SOLVING THE EDUCATION EQUATION

A new model for improving STEM workforce outcomes through academic equity

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A report developed for the Multi-stakeholder Coalition for Building a Diverse U.S. STEM Workforce

NAPE
National Alliance for Partnerships in Equity

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This report represents the work of a grassroots, multi-stakeholder coalition representing businesses, nonprofits, civil rights groups, K-12 and higher education, associations, and quasi-governmental agencies concerned about advancing U.S. global security and competitiveness through a strong STEM workforce. The ***Multi-stakeholder Coalition for Building a Diverse U.S. STEM Workforce*** has contributed to the formation of this report and supports its recommendations.

The Coalition thanks the **National Alliance for Partnerships in Equity (NAPE) and its Education Foundation and the Johns Hopkins University School of Education** for its work in convening stakeholders and providing leadership in re-visioning the education equation to achieve equally high academic outcomes for all students, regardless of race, gender, language, family income, or physical ability, leading to high-skill, high-wage, high-demand careers.

NAPE, chartered in 1990, is a consortium of state and local education and workforce development agencies, corporations, and national organizations committed to building educators' capacity to implement effective solutions for increasing student access, educational equity, and workforce diversity. **The NAPE Education Foundation, Inc. (the Foundation)** was established in 2002 in response to requests for assistance with program improvement efforts by education and workforce agencies across the nation. The Foundation shares NAPE's commitment to the advancement of access, equity, and diversity in classrooms and workplaces.

The **Johns Hopkins University School of Education** was established in 2007 and has quickly taken a place as a national leader in education reform through research and teaching. Ranked first nationally among graduate schools of education by *U.S. News & World Report*, the school is engaged in a variety of research and development activities that are making lasting improvements in student achievement—from early childhood to the adult learner.

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Supporters

- Academic Innovations
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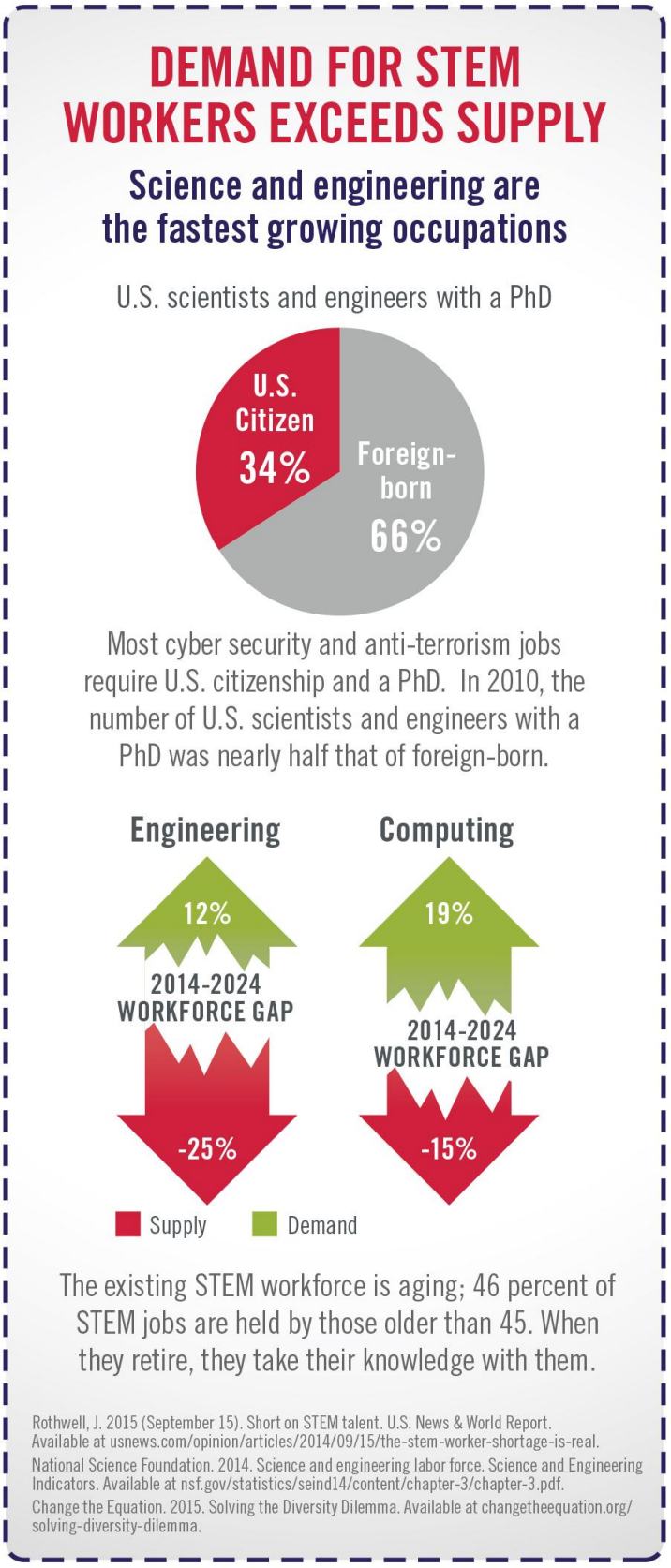
Executive Summary

Never has the need for science, technology, engineering, and mathematics (STEM) workers been more critical to expanding our economy, ensuring our environmental stability, and maintaining our national defense capabilities. Yet, changing workforce demographics highlight a growing concern about the nation's ability to meet the workforce demands for a literate and skilled STEM workforce. Today the United States is faced with the following workforce challenges in STEM:[1]

- an underrepresentation of women, Blacks, and Hispanics in STEM jobs at rates lower than their U.S. population representation;
- an aging STEM workforce;
- a STEM workforce that is disproportionately foreign-born compared to other occupations; and
- a demand for science and engineering workers that will increase at a rate that is higher than for all occupations (18.7 percent vs. 14.3 percent).

STEM fields, including those explored within career and technical education (CTE), offer middle- and high-skill jobs with significantly higher-than-average wages, increased employment opportunities and stability, and transferrable knowledge. The shortage of STEM professionals is evident, as indicated by climbing wages and significant job vacancies. For example, there are currently 4 million job openings for computer workers alone, and the median time to fill STEM vacancies is more than twice that for vacancies in other fields.[2] Sixty percent of companies surveyed by the Business Roundtable and Change the Equation reported that roughly 200,000 current U.S. job openings require basic STEM literacy and 42 percent require advanced STEM knowledge.[3]

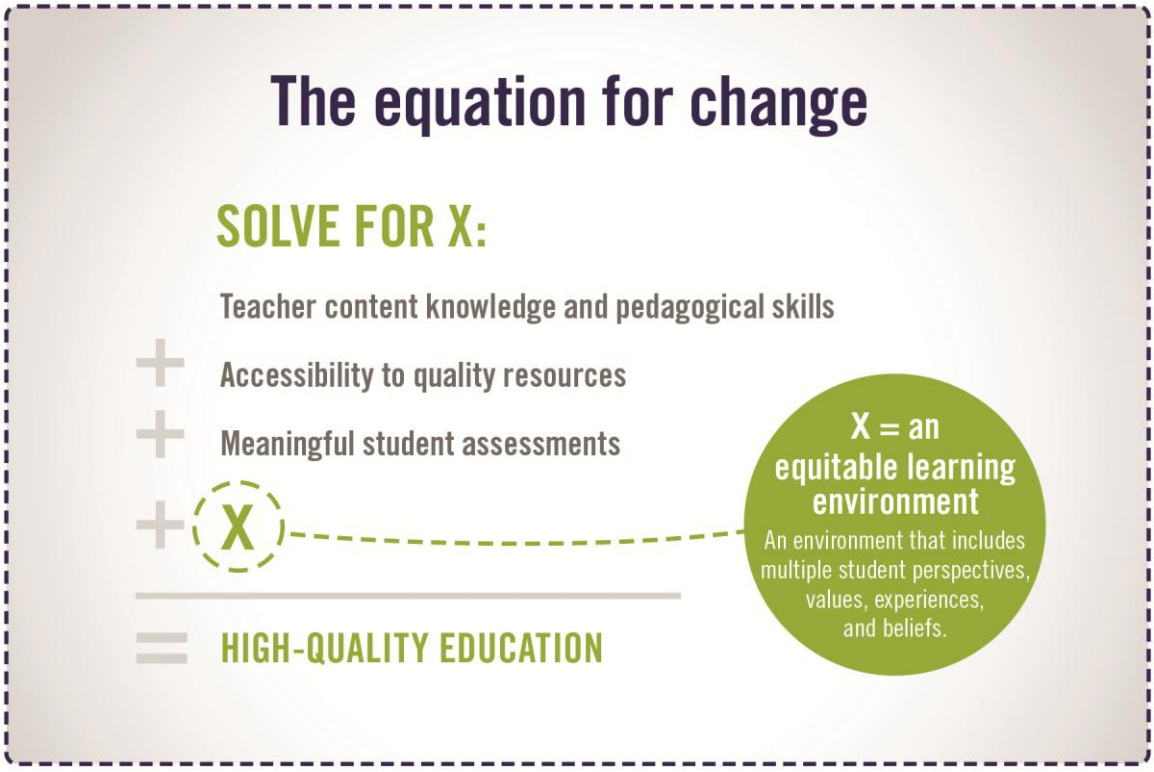
Failure to increase the numbers of STEM workers may have serious consequences, not only for individuals who remain in low-wage jobs, but also for our nation in the following ways:



- Workforce shortages may increase the risk of critical defense lapses;[4]
- Individuals, their communities, and the nation may lose significant revenues;[5] and
- The nation's ability to address growing instability due to climate change and environmental extremes may be weakened.

This report revises and reinvigorates previously developed goals from the 2011 National Research Council (NRC) report titled *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*[6] to expand the STEM workforce by targeting individuals who are least likely to pursue STEM careers.

Goal 1: Develop fully the achievement, interests, access, and resources needed for female and underrepresented minority students to improve STEM literacy and close academic gaps for all U.S. students.
Goal 2: Expand the number of female and underrepresented minorities who pursue advanced certificates, degrees, and careers in STEM fields to ensure full participation of all U.S. students in those fields.



The U.S. educational system must recognize all the required elements (or variables) to increase the numbers of students who are STEM literate and graduate from high school as college- and/or career-ready in STEM. To provide a high-quality education, today's teachers require strong content and pedagogical knowledge, plentiful quality resources and facilities, and meaningful, rigorous assessments. There is also a growing awareness of the importance of what students bring to the classroom in terms of social, emotional, and cultural contexts. Research is beginning to show the effects of these elements on building or impeding student self-efficacy in STEM.

This report discusses the need to rebalance the education equation to include equitable learning environments to ensure that teaching and learning are rich and relevant to students and connect meaningfully to STEM literacy

and competency. To build a strong STEM workforce, we must first "advance systemic changes that improve educational policies and practices" to create equitable learning environments.[7]

This report addresses two recognized gaps that challenge expansion of the STEM workforce:

1. Academic achievement gaps (also referred to as equity gaps that are measured by recruitment, retention, performance, and completion) between White/Asian students and students of color that are evident in most rigorous STEM courses and programs.
2. A lack of interest in STEM courses and careers, particularly among females, people of color, and people with disabilities, because of entrenched cultural attitudes and beliefs about innate abilities.

Although achievement and interest gaps present two distinct challenges, there is one common solution: address the culturally based explicit and implicit biases that exist in education (particularly in STEM courses and programs) and create inclusive, culturally responsive, equitable learning environments for every student.

CHARACTERISTICS OF EQUITABLE LEARNING ENVIRONMENTS

1. Educators and policy makers are aware of and responsive to the ways that diverse students may be marginalized by our current education system;
2. Educators take seriously the multiple perspectives, values, experiences, and beliefs of their students and their families and create daily opportunities for community contributions and collaboration; and
3. Classrooms are student-centered in that students are responsible for their own learning and self-assessment, are provided opportunities for free inquiry, experience learning relevant to their lives, and participate in collaborative learning and continuous reanalysis to learn essential knowledge.

The cost of failure is high. If we do not close achievement gaps in the next 35 years, then the U.S. economy is estimated to lose $14.7 trillion and the U.S. government is estimated to lose $5.3 trillion in revenues.[8] In mathematics alone, the United States could lose $75.0 trillion in Gross Domestic Product (GDP) over the next 80 years. [9]

Individual and community diversity provides the foundation for our culture (our strongest export), cultivates our innovation and drive, and provides a quality of life that is the envy of the world. However, the value of human diversity as an important variable in the education equation has yet to be satisfactorily recognized and addressed.

Recommendations for Policy and Practice Reform

Incorporate Evaluation into Regulation

Create regulatory procedures, with funding mechanisms, for tracking and evaluating efforts to ensure that all educators are competent to provide an accessible, inclusive, and equitable learning environment for every student in STEM.

Provide Proven Professional Development

Work with policymaking authorities to expand the standard for highly qualified educators to include the ability to provide an equitable learning environment for every student in STEM, and support local and state education agencies, accredited schools of education, technical assistance organizations, and education practitioners to provide professional learning so that every educator achieves the higher standard.

"One looks back with appreciation to the brilliant teachers, but with gratitude to those who touched our human feelings. The curriculum is so much necessary raw material, but warmth is the vital element for the growing plant and for the soul of the child."—Carl Jung

Measure Progress with Disaggregated Data

Require the use of accountability indicators and disaggregated sociodemographic data to measure progress toward closing achievement and interest gaps in STEM through policy and practice reform at the local, state, and national levels.

Conduct Targeted Research

Provide federal funding for pilot research studies that can deepen our understanding of the potential for equity in education to rapidly narrow achievement and interest gaps, as well as of the results of the strategies employed.

Report Progress to Congress

Every 5 years, conduct an evaluation and prepare a report to Congress that describes the nation's progress toward closing achievement and interest gaps in STEM for every student by 2050.

Build Databases of Quality Research and Practices

Work collaboratively with nonprofits and minority-serving institutions that purposefully serve low-income and first-generation college students to build and connect databases that host quality research and practice to broaden our understanding of equitable learning environments to ensure that every student is STEM proficient.

The Increasing Challenge of Providing a Strong STEM Workforce

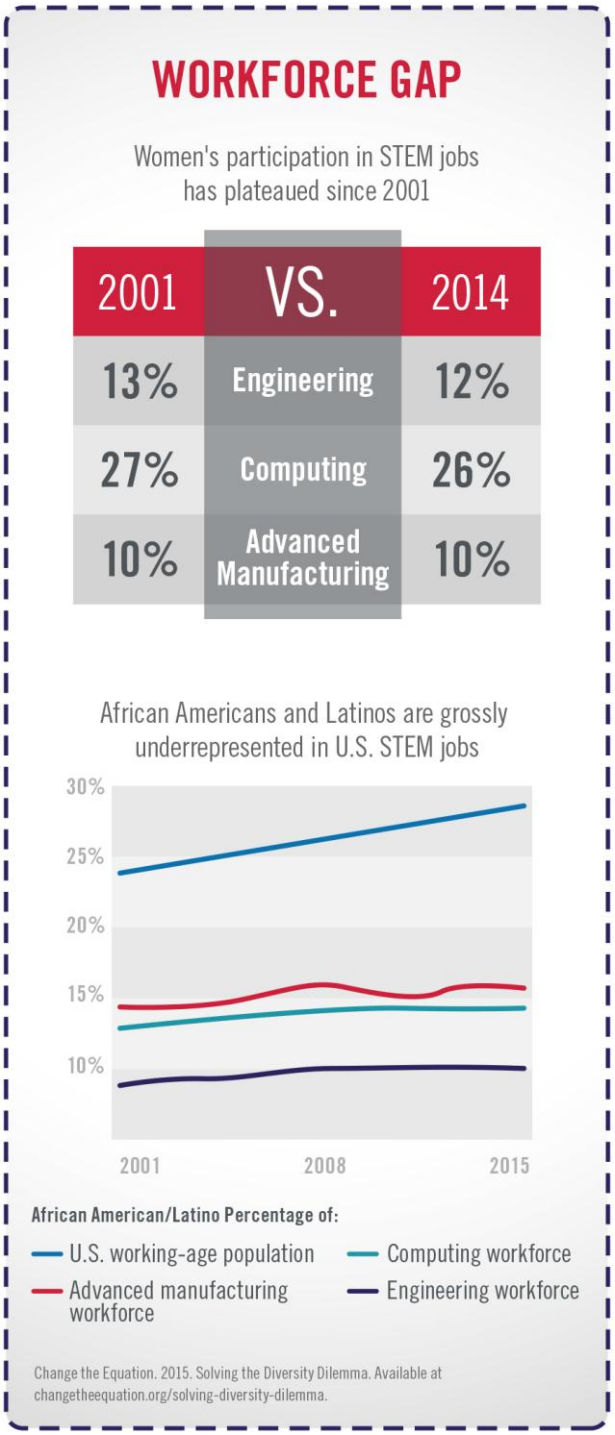
A Growing Shortage of U.S. STEM Workers

The unemployment rate among STEM occupations is approximately half of the national average and in some cases, such as computer and information systems managers, slightly greater than 3 percent.[10] This tight labor market combined with an aging STEM workforce[11] raises concerns for business growth. Of member businesses surveyed by the Business Roundtable[a] and Change the Equation,[b] 97 percent stated that the STEM skills shortage is a problem.[12] Sixty percent of those companies' roughly 200,000 job openings require basic STEM literacy and 42 percent require advanced STEM knowledge. In addition, companies will need to replace 945,000 U.S. workers who have basic STEM literacy and 635,000 U.S. workers who have advanced STEM knowledge over the next 5 years. Of great concern is that 38 percent of companies state that at least half of their U.S. job applicants lack basic STEM skills.[13]

Heightened concerns over national security and defense against cyberterrorism require that our best and brightest workers be U.S. citizens. Although finding STEM workers is challenging, finding Ph.D.-level qualified workers is even more problematic. Currently, 66 percent of computer and mathematical scientists and engineers in the United States with doctorates are not U.S. citizens.[14]

Perhaps most concerning is our continued failure to attract more students to STEM education and careers. Female participation in engineering, computing, and advanced manufacturing has remained flat since 2001. Although the Black and Hispanic percentages in the workforce population have steadily increased, their relative participation in these fields has declined for more than a decade.

According to the Business-Higher Education Forum (BHEF), 17 percent of high school seniors are both proficient in math and interested in the STEM fields.[15] Among Black students (who are underrepresented in STEM), only 6 percent are interested in STEM careers and college-ready in math.



[a] Businessroundtable.org.
[b] Changetheequation.org.

Among other underrepresented groups, such as females, Hispanics, Native Americans, and students with disabilities, similarly low interest or achievement inhibit access to STEM careers. BHEF concludes that the "current interest in STEM fields and proficiency in math are not sufficient to meet U.S. workforce demand."[16] With the overall number of Hispanic, Black, and Asian students in public K-12 schools now surpassing the number of White students, the need to address these shortages becomes even more pressing.

Reinvigorating Our Goals

A 2011 report from the National Research Council (NRC) titled *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*[17] established three ambitious goals. This report's authors have modified and condensed these goals to address the growing chasm between supply and demand of a skilled STEM workforce.

Goal 1: Develop fully the achievement, interests, access, and resources needed for female and underrepresented minority students to improve STEM literacy and close academic gaps for all U.S. students.
Goal 2: Expand the number of female and underrepresented minorities who pursue advanced certificates, degrees, and careers in STEM fields to ensure full participation of all U.S. students in those fields.

This report integrates decades of research and practice to highlight the importance of students' cultures, races, ethnicities, languages, genders, classes, disabilities, income, and geography as critical factors that define the classroom experience and are the key missing ingredients in creating an equitable learning environment for all students.

The Challenges Regarding the U.S. Education System

Public education has been undergoing reform for more than 50 years with limited success, particularly among low-income students, non-Asian minority students, and students with disabilities.[18] Although females have made significant progress in school performance and college enrollment and completion, they remain underrepresented in many STEM careers.

Reform efforts have increasingly focused on teacher content and pedagogical competency, which have evolved as technology innovates. Businesses voice their needs for soft skills, and teachers are expected to have the knowledge and capacity to build these skills in their students, which include problem solving, collaboration and teamwork, critical thinking, multicultural competence, and initiative. Current education models that are more didactic and teacher-centered often do not focus on developing soft skills but rather meeting the demands of high-stakes assessments. The result is an education system that does not meet the expectations of 21st-century STEM jobs and fails to connect to the culture of students' lives today.

Recognizing the importance of increasing the STEM workforce, President Obama launched "Educate to Innovate" in 2010. This campaign involves improving the participation and performance of U.S. students in STEM by setting three priorities:

1. Increase STEM literacy so that all students can learn deeply and think critically in STEM.
2. Move U.S. students from the middle to the top of the rankings in the next decade.
3. Expand STEM education and career opportunities for underrepresented groups, including women and girls.

The President's Council of Advisors on Science and Technology (PCAST) report titled *Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future (PCAST)*[19] recommended that 100,000 excellent STEM educators be hired over the next decade. The report defined an excellent STEM educator as one who has deep content knowledge of STEM subjects *and* mastery of the pedagogical skills required to teach them, but it did not acknowledge classroom-based cultural awareness, sensitivity, and competence as critical qualifications.

IN A *MEMO TO THE PRESIDENT'S EDUCATE TO INNOVATE CAMPAIGN,* more than 8,000 individuals and equity organizations requested that the White House "help educators change their interactions with students to engage and motivate all students by learning and acting to dispel stereotypes, build self-efficacy and confidence in students, change the classroom climate for underrepresented students, and change the mindset of everyone that these talents can be learned by many, not few."

NCWGE, MEMO to the EDUCATE to INNOVATE CAMPAIGN from "the July 19th COLLABORATION" and REPORT on "the July 19th COLLABORATION" Meeting, napequity.org/educate-innovate-memo.

In 2012, PCAST released *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*,[20] which made additional recommendations focused on the first 2 years of postsecondary education. This report stated that women and members of multicultural groups, the "underrepresented majority," must have full access to STEM pathways and suggested adoption of STEM teaching strategies that emphasize student engagement as one of three means to achieve excellence in STEM. Although moving in the right direction, the recommendations fall short of the system-wide refocus needed to create an educational model that closes achievement and interest gaps.

To date, most educational efforts in the United States have focused on equality, or the right of every student to have a high-quality educational experience, including highly qualified educators, a safe environment, excellent curriculum, diverse pedagogy, quality resources, and access to afterschool programs, role models, mentors, and other support resources. No doubt, if every student had access to all of these benefits, then student outcomes would improve. However, *providing equal education is not equivalent to providing equitable education because across the nation our students do not enter classrooms on an equal footing. Students experience education very differently depending on the school's location (i.e., urban, suburban, and rural), funding, age, resources, and family and community support.*

To improve STEM literacy and expand the STEM workforce, the nation should finally and firmly address the two entrenched barriers that seem resistant to change.

1. Academic achievement gaps between White/Asian students and students of color that are evident in most rigorous STEM courses and programs.

2. A lack of interest in STEM courses and careers, particularly among females, people of color, and people with disabilities, because of entrenched cultural attitudes and beliefs about innate abilities.

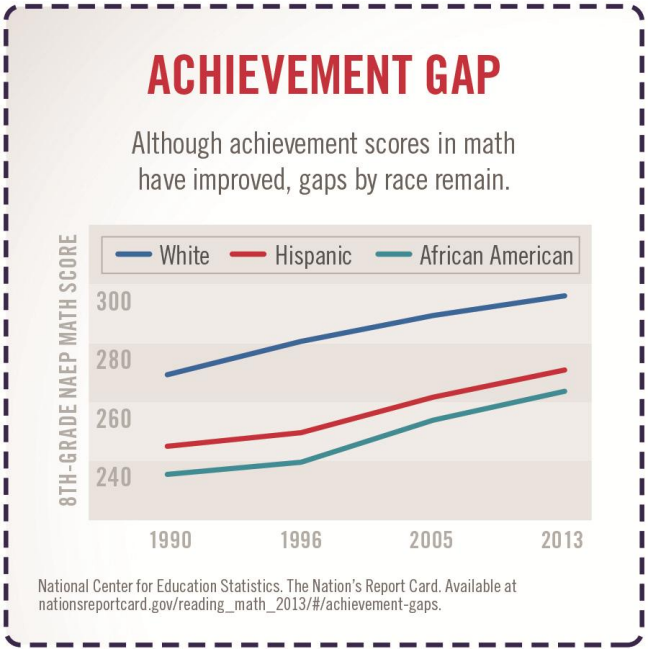
Closing the STEM Achievement Gaps

The education equation is imbalanced because the contributing factors that lead to STEM achievement gaps have not always aligned with the recommended solutions to address them. Extensive research on diverse student achievement has revealed that the gaps can be largely explained by community and school-based inequities, including the following causes:

- inequities in student resources;
- school and teacher attitudes;
- student motivation;
- school environment;
- family experience with education;
- cultural norms;
- racism, prejudice, and segregation; and
- poverty.[21]

For females, students of color, English language learners, students with disabilities, and students living in poverty, implicit biases can offer a very different educational experience than for White and Asian students, particularly in STEM.

When the data are disaggregated by race, the achievement gaps widen even more, with Black/African American and Hispanic/Latino students having less access to mathematics and science courses, lower participation rates in algebra I, one-half their expected participation rates in calculus, and an almost 20 percentage point gap in AP exam passage rates as compared to their White peers.[22] These gaps in participation, performance, and persistence in middle school and high school translate into even larger gaps in postsecondary education and employment.



Disparate academic scores have led to very different dropout rates: 42 percent of Hispanic, 43 percent of African American, 46 percent of American Indian, 17 percent of Asian, and 22 percent of White students will not graduate on time with a high school diploma.[23] National and state leaders need to ask "How can we expand the STEM workforce with high percentages of students not completing high school?" By not considering all elements of the education equation, our outcomes will continue to come up short.

Many high-quality programs have been initiated to increase diverse student participation in STEM. Project Lead the Way[c] and *FIRST*[d] are two examples of excellent engineering programs that struggle to recruit females and minorities. One solution has been to offer bioengineering options, which has worked well to recruit females but does not address the core problem—that is, the cultural biases that remain in traditional engineering education programs (e.g., electrical, computer, chemical, mechanical, civil, and aerospace). The teachers and informal

[c] pltw.org.
[d] usfirst.org/?gclid=CK7JisXAxsQCFUo6gQodqKgAsg.

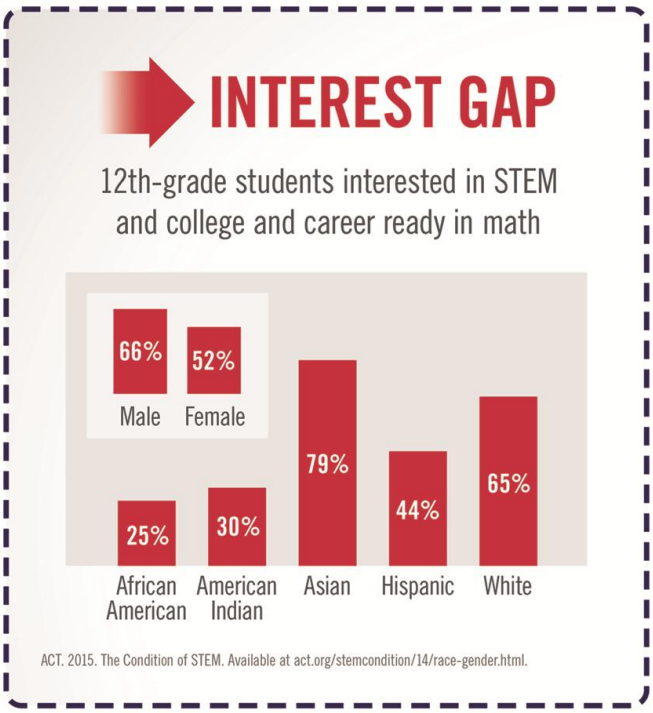
educators who often run these programs, like most educators, have little understanding of the needs of the changing diversity of students and the cultural influences and biases that negatively impact student interest and achievement. In fact, well-intentioned efforts focused on students who are low performing or underrepresented in a course or program may actually backfire and reinforce the very stereotypes they are trying to address. In 2011, the NRC presented K-12 indicators for high-quality STEM education.[24,25] Missing was a strong imperative to address the achievement and interest gaps among diverse students.

One of the most pressing education policy challenges that states face is the concern over closing the achievement gap; it is also one of the most commonly referenced phrases in the education discussion today.[26] Since 1965, recognition of the need to provide teachers with professional development related to the realities and complexities of racially diverse communities to ensure the "stability and survival of our society"[27] has been a call to action that has been largely ignored. Our inability to build a STEM workforce hinges on our ability to finally address this historical debt in education.

Closing the STEM Interest Gaps

Recent work by Change the Equation demonstrated that the participation of minorities in the STEM workforce is declining and female participation is stagnant in many STEM fields.[28] Although the achievement gaps may explain these outcomes, the cultural biases related to gender and race have created barriers to classroom equity and exposure and access to STEM courses and careers. Few students or parents understand the options for educational pathways to STEM, including CTE certifications, apprenticeships, associate degrees, as well as 4-year degrees.

Although the enrollment and achievement gaps between boys and girls in mathematics and science have been reported as narrowed,[29] further study reveals that the interest gap continues to exist in STEM and females continue to be underrepresented and underperforming in rigorous mathematics, physics, and STEM-related CTE programs of study. Although women now receive 57.2 percent of bachelor's degrees in all fields, they remain significantly underrepresented in many STEM degree fields.[30] Women earn 18.4 percent of engineering, 18.2 percent of computer science, and 43.1 percent of mathematics and statistics degrees.[31] Women of color earn slightly greater than 10 percent of all science and engineering bachelor's degrees.[32] Concurrently, women and people of color are overrepresented in the lowest paying occupations.[33]



Many efforts to date have overlooked the profound impact of cultural biases in the classroom on student identity and interest in course and career outcomes. Without awareness, educators, parents, and other adults inadvertently and unconsciously discourage underrepresented students from pursuing rigorous courses and career fields, particularly in STEM.[34,35,36,37] Cultural bias about STEM education and who can be successful

within it has led to educational inequities that cause students to avoid the field, or if attempted, to drop out to avoid the perceived failure.[38]

Rethinking the Education Equation

Students, educators, counselors, and administrators walk into schools and classrooms every day with enculturated biases and beliefs that impact students' self-efficacy, attributions, and beliefs about their academic abilities and career options. The impact of these implicit biases is reflected in the growing gap in STEM course and program enrollment, retention, performance, and persistence of underrepresented students—including females, Black/African Americans, Hispanic/Latino, American Indian/Alaskan Natives,[e] English language learners, students with disabilities, and students from low-income homes and communities—in rigorous STEM courses and programs, including CTE.

The current education framework[39] has been unable to address the needs of diverse students and the demands by business for a more technically literate workforce. Input from students, educators, and families can meaningfully impact school curriculum, practice, and policy, including assumptions, values, and traditions in terms of race, class, gender, sexual orientation, ability, language, and how students learn.[40] Student-centered learning that incorporates soft skill development with content can frame a new teaching and learning experience. Two models for building equitable learning environments are provided here.

Model One: Creating Classroom Equity

In 2013 NAPE published a new model recognizing school and community culture as an important part of the education equation. The NAPE Culture Wheel[41] advances a model that incorporates (1) micromessages (small, often subtle and unconscious messages that communicate our biases to others) to better frame the connection between implicit and explicit cultural bias, (2) their powerful influence in classrooms and educational programs, and (3) the impact over time of micro-inequities (negative micromessages) on students' self-efficacy and their resulting behaviors. The authors of that model and this report hypothesize that beliefs about an individual's ability and interest in STEM are influenced by cultural biases connected to gender, race, income level, class, language, or (dis)ability, and that these biases shape our communication in intentional and unintentional ways. This is true in all educational settings but is most observable in STEM programs where the enrollment and performance imbalances are largest. Micro-inequities can discourage a student from selecting a STEM course or career.[42] Students who demonstrate a perceived lack of interest, prematurely withdraw from a class or program, or declare themselves "bad" in a subject may be avoiding the risk of failure that they perceive as inevitable based on their own sense of self-efficacy. Shared among a large group, these behaviors shape the beliefs that we all witness and form our

NAPE Culture Wheel

[e] The race and ethnicity categories align with those of the National Center for Education Statistics, nces.ed.gov/ipeds/reic/definitions.asp.

cultural stereotypes. Research related to stereotype threat supports this hypothesis and explains the behaviors intended to avert the threat of failure.[43]

The NAPE Culture Wheel highlights the power of educator and student micromessages as a point of positive and negative impact on student self-efficacy. By supporting students' ability to inoculate against micro-inequities and to receive micro-affirmations, educators can interrupt the cycle of culturally based implicit biases and positively impact student self-efficacy to enter into high-skill, high-demand fields that provide a living wage. Although not intended as a panacea or a silver bullet for improving educational outcomes, NAPE's theoretical framework illustrates the power that culturally based communications can have on achievement and interest gaps. Using this equity framework, an independent evaluator compared student outcomes in a large, high-minority, Southwestern, urban school district and found significant academic improvement on a standardized system-wide assessment for both girls and boys and a narrowing of the gender-based achievement and interest gaps in physics, a gateway course to engineering. A similar result was found when the experiment was done with chemistry.

The study concluded that equitable learning requires educational systems to examine the communications, textbooks, classrooms, campuses, people, and policies that surround students. When educators create accessible, inclusive, and equitable learning environments through culturally competent messaging, then outcomes will change for every student.[44]

SAMPLE STRATEGIES THAT TEACHERS USE TO INTERRUPT CLASSROOM BIAS

- Practice recognizing and interrupting a micro-inequity in class. Consider that different populations perceive micro-inequities differently and that not all things mean the same to all people.
- Ward off unconscious micro-inequities by sending micro-affirmations. Focus on the strengths of the individual to filter potentially damaging comments or behaviors.
- Do not allow micro-inequities to go unnoticed. Find a way to acknowledge the occurrence, and address it in a positive way.
- Model behaviors that redirect inequities to affirmations.

Model Two: Creating School and District-wide Equity

The importance of providing equity training and models for principals and other school and district-based leaders to create equitable learning environments is supported by extensive research.[45] The PACE Framework, which was developed and used effectively in a large, diverse school system in the Mid-Atlantic, moves beyond the classroom to permanently transform policies, programs, structures, and processes that contribute to student underperformance. Its application has led to transformative outcomes for low-performing schools and significant achievement for teachers and students. Professional development for this model, like Micromessaging above, is a critical element for closing achievement and interest gaps in STEM.

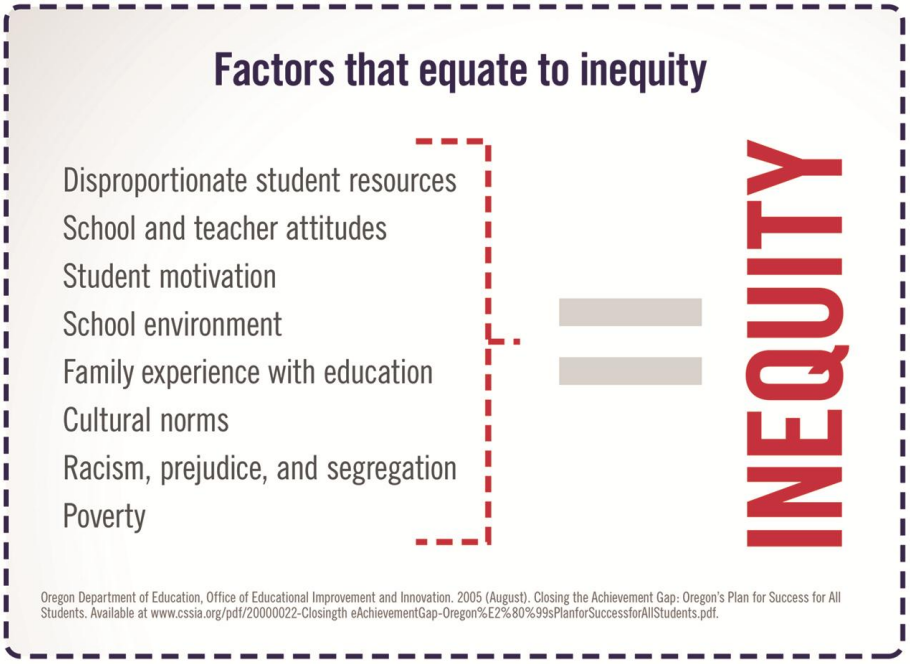
Change the Equation's STEMWORKs program recognizes the creation of equitable classrooms in STEM as an important proven practice.[46] Research has shown that highly successful people point to a person or experience that shaped their career choice, despite stereotypes.[47,48] The importance of one caring, educated, and culturally

competent adult in fostering an interest in and capability for STEM for each child cannot be overstated. Often, after primary caregivers, such as parents, the adult with the most contact time with a child is an educator.

Perhaps one of the most appealing elements of an equitable learning environment is how well it aligns with business needs for the development of soft skills. Equitable learning environments are characterized by the following:

- Group work and collaboration
- Continuous redesign and improvement
- Respect and value for nontraditional or culturally different behaviors
- Complexity, struggle, risk-taking, and creative solutions
- Adjustable timelines and course corrections.

By adding the missing variable, that is, what students bring to the classroom, to the education equation, not only will we attract and retain more diverse students in STEM, but also they will be better prepared for the global workforce they must now enter.



Final Thoughts

The benefits of closing the achievement gap on GDP are significant. The Center for American Progress estimates the average annual benefit to GDP alone between 2014 and 2050 would be $551.0 billion.[49] By another estimate, by 2050 cumulative increases in GDP could amount to $14.7 trillion and tax revenues could increase by $5.3 trillion; by 2075, these numbers could be $86.5 trillion and $32.4 trillion, respectively.[50] The impact of closing just the mathematics achievement gap over the next 80 years could yield a cumulative increase in GDP of $75.0 trillion.[51] Addressing the interest gap in addition to the achievement gap could increase our GDP to unimagined levels.

As the decade reaches a critical halfway point, the authoring organizations of this report, NAPE and the Johns Hopkins University School of Education, along with the supporters listed within this report, call for a review, renewed thinking, and reconsideration of the education equation so that all students can finally benefit from the high levels of knowledge and skills required for robust economic growth; participate in an expanding, thriving middle class; and enjoy a shared economic prosperity that benefits all Americans.

If there is no educational equity, then the STEM workforce shortage is absolute.

IF YOU DON'T SOLVE IT, THEN:

U.S. Economy
LOSES $14.7 TRILLION*

\- U.S. Government
TAX REVENUE DECREASES BY $5.3 TRILLION*

\- U.S. Mathematics Sector gross domestic product (GDP)
DECREASES BY $75 TRILLION**

*OVER NEXT 35 YEARS **OVER NEXT 80 YEARS

= **$95 TRILLION LOST**

AND:

CRITICAL DEFENSE LAPSES

ALTERED ECOSYSTEMS

DECLINING COMPETITIVENESS

IF YOU DO SOLVE IT, THEN:

State and Local Governments
GAIN $3.3 TRILLION IN TAX REVENUE*

\+ U.S. Government
TAX REVENUE INCREASES BY $4.1 TRILLION*

\+ U.S. GDP
INCREASES BY $20.4 TRILLION*

*OVER NEXT 35 YEARS

= **$27.8 TRILLION GAINED**

AND:

A SECURE NATION

A SUSTAINABLE ENVIRONMENT

ECONOMIC PROSPERITY

Philanthropy News Digest. 2015 (February 4). Closing achievement gap would boost economy report finds. Available at philanthropynewsdigest.org/news.

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Recommendations for Policy and Practice Reform

As a nation, we should (1) incorporate evaluation into regulation, (2) provide proven professional development, (3) measure progress with disaggregated data, (4) conduct targeted research, (5) report progress to Congress, (6) build databases of quality research and practices.

Create regulatory procedures, with funding mechanisms, for tracking and evaluating efforts to ensure that all educators are competent to provide an accessible, inclusive, and equitable learning environment for every student in STEM.

Equity is now a recognized issue in most educational policy efforts, but how it is achieved and measured is less well understood. Too often equity work is relegated to small equity offices rather than integrated within all educational domains, from curriculum development to teacher selection and professional development to building layout and appearance. School and district leaders responsible for educational policies need their own training to better understand access, equity, and diversity and should take responsibility for and be held accountable for closing the achievement and interest gaps among all students.

Policies should be put in place that keep individuals and organizations mindful of the importance of placing access and equity first, rather than as an afterthought once “all” students are considered. This will ensure that we move the nation forward in purposeful and intentional ways to narrow equity gaps and build the STEM workforce needed.

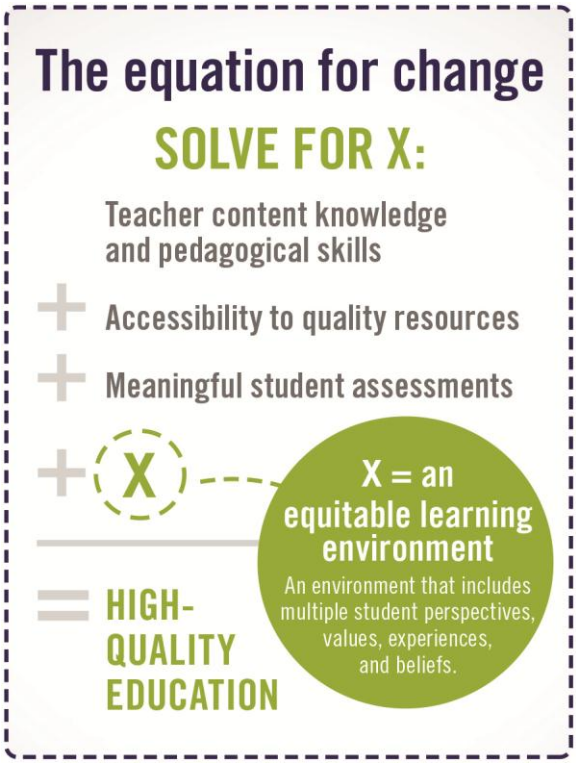
Work with policymaking authorities to expand the standard for highly qualified educators to include the ability to provide an equitable learning environment for every student in STEM, and support local and state education agencies, accredited schools of education, technical assistance organizations, and education practitioners to provide professional learning so that every educator achieves the higher standard.

Problem-based learning and engineering design programs are being successfully infused into classrooms as a means to better engage all students and improve critical thinking skills, collaboration, and problem solving. Unless education is viewed through a culturally competent lens, traditional and innovative methods to educate students will be ineffective for underrepresented students and STEM pathways to college and careers will remain leaky or clogged for all students.

Evidence strongly indicates that improving classroom equity using culturally sensitive communication that conveys genuine caring and expectations can directly impact student outcomes. Only through equitable classroom experiences can every student meet the highest standards of achievement. Until current and future educators are provided the knowledge, tools, resources, time, processes, and incentives required to build an equitable learning environment in their schools and classrooms, they will never be fully equipped to provide every student with what is needed for success in postsecondary education and/or a STEM career.

Require the use of accountability indicators and disaggregated sociodemographic data to measure progress toward closing achievement and interest gaps in STEM through policy and practice reform at the local, state, and national levels.

If legislation and policies were to provide funding for accountability systems that measure gaps and the success of strategies to close them, then the importance of this issue would be elevated for all organizations and not only those in education. The availability of valid and reliable data disaggregated and cross-tabulated by various student demographics is critical in this process. Often the availability of these data is driven by the accountability measures and requirements connected to various education funding sources. Without these data and the policy requirements that push state and local education agencies to create accountability systems with adequate sophistication, progress will be significantly hindered.



Provide federal funding for pilot research studies that can deepen our understanding of the potential for equity in education to rapidly narrow achievement and interest gaps, as well as of the results of the strategies employed.

More research is needed to study programs and processes that increase access and equity in classrooms to finally close the achievement and interest gaps for diverse students. Still lacking are highly rigorous studies that identify effective practices to inform the development of new models that could move the field forward. Federal agencies, such as the U.S. Department of Education, National Science Foundation, U.S. Department of Labor, and others, should continue to encourage new research, model building and testing, and dissemination that inform efforts on behalf of students and workers. Research initiatives that specifically address underrepresented student interest, engagement, and achievement must be supported, funded, and prioritized in the federal research strategy to ensure that pathways out of poverty are indeed accessible for every individual. Finally, funding must support efforts to move theory to practice by requiring partnerships between business, education, and nonprofits so that well-researched pilot programs do not end up collecting dust on shelves.

Every 5 years, conduct an evaluation and prepare a report to Congress that describes the nation's progress toward closing achievement and interest gaps in STEM for every student by 2050.

In September 2000, the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development released a report highlighting the importance of focusing on women, minorities, and persons with disabilities as a means to develop a strong STEM workforce. In the executive

summary, the Commission concludes, “[I]f women, underrepresented minorities and persons with disabilities were represented in the science, engineering, and technology workforce in parity with their percentages in the total workforce population, this shortage could be largely ameliorated.”[52] Fifteen years later the hoped-for progress has not been realized. If an independent body were charged with careful monitoring and evaluation of efforts to close the gaps, as well as with high-level reporting out of its results every 5 years, then the nation would have the tools and time required to measure progress and to correct course.

Work collaboratively with nonprofits and minority-serving institutions that purposefully serve low-income and first-generation college students to build and connect databases that host quality research and practice to broaden our understanding of accessible and equitable learning environments that ensure that every student is STEM proficient.

Transforming educators, educational systems, and systemic practices takes time. One-hour workshops, 1-day retreats, or 3-day conferences will not affect the change the nation needs. According to the nationally recognized Standards for Professional Learning (developed by Learning Forward[53]), transformation takes time, research, resources, and support provided through communities. As the nation looks to improve education by adding the variable that builds equitable learning environments, we need to gather the best content knowledge, delivery mechanisms for that content, and assessment tools that measure impact and sustainability to address the diverse intersections of culture, race, gender, ability, and poverty that play out in classrooms every day so that teachers are able to address the achievement and interest gaps.

Glossary of Terms

Achievement Gap—The "disparity in academic performance between groups of students. The achievement gap shows up in grades, standardized test scores, course selection, dropout rates, college completion rates, and other success measures" (http://www.edweek.org/ew/issues/achievement-gap/)..

Implicit Bias—Attitudes or stereotypes that affect our understanding, actions, and decisions, in an unconscious manner.[54]

Interest Gap—The observed, persistent disparity of expressed interest in STEM by students who are typically underrepresented in STEM programs and careers.

Intersectionality—A theory that demonstrates the interconnectedness of forms, frameworks, or systems of oppression, domination, or discrimination to cultural and social constructs, such as race, class, physical ability, age, and gender.[55]

Micromessages—Subtle nonverbal messages that people send through facial expressions, body language, tone or inflection in their voice, the omission of communication, or their physical surroundings.

Multicultural Competence—The ability to understand another culture well enough to be able to communicate and work with people from that culture.[56]

Self-efficacy—Belief in one's ability to be successful (or unsuccessful) in performing an activity or taking on a program or project. This can be influenced by cultural biases such as "Girls can't be engineers, so, as a girl, it is not a career path I will consider."

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