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Paradigm Shift- The Development of STEM in our American Education System

Americans have crafted a love-hate relationship with the public education system in which the majority of our future leaders learn, grow, and develop necessary skills. This relationship results from the faults that the system as a whole, continues to embody because of its original design. Indeed, the United States education system has only done what it was designed to do, over one hundred years ago when our country had different needs, in a different world economy. The American plan was to prepare well-rounded students to enter industry. Unfortunately, our students reached the potential of that system decades ago, and the bar for the traditional primary and secondary education was never raised.

The start of the twenty first century brought a sea of concerns as televisions flashed images of Asian international students tremendously outperforming American students. President George W. Bush responded to the concerned call from numerous national education organizations in his 2006 State of the Union Address with a plan to refocus (McDermott). Following the implementation of these initiatives, the United States watched a shift occur in the American education system toward a focus on STEM, which is short for science, technology, engineering and math, in order to increase competitiveness with the world at large. This speedy implementation can be attributed to the fear and worries of leaders in the U.S. government that believe the education system has been let go for too long.

To some, the letters S T E & M are insignificant, but to many, their meaning is known and appreciated. STEM encompasses science, technology, energy and math. The acronym arose in common use shortly after a science education interagency meeting held at the National Science Foundation (NSF). Scientists, including NSF Director Rita Colwell and Winona State University President Judith Ramaley, suggested a change from the older and uncommon acronym SMET to STEM (Christensen). Dr. Colwell advocated for the NSF to institute the acronym change and it clearly stuck, as the development of STEM in education was speedy.

In the early twentieth century, the American education system was driven by business leaders, such as Henry Rockefeller and Andrew Carnegie, who watched the United States in its transformation from an agricultural economy to an industrial one. There was a tremendous need for children to learn to read, write, and complete basic arithmetic in order to proficiently operate the country's newest factories when they became adults. The industrial revolution created millions of jobs, while altering the American way of life and allowing the country to lead the global economy. The businessmen of the late 1800's knew that a workforce with appropriate training and education was essential for success in business. They used America's education system to satisfy the needs of the country (White). The education system evolved into its own small educating factory, as students moved from one class to another, each and every day. The system was dedicated to producing well-rounded students without any specific focuses. It was based solely on the basics of reading, writing, and arithmetic. This design failed to adequately prepare citizens to compete and be successful in the technological world of today. Unfortunately, not much about the factory-like educational structure has changed since the time of those business giants.

STEM, as an acronym, was born out of worry about American competitiveness and maintaining a position of global leadership. In 2006, the United States National Academies expressed their concern about the declining state of STEM education in the United States. The Committee on Science, Engineering, and Public Policy developed a list of suggested actions. Its top three recommendations were to increase America's talent pool by improving K–12 science and mathematics education, strengthen the skills of teachers through additional training in science, mathematics and technology, and enlarge the pipeline of students prepared to enter college and graduate with STEM degrees. President George W. Bush quickly got word of this national concern. In his 2006 State of the Union address, President Bush addressed his concern for and fear of an inability to compete against the international community. President Bush encouraged “innovation throughout our economy and to give our nation's children a firm grounding in math and science.” He proposed that “if we ensure that America's children succeed in life, they will ensure that America succeeds in the world” (McDermott). President Bush worried that there was a lack of high quality STEM research and education initiatives. Following his expression of concern, the President introduced the American Competitiveness Initiative to assist the advancement of our education system.

STEM became a household name, in part, because of the efforts of President Bush and lawmakers to change the face of education. The American Competitiveness Initiative was driven by the belief that a student’s education is the gateway to opportunity and the foundation of a knowledge-based and innovation-driven economy. The goal of this \$136 billion initiative was to increase investments in research and development, strengthen education, and encourage entrepreneurship and innovation. President Bush focused on tax credit for research and

development. To prepare our citizens to compete more effectively in the global marketplace, the American Competitiveness Initiative proposed \$380 million in new Federal support to improve the quality of math, science, and technological education in our K-12 schools and engage every child in rigorous courses that teach important analytical, technical, and problem solving skills. This initiative also expanded the Advanced Placement/International Baccalaureate Program. The AP/IB portion expanded access for low-income students to AP/IB coursework by training 70,000 additional teachers over five years to lead AP/IB math and science courses (Bush).

While the country understood the importance of its new STEM focus, it quickly became a national priority because so many STEM related jobs were going unfilled across the country. As United States unemployment statistics hovered around eight percent in 2012, a close look reveals a clear contradiction. Those historically high levels never showed the types of jobs that went unfilled. Many of those unfilled jobs needed an education background in STEM (Engler). This suggests an apparent skills shortage of STEM professionals with advanced degrees. According to the Council on Foreign Relations in September 2014, “60% of United States employers are having difficulties finding qualified workers to fill vacancies at their companies.” The Department of Commerce estimated that “by 2018, the United States will have more than 1.2 million unfilled STEM jobs” (Bennett). In addition, “STEM occupations will grow 1.7 times faster than non-STEM occupations from 2008 – 2018” (Good Jobs and American Competitiveness). Last year, the Department of Commerce estimated that “the number of STEM jobs will grow 17 percent by 2018 versus 9.8 percent for all other fields” (Bennett). These statistics clearly show the obvious and desperate call for employees in 2012, further solidifying the concrete need for STEM to be a national priority.

Today, the United State has lofty goals to pursue and accomplish. It seems as though the evolution of STEM is necessary to achieve at least one economic goal. America is crying for a shifted direction toward a “creativity economy,” in which people are a part of “imaginative processes with outcomes that are original and have value”(Pell). In order to achieve this creativity within the technological world, the conditions for creative thought must begin in the classroom. Michael Petrilli, vice president of the Fordham Foundation, a school-reform think tank, agreed with Thomas Friedman’s bestselling book in 2006, that “the economy is fundamentally different today. If our kids are going to have an opportunity to have good-paying jobs and enjoy the lifestyle they're used to, they're going to have to be able to use their brains. By any measure, our students are falling behind the rest of the world, especially in math and science” (Feldman). Because of these economic goals, STEM has shifted into the largest part of the basic education for students.

STEM continues to act as a priority in the American education system due to the problems that persist, as well. Unfortunately, we continue to test below some international averages in mathematics. Fifteen year olds in the United States continue to turn in “flat results” in internationally standardized tests. We have barely been able to crack the global top twenty in reading, science and mathematics among students from other developed nations. In the latest Program for International Student Assessment math exam, American students missed the mark for the international average. At the same time, they scored above average on the PISA reading and science proficiency exams. According to the same article from NPR, “the math scores of students in Shanghai showed that they are "the equivalent of over two years of formal schooling ahead of those observed in Massachusetts, itself a strong-performing U.S. state” (Chappell). But,

we must take this information with a grain of salt, considering the fact that “twelve provinces in China took the 2012 PISA test, the OECD confirmed, but only the results from Shanghai, Hong Kong, and Macao were publicly released. OECD “cut a special deal” with the Chinese government, allowing for “cherry-picked” results. In 2011, a Chinese website leaked the average PISA scores from 2009 for all 12 participating provinces. According to those results, China scored measurably above the United States in math and science, but significantly below the U.S. average in reading” (Heiten). Beyond this partial Chinese bias, Arne Duncan, the Secretary of Education, commented on the report and addressed the “educational stagnation” that it portrays. This stagnation shows how American STEM education has a long road ahead to set our country back on track.

The shift toward STEM in the American education system has been speedy and efficient, for the most part, and this becomes evident when analyzing the large amount of success and progress, as a result of the American Competitiveness Initiative. This distinct focus on increasing students’ exposure to advanced STEM courses allowed exponential progress for the College Board and students, in general. Of the thirty-four 34 Advanced Placement courses made available to students in the United States, ten of them are defined by the College Board as STEM tests. The involvement of American students in AP classes has increased from 380,000 students to 1.5 million students in just six short years (Morse).

The American Competitiveness Initiative also funded numerous programs for research and development. At the same time, organizations were hopping onboard with STEM as companies and organizations contributed to the start of STEM programs for students, both young and old. In addition, the students in my English class are participating in the Summer Bridge of

the Pennsylvania State University Millennium Scholars Program. This program was founded to increase the diversity of researchers in science, technology, engineering and mathematics. This highly selective program is open to academically strong high school seniors whose future plans include a commitment to pursuing a doctoral degree in science or engineering. The collective goal of contributing to society through diverse, world-class research is achieved through academic excellence, sharing the knowledge amongst scholars, and using the available program resources including mentoring, tutoring and advising. The Millennium Scholars Program is directed by Starlette M. Sharp who plans to change the face of scientists and engineers leaving Penn State for graduate school. As a candidate for the third cohort of Millennium Scholars, I hope to increase the number of females with a Ph.D. in mathematics as there is a clear underrepresentation of women. The other members hope to do the same. If it weren't for the evolution of STEM in education during our years in grade school, who knows if the Millennium Scholars program would even exist or if we would be here.

In addition, the United States has come out as the best in the world in one of this year's most intense intellectual competitions. This month, top-ranked high school math students competed in an international competition against competitors from over 100 countries at the 56th International Mathematical Olympiad in Thailand. For the first time in over two decades, the Americans won. In light of these recent reports that American math students are falling behind, Po-Shen Loh, the director of Team USA was happy that "At least in this case with the Olympiads, we've been able to prove that our top Americans are certainly at the level of the top people from the other countries" (NPR Staff).

It becomes more evident that STEM has taken over our educational world once you take a moment to walk around a school or listen to the news. Science, technology, engineering and math are the way of our future economy, culture and world. The United States began to fall behind in STEM at the turn of the twenty first century and we should be incredibly grateful that people caught on to our shortfall sooner than later.

## Works Cited

Bennett, William J. "Hey, America, Here's How You Spell Success: S-T-E-M." *Fox News*. FOX News Network, 06 Mar. 2014. Web. 16 July 2015.

Bush, George W. "President's Letter." *American Competitiveness Initiative*. White House, 2 Feb. 2006. Web. 10 July 2015.

Chappell, Bill. "U.S. Students Slide In Global Ranking On Math, Reading, Science." *NPR*. NPR, 3 Dec. 2013. Web. 10 July 2015.

Christenson, Jerome. "Ramaley Coined STEM Term Now Used Nationwide." *Winona Daily News*. Winona Daily News, 13 Nov. 2011. Web. 21 July 2015.

Engler, John. "STEM Education Is the Key to the U.S.'s Economic Future." *US News*. U.S. News & World Report, 15 June 2012. Web. 13 July 2015.

"Good Jobs and American Competitiveness." *The Case for STEM Education as a National Priority* (2014): n. pag. Sept. 2014. Web. 9 July 2015.

Heiten, Liana. "U.S. Achievement Stalls as Other Nations Make Gains." *Edweek.org*. Education Week, 3 Dec. 2013. Web. 17 July 2015.

Feldmann, Linda. "Can Bush Make America More Competitive in Math and Science?" *The Christian Science Monitor*. The Christian Science Monitor, 10 Feb. 2006. Web. 10 July 2015.

McDermott, Tricia. "Text: 2006 State Of The Union." *CBSNews*. CBS Interactive, 31 Jan. 2006. Web. 12 July 2015.

Morse, Robert, and Matt Mason. "The Data Behind the 2015 STEM Index." *US News*. U.S. News & World Report, 29 June 2015. Web. 10 July 2015.

NPR Staff. "They're No. 1: U.S. Wins Math Olympiad For First Time In 21 Years." *NPR*. NPR, 18 July 2015. Web. 20 July 2015.

Pell, Allison Gaines. "STEAM: Person, Place or Paradigm Shift?" *The Huffington Post*. TheHuffingtonPost.com, 1 Mar. 2015. Web. 10 July 2015.

"State of the Union- American Competitiveness Initiative." *SOTU: American Competitiveness Initiative* (2006): n. pag. *Cbsnews.com*. CBS News, 31 Jan. 2006. Web. 18 July 2015.

White, Harvey. "Our Education System Is Not so Much "Broken" – as It Is Totally Outdated!" *Steam Not Stem*. STEAM, June 2011. Web. 22 July 2015.