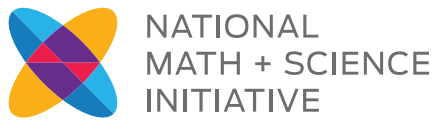


Increasing the Achievement and Presence of Under-Represented Minorities in STEM Fields



Transforming Math & Science Education



Abstract

Two major problems contributing to the U.S. STEM crisis are the lack of student engagement in STEM subjects and the shortage of qualified STEM teachers. These issues are interrelated and the U.S. STEM crisis cannot be remedied without a comprehensive and well-rounded approach to ensure that both students and teachers are on a path toward success. NMSI's approach to these problems has focused on scaling effective programs nationally. This white paper highlights the major components of the Comprehensive Advanced Placement and UTeach Programs, how they aim to address the STEM crisis, their relative successes, and how NMSI has increased student outcomes among minority groups in STEM subjects.

Background and Problem

This year marks the 30th anniversary of *A Nation at Risk*, a seminal report that warned of a “rising tide of mediocrity in the nation’s schools.” Despite the report’s clarion call to dramatically improve America’s schools and maintain the country’s “slim competitive edge,” the U.S. education system is still mired in mediocrity, continually bested by those of other countries. As a result, there are about 4 million unfilled jobs in this country, even though 12 million Americans are out of work. Many unemployed Americans simply do not have the educational background and skills to fill those jobs. McKinsey & Co. reported that the academic achievement gap between children in the United States and other countries deprived the U.S. economy of as much as \$2.3 trillion in economic output in 2008. These economic impacts are exacerbated by an increasing scarcity of workers qualified to fill crucial positions. Consider these facts:

- **The knowledge economy is increasingly dependent on college-educated professionals.** By 2018, the economy will have created 46.8 million new jobs.ⁱ Nearly two thirds of these will require workers with at least some college education, with a slight majority of these requiring workers with a Bachelor’s degree or better.ⁱⁱ
- **But current college completion can’t meet this need.** The U.S. Census Bureau reported in 2010 only 39% of non-Hispanic whites ages 25-29 had Bachelor’s degrees; the numbers were even less for African-Americans (19%) and Hispanics (14%).ⁱⁱⁱ
- **In addition, there is a shortage of graduates in STEM-related disciplines.** Economic data show that 1 million additional STEM graduates will be needed over the next decade to fill America’s economic demand. STEM-based jobs are expected to grow 17% in the next 10 years, outpacing the overall job growth of 10%.

Undeniably, STEM education in the U.S. is lagging behind, and there is growing momentum to remedy the situation. The National Math and Science Initiative (NMSI) was founded to address one of this nation’s greatest economic and intellectual threats: the declining number of students who are prepared to take rigorous college courses in math and science and be equipped for careers in the knowledge-based economy. As we create strategies for promoting STEM education, it is important to create best practices based on proven programs and measurable results.

NMSI was launched in 2007 to transform schools to prepare students for success by building strong foundations in science, technology, engineering and math. NMSI achieves its mission nationally by inspiring and engaging students to develop strong interest in STEM fields, transforming schools into centers of college-readiness and producing, training and retaining content-rich teachers. NMSI works to increase instructional rigor in the classroom based on best practices from our first-hand experience in implementing programs with proven effectiveness and quantifiable results.

Its ability to increase student outcomes after only one year of program implementation is what makes NMSI unique in education. For example, NMSI has collected extensive data on schools following its methods for improving student achievement and its impact on AP programs in high schools across the nation. In NMSI program schools, the average increase in AP qualifying scores in English, math and science is 79% in the first year – 11 times the national average – and 137% after three years, almost six times the national average of 24%. NMSI's results are even more impressive for under-represented groups: qualifying scores for African-American and Hispanic students increased an average of 107% in math; female students increased an average of 84%, 12 times the national average. These results in improved student outcomes in mathematics and science are extremely important in light of the STEM crisis in America.

Promising Practices & Solutions for Solving the STEM Crisis

NMSI believes that adequately preparing students for career and college readiness is essential to solving the STEM crisis. U.S. college readiness is not where it needs to be. Only 70% of students in public high schools graduate, and only 32% of students leave high school qualified to attend four-year colleges. The statistics are even worse for minorities: only 51% of African-American students and 52% of Hispanic students graduate, and only 20% of African-American students and 16% of Hispanic students leave high school college-ready.^{iv} According to Complete College America's 2012 report, 1.7 million students entering college required at least one remedial course, which cost states and students more than \$3 billion annually. How do we increase career- and college-readiness, college enrollment and graduation, and STEM degrees among minority groups? At the National Math and Science Initiative, we find that there are three key factors that contribute to student success across all groups – student engagement, motivation and exposure to STEM subjects.

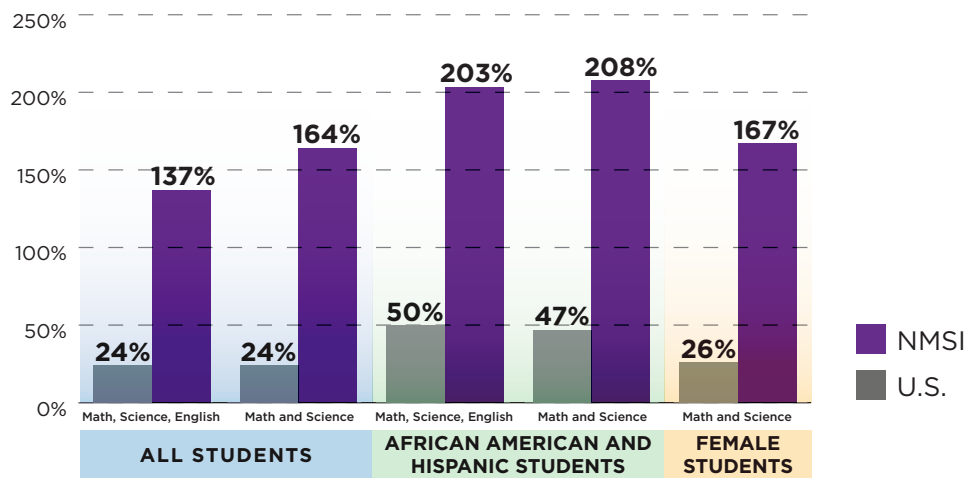
Student Engagement

Students who are engaged and active in the classroom are more apt to increase their critical thinking skills. Of course, this is highly contingent on the teacher's classroom instruction, and that is where NMSI comes into play. NMSI gives teachers the rigorous training and effective tools they need to succeed in the classroom. A K-12 system that does not emphasize instructional rigor will not adequately prepare students for the modern workforce or challenging college coursework.

We should not be afraid to challenge students – in fact, challenging students is the key to active student engagement. NMSI's schools have been ranked as some of the

most challenging in the U.S., and research has shown that students passing AP exams are three times more likely to earn a college degree than students who do not pass. Through the Comprehensive Advanced Placement Program, NMSI transforms high schools into centers of college- and career-readiness, and it has had a tremendous impact on African-American and Hispanic students; in just one year of program participation, schools typically see a 200% increase in the number of students passing an AP exam.

Three Year Results – Percentage Increases in Qualifying Math/Science/English AP Scores



Research indicates an AP course that culminates in an AP exam grade of 3 or greater has a significant, positive impact on a student’s likelihood of college success among academically comparable students.⁹ This is especially true for African-American and Hispanic students, who have a 28% greater likelihood of college success when they take an AP exam compared to those who do not. Unfortunately, in 2012 only 27% of juniors and seniors nationally took AP exams (and only 13% of African-American and 21% of Hispanic students did so). For math and science AP exams taken in 2012, the situation is even worse – only 10% of all juniors and seniors nationally, 4% of African-American and 6% of Hispanic students took the tests. Dr. C. Kirabo Jackson, an assistant professor at the School of Education and Social Policy at Northwestern University, studied both the short- and long-term evaluations of NMSI’s work. His first study in 2007 found that NMSI’s Comprehensive AP Program not only produced significant increases in AP scores but also contributed to substantial increases in SAT/ACT scores and college matriculation, and that these effects continued to increase over time. From 1994-2005, Dr. Jackson’s study compared student cohorts at partner schools before and after the NMSI Comprehensive AP Program implementation. Comparing student outcomes from participants and non-participants of NMSI’s Comprehensive AP Program, Dr. Jackson found that participation in the NMSI AP program produced:

- A 22% average annual increase in AP exam qualifying scores (3 or greater);
- A 30% increase in the number of students scoring at least 24/1100 on the ACT/

SAT (on the 1600 scale); and

- An 8% increase in college matriculation.

Following the same student cohorts, Dr. Jackson's second study in 2010 demonstrated that the increases in student achievement caused by NMSI's Comprehensive AP Program persisted into college, with particularly positive effects on college outcomes for African-American and Hispanic students:

- NMSI students were 22% more likely to persist in college than students not enrolled in the NMSI Comprehensive AP Program.
- African-American students in the NMSI program were 69% more likely to graduate from a four-year college than African-American students not participating in the NMSI program.
- Hispanic students in NMSI's AP Program were 83% more likely to graduate from a four-year college than Hispanic students not in the program.

Motivation

As college graduation rates among minorities increase, underrepresented groups in STEM fields have more role models to inspire them. Strengthening the educational pipeline for minorities in STEM fields will have a huge impact on their motivation to study and work in those fields. Another big factor in determining a student's motivation to increase academic achievement is their capacity to complete rigorous coursework, a skill that can only be acquired through effective classroom experiences.

A recent report by the National Bureau of Economic Research found that students who are interested in a science major but not academically prepared for challenging classes often struggle in college science courses.^{vi} Disappointed and discouraged, they opt out of their planned STEM majors for courses that may prove less difficult. Engaging various stakeholders such as parents and community members also helps construct a positive learning environment where students are motivated to succeed. With better preparation these students could thrive in a college setting, continuing with a major about which they are passionate – and for which America has a desperate need.

Exposure to STEM subjects

Not only is early exposure to STEM subjects important, being surrounded by a community of STEM professionals is vital. Student participation in active research, hands-on experience and proven programs all increase student persistence and graduation in STEM majors. Creating the pipeline for the future STEM workforce is highly dependent upon effective STEM teachers. Recruiting the right people to become teachers and developing them into effective instructors are two of the most important factors in driving improved performance in schools. In its 2007 report, *How the World's Best-Performing School Systems Come Out on Top*, McKinsey & Company studied 25 school systems across the globe to identify common attributes of high-performing schools. A key finding from the research showed that schools with the

best teachers improve faster and perform more consistently. The President's Council of Advisors on Science and Technology (PCAST) estimates that the U.S. will need more than 100,000 STEM teachers in 10 years. The PCAST also concluded that:

"To meet our needs for a STEM-capable citizenry, a STEM-proficient workforce, and future STEM experts, the nation must focus on two complementary goals: We must prepare all students, including girls and minorities who are under-represented in these fields, to be proficient in STEM subjects. And we must inspire all students to learn STEM and, in the process, motivate many of them to pursue STEM careers."^{vii}

The UTeach Program addresses this STEM crisis at a fundamental level, creating the next generation of math and science teachers with rigorous pedagogical training and deep understanding of STEM subject matter. UTeach provides students with intensive field experiences during the program and matches students with a mentor to help them master their coursework. Because of the sustained exposure and mentoring, 90% of students in the UTeach program go into teaching, and 80% of those teachers remain in their profession after five years (compared to retention rates of less than 50% for other teacher preparation programs).

Summary and Call to Action

In conjunction with more emphasis on STEM education at a young age, complementary activities outside of the classroom can increase student engagement in STEM fields. NMSI is a supporter of relevant and hands-on strategies for engaging students inside and outside of the classroom, and is proud to have an impact on student outcomes among minority groups in mathematics and other STEM subjects. With commitment and the proper tools, we can make an impact on all students and increase STEM talent in the U.S., including under-represented minorities (URMs).

Now is the time to invest in the future of students and our STEM workforce. This investment can only be achieved by promoting measurable programs that promote STEM education and make STEM careers available to everyone. The success of NMSI's programs and other STEM initiatives depend on robust funding mechanisms and streamlining of national STEM programs. NMSI favors a targeted approach for funding agencies and specific activities to ensure that available funding is used effectively to produce impactful results. In addition, NMSI supports a robust and balanced approach that will funnel resources to where the funds are needed most and to programs that have a proven impact and produce favorable results in schools.

References:

ⁱ<http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/FullReport.pdf>

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