# How to Increase American Students' Participation Rate in STEM Careers

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**ABSTRACT:** Science, technology, engineering, and mathematics (STEM) has been a powerful engine of prosperity in the United States since World War II. Currently, American students' performance and enthusiasm in STEM education are inadequate for the U.S. to maintain its leadership in STEM professions unless the government takes more action to motivate a new generation of U.S. students toward STEM careers. The current situation is that the U.S. is largely dependent on the foreign-born STEM workforce. This paper starts with a deeper look at the participation rate of American Students in STEM Careers and concludes with recommendations for how to motivate more U.S. students to pursue STEM careers.

## Introduction

Science, Technology, Engineering, and Mathematics (STEM) includes some of the most versatile and important careers in the contemporary world. Most new developments that are making the world a better place to live in are from the contributions of STEM fields. As the world becomes more technologically developed, the economy, power, and leadership of the U.S. is becoming more heavily based on effective practice and the number of skilled workers in these fields, As a result, the success, security, and leadership position of a nation depends not only on the use of technology but also the number of native workers in STEM fields. The technology driven economy and skilled workforce in STEM fields is the driving force for innovation of a nation. The United States possesses the most innovative, technologically capable economy in the world. Despite a glorious record of achievement in technology, the U.S. lags behind many less developed nations in STEM education in elementary, secondary, and higher education. As the U.S. invests more money and effort to promote improvement in STEM education, the number of foreign students and workers in these fields is increasing significantly (Borjas, 2004; Kuenzi, 2008; National Center for Education Statistics, 2009).

Although many U.S. students excel in STEM, as a whole, U.S. student performance in international comparisons on science and mathematics tests is consistently below average or in the third quartile (PCAST, 2010). The situation is that STEM education in the U.S. is failing to motivate American citizens to attain sufficient skills and knowledge required to meet the century's challenging economic and leadership needs (National Science Board, 2007). There are wide disparities in STEM achievement among various ethnic groups and too many American students and parents believe that STEM subjects are too difficult, boring, or exclusionary (PCAST, 2010). Research evidence indicates that many of the proficient American students, especially the minority and women groups, have been switching their career choice in STEM fields toward other professions (Denson & Hill, 2010). Although Hispanics and black students in America's college-age population are increasing, their participation rates in STEM fields are significantly lower than those of White and Asian Americans (Sanders, 2004).

As the nation continues to advance through the first quarter of the 21st century, there is a growing need for educators to be less dependent on the foreign or foreign-born STEM workers, and to take appropriate actions to inspire and prepare native-born American students towards STEM education. The rest of the paper addresses the following: Statement of the problem; and a closer look at the participation rate of American students in STEM careers. It closes with some recommendations to motivate more U. S. students to pursue teaching in STEM areas.

## Statement of the Problem

Over the past two decades the U.S. STEM workforce has grown at more than four times the rate of total employment. At the same time, the proportion of U.S. citizens qualified to fill STEM jobs is stagnating (University of California, 2010). According to a 2004 high powered U.S. Education Commission, the STEM workforce in the U.S. largely depends on foreign-born mathematicians, scientists and engineers (Sanders, 2004). In this rapidly growing competitive market, industry prefers graduates who have the potential to meet their research and development needs and compete effectively with their counterparts worldwide.

As the nation continues to advance through the second decade of the twenty-first century, there is a growing need to, not only depend on the foreign-born workforce in STEM fields, but also to take appropriate initiatives to prepare local expertise in these fields. This, problem is causing difficulty for American educators and legislators during the recovery of the current recession and it hinders the U.S. ability to sustain its' competitive position. Thus, the question arises as to whether the U.S. should continue its dependence on other countries for required STEM workers or take action to motivate more American middle and high school students toward the STEM pipeline.

## The Participation Rate of American Students in STEM Careers

The current pipeline and participation rates for U.S.-trained STEM professionals are thought to be inadequate to meet the nation's needs. Due to lack of proper motivation, many high-STEM-ability students fail to realize their full STEM potential in high-school or leave the STEM track in college. According to the Engineering Workforce Commission (EWC) report of 2005, over the past 20 years, the total number of students who received bachelor's degrees in engineering declined by 19.8% in the U.S. During the 2000–10 period, employment in science and engineering occupations would have been expected to increase about three times faster than the rate for all occupations. According to another report from the Computing Research Association, enrollment in undergraduate degree programs in computer science is more than 50% lower than it was five years ago. Between 2005-06 and 2006-07, the number of new students declaring computer sciences as a major fell 43%, to 8,021 (eSchool News, 2008a). The report did agree with the U.S. Bureau of Labor Statistics in 2008 that between 2006 and 2016, 854,000 professional IT jobs will be added, an increase of about 24% with the estimated 1.6 million IT jobs replaced in the 10-year period fields.

In a 2008, a public high school authority in the U.S. discovered an extremely low level of interest for participating in STEM related career academics in high school among middle school students; however, the students showed higher interests in arts, literatures, business, and entertainment related careers, specially the girls (Rogers, 2009). Thus, it sometimes becomes a challenge for many high schools in the U. S. to get a sufficient number of students to choose to enroll in STEM related academics. If low enrollment in STEM fields and low interest in STEM academics continues, all high school academics that lend to STEM major will be at great risk (Rogers, 2009). The Nashville Area Chamber of Commerce in Tennessee, and numerous national sources point out that the U.S. needs more workers in STEM fields.

Experts warn that the United States' apathetic performance in encouraging students to enter STEM careers can complicate the troubles of the nation's already ailing economical situation (Ramirez, 2008).

Furthermore, science and mathematics teachers face inadequate support, including appropriate professional development as well as interesting and intriguing curricula. School systems lack tools for assessing progress and rewarding success. The Nation lacks clear, shared standards for science and math that would help all actors in the system set and achieve goals. As a result, too many American students conclude early in their education that STEM subjects are boring, too difficult, or unwelcoming, leaving them ill-prepared to meet the challenges that will face their generation, their country, and the world. Studies find that many U.S. teachers are not well prepared to teach math and sciences (EducationNews, 2010). Future mathematics teachers are getting weak training and are not prepared to teach the demanding curriculum needed for U.S. students to compete internationally

If too many students continue to pursue degrees and careers in fields other than STEM related areas, the U.S. will find it difficult to compete in the global economy. Furthermore, the U.S. will not be able to meet its future workforce needs. The U.S. needs 400,000 new graduates in all STEM fields by 2015 (Obama, 2009). Since only 15% of all college graduates currently choose STEM as majors or minors, which impacts American competitiveness, there is a projected shortfall of more than 280,000 math and science teachers by 2015 (eSchool News, 2008b). Microsoft reports that only 14% of students graduating with bachelor's degrees in Washington state have the skills that they need (University of California, 2010). Without a solid foundation in STEM, students will not be qualified for many jobs in the workplace – including many jobs beyond traditional engineering and science.

## How do we motivate more U. S. students to pursue teaching in STEM areas?

To meet U.S. needs for a STEM-capable citizenry, a STEM-proficient workforce, and future STEM experts, the U.S. should focus on the following goal: The U.S. should prepare all students, especially minorities and girls who are underrepresented in these fields, to become more motivated and proficient in STEM subjects. To support this goal, partnership and collaboration of private and philanthropic groups with local and state government is essential. To motivate a great number of students and the non-STEM workforce to join the STEM pipeline, a number of steps at various levels should be taken and monitored closely. Collaborating with other education organizations, the private sector, and local community organizations is the most effective and promising way to accomplish the shared vision for motivating workers to join the STEM pipeline. Initiatives should be started to promote education in the related areas so that students who are enrolled in the industrial areas can do their internships while they are being prepared to study STEM fields in college. Most importantly, students, teacher and educators at all levels should acknowledge that STEM careers require significant investments and hard work during preparation. Students who do commit themselves from the very beginning of middle school and have the opportunities to take high school or vocational courses in science and mathematics can succeed in the STEM path in their future studies.

STEM initiatives should be monitored by the Department of Education and the federal agencies such as the National Science and the Foundation, and the National Council of Teachers of Mathematics, for effective STEM education in K-12 levels. The Federal Government must actively engage with each of these partners, who must in turn fulfill their own distinctive roles and responsibilities. According to the PCAST (2010), in recent decades, relatively little Federal funding has been targeted toward catalytic efforts which have the potential to transform STEM education. Too little attention has been paid to replication and scale-up to disseminate proven programs widely. And, too little capacity at key agencies has been devoted to strategy and coordination.

Thus, coherent strategy and sufficient leadership should be taken by the federal government. The Federal Government should provide vigorous support to the state-led effort to develop common standards in STEM subjects by providing technical and financial support to states for high-quality professional development that is aligned with shared standards and the development, evaluation, administration, and

ongoing improvement of assessments aligned to those standards. Most importantly, the Federal Government should provide vigorous support in setting goals that ensure the recruitment, preparation and induction support of at least 100,000 new middle and high school level STEM teachers with majors in STEM fields and strong content-specific pedagogical knowledge, by 2020 (PCAST, 2010).

Last, the U.S. must provide more investment in supporting teacher preparation programs that provide strong content and pedagogical knowledge in STEM subjects. In making investments, special focus should be given to programs that are scalable, because they will have the greatest impact in terms of the number of teachers produced and the greatest opportunity for learning about elements of successful programs (PCAST, 2010).

## Conclusions

Success in STEM requires both technical and nontechnical skills and dispositions. Curiosity, the ability to think logically and creatively in problem-solving, communication skills, and the ability to work in teams are all required to succeed in STEM careers. Mathematics and science knowledge are an important base for all STEM workers. Students need to be inspired in STEM subjects beginning in the middle school grades with coursework and extracurricular activities focusing on honing problem-solving skills in the high school grades. After high school, STEM career requirements are more specific to the specific occupations.

The solution to the STEM education problem should be handled in an interdisciplinary manner, which must be grounded in the STEM discipline departments as well as the Colleges of Education and Human Development. STEM education should be considered as a targeted education component for graduate students who will later after work experience become the future STEM undergraduate and graduate faculty. Meaningful preparation of K-12 and higher education STEM faculty should be considered as an undoubted necessity to meet the needs of a scientifically and technologically literate work-force in a modern and technology driven nation.

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