The Future of STEM Education: An Analysis of Two National Reports

P.K. Raju and Ashley Clayson

Auburn University

In September, two major reports were released discussing the current crisis in STEM education. Both the National Science Board (NSB) and the President's Council of Advisors on Science and Technology (PCAST) reported alarming facts and figures about the United States' position in the global knowledge economy. The U.S. is no longer competing as we have in the past in STEM fields internationally—the result of falling interest and performance in STEM education. Both reports propose several programs and projects to tackle this increasing problem.

The Problem

The problem, as David Pittman (2010) writes in a recent issue of *Chemical & Engineering News*, is one that "has been preached [about] for years" (para. 5). Researchers immersed daily in STEM education already know what these reports claim: that the U.S. STEM pipeline is diminishing at alarming rates, and is falling significantly behind other countries' progress in STEM education.

Part of this decrease is due to our students' lower achievement in STEM areas. Both reports cite statistics from the Program for International Student Assessment (PISA) test: our top students (in the 90th percentile) "scored below their peers in 29 countries on mathematics literacy, and below 12 countries on science literacy" (National Science Board, 2010, p. 8), a clear indication that our nation is lagging behind in STEM education.

Another major problem, the reports state, is that our students simply aren't as interested in STEM fields as they used to be, and certainly not as interested as students in other nations. The NSB reports that only 16 percent of U.S. undergraduates chose majors in natural science and engineering, which is lower than students in the European Union (25%), South Korea (38%), and China (47%) (p. 8). Similarly, PCAST states that "Only about a third of bachelor's degrees earned in the United States are in a STEM field, compared with approximately 53 percent of first university degrees in China, and 63 percent of those earned in Japan" (President's Council of Advisors on Science and Technology, 2010, p. 2). Statistics like these baffle educators, especially in a country that was a stronghold of STEM innovation and education mere decades ago; our nation's achievements in nuclear and rocket science in the mid-twentieth century seem like distant memories in a nation whose students are so rapidly falling behind.

The Solutions

PCAST and NSB both offer up solutions to put the US back on top in STEM education and, subsequently, innovation; their approaches, however, differ drastically. PCAST's recommendations focus on bettering STEM education across the board; NSB, however, while recognizing that improving overall STEM education is a noble goal and should be pursued, also argues that we should put a greater emphasis on identifying and developing STEM talent. Both groups do agree, as evidenced in their recommendations, that immersing students in STEM fields should begin at a young age. If educators can spark the interest of younger students, the logic seems to imply, they will be more likely to follow through with a STEM-related education when they are older.

PCAST

The PCAST report, officially titled "Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Mathematics (STEM) for America's Future," focuses on increasing federal involvement in STEM Education. Their first recommendation supports the state-led movement for shared standards in math and science education, and asks the federal government to assist by providing financial and technical support to states. Such a recommendation is worthwhile; any support for states trying to increase math and science standards is well-deserved. However, states must find a balance between raising standards and educational equity. Particular care should be taken to ensure that states and regions with a high concentration of historically rural, low-achieving

areas and a lack of funds are guaranteed the support that will help them achieve at rates on par with historically well-funded and higher-achieving areas.

Standards are only the first step to PCAST's plan, however. They make a number of other recommendations that they believe will lead to higher achievement in STEM for the U.S. Their recommendation to create a "STEM Master Teachers Corps" is especially excellent. The Master Teacher Corps would recognize and reward the top five percent of the nation's STEM teachers. Teachers in the Master Corps would receive salary supplements and additional funds for their schools' programs and activities. Such a program will encourage current STEM educators to constantly reflect upon and improve their instructional strategies, which is always important if we are to move forward.

PCAST's goal to recruit 100,000 STEM teachers over the next decade, however, is may not be quite as effective toward their overall objectives. We should, of course, constantly be working to recruit excellent candidates to STEM education, but too great a focus on quantity may in fact, in the end, sacrifice quality. Unfortunately, education is not an especially glorified field in our nation; teachers work long hours at often low rates, which often drives highly qualified candidates from the profession. Until our nation recognizes and works to change this, it will continue to be difficult to achieve such an ideal goal.

PCAST's focus on scholastic and extracurricular activities, on the other hand, are another strength of the report. Their goal is to create 1,000 STEM-focused schools over the next decade; yet again, a lofty number, but perhaps one that is more achievable. STEM schools encourage scientific inquiry and give students opportunities to learn more about STEM fields than they would perhaps receive at a traditional school. Most of the U.S.'s current 100 STEM school are high schools; PCAST recommends that several of the new schools be elementary or middle schools. In this way, students are encouraged in STEM fields from a very young age and are more likely to stick with STEM fields in the future. The report also recommends a coordinated initiative, INSPIRE, to support extracurricular STEM programs. Such programs give students further opportunities to learn about STEM fields, often in smaller, more hands-on environments than the traditional classroom.

Overall, the report makes excellent suggestions for improving STEM education, even if particular care should be taken in executing certain objectives.

NSB

The NSB report also makes admirable if lofty suggestions, but instead of focusing on tactics for improving general STEM education, they focus on "Identifying and Developing our Nation's Human Capital," as their subtitle states. Their three Keystone Recommendations are designed to foster exceptional STEM talent. Their goals, the NSB argues, will provide opportunities and motivation for exceptionally bright students to pursue excellence in STEM fields without sacrificing the education of other learners. NSB breaks down its recommendations into three general areas: 1.) Providing opportunities for excellence, 2.) Casting a wide net, and 3.) Fostering a supportive ecosystem.

First, says the NSB, we must give students the opportunity to excel. This recommendation includes steps to increase access to and quality of accelerated coursework, support rigorous STEM preparation for teachers, and provide Federal support to programs that foster potential STEM educators.

Next, we must identify and nurture all types of talent from all types of demographics. This can be achieved by improving talent assessment programs and teaching educators how best to identify and develop exceptional talent. The report claims that "the U.S. education system too frequently fails to identify and develop our most talented and motivated students who will become the next generation of STEM innovators" (p. 5) Part of this, they claim, is because traditional talent assessments don't measure spatial talent—"a talent highly valuable for developing STEM excellence" (p. 9). Identifying and nurturing spatial ability in young students and inspiring STEM interest in them will, the NSB argues, increase our nation's pool of STEM innovators by nurturing an ability vital to STEM fields.

Such a focus is not designed to leave behind students who are struggling to meet the baseline standards in STEM. The report emphasizes that "the dual goals of raising the floor of base-level performance and elevating the ceiling for achievement are not mutually exclusive" (p. 10). This attitude, that educators can better serve both groups of students through the recommendations in this report, is encouraging. Our nation's recent focus on "raising the floor" through No Child Left Behind, though a noble goal, may have contributed to findings by recent studies on high-achieving students: "test scores for students in the ninetieth percen-

tile (high achievers) have, at best, experienced modest gains and, at worst, stagnated" (p. 12). Though this connection is not necessarily causal, the statistics show that, whatever the cause, our high-achieving students need higher levels of stimulation than they are currently receiving in order to continue to develop.

NSB's final recommendation is designed to "nurture and celebrate excellence and innovative thinking," and calls for parents, professionals, educators, and students to "work together to create a culture that expects excellence, encourages creativity, and rewards the successes of all students…" (p. 3). Creating a culture that values education is certainly a noble goal, but one that seems quite lofty in a nation where sports figures and pop artists receive million-dollar salaries while educators often start at below $50,000. However, NSB does propose several concrete steps to create such a culture, including a national campaign to increase the appreciation of academic excellence and encouraging the creation of positive school environments. The most innovative and interesting recommendation in this category is III.C: "Support the expansion of computing and communication infrastructure in elementary, middle, and high schools to foster peer-to-peer connections and collaborations, and direct connections with the scientific research community" (p. 4). Today's students are already computer-minded, and already use these technologies to network socially. Why not tap into this generation's "Facebook mindset" to foster social support for academic excellence?

Policy Change: What Can We Do?

Though these reports make sound concrete suggestions, they are, according to Pittman, essentially doing the same thing that researchers have done for the past several years, ever since our nation's STEM pipeline began to decrease: warning the government of what inaction will mean for our nation, while simultaneously being powerless to create nationwide change themselves. Pittman's article states: "…the pair of reports offer no real sign of actual policy change" (para.5). Unfortunately, researchers in education have only what power is given to them. True policy change depends upon our Legislative and Executive branches of government, who, unfortunately, are often slow to act upon educators' recommendations.

In the meantime, however, all that we as researchers can do is continue doing what we have always done: research the best ways to reach our students, be they high achievers, low achievers, or somewhere in between. In the end, it is each us of who holds the fate of our nation's future. We must continue to research better methodologies, better recruitment strategies, better talent assessment programs, in order to get our nation back on the road to STEM excellence. We must continue to provide support and inspiration for our students, regardless of what happens in Washington. We must first, as Gandhi said, "be that change we wish to see in the world." Hopefully, policy change will eventually follow.

References

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P.K. Raju is the Thomas Walter Distinguished Professor of Mechanical Engineering at Auburn University. He has made significant research contributions in acoustics, noise control, nondestructive evaluation, and engineering education. He has published 17 books, 8 book chapters and 160 papers in journals and conference proceedings. He received several awards for his work in the area of case studies in engineering education. Dr. Raju is the director of the Laboratory for Innovative Technology and Engineering Education (LITEE) and the Auburn Engineering Technical Assistance Program (AETAP). He is a Fellow of ASEE, ASME, the Institution of Engineers, India, and the Acoustical Society of India. Dr. Raju is the Editor-in-Chief of the *Journal of STEM Education: Innovations and Research*.

Ashley Clayson is a second-year Master's student in Technical and Professional Communication at Auburn University. Her research interests include engineering communication, human-computer interaction, genre studies, and communication pedagogy. She is the recipient of the Betty T. Naugle Fellowship in Technical and Professional Communication. Ms. Clayson is the Editorial Assistant for the *Journal of STEM Education: Innovations and Research*.