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Improving U.S. Competitiveness

with K–12 STEM Education and Training

Domestic Policy Studies Department • The Douglas and Sarah Allison Center for Foreign Policy Studies

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A Report on the STEM Education and National Security Conference, October 21–23, 2008

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Contents

Our science, technology, engineering, and mathematics workforce is the backbone of our innovation economy and the source of our economic and national security. We must value science, those who do it, and those who teach it—and we must tap all of the talent this nation has to offer. Success begins in the classroom.

—Shirley Ann Jackson, president, Rensselaer Polytechnic Institute;
chairman, U.S. Nuclear Regulatory Commission (1995–1999)

From October 21 to 23, 2008, The Heritage Foundation, supported by the McCormick Tribune Foundation, convened leading education and national security experts as well as private-sector representatives to discuss methods for strengthening America's competitiveness by improving its performance in science, technology, engineering, and mathematics (STEM) education. This report attempts to describe the current state of STEM education, summarize the main points discussed at the conference, and present the conference attendees' conclusions on how to improve STEM education and advance America's defense capabilities and economy.

This report is aimed at education and private-sector leaders as well as at national defense strategists, but can also be useful to other interested parties. The private sector and defense industry will need to work closely with education reformers to create a feasible plan for improving the current state of STEM education: Success in both industry and defense is vitally linked and inextricably tied to the capabilities of the STEM workforce.

Overview

In order for the United States to be globally competitive, innovative, and prepared for new economic and security challenges, the U.S. must have a competitive and innovative educational environment that encourages entrepreneurship and excellence in STEM subjects. Doing so will require federal and state policymakers, as well as the private sector, to take the following steps:

- **Strengthen the quality of the elementary and secondary teacher workforce, particularly in STEM subjects.** Encourage industry and the national security community to get involved in the classroom through innovative partnerships with educators and schools. Schools need the financial flexibility to provide differential pay and performance bonuses for excellent teaching.
- **Reform the traditional public school system to encourage greater innovation and superior instruction.** Legislation and old habits need to change so that funding can be allocated to where it has the biggest impact. School choice, charter schools, online classes, and online learning communities hold promise for encouraging innovation and better learning opportunities for American students and should be funded.
- **Implement aggressive reforms to change the governance of the traditional public school system.** Given that states have the greatest authority for funding and regulating public education, state leaders are in the best position to implement aggressive reforms to change the governance structure of the traditional public school system. Experience has shown that aggressive state-level reforms can spark improvement in students' learning.
- **Resolve the H-1B visa shortage.** To ameliorate the effects of the current STEM crisis, the cap on H-1B visas should be raised from the current level of 65,000 to its pre-9/11 level of 195,000 visas a year. Eventually, the number of H-1B visas granted should be flexible and correlate to the needs of the marketplace of the time. To enhance cultural relations and to regain the U.S.'s position as a leader in STEM, visa-eligible foreign students with American degrees should be allowed to stay in the U.S. and work for the duration of their visa.

The Current State of STEM Education

Every day, a new technology is brought to market by the STEM workforce, enabling people around the world to live longer, better lives. From computer chips to microwaves, from cell phones to antibiotics, access to technology and technological innovation is what separates the developed world from developing nations. The U.S. depends on science, technology, engineering, and math to maintain its position as the world superpower.

In today's world, technology begets technology. Multidisciplinary research is a prerequisite for any nation to maintain, let alone gain, a competitive edge. The physicist must work with the structural engineer to create alternative energy sources; neither can do it alone. The ocean engineer must work with the nuclear engineer to create world-class submarines. Such technologies keep the economy thriving and protect the country in times of war. Advances in robotics can improve manufacturing. When a company fails to make progress in materials science, it means a competitor's microchips will be smaller. Falling behind in any technological field has a detrimental domino effect because every field is dependent on the others.

For years, the U.S.-dominated science and technology fields filed record numbers of patents, which in turn empowered its military and fueled its economy. But times are changing. China has gained ground in electrical engineering and computing, and India has made enormous strides toward becoming the leader in accounting and financial services. Ninety-five percent of Fortune 500 CEOs believe that there is a severe shortage of U.S. citizens working in STEM fields. Sixty-eight percent believe that the U.S. is less focused on STEM than other countries.

In America, K–12 education is compulsory. Even so, 30 percent of 18- to 22-year-olds do not have a high school diploma. Every year, there are 200,000 U.S. engineering jobs that need to be filled and every year only 60,000 U.S. engineers graduate—leaving more than two-thirds of these STEM positions vacant. While STEM engineering work can arguably be outsourced to other nations, such as China and India (each of which graduates 600,000 engineers per year), continually sending U.S. work to be performed in other countries is not a sustainable solution: Over time globalization will directly and negatively impact America's industrial economy, national defense, and homeland security.

In some parts of the world, the positive correlation between STEM expertise and economic prosperity has been recognized with increased investment. India, for example, has recently experienced a 600 percent increase in research and development (R&D) centers. These centers are not only funded by Indian companies but by U.S. companies as well—evidence that U.S. graduates are not meeting domestic business demands in quantity or in quality. If the U.S. stays on its current trajectory, more and more high-tech, high-paying jobs will be sent overseas. But the STEM crisis extends far beyond economic prosperity. In an alarming development, America is rapidly moving toward a future where its top defense technologies are invented, designed, and manufactured in foreign countries, leaving the U.S. vulnerable in times of war.

Schools across the U.S. place more emphasis on extracurricular activities than on STEM education. In many schools, there are multiple fundraising activities for sport teams but few for science fairs or math competitions. Likewise, students who excel in sports are considered heroes while students who excel in science are considered geeks. Detrimental to national competitiveness, low achievement in STEM fields at all levels of education and beyond is becoming not only culturally acceptable—it is becoming the norm.

The Federal Government Cannot Solve the STEM Crisis Alone. Decades of engagement show that the federal government is incapable of adequately resolving crises in education. Federal money is quickly thrown at the problem and there is often little or no accountability for how it is spent. New programs and spending are often more symbolic than substantive. The resulting "solution" is not something that benefits the country, but fits the desires of the most effective lobbyists.

America needs a real solution to today's STEM crisis. There are no shortcuts to solving the problem. Solving the STEM-education crisis will require making significant changes in the elementary and secondary education system to improve learning opportunities for all children from kindergarten through high school in order to prepare more students to succeed in STEM coursework.

Essential: Recruiting and Maintaining Quality Teachers. Many of the above-mentioned issues are well-known problems that plague the entire K–12 system. They are not limited to STEM education. However, when it

comes to STEM, many of the problems are magnified. Take the problem of recruiting and retaining quality teachers. Research shows that teacher quality is directly related to subject matter proficiency. Passionate students often acquire their enthusiasm directly from passionate teachers.

When it comes to STEM, the highest-paid positions are found outside of teaching: Many STEM professionals are paid at least two to three times what they would earn at an equivalent level as teachers. Since they have so many other options, quality STEM professionals are unlikely to be recruited to be teachers and even less likely to be retained at a similar level as their liberal arts peers.

In today's schools, the majority of math and science teachers do not have math or science degrees. Elementary school teachers in particular are often not as passionate or trained in STEM subjects as they are in the arts. An unfortunate consequence is that many students mirror their teachers' preferences and acquire a lifelong disinterest in STEM by the time they reach middle school.

This result is the problem of the "leaky pipeline." In the education pipeline from elementary to graduate education, not enough students are making it to the advanced levels of STEM studies. In many cases, this is due to the poor-quality education at early levels that leaves students ill equipped to pursue higher levels of STEM education. High school students are not being trained at a high enough level to compete with international students once they reach college. Too few freshmen who declare a STEM major graduate with a degree in STEM. Many STEM students migrate to liberal arts, but very few liberal arts majors migrate to STEM.

A Matter of Security. The leaky education pipeline impacts not only STEM industries but America's defense capabilities. Many of today's best-trained STEM professionals choose non-engineering fields after graduation. They quickly realize that they can make more money as consultants and investment bankers than as engineers or mathematicians. To keep engineers in engineering, there must be a benefit to staying. To be competitive, STEM firms and laboratories need to provide their staff with benefits that these higher-paying fields cannot or do not offer, such as work-life balance or the ability to do top-level research.

While there are many ideas and proposals for transforming the current state of education, they all too often lack a truly transformational character. Proposals that are innovative regularly face resistance from those entrenched in the current system. In order to bring about real change, systemic interests will have to be challenged—in the interests of excellence and of American students achieving their full potential.

Approaches that Work

School Choice. One education reform approach that holds promise for addressing the STEM education crisis is school choice—policies that give parents the ability to choose the right school for their children and allow school leaders the flexibility to create a successful learning environment for students. School choice allows families to enroll their children in a school that better meets their needs, while encouraging schools to improve their services as they compete to attract students. By fostering systemic improvement, expanding school choice is a promising strategy for ensuring that more children receive a quality education during their earlier elementary and secondary school years—helping to fix the leaky pipeline of students who are leaving high school lacking the skills to pursue STEM education fields in college or in the workforce.

School choice policies can take many forms. An increasing number of states and cities are offering private-school choice through scholarships, vouchers, or education tax credits. A growing body of empirical research has found that these programs are succeeding in improving education by increasing parent satisfaction with their children's schools, boosting participating students' test scores, and increasing public school efficiency in response to competition created by new school-choice options.

Another form of school choice that is gaining momentum is choice of school within the traditional public-school system. Increasingly, large school districts, such as San Francisco, Houston, and New York City are reforming the structure of their public school systems to allow parents to have greater flexibility to choose the right public school for their children within their school district. This expanded choice option is coupled with greater decentralization:

The school district transfers greater budget and decision-making authority to the school level where principals have the authority to set and implement their school's mission. Under this system, which has been called "backpack funding" or the "weighted student formula," a child's share of public school funding follows the child to the school of their parents' choice and is included in the school budget to be spent on priorities set by the school principal. This choice-based school-finance system has been structured to provide additional funding to students who have greater needs, such as those with physical or emotional disabilities, or students from poor families.

In both public- and private-school choice, the incentives are structured in a school system to encourage greater innovation and improvement by mixing freedom with accountability. Parents are free to choose a school that is the right fit for their children. School leaders are given the autonomy to direct their schools' mission and ensure that their school provides a quality learning environment. They are accountable to parents, since only schools that deliver quality services will increase enrollment. Over time, promoting this kind of healthy competition in public education should significantly improve quality and students' academic achievement—which will help to fix the leaky pipeline in STEM education.

Case Study Florida. In 1999, nearly half of Florida fourth-graders scored "below basic" on the NAEP (National Assessment of Educational Progress) reading test. Florida recognized that its education system was in crisis and decided to do something about it. Over the past decade, lawmakers have enacted multiple reforms to change school governance. Social promotion was ended and students were not automatically advanced to higher grade levels. Those held back were provided with aggressive remediation. The state changed its policies for hiring and retaining teachers. Alternative certification was allowed to encourage talented professionals to enter the education profession. Teachers became eligible to receive merit pay. Dissatisfied parents were given more school-choice options, encouraged by scholarships, tax credits, and charter school options. Less than a decade later, 70 percent of Florida's fourth-graders scored at "basic" or "above basic" on the NAEP—improvement that outpaced the average of students across the nation.

These changes brought with them even more encouraging developments. In 2007, the average reading test score for Hispanic fourth-grade students in Florida was higher than the average score of students in 15 other states (Alabama, Alaska, Arizona, Arkansas, California, Hawaii, Louisiana, Mississippi, Nevada, New Mexico, Oklahoma, Oregon, South Carolina, Tennessee, and West Virginia). Even low-income Hispanic students in Florida (those eligible for a free or reduced-price lunch under federal poverty guidelines) outscored the average student in seven of these states.

A concrete example of Florida reforms is One Florida, an initiative intended to replace affirmative action at the university level by creating incentives for schools to prepare affirmative-action-eligible students to pass Advanced Placement (AP) exams in high school. Under One Florida, schools received $700 from the state for each student who passed at least one AP test with a score of a three or better (the highest score is five). If that student's school previously had a D or F rating under the state standards and accountability guidelines, the school earned an additional $400 as a reward for their progress. Teachers of the students who passed AP exams received a bonus as well—$50 per student, up to $2,000 per year.

The success of Florida's reforms demonstrates that, under the right circumstances, schools can succeed in improving the academic achievement of students from all backgrounds. Schools are capable of improving with policies that impose standards, hold schools accountable for student performance, and increase students' school choice options. This type of systemic improvement is what will help address the STEM crisis by preparing more students to succeed in STEM coursework.

Online Learning. Online learning provides a low-cost option with the potential to resolve a variety of student, family, and community needs. Online learning communities can provide students with access to a wider range of materials than traditional schools. Moreover, online classrooms provide students who live in remote areas unprecedented access to course materials and classmates. AP courses can be taken by both public- and home-school students who currently have no access to them.

The creation of virtual chemistry and biology laboratories shows specific STEM benefits of online education. These virtual labs use gaming techniques to allow students to perform experiments in schools that cannot afford tra-

ditional laboratories. While these online set-ups are not on par with learning with a Bunsen burner, as technology advances, they will become better and better.

Online learning can also revolutionize the educational process. Computers have not yet reached their full potential for fundamentally changing the education model. Thus far they have only supplemented the current four-walled approach to education. For instance, students failing a course can find extra help online.

Much more innovation in online learning is possible. Since different people learn in different ways, online modules could be specifically designed for individuals and tailored to their learning styles. One such system, Carnegie Learning, uses artificial intelligence to track students' work. In real time, lessons are tailored, feedback is given, and when needed, hints are provided to the student. By collecting information on a particular student's performance, the software can inform a teacher about which concepts a student is struggling to understand.

Charter Schools. Some of the most impressive improvements in STEM scores have been accomplished by charter schools. The U.S. currently has 4,300 charters serving 1.3 million students, 3 percent of the public-school attendees. On national tests, students in charter schools score on average 10 percent higher than students in traditional public schools.

Charter schools can fill specific niches allowing students of all abilities to find an environment that suits their learning styles and skills. Charters can provide opportunities for gifted and talented students beyond what a regular public school can offer. At the same time, charters can enable children who are not college bound to tailor their high school education to a future in a specific trade. These students could have lucrative STEM careers, filling some of the chronic vacancies that exist in STEM fields.

Because of their capacity to be innovative—unhampered by the standard public school bureaucracy—while being held accountable for results, charters have the potential to redefine today's state of education. But current policies make it unlikely that this potential will ever be fully realized. Many states have caps on the number of charter schools that are allowed to exist. By limiting the number of charters, the system handicaps itself, decreasing school choice and competition. Charters also receive less federal money per student than regular public schools.

Despite this uphill battle, many students in charter schools have delivered high test scores and possess fantastic post-graduation prospects. In order to better understand the potential and range of charter schools, two examples are included in this report: the KIPP schools and BASIS schools. These schools demonstrate why charter schools are making such promising progress.

KIPP Schools. The KIPP charter schools are taxpayer-funded, open-enrollment, college-preparatory public schools where underserved students develop the knowledge, skills, and character traits needed to succeed in top-quality high schools, colleges, and beyond. Each of the 67 KIPP schools in the country is governed by a local board of directors and headed by a school leader, usually a principal, who is recruited and trained by the KIPP Foundation.

Teachers in KIPP schools are available to their students from 7 a.m. to 9 p.m. on school days. If a student is struggling, his teacher works extra hours with him, ensuring that no student passes to the next grade or graduates until he has mastered the requisite skills. KIPP teachers also teach business etiquette that increases students' marketability in the future, such as sitting up straight and looking at people when they are talking. The parents of KIPP students are required to be involved in their children's education through such responsibilities as checking homework.

Each of the KIPP schools has a different flavor, but all share a set of core operating principles:

- **High expectations.** KIPP schools have clearly defined and measurable expectations for all students, regardless of background. Students, parents, teachers, and staff create and reinforce a culture of achievement and conduct through a range of rewards and consequences for academic performance and behavior.
- **Choice and commitment.** Students, their parents, and the faculty of each KIPP school all participate voluntarily. No one is assigned to a certain school or forced to attend a KIPP school. Each person involved must make and uphold a commitment to put in the time and effort required to achieve success.

- **More time.** With an extended school day, week, and year, KIPP students have more time in the classroom. KIPP students spend 60 percent more time in school than the average public school student, typically from 7:30 a.m. until 5:00 p.m. on weekdays, every other Saturday, and for three weeks during the summer. Rigorous college-preparatory instruction is balanced with extracurricular activities, experiential field lessons, and character development. In spite of these longer hours, average daily attendance at KIPP schools is 96 percent, significantly higher than at traditional public schools.
- **Power to lead.** The principals of KIPP schools are effective academic and organizational leaders. They have authority over their school budget and personnel; they are free to swiftly move dollars or make staffing changes.
- **Focus on results.** KIPP schools focus on how students perform on exams. There are no shortcuts and no excuses. Students are expected to achieve a level of academic performance that will allow them to succeed at the nation's best high schools and colleges.

More than 85 percent of KIPP schools are middle schools. The average four-year KIPP student enters the fifth grade testing at the 40th percentile in math, and the 32nd percentile in reading. After four years at KIPP, these same students are performing at the 82nd percentile in math and the 60th percentile in reading. After one year at KIPP, approximately two-thirds of KIPP fifth-graders outperformed their local districts in reading and math. After four years at KIPP, 100 percent of KIPP eighth-graders outperformed their district averages in reading and math.

BASIS Schools. The first BASIS charter school was opened in 1997. Similar to the KIPP approach, the BASIS philosophy focuses on helping students reach their academic potential through dedicated, talented teachers. BASIS schools feature an accelerated curriculum and small class sizes. Students are required to complete algebra by eighth grade. In BASIS high schools, students are required to take Honors and Advanced Placement courses in every core subject. Moreover, students have the opportunity to take advanced coursework even in middle school, such as an AP economics course for eighth graders.

In BASIS schools, AP teachers are involved in developing the lesson plans for each grade. In this way, teachers across all grade levels work together to develop a fluid multi-year path that ensures, in a feasible step-by-step fashion, that students will be on track to complete AP coursework in high school. These collaborations extend beyond single disciplines. Latin is a core course for fifth and sixth graders because it prepares them for AP biology and modern foreign language classes. The fifth-grade Latin teacher, for instance, develops lesson plans with input from the AP biology teacher. Through these partnerships, the BASIS philosophy embodies the synergism of interdisciplinary learning.

In BASIS schools, 56 percent of teachers possess a master's degree in the subject they are teaching; 10 percent possess a Ph.D. Many charter schools, including BASIS, direct their recruiting efforts at people who want to apply their passion for a subject to teaching, while traditional teacher certification requirements severely restrict the pool from which public schools can recruit.

Alternative Teacher Certification. Since college STEM majors traditionally have more structured requirements and fewer electives than their non-STEM peers, it is more difficult for STEM majors to earn a second major in education, which is usually required for teaching at a standard public school. Increasingly, states are creating programs for alternative teacher certification to create new pathways for talented professionals to become school teachers without completing a traditional teacher certification program. Rather than requiring a prospective teacher to complete an estimated 30 credit hours of education-related coursework, alternative teacher certification programs generally require aspiring teachers to have a college degree, pass a background check, and pass a test demonstrating their knowledge of pedagogy and subject area expertise.

Some alternative teacher certification programs are focused specifically on recruiting, training, and retaining STEM majors and STEM degree holders. One program, Cal Teach at the University of California at Berkeley, prepares and supports STEM majors who are interested in becoming K–12 math and science teachers. Cal Teach consists of a sequence of courses and experiences, including time spent teaching and practicing skills on students in classrooms, aimed at training these STEM students to become great teachers without interfering with the requirements of their undergraduate STEM classes.

Teach for America (TFA) is another program that provides alternative certification. TFA has begun to intensely recruit teachers at schools with strong math, science, and engineering programs, in many cases offering full certification for students who have worked with TFA for two years. Since intensifying their recruitment efforts at top STEM universities, TFA has experienced a 135 percent increase in the number of math, science, and engineering majors who apply to its program.

Another promising alternative teacher certification program is the American Board for Certification of Teacher Excellence (ABCTE). ABCTE has demonstrated success in creating a rigorous but low-cost alternative certification program that focuses on helping experienced professionals transition into careers in the classroom. Given the potential for looming shortages of teachers in STEM education subjects, programs like ABCTE can help solve this problem by providing professionals with STEM expertise a more convenient pathway into the teacher workforce.

Differential Pay. Traditionally, public school teacher salaries are based on credentials and years of classroom experience. This might mean that an AP calculus teacher with two years of teaching experience and a bachelor's degree in mathematics is paid the same amount as a second-year physical education teacher with a bachelor's degree in general arts. This approach fails to recognize the labor market realities and the fact that teachers with STEM-related expertise can command higher salaries in the private sector.

If differential pay is enacted in primary and secondary schools, STEM-trained professionals who have multiple career options might receive higher salaries than other teachers of similar seniority, credentials, and accomplishment in non-STEM fields. Such compensation could also come in the form of loan forgiveness, signing bonuses, or other incentives. If compensation were not based on a single salary schedule, a school principal could afford a STEM teacher at a genuine competitive salary and still afford a good teacher in another subject at a more reasonable rate.

Increasing STEM teacher salaries may require a shift in the way money is spent across the current school budget. School districts could pool money and redistribute it to principals who could in turn pay teachers at whatever rate per subject the principal deemed appropriate.

Inquiry-based Learning. While changes need to be made in the way STEM teachers are trained and retained, there is also much room for innovation when it comes to teaching methods. Inquiry-based learning is one such innovation that offers a tool for successful STEM programs. In inquiry-based learning, students are required to work together in teams to solve problems. The teacher's job in an inquiry-based learning environment is to help students discover knowledge for themselves rather than spoon-feeding it to them.

Phillips Exeter Academy in New Hampshire has created an extraordinary approach to inquiry-based mathematics. The curriculum is problem-centered. Topics and theorems become apparent to students as they work through the problems. The methods used in solving the problem, the corrections that are made to the approach, and the ability to communicate are considered just as important as arriving to the correct answer.

Project Lead the Way. While the Phillips Exeter inquiry-based approach to math is virtually unseen in public and charter schools, some have begun to introduce inquiry-based-learning programs for engineering subjects. One successful program is Project Lead the Way (PLTW).

The PLTW curriculum makes math, science, and engineering relevant for students. Through hands-on, real-world projects, students become engaged and excited as they learn how their classroom skills can be applied to everyday life. This hands-on approach is often called activities-, project-, and problem-based learning (APPB-learning). Schools that take an APPB-learning approach experience an increase in student motivation, in cooperative learning skills, and critical thinking.

Modules in PLTW are aimed at teaching a particular process or procedure in a step-by-step fashion. These steps function as building blocks. Multiple past steps are needed to solve future assignments. Students learn how to break down complex problems into modular, solvable pieces and learn how these parts can be tied together in order to elegantly solve the problem.

The PLTW approach works for 80 percent of students. While PLTW does not replace math classes, it bolsters math interest. Students in PLTW are less likely to fall victim to the leaky pipeline problem. For instance, at the Mil-

waukee School of Engineering, over 90 percent of PLTW students who declared engineering as their major as freshmen go on to graduate with an engineering degree.

Teachers in PLTW work tirelessly to acquire industry-standard tools and simulators for their students. Autodesk, a design and engineering software tool used in PLTW classrooms, is very similar to that used in many engineering and design positions at Harley Davidson. Because of these industry partnerships, students can go from high school straight to an industry job, saving their employers large amounts of training resources. These students already have a good understanding of what their chosen career entails. As a result, there is less attrition: Employees know what they are getting into before they ever step onto an employer's terrain.

PLTW is not the only program that works together with industry. The Manufacturing Institute supports and promotes competency-based learning with industry-led credentials and assessments that verify those competencies. By endorsing industry credentials and customized training, students can enter the workforce faster and more effectively on day one than they can through traditional programs that require a certain number of classroom hours. In March, the National Association of Manufacturers (NAM) and the Manufacturing Institute launched a Manufacturing Skills Certification System to help meet the workforce demands of the manufacturing sector. The program focuses on "core, basic skills required for entry level workers in all sectors of manufacturing."

Industry partnerships have been incredibly successful in decreasing the leaky pipeline problem. While industries cannot sponsor every change in education, nearly all industries provide scholarships and summer internships to gifted and talented students.

Gifted and Talented Students. Industry has economic reasons for spending its effort and resources on the top 1 to 2 percent of students. These gifted students are the individuals who in the future will be greatly responsible for employing the rest of the population and inventing the technologies that give America a competitive edge. Investing in these gifted students, particularly those gifted in STEM, is a logical step to ensure that they have the training to help the rest of the country be competitive.

Foreign Students. Gifted and talented students from around the world come to work and study in the U.S. Highly skilled foreign workers with a college degree or higher may be granted an H-1B visa so that they may temporarily work in the U.S. After 9/11, Congress drastically lowered the cap on H-1B visas by almost 70 percent from 195,000 to 65,000. Of that 65,000, more than 30 percent are reserved for foreigners with graduate degrees or higher.

When it comes to STEM positions in the U.S., there are 140,000 vacancies a year. Since there are not enough American citizens trained in STEM, the U.S. is dependent on these H-1B visa holders. Even with 65,000 foreign STEM workers in the U.S. a 75,000 STEM worker vacancy remains. The shortage of domestic STEM employees coupled with the inability to import more STEM H-1B visa holders has resulted in many American companies being forced either to expand outside the United States or not to expand at all.

Low caps on H-1B visas are also detrimental to international relations with students from other countries who have studied in the United States. Foreign students who hold degrees from American universities undergo the same application process for H-1B visas as those who have never set foot in the U.S. If foreign students who received a top-level education at an American university want to stay in the U.S. and help American companies grow and profit, they should be allowed to do so. If they are not, they will have no choice but to go to another country and use their U.S.-attained education to compete against U.S. companies.

As a result, the U.S. puts itself at risk when it educates foreigners and then forces them to leave. Educating the competition is equivalent to letting a player from the opposing team into your huddle. It is hard to win the game when the other team knows your plays. If Coca-Cola released its trade secret recipe, it should not be surprised if it started losing market share. In the same way, if the U.S. is going to allow foreign students into its huddle, it needs give them the option of playing for the U.S. team.

Conclusion

The STEM crisis in America demands a sense of urgency and an openness to innovative educational and policy solutions. Complacency is causing the U.S. to lose its economic edge. But promising strategies with a proven track record are available and should be expanded.

By freeing the path to teaching, more people with a passion for STEM will be enabled to pass on their passion to students. More STEM professionals can be recruited and retained by implementing merit pay or bonuses for advanced teaching. By creating rewards for excellence, especially those resulting from the engagement of industry and national security, new partnerships can be fostered, uniting both industry and defense with the public.

Innovative ways of delivering K–12 STEM education are within reach. Charter schools, school choice, and virtual education offer excellent models. Integrating state-level reforms into public K–12 education is essential. As in the Florida case study, teacher, student, and school accountability systems are critical.

While the U.S. is talking about strategies for resolving its STEM crisis, other countries are rapidly gaining ground. The U.S. is losing its lead at an alarming pace. To stay globally competitive and prepared for new economic and security challenges, federal and state policy must encourage entrepreneurship and excellence in STEM education.

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Leadership *for* America Ten Transformational Initiatives

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