

Bridging the Creativity and STEM Crisis

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Abstract

International economic competition, visa restrictions after the 911 attack, Baby Boomer retirees, and students loss of focus have already begun to threaten American economic growth and stability by reducing the available pool of creativity workers, such as engineers, researchers, programmers, etc. Many countries are developing centers of research that are attracting the best workers, who at one time flocked to America to participate in the technology revolution. These foreign workers filled the gap for creativity workers that America's educational systems were unable to produce. A shortage of trained creativity workers can result in a long term reduction of innovations and loss of the technical cutting edge that will impact growth and jobs for many years.

American youth have become less creative in the past twenty years, impacting the numbers who are focusing on Science, Technology, Engineering, and Mathematics (STEM) subjects. Finding ways to foster creativity growth in students, can increase interest in STEM and prepare some to enter STEM careers. However, schools cannot alone generate significant interest in STEM topics. The use of Technology Competitions can provide constructive environments where students can solve challenging complex open ended problems with the guidance of adult mentors from STEM fields. The For Inspiration and Recognition of Science and Technology (FIRST) Robotics Competition is one of the best examples of a Technology Competition.

Keywords: STEM, Conference Proceedings, Critical Thinking, Creativity

Introduction

Strong creativity skills are the number one leadership competency of the future for those entering the work force, according to more than 1,500 Chief Executive Officers surveyed by IBM (IBM News Room, 2010). Without additional creative talent America's economic growth will certainly diminish. Florida continues and boldly states that wherever in the world creativity goes economic growth will follow. In the Harvard Business Review article entitled "America's Looming Creativity Crisis" Florida maintains that America's miraculous decades of continued economic growth occurred by harnessing the workers creative energies, (Florida, 2004).

In 2004, a Global Creative-Class Index (GCCCI) was computed for 25 nations. The United States ranked 11th with an index of 23.6 percent, with Ireland having the high index of 33.5 percent, and Austria having the low index of 17.2 percent. Ireland and other countries are growing the size of their creative class using committed investments to education through government-subsidized laboratories, and partnerships with universities and local industry, (Florida, 2004).

The post-911 reduction in student and work visas to those who wanted to be a part of the technology revolution has resulted in inadequate human creative capital in America. Also, the focal point of creativity and innovation is shifting to other countries with lenient entrance policies (Florida, 2004).

The reduction of foreign talent is compounded by the approaching retirement of the Baby Boomers over the next decade that makes up one-third of the workforce (Reeves, 2005). Their

departure will result in inadequate human capital with the needed STEM education and creativity skills, which will reduce America's ability to innovate and compete (Rosenstone, 2005).

Florida's recommendation is to, "tap into more people's creative capabilities," (Florida, 2004). On the surface this seems like a sound recommendation. However, Kim has documented another creativity crisis on a second front that is within America, where even though Intelligence Quotients (IQ) and Scholastic Assessment Test (SAT, formerly called the Scholastic Aptitude Test) scores have risen since 1966, creativity scores have fallen from 1990 to 2008, (Kim, 2012). This can indicate a widening gap in available talent to fill jobs in the creativity sectors.

Kim believes this gap is caused by a shift away from critical and creative thinking, which results in creative students who are not able "to release their creative energy in school," (Kim, 2012). This in turn results in underachievement that leads to dropouts. Kim cites two sources stating that 18 – 30 percent of high school dropouts are gifted students, (Kim, 2008). Underachieving and dropout students show poor workplace and college readiness that negatively affect not only the student, but also the American economy and society, (Cratty, 2012, p. 644).

Children start out creative and creativity continues to grow until high school, then levels off and starts to decrease throughout adulthood (Kim, 2012). "Novel creative thought and expression should be encouraged, and opportunities should be made available for participation in active, critical discussion" (Kim, 2012). Creativity in children almost disappears because of societal pressure for intellectual conformity, (Sternberg, 2006). Sternberg states that being creative is a choice that is specifically not made, because of the high negative cost in terms of risk of mental pain, personal and professional criticism, rejection, embarrassment, etc., (Sternberg, 2003). In a recent TED (Technology, Entertainment, Design) talk Ken Robinson said that, "If you're not prepared to be wrong, you'll never come up with anything original... And by the time they get to be adults, most kids... have become frightened of being wrong" (Robinson, 2006). A safe environment is needed where creative risk taking and experimentation is encouraged.

Building the Bridge

Technology Competitions (or academic competitions) have emerged where students interested in STEM are encouraged to develop their talents guided by adult mentors who are STEM professionals. FIRST runs four levels of age appropriate Technology Competitions for primary and secondary school students. The Junior FIRST LEGO League is for ages 6-9, FIRST LEGO League is for ages 9-14, FIRST Tech Challenge is for ages 9-18, and the highest level is the FIRST Robotics Competition (FRC) for ages 14-18.

The FIRST programs present students with complex and open ended problems requiring that a number of skills be brought together to build their robot. STEM education and creativity are at the very heart of FIRST, resulting in a new kind of culture called the 'New Cool' (Bascomb, 2011), where being a geek is celebrated.

Guilford's 1950 speech to the American Psychological Society is said to have started the modern age of creativity research, (Kuo, 2011). In that address he stated that there is a double problem. The first is "How we can discover creative promise in our children and our youth?" and the second problem is "How can we promote the development of creative personalities?" (Guilford, 1950). A recent study exploring Guilford's second problem examined whether creativity can be promoted through a Technology Competition with 12 primary school students participating on three Junior FIRST LEGO League teams (Kim & Coxin, in press). They found a statistically significant increase of 19 points in divergent thinking test scores, one of three areas

measured. The other two areas measured were creative attitude and emergent thinking, which increased 11 and 5 points, respectively, which are noteworthy, but not statistically significant. Noteworthy in this circumstance is a very positive finding.

My coming dissertation will examine the effects on secondary school students who did and did not participate on a FRC team. In the FRC, students collaborate with teachers and mentors, to design, build and operate a sophisticated 160 pound robot to compete against other robots in accomplishing specific tasks, (Wilczynski & Slezycki, 2007). Participation on a FRC team can inspire students and foster creativity, (Wilczynski and Slezycki, 2007), which may impact their creativity scores on standardized instruments that measure creativity. This larger study may validate Kim's and Coxin's finding.

To bridge the looming crises, STEM education programs like FIRST, must be embraced by industry liberally providing both funding and employees to serve as mentors. The schools cannot solve the creativity and STEM crisis alone. The industry and the community must play a larger role in the development of creative STEM professionals by mentoring students, offering summer internships, or running summer technology camps, thus increasing the rewards and decreasing the cost of learning STEM. Technology Competitions may become an effective way of tapping into and developing the creative abilities of American students. America's economic future and standard of living depends on how we bridge the creativity and STEM crises.

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Author's Information

Daniel Katanski is a Ph.D. Candidate at Eastern Michigan University, College of Technology and is a fourteen year mentor/volunteer with the FIRST Robotics Competition as a software mentor and event Lear Robot Inspector. This paper provides background information about the author's dissertation that will investigate the impact on student creativity levels from participating in a Technology Competition. Daniel is also a Senior Business Analyst at DTE Energy at the Fermi 2 Nuclear Energy Center for over eleven years.