Community for Advancing Discovery Research in Education

This brief draws on research supported by the National Science Foundation to highlight considerations for educational leaders and others who make decisions about supporting inclusive STEM education.

Creating Inclusive PreK–12 STEM Learning Environments

What Is STEM?

In this brief, "STEM" is meant to include science, technology, engineering, and mathematics as individual disciplines and as the integration of those disciplines with each other. The brief refers to individual disciplines when research specifically addresses those disciplines.

The Challenge

STEM-related skills, knowledge, and qualifications are highly valued in our society. Yet, specific groups of students have had, and continue to have, unequal opportunities to learn STEM from PreK through high school. This exclusion is caused by many factors and has led to well-documented disparities in the selection of STEM-related majors and careers. Redressing these inequities is a moral imperative.

The Opportunity

Broadening participation in PreK–12 STEM provides ALL students with STEM learning experiences that can prepare them for civic life and the workforce. In this way, broadening participation has the potential to transform society by reducing social and economic inequities, and by bringing new knowledge to scientific problems and solutions. The shifts called for by many recent state mathematics and science standards and increased attention to K–12 engineering and computer science provide an opportunity to reshape PreK–12 STEM education to be more inclusive of groups who are underrepresented in STEM. These groups include females; Latinos, Hispanics, Blacks, and other students of color; English learners; and students with disabilities.

What We Are Learning

Inclusive STEM learning spaces look and sound different.

Inclusive STEM classrooms embody what we know about high-quality STEM teaching, with an emphasis on the learning of ALL children. In inclusive classrooms:

- ALL students are doing and learning STEM. Children in ALL grades, of ALL abilities, and from ALL backgrounds talk and collaborate as they engage with STEM-related concepts and phenomena. They share their ideas, knowledge, and work, even if they do not have all the answers. As a result, these classrooms may be more active than traditional classrooms.
- Teachers believe that ALL students are capable of thinking about, knowing, and learning STEM. They do not expect students to have all the answers, and they accept "failure" as a natural part of doing STEM. They listen to students' ideas; find different ways for students with diverse languages, backgrounds, and abilities to express those ideas; and connect the knowledge students bring to the classroom with STEM.
- STEM learning and language learning are intertwined. When students engage in science, mathematics, and engineering practices, they collaborate to engage with phenomena, explore and analyze ideas, and develop and justify their explanations. Talking and reasoning about STEM, with support from teachers and peers, encourages ALL students to extend their vocabulary to express their ideas.

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- Allowing ALL students to experience the joy of discovery takes time. STEM involves trial and error, and it involves collaboration to explore and analyze ideas. Although this type of learning takes more time than covering a predetermined sequence of ideas, it builds genuine understanding in STEM.

Broadening participation also includes families and communities.

- A deep understanding of the learning assets in students' communities can help leverage their cultural and linguistic resources for STEM learning. Teachers who have this understanding can encourage students to share knowledge they bring from outside the classroom. This approach can strengthen the connection between students' lives and school STEM concepts.

- Community-based STEM learning opportunities can help families, businesses, and communities while supporting children's aspirations and interests. Parents and caregivers can build relationships with their children's teachers and learn how to support their children's interests in STEM. Families also enjoy engaging in STEM activities alongside their children and discussing STEM-related ideas that are connected to their lives.

Broadening participation requires a different set of responses from the education system.

Creating inclusive environments involves systemic changes that require the strategic use of human and material resources. Schools, districts, and states must take deliberate action to broaden participation over the long term. These actions will vary at each level of the education system.

Action Steps for Creating Inclusive PreK-12 STEM Learning Environments

1 Articulate a clear vision for, and long-term commitment to, broadening participation in STEM.

This vision should demonstrate a commitment to increasing availability of and participation in high-quality STEM learning experiences for ALL students. Among other things, it should recognize the importance of science in the elementary grades, capitalize on the new opportunities that engineering and computer science offer for engaging students, adopt an asset-based approach to engaging families and communities, and address long-term sustainability of broadening participation efforts.

2 Rethink professional learning.

Expectations and opportunities to learn STEM are set from the moment a child enters the classroom. Creating inclusive classroom learning environments is an essential yet underdeveloped skill. Professional learning for teachers

should blend the elements of teaching STEM and broadening participation. It can include families and students to help educators appreciate families' commitment to education and understand students' thinking about STEM. Involving administrators can increase their awareness of the changes needed to broaden participation in STEM.

3 Provide the specific types of tools, materials, and other supports that inclusive learning environments require.

Teachers need time, tools, and supports to facilitate broad participation in STEM learning. Tools might include objects and systems that enable students with language or learning differences to express their STEM knowledge, and new STEM workspaces and equipment. Supports might include instructional coaches to help teachers integrate STEM content with strategies for broadening participation.

4 Consider the effect of existing and prospective policies on students' STEM learning.

Numerous policies at different levels of the education system can enhance or limit STEM participation. It is especially important to consider the positive and negative effects of STEM course offerings and policies related to curriculum, pacing, tracking, and the inclusion of English learners and students with disabilities. Organizational policies and structures that enhance teachers' expertise and support their efforts to broaden participation (e.g., time to collaborate) also merit attention. Finally, it is important to be aware of broader societal conditions (e.g., food insecurity, fear of deportation, the need for adolescents to earn income) that could affect the participation of some students and their families in STEM programs.

5 Recognize different types of success and share success stories.

Success comes in many forms. Just as test scores and grades count as success, so, too, does solving STEM problems or representing STEM ideas in novel ways. When underrepresented students see their successes in STEM recognized and celebrated, they may develop strong STEM identities and shift teachers' and communities' ideas about who can do STEM. Stories of classrooms and schools that broaden participation for underrepresented students in these and other ways should be shared widely within the school, the district, and the community.

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