Equity in K–12 STEM Education

Framing Decisions for the Future

The promise of science, technology, engineering, and mathematics (STEM) lives in the American imagination as one of the nation's most reliable economic engines, necessary to maintain the country's global competitiveness, the key to innovation and discovery, and a pathway toward both individual and collective prosperity. Despite the importance of the STEM disciplines in the landscape of U.S. political, economic, and social priorities, STEM learning opportunities are unevenly distributed, and the experiences an individual has in STEM education are likely to vary tremendously based on their race, ethnicity, socio-economic class, gender, and a myriad of other factors. Ensuring equity in the learning of STEM requires substantial and intentional ongoing effort.

To address inequities in K–12 STEM education, the National Academies of Sciences, Engineering, and Medicine's Board on Science Education convened an expert committee to explore the range of issues associated with equity in STEM education and to outline steps toward more equitable STEM education experiences. The 16-member committee included experts in PK–12 education policy, STEM education, education leadership, teaching and learning, assessment and measurement, and diversity and equity in STEM.

THE CURRENT CONTEXT OF K–12 STEM EDUCATION
The current context of STEM education is shaped by history, policy, and the decisions made by individuals throughout the education system over decades, if not centuries. From its inception, the American educational system has functioned to maintain social stratification and access to power and privilege, even while some

individuals and communities have leveraged education to access opportunity.

Results from national and state-level assessments of performance in STEM subjects consistently document persistent achievement gaps across demographic groups, despite accountability-based reform efforts intended to address these gaps. Examining achievement gaps alone, however, provides little insight into the sources of observed differences in performance. Instead, it is important to examine differences in opportunities to learn. Access to high-quality learning experiences in STEM disciplines is uneven across preK–12 education with strong associations between school-level racial-economic segregation.

In addition to large-scale trends in opportunities to learn, the experiences of children and youth in classrooms and schools also play a role in reproducing inequities. Classroom processes, norms, participation structures, and interpersonal dynamics can send signals about who belongs or can be competent in STEM. The resulting moment to moment interactions shape the individual experiences of children and youth with consequences for their learning, identity, and sense of belonging in STEM. Thus, understanding and addressing inequity in STEM education involves addressing both population-level trends and the individual- and classroom-level interactions that contribute to them.

ADVANCING EQUITY IN STEM THROUGH DECISION-MAKING

The committee approached equity in STEM education not as a singular goal but as an ongoing process that requires intentional decision-making and action toward addressing and disrupting existing inequities and envisioning a more just future. Given the specific histories and contexts of different schools, districts, communities, and regions, equity-related goals and the strategies for achieving them may vary substantially from place to place and may need to change over time.

The education system in the United States is organized across multiple levels including federal-, state-, district-, and school-level policies and practices. Opportunities to advance equity in STEM learning exist at each of these levels. Identifying these opportunities requires an understanding of the policies, the key actors in the context, potential resources to leverage, and a willingness to be creative. Consequential decision-making for increasing equity in STEM education involves balancing short-term gains while maintaining a vision for and strategic action toward long-term, continuous, and broad systemic change.

FRAMEWORK FOR DECISION-MAKING

Stakeholders at all levels of the education system—including state, district, and school leaders and classroom teachers—have roles as decision-makers who can advance equity. The committee has developed five equity frames as a guide to help decision-makers articulate short- and long-term goals for equity and make decisions about policy and practice.

Frame One: Reducing Gaps Between Groups

Aim to address gaps between different groups based on race, gender identity, or some other factor such as social class. Those gaps might be related to interest in STEM, achievement, or representation within the STEM workforce. The approaches tend to emphasize interventions, typically implemented in schools or within ecosystems, evaluated in terms of their ability to reduce such gaps, and they often target members of social groups.

Frame Two: Expanding Opportunity and Access

Focus on access to opportunities in STEM, such as those that result from differences in social and material resources necessary to learn; access to well-prepared educators; a network of adult and peer supporters for learning; and high-quality curricular experiences. Approaches to increasing access and opportunity vary, but typically focus on changing conditions for access through policy changes within institutions or use strategies for brokering opportunities across institutions.

Frame Three: Embracing Heterogeneity in STEM Classrooms

Emphasize engaging with the concerns, lived experiences, and identities of students who have been and often continue to be marginalized in STEM education settings. Emphasize the importance of embracing the

different ways of thinking, feeling, and being of young people within STEM classrooms.

Frame Four: Learning and Using STEM to Promote Justice
Center learning STEM as a resource within movements for social and socioecological justice. Throughout history, there are examples of ways that the STEM fields have been used as instruments in larger agendas of nationalism and colonialism, and their role as an instrument for justice for marginalized communities has been diminished, both in practice and within education.

Frame 5: Envisioning Sustainable Futures Through STEM
Emphasize a role for STEM education in cultivating equitable, just, and thriving social and ecological futures that attend to and support both ecological and human well-being. This frame is very forward looking including potentially re-imagining the structures and setting for schooling.

LEVERS FOR ADVANCING EQUITY
To advance intentional, coherent change the report recommends that state, district, and school education leaders and decision-makers across both in- and out-of-school spaces should develop strategic plans for advancing equity in STEM education guided by a clear articulation of equity-related goals. These endeavors should ensure that the specific histories and cultural contexts of impacted communities are represented in the decision-making process.

To develop and advance the strategic plans, leaders should conduct an initial "equity audit" to identify patterns of inequity and to aid in prioritizing investments and changes in policy and practice; collect ongoing data to document progress toward equity goals and inform ongoing improvement efforts; and identity problematic or harmful policies and practices and revise decisions as appropriate.

The committee identified key policy domains that can be leveraged to advance equity through intentional decision-making and action. These include Instruction, Professional Learning for Teachers, Instructional Materials, Assessment, and Pathways for Students. The committee makes recommendations in each domain for steps to take that can advance equity. A complete account of recommendations can be found in the full report.

FUNDING SUPPORT
To support equity in STEM education, funders of PK-12 education such as philanthropic organizations, government agencies, and business and industry should provide resources for the development of STEM instructional materials and associated professional learning materials for teachers that include attention to equity and are designed with robust conceptions of equity at the center. Organizations should prioritize funding proposals for STEM education programs that identify a specific vision of equity, articulate a clear plan for how the project will achieve its equity goals, and center equity throughout the project design and expand how projects can demonstrate success to include measures that go beyond narrow definitions of student achievement.

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