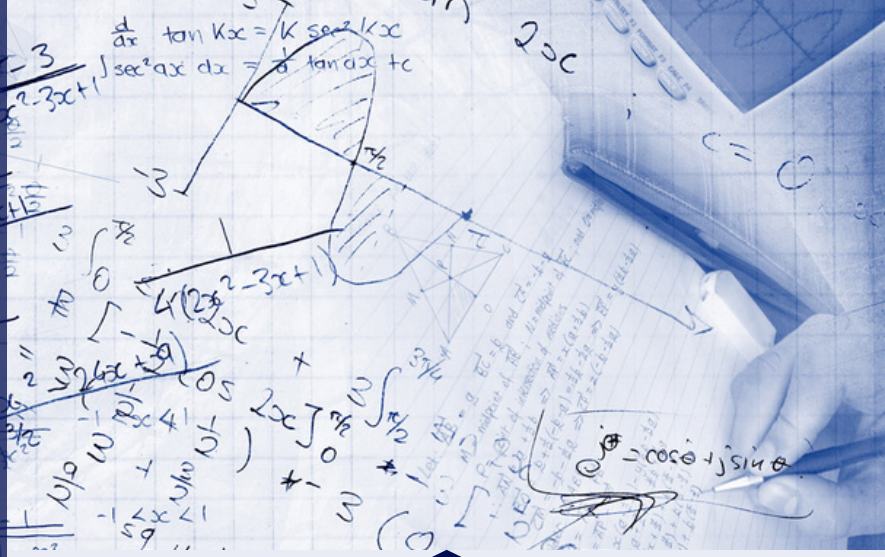
EQUITY IN MATHEMATICS EDUCATION

A Joint Position Statement for Connecticut



We assert three central commitments to re-conceptualize and transform mathematics education policies and practices

Equitable outcomes require us to:

01 **Support Students' Math Identities**

02 **Modernize Mathematics Programming**

03 **Align and Advance Systems**

We also establish a foundation of essential conditions, which are necessary but insufficient conditions for an equitable system in mathematics education.

EQUITABLE MATHEMATICS EDUCATION

Support Math Identities

- Ensure that all students see themselves as capable math learners
- Create opportunities for student agency in all classrooms
- Build from students' personal knowledge, experiences, and attitudes

Modernize Mathematics Programming

- Modernize content for 21st century demands
- Enhance relevance for students
- Diversify offerings including pathways of courses

Align and Advance Systems

- Align assessment with instructional goals and pedagogy
- Collaborate to establish consistent vision among K-12, postsecondary, and state-level stakeholders
- Review and reform systems that sort students and limit opportunities and lower expectations

Essential Conditions

Focus on Strengths; Eliminate Deficit Perspectives	Create Structural Alternatives to Tracking	Prioritize Math on Equal Footing with Literacy	Assess to Improve Student Learning	Consistently Implement High-Quality Curriculum

Collaboratively authored by
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Support Students' Math Identities

Equitable outcomes require that we cultivate students' positive mathematical identities and sense of agency as doers of mathematics [1, 2]. Student agency is fostered when students have a role in their own mathematical development and feel they can influence the environments in which they participate. Equally important, mathematics identities, which are the "dispositions and deeply held beliefs that students develop about their ability" [3], to be critical components of framing knowledge, skills, habits, attitudes, beliefs and relationships to develop as successful mathematics learners [4-7]. Positive identities follow from ensuring meaningful engagement, communicating a genuine belief in students' ability to do mathematics, and holding all students to high expectations in their math classes. Mathematics has traditionally marginalized groups of students through our cultural practices of keeping students as receivers of knowledge, and not creators. Classrooms must provide students, especially students of color and females, a strong sense of agency so they can become the creators of mathematics.

Students should have opportunities to collaborate about mathematical concepts as well as personal understandings. Student learning experiences must grow and develop their mathematical view of the world so that students can recognize and analyze real-world problems to ultimately solve society's current and future problems [8, 9]. Students each bring their own unique background as they develop their mathematics identity. These backgrounds must be respected and used as a way to help all students apply what they learn to the problems within society. This can be accomplished through mathematical practices [10, 11], such as reasoning and sense-making, developing perseverance in the face of challenge, constructing viable arguments and critiques of others' ideas, and developing various models to represent ideas. All students must be provided access to these ways of mathematical thinking if students are to grow positively in their mathematics identity and belief that they can do mathematics.

Classrooms must provide students a strong sense of agency so they can become the creators of mathematics.

Modernize Mathematical Programming

All students should have access to grade-level appropriate courses that teach 21st-century content and skills that prepares them for the mathematics that modern daily and work life demands [12]. Equitable outcomes require a diversification of mathematical offerings, particularly at the secondary level, to create programs that engage students and attend to students' current lives and future trajectories [13]. Modernizing mathematics programming will benefit all students, and it is especially important for students who identify as members of groups that have been historically marginalized in our current systems. Modernizing programming requires reducing emphasis on antiquated content and expanding content and course offerings to ensure our graduates are prepared with the mathematical knowledge and know-how to be successful in the world they face. Our modernized mathematical programming needs to reflect the reduced role of computation while emphasizing computational thinking and providing the skills needed to utilize modern technology [14, 15].

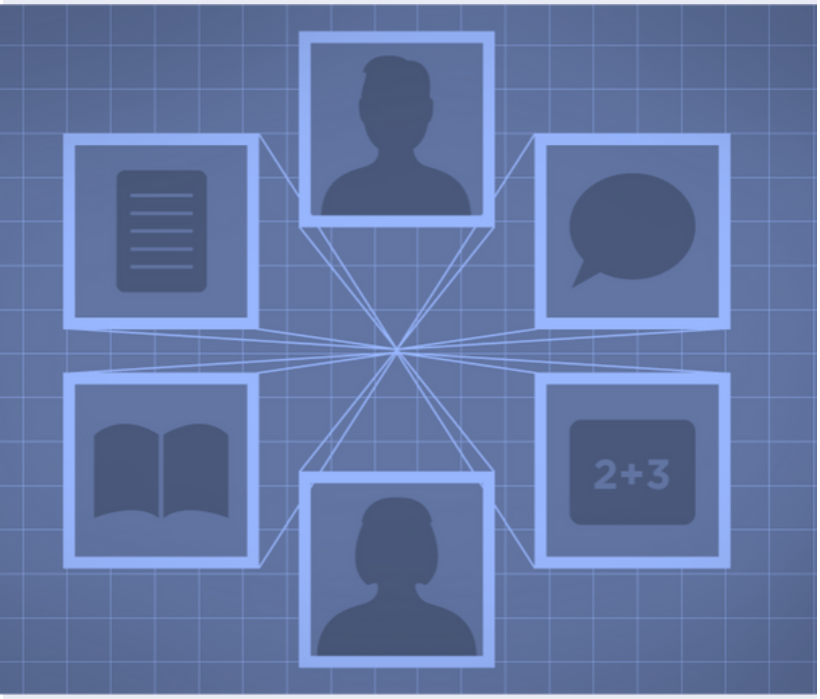
The mathematical needs of work and life have changed immeasurably over the past decades, especially with the arrival of technologies, yet current PreK-12 mathematics remains rooted in past practices and content [16-18]. The emphasis continues to be paper-and-pencil algorithmic skills at the elementary level and programming that prioritizes a pathway to calculus at the secondary level. Learning mathematics needs to be considered purposeful and important not only for college (both STEM and non-STEM related careers) and life, but also as a human endeavor that prepares students for our data-driven society, ultimately equipping them with the quantitative tools to be engaged in their communities and to empower them to be informed members of a democratic society and challenge the status quo. Graduates of our PreK-12 mathematics programs should feel equipped with quantitative literacy and critical thinking processes that will enable them to make sound decisions in their personal lives relative to their own health, wealth, and well being. It is our collective responsibility to provide all students with mathematical experiences that engage them in ways that are meaningful and relevant to their current lives and that include regular opportunities for inquiry, problem solving, modeling, collaboration and to develop technology skills and communication skills.

Guided by state standards, policies, and initiatives, many districts have made changes to their programming. At the K-8 level, our understanding of computational and procedural fluency is more aligned to 21st-century demands, although often there is still an overemphasis on making all students proficient in traditional algorithms at the expense of further developing mathematical reasoning and problem-solving. At the high school level, there are opportunities for districts to utilize the revised state high school graduation requirements to expand pathways in order to provide mathematical programming that is relevant to all students and reflective of society's many uses of math. One approach to modernizing mathematical programming is implementing the key recommendations set forth in the National Council of Teachers of

Mathematics' (NCTM) *Catalyzing Change for High School Mathematics* (2018) [19], which would ensure that each and every student has sufficient opportunity to master the identified Essential Concepts during the first 2-3 years of high school. The final year(s) could offer students innovative courses that address students' interests and future needs, including those needed for both STEM and non-STEM related careers. For example, high schools might offer students courses such as a full year of statistics and modeling, data science, and/or electives such as Advanced Mathematical Decision Making.

Equitable outcomes will require that all pathways and courses offered are "consistent with one another with respect to mathematical rigor, demand for reasoning, relevance and the postsecondary opportunities that they afford students" [20]. No student should be held back from such course offerings due to an inability to compute. Mathematical programming must be modernized to offer all students relevant content. Equitable outcomes in mathematics cannot be obtained otherwise.

A strong equitable system begins with alignment



Align and Advance Systems

Equitable outcomes in mathematics education require systems, policies, and regulation at the state, district, and school levels that collectively provide consistent, coherent, high-quality opportunities to all students for learning mathematics. Alignment is essential. One part of the system cannot undermine others. All stakeholders must work together to establish effective, equitable systems for Connecticut that are reviewed and evaluated regularly for the purposes of continual improvement and growth.

A strong, equitable system begins with alignment among standards, curriculum, instruction, and assessment, as well as policies that shape how these four elements interact and support student learning. Best practices in assessment require multiple measures and multiple data points to document what students know [21, 22] and to support instruction. Comprehensive assessment practices that seek to link assessments with learning goals and instruction support student learning. A more equitable system, therefore, uses multiple data points to triangulate student learning and offers multiple forms of

assessment to capture and value students' different and changing capacities. Further, assessment policies and practices that are multi-faceted can more effectively capture students' development of dynamic mathematical practices such as modeling, argumentation, and strategic use of tools. Assessment policies must align with instructional goals and pedagogy in ways that are responsive to students and that support engaging students in relevant mathematics.

An equitable, well-functioning system also requires careful attention to alignment among college requirements and state-level graduation requirements [23]. Teachers and districts need to be guided by a consistent vision and expectations. Without intentional, purposeful alignment, students are subjected to competing, and potentially contradictory, demands that emerge as they navigate college admission requirements, placement requirements, and state graduation requirements. Requirements are very valuable in setting goals and supporting meaningful programming. In order to promote alignment among requirements, stakeholders from all sectors should be engaged in the review and setting of requirements that are external to PreK-12 schools, but that have a forceful impact on student learning opportunities.

At the district and school level, systems that identify and sort students deserve special attention. These systems include programming for remediation, acceleration, or intervention, as well as systems of leveling or tracking. An equitable system does not separate and label students. Equitable student outcomes require curbing and ultimately eliminating tracking practices that result in limited opportunities and lowered expectations [24, 25]. To promote equitable outcomes, all programs and structures must be designed to be asset-based, acknowledging and building on the strengths students (and teachers) bring to mathematics learning. All learning moves along a continuum that is not static and must be responsive to students' changing needs. Any systems that identify and sort students in any way need to be subject to ongoing examination (for example, through action research; evaluation), reflection and revision, as appropriate, to ensure the desired outcomes are achieved and that the system is functioning equitably for ALL students.

Essential Conditions

To achieve the goal of equitable mathematics education, we recognize that a foundation of essential conditions must be established.

1. Focus on Strengths - Eliminate Deficit Perspectives of Students
2. Create Structural Alternatives to Tracking
3. Prioritize Mathematics on Equal Footing with Literacy
4. Assess for Improving Student Learning
5. Consistently Implement High-Quality Curriculum

Essential Conditions

1. Focus on Strengths - Eliminate Deficit Perspectives of Students

Deficit perspectives define students by their weaknesses; by contrast, asset-based approaches recognize and use students' knowledge, experiences, creativity, and personal goals as valuable resources in designing policies and programming to systematically develop powerful mathematical competencies in students. Due to the effects of systemic racism, it is easy to fall into deficit thinking by focusing on the challenges faced by individuals or particular groups (e.g., low-income families, students of color) [26]. To accomplish the goals we set forth in this document, it is necessary that actors in every part of the mathematics education system promote and act on views and language that are asset-based to acknowledge the strengths students bring to the learning of mathematics [27, 28]. Students are capable of learning mathematics at high cognitive levels - often higher than we give them credit for. By focusing on students' strengths, teachers can promote positive mathematics identities that support students to see themselves as doers of mathematics. Teaching mathematics equitably requires that "rather than trying to know what to do to students, we must work with students to interpret and deepen their existing knowledge and enthusiasm for learning" [29].

2. Create Structural Alternatives to Tracking

The goals outlined here cannot be achieved if a system restricts some students' access to rigorous and high-quality mathematics. Unfortunately, students' access to rigorous mathematics can be limited as a result of good intentions, often as a result of deficit perspectives used, even subconsciously, to make decisions about what mathematics students are "ready" to learn and the ways in which they "can" learn it. These deficit perspectives can lead to tracking students into remedial courses or create other negative school environments [30, 31]. Systems that track students into a series of courses with limited opportunities to reason or problem solve, often with lowered expectations, are inherently inequitable [32, 33]. Consequently, an essential condition of equitable mathematics requires that schools and districts curb and ultimately eliminate practices that limit students' access to rigorous mathematics and instead provide opportunities for rich mathematics and high expectations for all students.

3. Prioritize Mathematics on Equal Footing with Literacy

Numeracy, the ability to work with and understand numbers, has been shown to be critical for students' long-term success, including in schooling and employment [34]. Working towards equitable mathematics education for all students requires that mathematics is a priority throughout all levels of the state education system. Prioritizing mathematics includes ensuring time for teachers and students to engage with the content deeply as well as providing consistent and meaningful support for teachers' development via coaching and other opportunities. On-going professional learning for teachers is also essential to develop equitable mathematics instruction.
Furthermore, there must be an ample supply of high-quality teachers of mathematics. Due to the consistent

shortage of mathematics teachers in Connecticut, achieving an ample supply requires investment and planning. Our schools need experts in numeracy to ensure all students ultimately master foundational quantitative competencies. Our systems support literacy instruction with highly trained reading specialists. A parallel system for mathematics education would recognize the essential nature of mathematics for all CT school children. [35]

4. Assess for Improving Student Learning

We know from research that formative assessments and feedback have powerful impacts on students' mathematical learning [36, 37]. Teachers need information about what their students know and can do, readily available, so that they can act on that information and adjust their instruction accordingly. Equally important, students need information about their performance, particularly in the form of clear and actionable feedback. Assessments should include opportunities for students to engage with the kinds of mathematics we know to be essential for all students, such as reasoning, sense-making, problem-solving. Summative assessments should elicit a broad range of types of students' thinking and provide options for students to document their thinking in a variety of ways. Such assessments provide important information about students' knowledge and skills in ways that reflect their unique identities and diverse goals. Grading practices, which are different from assessment practices, have the power to support or impede student learning. Therefore, equitable mathematics instruction relies on grading practices that allow assessments to be used to their full potential.

5. Consistently Implement High-Quality Curriculum

A high-quality mathematics curriculum supports students' development of procedural fluency, conceptual understanding, and reasoning and problem-solving [38]. It is coherent and includes meaningful development of concepts that support students to make connections among ideas. Although there is a proliferation of resources available online, the challenge lies in implementing curricular resources in ways that support rich mathematical thinking. Curriculum resources establish a foundation upon which teachers can build. In order to focus on the work of creating equitable classroom communities and engaging instruction, teachers need to continuously use relevant, rigorous, meaningful tasks that allow students to solve non-routine problems. Consistently implementing high-quality curriculum also requires supports.

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