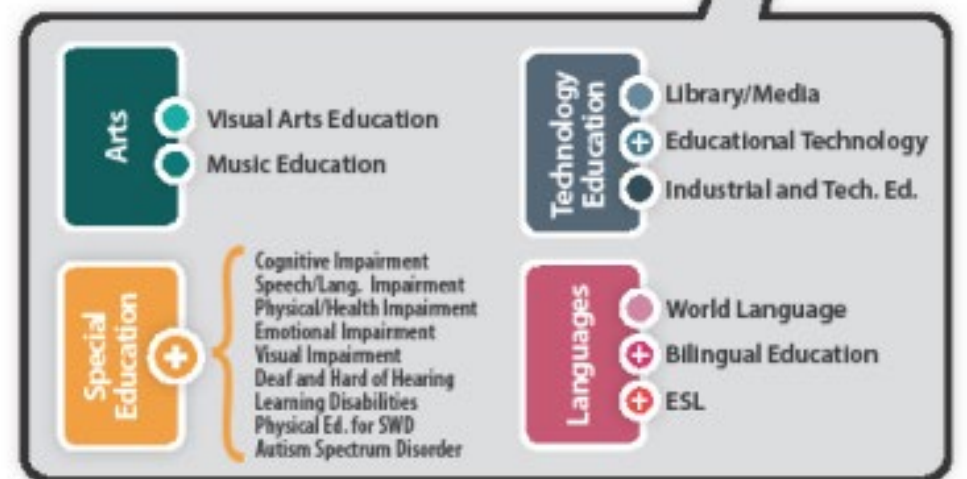
Michigan stakeholders have developed a **students-first** certification **system** that prepares effective **mathematics educators** to use **differentiated supports** and meet the needs of the **whole child**.

TEACHER CERTIFICATION STRUCTURE

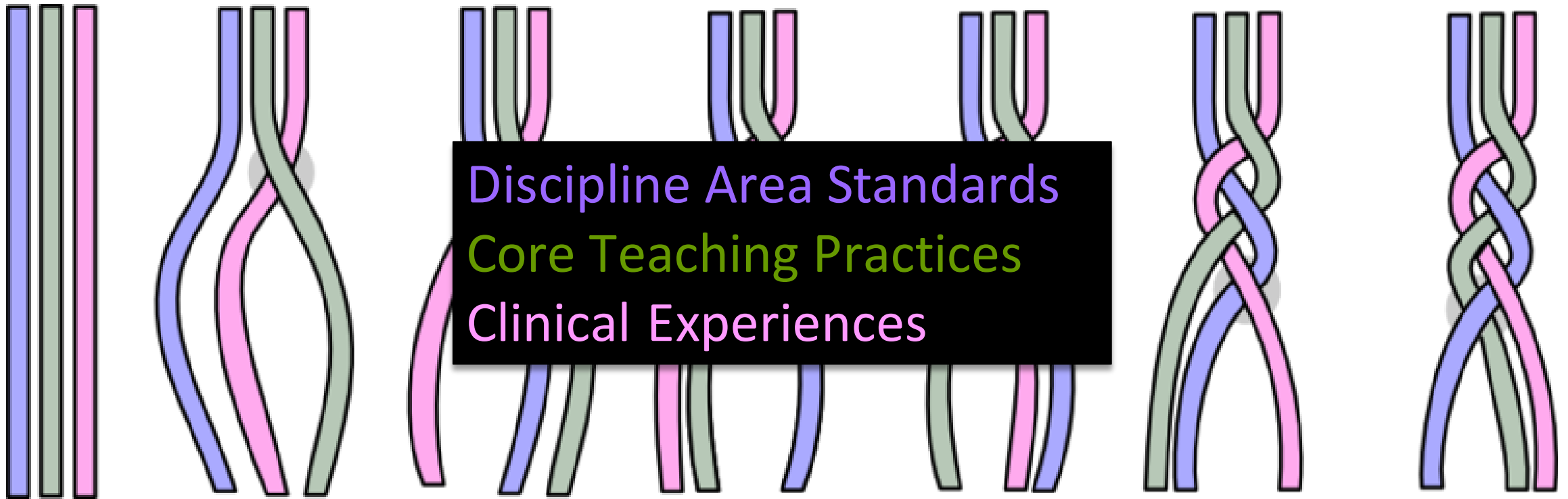


PROGRAM COMPONENTS

- Social-Emotional Competence
- Learner-Centered Supports
- Early and Ongoing Clinical Experiences
- Educational Technology
- Assessment Literacy
- Family and Community
- Needs of Diverse Learners and Cultural Competence
- Emphasis on Content-Specific Pedagogy
- Interaction with Special Populations of Students



▲ Foundation coursework requirements apply to both General and Special Education
 * CD: Child Development | RS: Relationships | BMMT: Business, Management, Marketing, and Technology
 ♦ Career and Technical Education (CTE) endorsements will remain valid for grades 9-12 and Classification of Instructional Programs (CIP) codes will not change.
 ⊕ Indicates a preparation program that must be paired with core content area

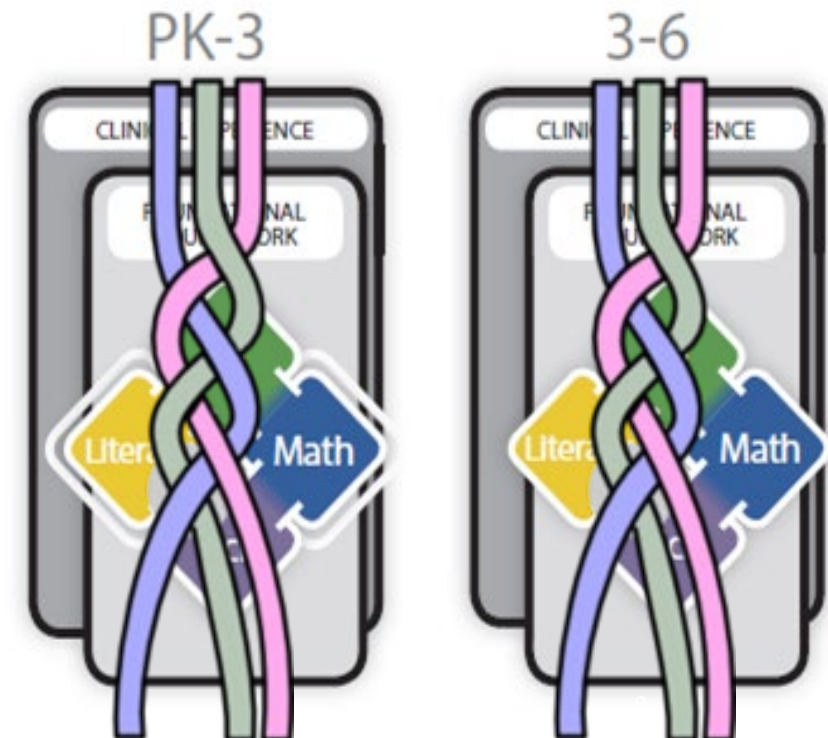


MDE's Vision: Cohesive, Connected Preparation

Administrative Rule Minimums

Must haves:

- 20 credits “theoretical & practical knowledge”
- 3 credits literacy
- 300 hours student teaching / internship

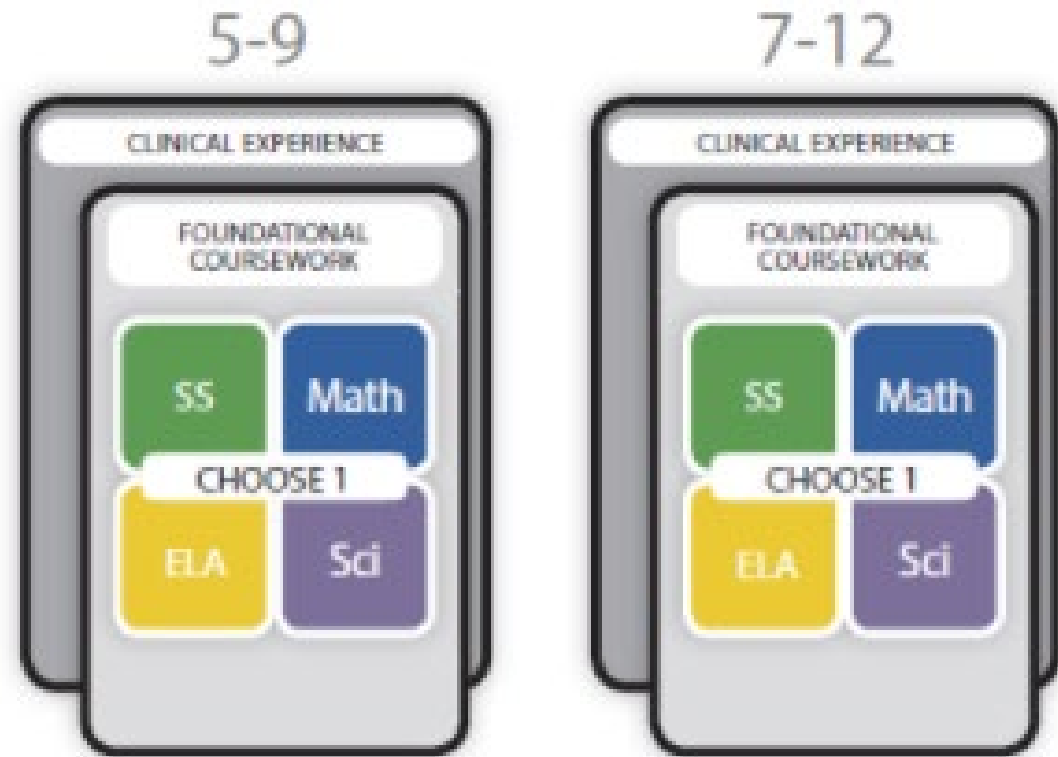


Overview of Middle Grades and High School Standards

Five Sections

1. Professional
2. English Language Arts
3. Mathematics
4. *Science**
5. *Social Studies**

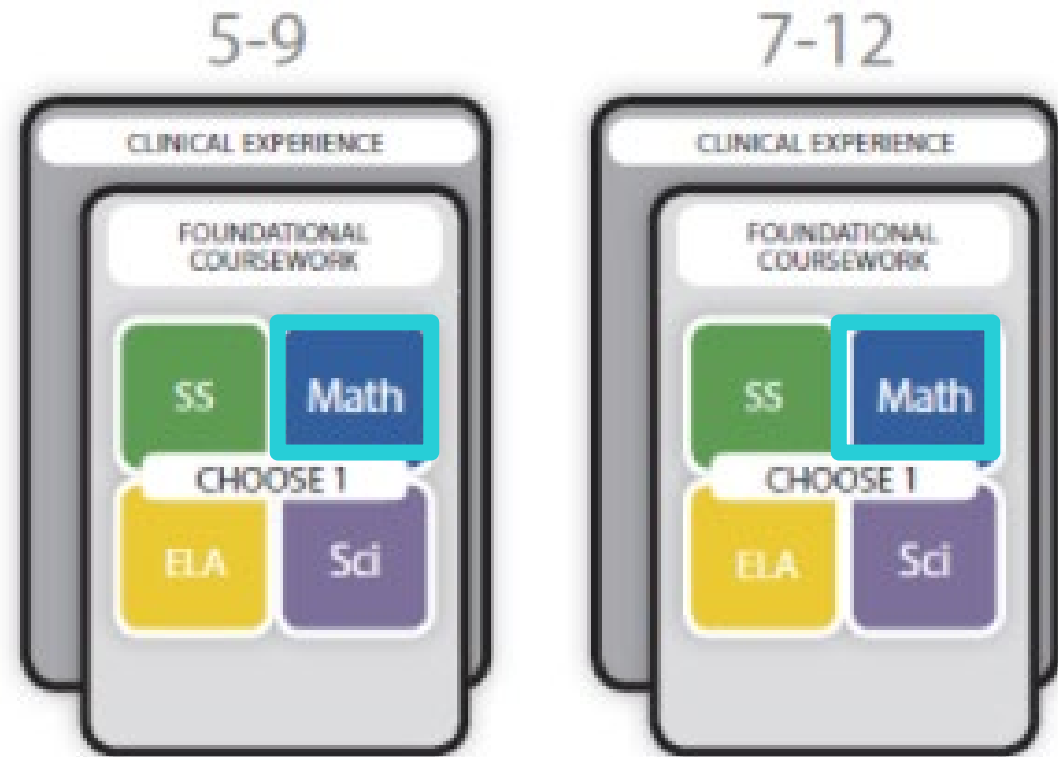
**Coming Soon*



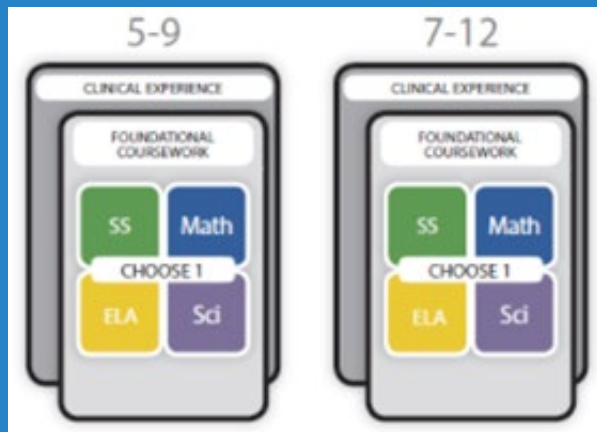
Overview of Middle Grades and High School Standards

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1. Professional
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4. Science
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Mathematics Middle Grades and High School Implementation Timeline



SBE approval - August 11, 2020



Webinar - Winter 2021; Spring Conferences



EPI program build - 2021-2023



First program application and review - Fall 2021
Freshmen exit 2027, Juniors exit 2025



First candidates enter programs - Fall 2022



Mathematics MTTCs Operational - 2023



Old MTTC cut-off - Spring/Summer 2029

Part One: Mathematics Standards' Rationale and Development



Rationale

Currently not meeting *all* students' needs

- 2019 Nation's Report Card - Michigan
 - 4th grade - 64% below proficiency
 - 8th grade - 69% below proficiency
 - 12th grade - 75% below proficiency
- Gaps for race, ethnicity, ELL, special education

The standards' inclusive vision of teaching practices support the needs of individual students in Michigan's increasingly diverse classrooms.



Standards for the Preparation of Teachers of

Mathematics

Middle Grades (5-9) and High School (7-12)



Michigan State Board of Education

Approved

August 11, 2020

Key Factors in the Redesign

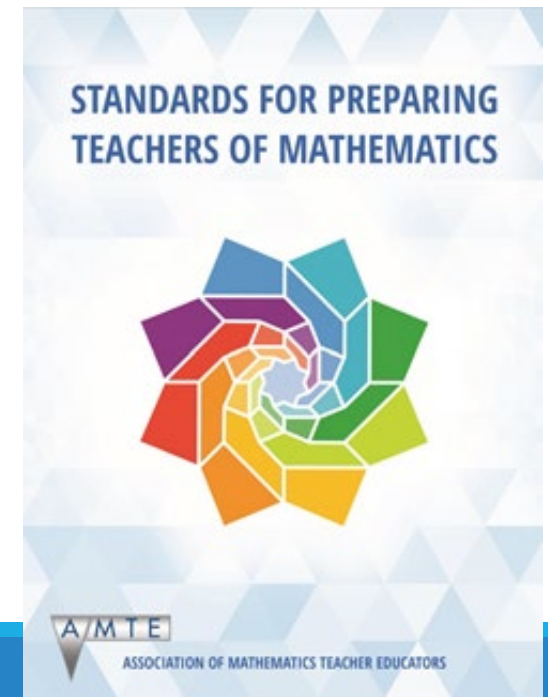
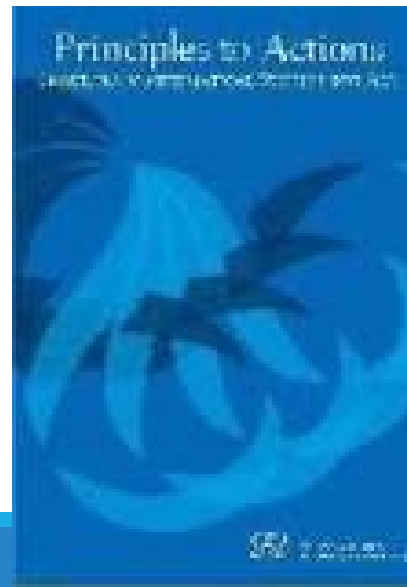


In the design of the new standards, the committee considered: the research base, the current (2000) standards, and current practice which led to:

- Writing performance expectations for beginning teachers
- Integrating content courses and pedagogical courses
- Emphasizing teaching mathematics for understanding
- Ensuring equity is a focus across all elements of the mathematics teacher preparation program
- Focusing on understanding students as learners of mathematics

Primary Resources

- AMTE Standards for Preparing Teachers of Mathematics
- NCTM Catalyzing Change
- CAEP/NCTM Standards for Mathematics Teacher Preparation
- Principles to Action
- Social Justice Standards



Continuity Between Grade Bands

With Upper Elementary (Grades 3-6) Mathematics

- maintaining focus on key content needed for teaching
- continued integration of core teaching practices and whole child approaches
- ensuring preparation for teaching the Michigan mathematics standards at grade bands

Who Participated in the Update?



The standards were updated by a committee of 28 stakeholders who directly contributed, representing multiple perspectives:

- Teacher preparation researchers and faculty
- General and special education teachers
- ISD consultants
- Professional association leaders
- Parents and child advocates
- MDE cross-office consultants

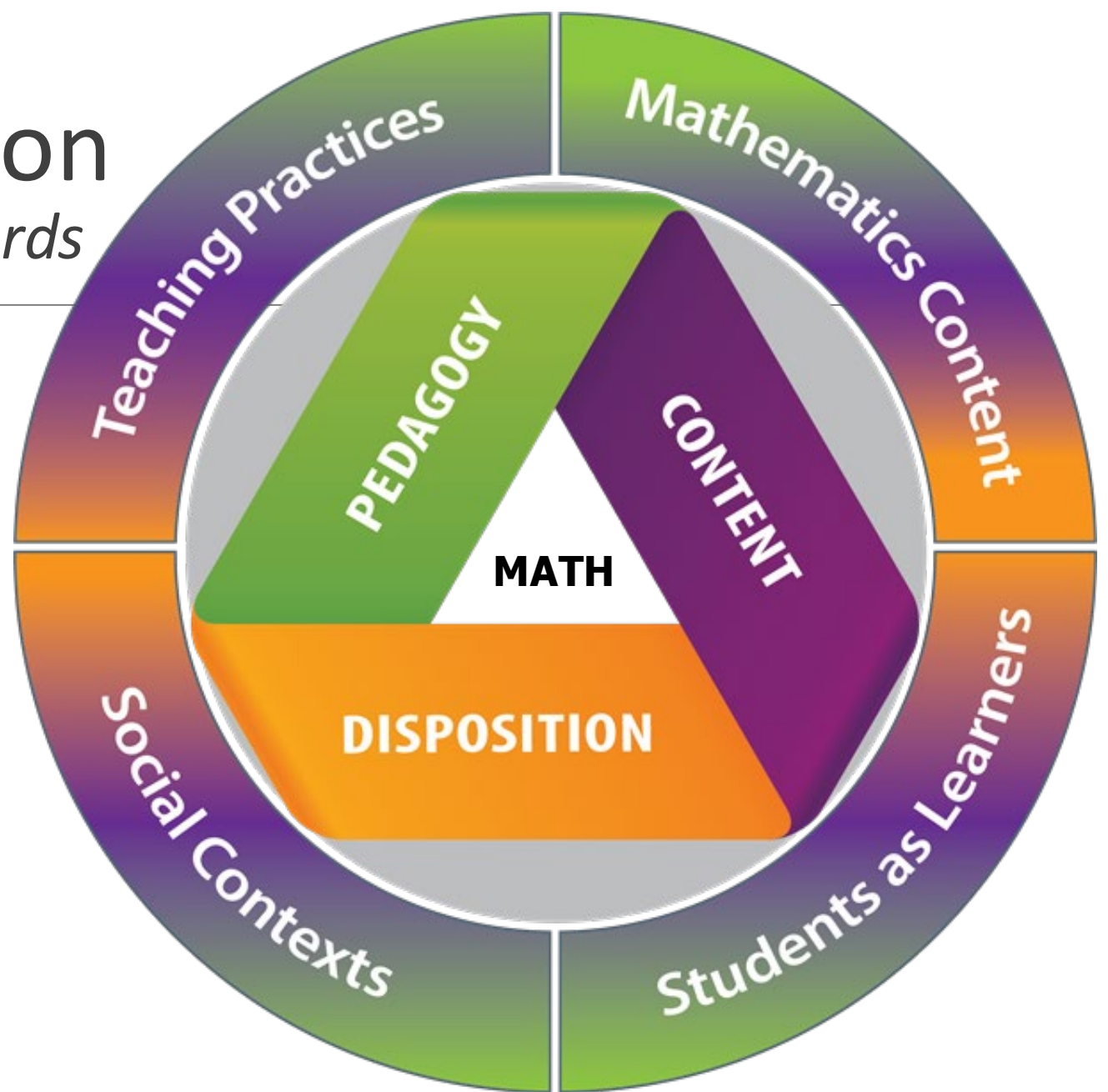
A total of 201 individuals from across the state (PK-12 teachers, teacher candidates, school administrators, teacher educators, education organization representatives, parents, and interested citizens) participated in the public comment survey.

Part Two: Mathematics Standards' Theoretical Foundation



Theoretical Foundation *of Michigan Mathematics Standards*

Integrated
development of
Pedagogy,
Content, and
Disposition (PCD)



Theoretical Foundation

of Michigan Mathematics Standards

What is “PCD”?

Pedagogy

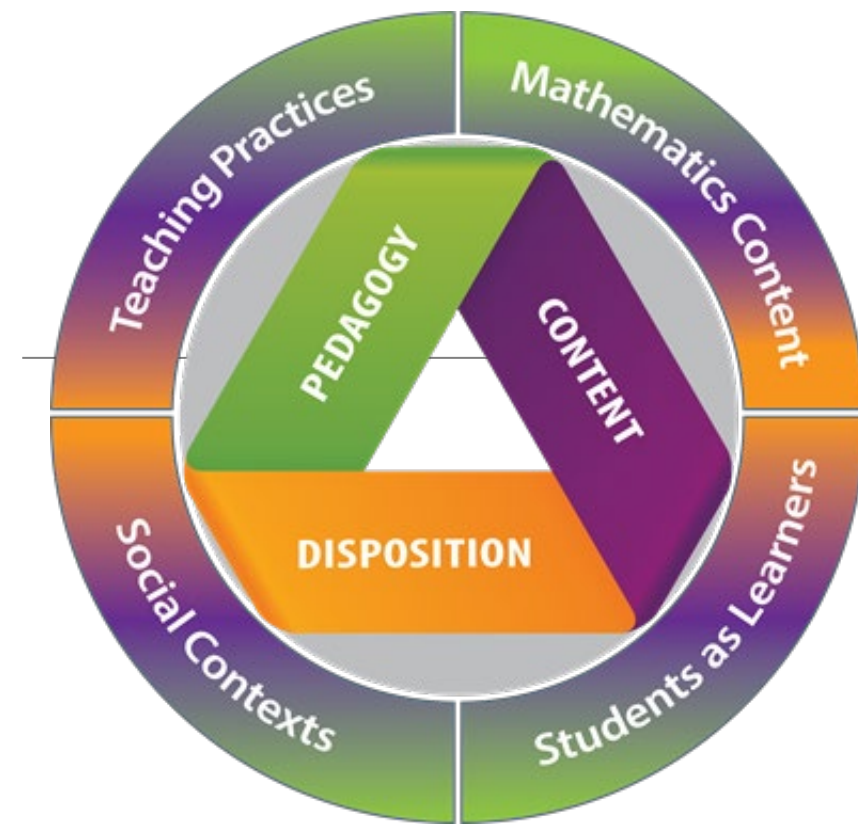
the ways of teaching mathematics

Content

the what of teaching mathematics

Dispositions

the beliefs and attitudes about mathematics, mathematics teaching, and mathematics learners



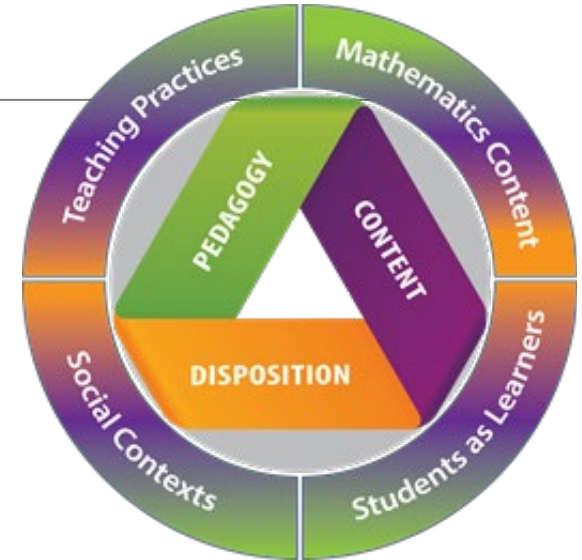
Theoretical Foundation *of Michigan Mathematics Standards*

A. Pedagogical Knowledge & **Practices for Teaching** Mathematics

A. **Students as Learners** of Mathematics

A. Understanding of **Social Contexts** of Mathematics Teaching and Learning

A. Understanding **Mathematics** Concepts, Practices, Dispositions, & Curriculum [*includes mathematical content*]



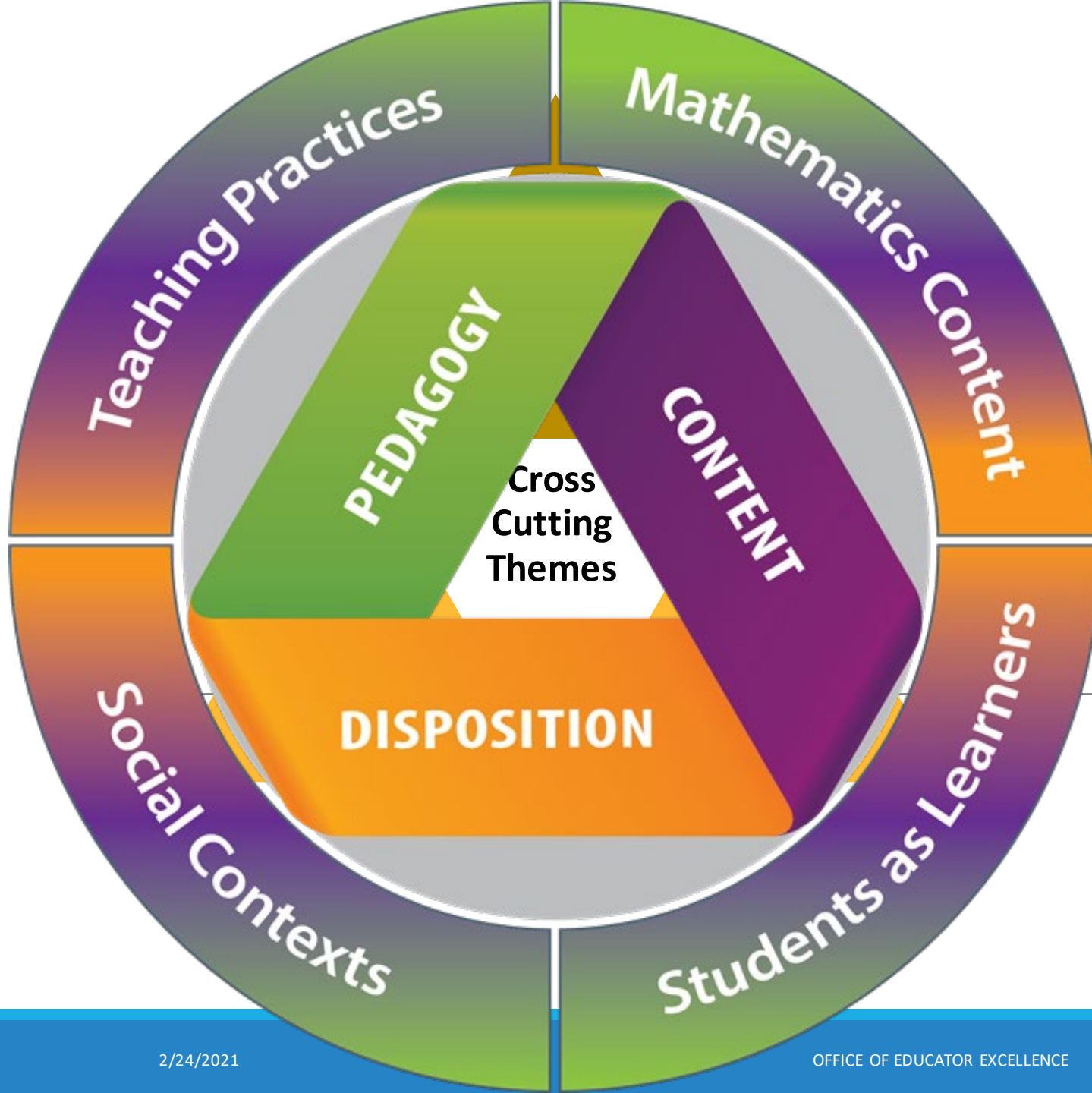


Example of Integrated PCD

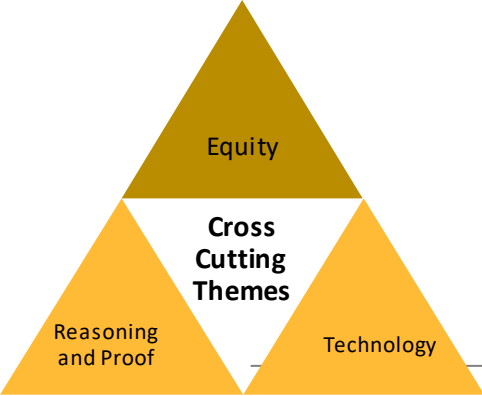
B1. Anticipate and Attend to Students' Thinking About Mathematics Content

Well-prepared beginning teachers of mathematics ...

- Understand learning progressions within the mathematical content domains they may teach which includes knowledge of the mathematics that comes before and after a given mathematics topic. **(content)**
- Elicit and analyze students' thinking to understand where students lie on the learning progression. **(pedagogy)**
- Utilize understanding of students' thinking to plan for and execute instructional moves to advance students' learning. **(pedagogy)**
- Provides frequent opportunities for students to be metacognitive about their own learning and understandings. **(pedagogy)**
- Recognize the importance of eliciting and understanding student experiences and identity in shaping their mathematical thinking. **(disposition)**



Cross Cutting Themes



Cross Cutting Themes

Equity

Equitable teacher preparation programs provide opportunity, support and advocacy for every potential teacher candidate and ensure that candidates are prepared to enact these three components of equity for every student in their care and for all students impacted by the system. This is particularly important given the structural barriers often in place that restrict access to rigorous mathematics and reduce student agency (NCTM, 2018).

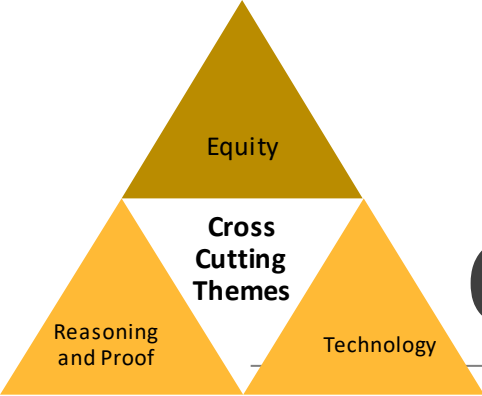
Technology

Computer software, interactive applets, and graphing calculators allow students to engage in mathematics that would have been out of reach without the technology, enable a focus on developing conceptual understanding and serve as platforms for exploration and making and testing conjectures.

Reasoning and Proof

Teacher candidates should have experiences with inductive and deductive reasoning and understand the differences. Programs should emphasize reasoning and proof in all content areas not just geometry.

Cross Cutting Themes - Examples



Equity

A.1.d Facilitate multiple opportunities for all students to formulate, represent, analyze, interpret mathematical models using a variety of tools including technology.

D.3.e Identify beliefs and classroom practices that produce equitable and inequitable mathematical learning experiences ... and seek to create more equitable learning environments.

Technology

A3.j Implement the use of appropriate mathematical tools (e.g., technology and manipulatives) to develop students' conceptual understanding.

D.a. Use different technologies to enhance the learning of mathematics ...

Reasoning and Proof

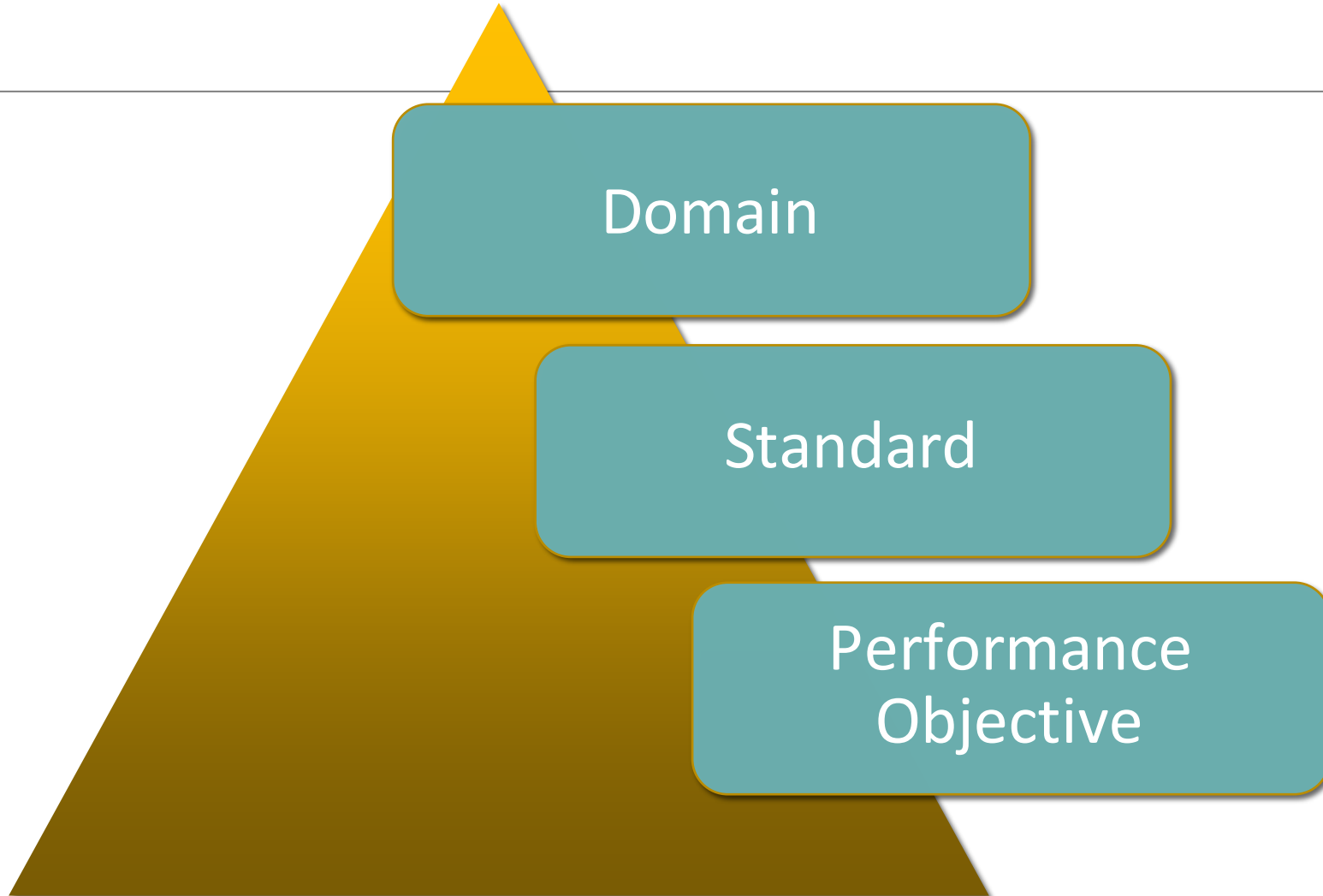
B.2.a Anticipate that students will present various approaches to problems and support students in analyzing, comparing, justifying, and proving their solutions.

D.1.3.d Describe the role of and be able to apply definitions, reasoning and proof in algebra including ...

Part Three: Overview and Structure of the Mathematics Standards



Hierarchy of Standards



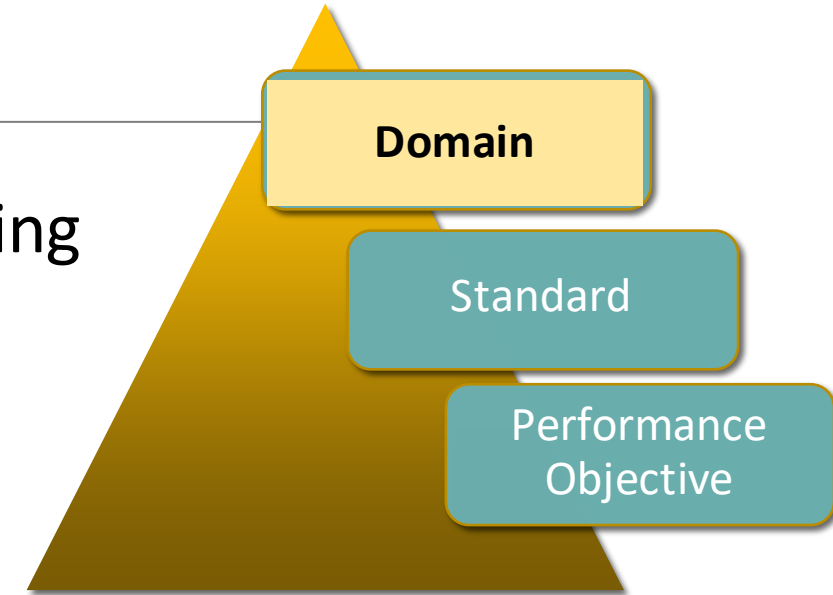
The Four Domains

A. Pedagogical Knowledge & Practices for Teaching Mathematics

A. Students as Learners of Mathematics

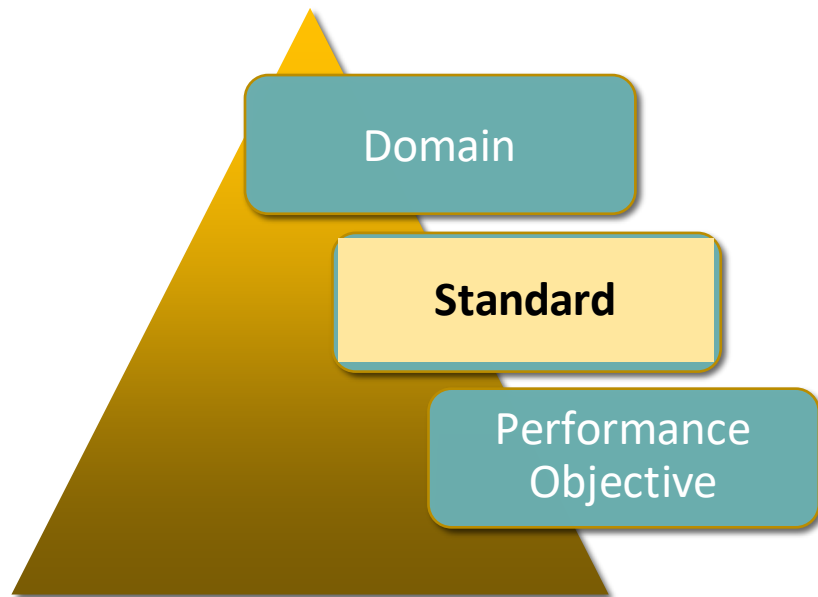
A. Understanding of Social Contexts of Mathematics Teaching and Learning

A. Understanding Mathematics Concepts, Practices, Dispositions, & Curriculum *[includes mathematical content]*



Domain A Standards

A. Pedagogical Knowledge and Practices for Teaching Mathematics



A.1. Promote Equitable Teaching

A.2. Plan for Effective Instruction

A.3. Implement Effective Instruction

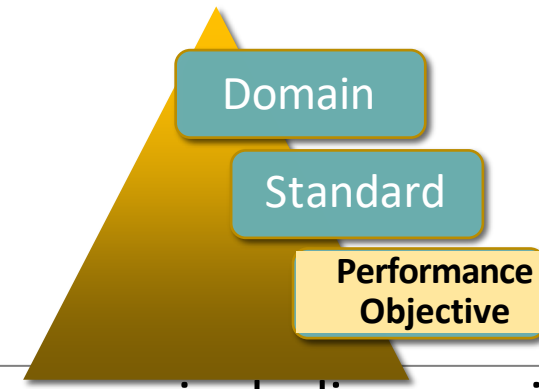
A.4. Enhance Teaching Through Collaboration With
Colleagues

Key Shift: A Change in How Equitable Teaching is Addressed

From the Previous Version of Secondary Mathematics Standards (2000)

- Teacher Preparation Programs should prepare teachers of mathematics to develop and use their knowledge of student diversity to affirm and support full participation and continued study of mathematics by all students. This diversity includes gender, ethnicity, socioeconomic background, language, special needs, and mathematical learning styles

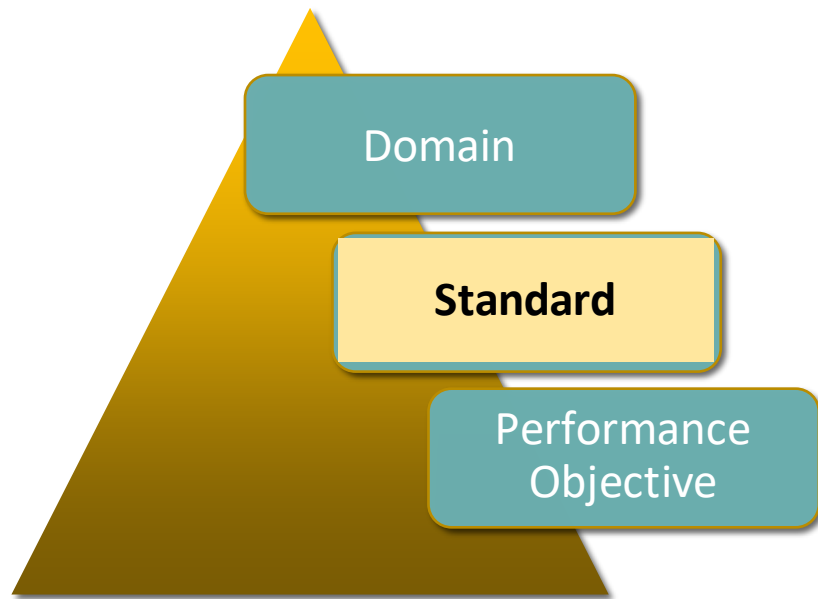
A.1. Promote Equitable Teaching



- a. Facilitate a range of tasks through equity-based pedagogy, including consideration of students' individual needs, cultural experiences, and interests, as well as prior mathematical knowledge.
- b. Develop a classroom community in which students present ideas, challenge one another's ideas respectfully, construct meaning together, value and celebrate varied mathematical strengths, and use mathematics to address problems and issues in their school, homes, and communities.
- c. Ensure all student approaches, responses, representations, experiences, and voices are valued in mathematical inquiries, discourse, and problem solving.
- ...
- f. Engage all students in challenging mathematics content, building from their own funds of knowledge as they use multiple representations and models of their choice.

Domain B Standards

B. Students as Learners of Mathematics



B.1. Anticipate and Attend to Students' Thinking About Mathematics Content

B.2. Promote Students' Engagement in Mathematical Practices

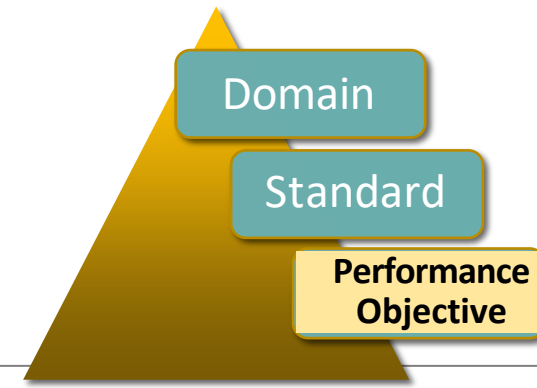
B.3. Cultivate Positive Mathematical Identities of Students

Key Shift: Cultivate Positive Mathematical Identities in Students Represents a Shift in Understanding

From the Previous Version of Secondary Mathematics Standards (2000)

2.11 Programs prepare prospective teachers to understand, use, and evaluate district mathematics curricula and to deliver the curriculum to each student.

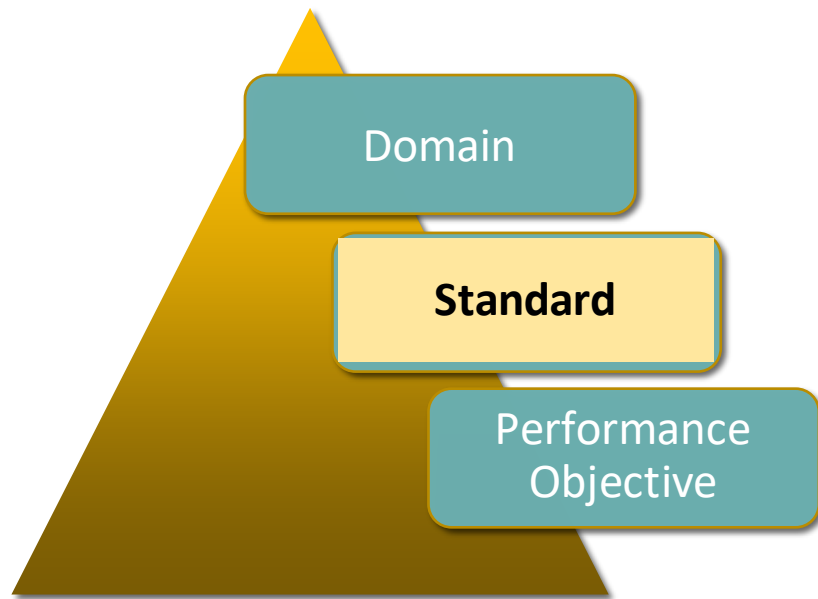
B.3. Cultivate Positive Mathematical Identities of Students



- a. Are reflective practitioners, understanding that student learning of mathematics relies upon the teacher and should view their roles as supporting the development of students' mathematical identities through their interactions with students and instructional decisions.
- b. Plan and implement mathematics instruction that draws on all students' mathematical strengths and positive mathematical identities that will allow them to be successful with the mathematics they are learning which in turn continues to develop positive mathematical identities.
- c. Analyze their task selection and implementation, reflecting on ways this shapes students' mathematical identities and consider how the experience of doing the task supports developing a positive mathematical identity for each student.
- d. Create classroom environments and orchestrate classroom discussions that enable respectful communication about mathematical ideas that support the development of positive student identities.

Domain C Standards

C. Understanding of **Social Contexts of Mathematics** Teaching and Learning



C.1. Provide Access and Opportunity

C.2. Understand Power and Privilege in the History of Mathematics Education

C.3. Enact Ethical Practice for Advocacy

Key Shift: Understand Power and Privilege in the History of Mathematics Education

From the Previous Version of Secondary Mathematics Standards (2000)

1.6 Programs prepare prospective teachers who have a knowledge of historical development in mathematics that includes the contributions of under-represented groups and diverse cultures.

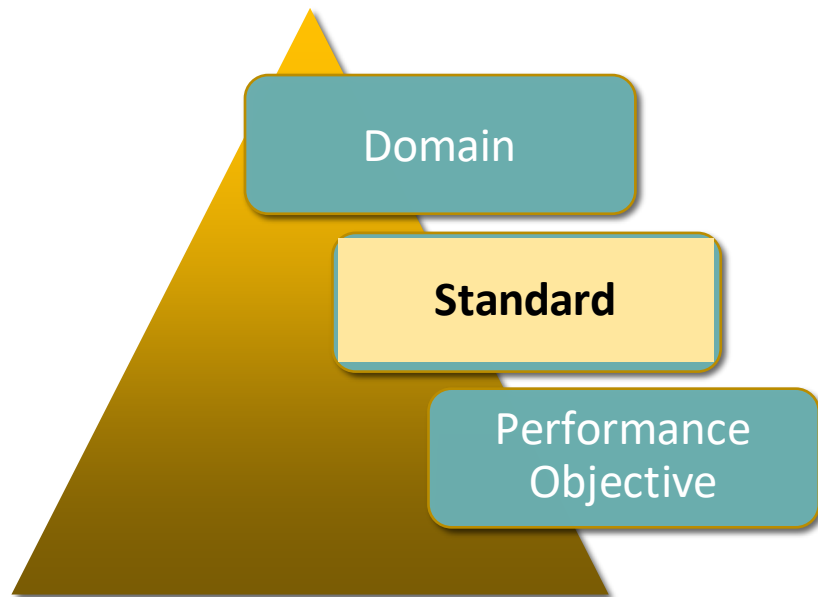
C.2. Understand Power and Privilege in the History of Mathematics Education



- a. Understand current and historical mathematical educational practices that contribute to inequitable student opportunities and outcomes...
- b. Are knowledgeable about national reform movements in mathematics education, including the strides and challenges in affording every student a quality mathematics education.
- c. Recognize and are willing to advocate for changes to policies and procedures that have negatively impacted mathematics learning, particularly for those students who have not historically experienced success in mathematics.
- d. Analyze mathematical curriculum and instruction to determine whether either is likely to contribute to inequitable mathematical outcomes and opportunities for students.
- e. Recognize implicit and explicit biases in themselves and others, including biases in the school/district culture, which work against equitable mathematics learning opportunities and support for all learners; works to counter these biases so that all students learn challenging mathematics deeply and well.

Domain D and Standards

D. Understanding Mathematics Concepts, Practices, Dispositions, and Curriculum



D.1. Know Relevant Mathematical Content

D.2. Demonstrate Mathematical Practices

D.3. Exhibit Productive Mathematical Dispositions

D.4. Analyze the Mathematical Content of Curriculum

D.5. Use Mathematical Tools and Technology

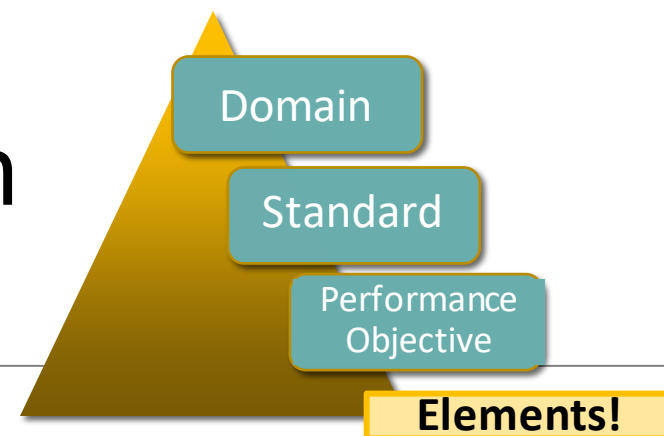
Key Shift: A Change in how Content is Addressed

From the Previous Version of Secondary Mathematics Standards (2000)

Programs prepare prospective teachers who can:

- 1.5.2 apply numerical computation and estimation techniques and extend them to algebraic expressions;
-
- 1.5.10 have a firm conceptual grasp of limit, continuity, differentiation and integration, and a thorough background in the techniques and application of calculus

Essential Concepts are in Each Content Area E D.1.1



D1.1 Essential Concepts in Number

Well prepared beginning teachers demonstrate and apply conceptual understanding, procedural fluency, factual knowledge and applications of the major mathematical concepts in number including flexibly applying computational procedures, using real and rational numbers in contexts, solving problems involving numbers and evaluating the solutions. Essential concepts in number include *integers, fractions*, number theory, operations (including exponentiation) and their meanings and properties, meanings of complex numbers, **operations with complex numbers, matrices, vectors, and graphing in a polar coordinate system**. Well prepared beginning teachers...

- A. Demonstrate “number sense” - flexible reasoning with and about whole numbers, integers and rational numbers in a variety of situations and applications through opportunities such as composing and decomposing numbers and number talks. (disposition)
- B. Describe the underlying structure of the *real / complex* number system and the learning progression for the development of number across the grades from kindergarten through high school. (pedagogy)
- C. Identify and apply a variety of strategies to compare and estimate rational and irrational numbers. (pedagogy & content)
- D. Understand and are fluent in using operations and appropriate notation, including exponentiation **and logarithms**, with *rational / complex* numbers, and can apply and justify multiple strategies for adding, subtracting, multiplying and dividing *rational / complex* numbers. (content)
- E. Apply and connect concepts such as factor, prime, divisible, and multiple to particular numbers and sets of numbers. (content)
- F. Reason about and prove basic theorems about real numbers (e.g., the product of two negative numbers is positive, $\sqrt{2}$ is irrational, or the product of two odd numbers will be odd). (content)
- G. Use technology to investigate certain numbers (e.g., value of pi, compare the relative size of two numerical expressions, evaluate limiting processes, or **compute with matrices**). (content)
- H. Understand how complex numbers are related to the solutions of *quadratic / polynomial* equations. (content)
- I. **Recognize that vectors and polar coordinates are useful mathematical tools to describe both location and direction and are able to employ these tools in contextual situations.** (content)
- J. **Recognize that matrices are a shorthand notation for organizing information and for carrying out computations on that information.** (content)

D. Understanding Mathematics Concepts, Practices, Dispositions, and Curriculum



D.2. Demonstrate Mathematical Practices:

Identify beliefs and classroom practices that produce equitable and inequitable mathematical learning experiences and outcomes for students and seek to create more equitable learning environments.

D.3. Exhibit Mathematical Dispositions

- b. See themselves as perpetual learners of mathematics and look for new and innovative ways to solve problems and seek out new mathematical tools and techniques.

D.4. Analyzing the Mathematics Content of the Curriculum:

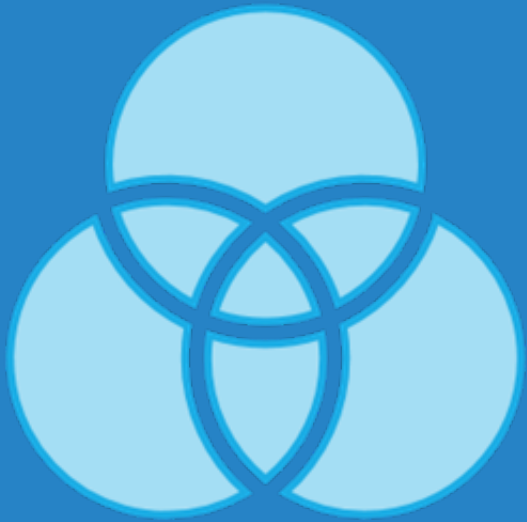
Programs prepare prospective teachers to understand, use, and evaluate ... standards documents, learning progressions, mathematics curricula, instructional materials, and assessment frameworks for the grades in which they are being prepared to teach. ... adjacent grade levels and ... mathematical standards for all of PK-12.

D.5. Use Mathematical Tools and Technology

Well-prepared beginning teachers of mathematics are proficient with tools and technology designed to support mathematical reasoning and sense making, both in doing mathematics themselves and supporting student learning of mathematics.

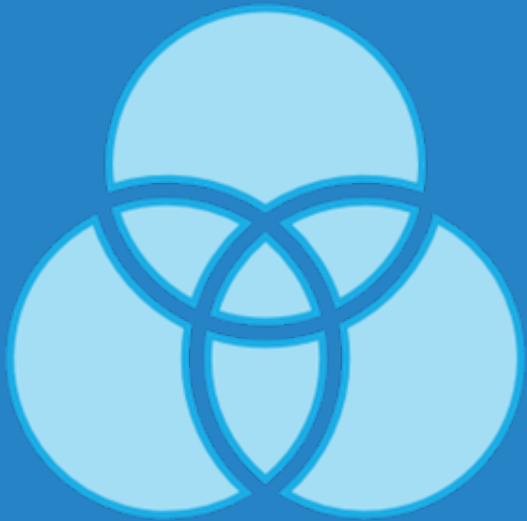
Part 4 Grade Band Detail

Commonalities Between 5-9 and 7-12 Grade Bands



- Same theoretical framework of PCD and Domains
- Same basic standards in Domains A, B and C and standards D.2-D.5
- Same overarching disciplinary content areas in D.1

Differences Between 5-9 and 7-12 Grade Bands



Key differences in the context!

- “all students” or “all learners” at the grade bands
- “grade-level or developmentally appropriate”

Key Differences in Content: Grade Band Differentiation

in Number Sense

Grades 5-9

Grades 7-12



Essential concepts in number include *integers, fractions*, number theory, operations (including exponentiation) and their meanings and properties, meanings of complex numbers, **operations with complex numbers, matrices, vectors, and graphing in a polar coordinate system.** *Well-prepared beginning middle school (5-9) teachers are expected to have a comprehensive, robust understanding of the essential concepts related to algebra content at the 5-9 level;* the **well-prepared beginning high school (7-12) will have a comprehensive, robust, understanding of algebra and a basic understanding through linear algebra.**

...

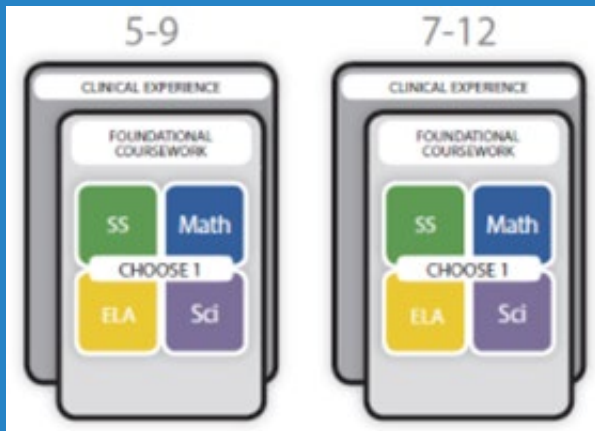
- a. Describe the underlying structure of the *real/complex* number system and the learning progression for the development of number across the grades ...
- b. Understand and are fluent in using operations and appropriate notation, including exponentiation **and logarithms**, with *rational/complex* numbers, and can apply and justify multiple strategies for adding, subtracting, multiplying, and dividing *rational/complex* numbers.
- g. Use technology to investigate certain numbers (e.g., value of pi, compare the relative size of two numerical expressions, evaluate limiting processes, or **compute with matrices**).
- h. Understand how complex numbers are related to the solutions of *quadratic/polynomial* equations.
- i. **Recognize that vectors and polar coordinates are useful mathematical tools to describe both location and direction and are able to employ these tools in contextual situations.**

Takeaways, Resources, Connections

Key Takeaways

- Integration of pedagogy, content, and disposition
- Intentional focus on content knowledge needed for teaching
- Equity focus throughout the experiences for beginning mathematics teachers
- Emphasis on students as learners of mathematics
- Written as performance expectations for beginning mathematics teachers

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Diversity Resources

Instructional Practices



Edutopia: Culturally Responsive Teaching - Articles & videos, Retrieved from <https://www.edutopia.org/article/bringing-culturally-responsive-lens-math-class>

Gutstein, E. Home Buying While Brown or Black: Teaching mathematics for racial justice. Retrieved from <https://rethinkingschools.org/articles/home-buying-while-brown-or-black/>

Gutstein, E., & Peterson, B. (Eds.). (2013). *Rethinking mathematics: Teaching social justice by the numbers* (2nd Ed.). Milwaukee, WI: Rethinking Schools, Ltd.

Diversity Resources - Instructional Mindsets



Hammond, Zaretta. *Culturally Responsive Teaching and The Brain*. Corwin Press, 2014.

Jurdak, Murad, et al. *Social and Political Dimensions of Mathematics Education: Current Thinking*. SpringerOpen, 2016.

Kendi, I. X. (2020). *How to be an antiracist*. New York: Random House Large Print, 9780593396803

Leonard, J., Napp, C., & Adeleke, S. (2009). The Complexities of Culturally Relevant Pedagogy: A Case Study of Two Secondary Mathematics Teachers and Their ESOL Students. *The High School Journal*, 93(1), 3-22. Retrieved from <http://www.jstor.org/stable/40363967>

Test Development

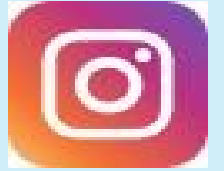
Volunteer for MTTC development committees at <http://www.mirecruit.nesinc.com>



Contact Information

For more information regarding the Middle Grades and High School Teacher Preparation Standards for Mathematics, please contact:

Darcy McMahon - McMahonD2@Michigan.gov



Connect With Us!

Please share your feedback about this meeting with us using the [Evaluation Survey](#) or access with QR code below.



Questions? Please contact Darcy McMahon
McMahonD2@Michigan.gov

@MIEducator

#proudMIEducator / #PME

