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STEM Education Fiscal Year 2015: An Analysis of Educational Investments and Expectations

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ABSTRACT

In his Fiscal Year 2015 budget, President Obama proposed a strengthened investment in education with particular emphasis on STEM. With a \$600.1 million budget, the President proposed several initiatives directed primarily at pre-Kindergarten through Grade 12 (P–12) education. These initiatives will target the improvement of teaching and learning in P–12. Also, the postsecondary sector will target the improvement of undergraduate STEM education and increase minority participation in STEM. Anticipated returns on these investments include more and better prepared, connected, and informed STEM teachers; accelerated introduction of proven, evidence-based STEM pedagogies; increased youth engagement in STEM in traditional and informal settings; increased participation in STEM from traditionally underrepresented groups; and increased retention of students in STEM. With the President's strong motivation toward providing students with relevant learning experiences that teach real-world skills, integrative STEM education is proposed as the vehicle to achieve the articulated goals. It is anticipated that STEM will become a foundational component of every student's educational experience across the country, which will ultimately lead to a broader STEM-literate populous and a more robust STEM workforce. STEM education is touted as a critical area of education that will determine the future global positioning of the United States. This governmental and monetary support is encouraging, but we question whether STEM is a genuine priority considering that the STEM education budget represents less than 1% of the U.S. Department of Education's budget and only 0.015% of the country's overall budget. Is the funding in line with the purported importance, and will it be sufficient to achieve the articulated goals and expected returns on investment?

Keywords: Integrative STEM education, STEM education

Science, technology, engineering, and mathematics (STEM) is seen as our country's means to remain globally competitive and produce responsible and productive world citizens (Duncan, 2010; Sanders, 2009). Atkinson and Mayo (2010) identify that despite the implicit importance and value of STEM education, the U.S. educational system is criticized for falling short and failing to sufficiently provide for our future needs. In his Fiscal Year 2015 (FY15) budget, President Obama has proposed a strengthened investment in education at the rate of a 45% increase in the U.S. Department of Education's annual budget compared to FY14 (U.S. Department of Education [ED], 2014) with particular emphasis on STEM education as part of his goal to empower all Americans with the education and skills that they need to be successful in the 21st century. The increased attention and monetary support for these subject areas denotes that STEM education is a priority

area for FY15.

The Budget proposes a fresh Government-wide reorganization of STEM education programs designed to enable more strategic investment in STEM education and more critical evaluation of outcomes, leveraging Government resources more effectively to meet national goals. This proposal reduces fragmentation of STEM education programs across Government, and focuses efforts around the five key areas identified by the Federal STEM Education 5-Year Strategic Plan: P–12 instruction; undergraduate education; graduate education; broadening participation in STEM to women and minorities traditionally under-represented in these fields; and education activities that typically take place outside of the classroom. (Executive Office of the President of the United States, Office of Management and Budget, 2014, p. 23–24)

As is the case in most contexts, there is an implied expectation of return on investment. This paper considers the situated importance and status of STEM education, priorities of the FY15 budget related to STEM education, explores the necessary actions to be taken to achieve President Obama’s goals, recommends prospective short- and long-term deliverables resultant of increased investment in STEM education, and discusses one model to achieve these goals, Integrative STEM Education.

Importance of STEM Literacy

Every facet of our lives is affected by technological developments and innovations in national security, communication, automation, engineering, healthcare, and many other fields. Information has become the currency of power and success. Our world is increasingly complex and rapidly evolving, and it is STEM workers who make technological breakthroughs that move our country forward by “generating new ideas, new companies and new industries” (Langdon, McKittrick, Beede, Khan, & Doms, 2011, p. 1). With these rapid advances, countries now look beyond their borders to a global economy in which the advantage goes to companies that are the first to invent, design, and produce innovative processes and products.

In order to be globally competitive, the United States must remain innovative and technologically savvy, and this is thought to be dependent on the prevalence of STEM-literate workers that the country produces. “The Department of Commerce has estimated that from 2008-2018, STEM occupations are projected to grow by 17 percent, while non-STEM job prospects are expected to grow by only 9.8 percent” (Kamali, 2014, para. 3), at a rate of almost 1.75 times that of non-STEM fields (see Langdon et al., 2011, p. 1, Figure 1). In addition, rapidly changing technology has affected expectations of the workforce in other industries not traditionally considered to be STEM, such as construction, retail, transportation, and hospitality, in which STEM skills are required for success (U.S. Department of Labor [DOL], 2007). Beyond this desire to ensure economic competitiveness, there is an essential need for a technologically and scientifically literate citizenry who can understand political issues in order to make informed decisions that span from merely personal to global in scope.

Despite this demand for STEM-literate workers, many students never make it into the STEM pipeline because of inadequate preparation in foundational STEM areas. Internationally, the United States is falling behind, with overall scores in math and science declining since 2000, and ranks 26th in mathematics and 21st in science among industrialized nations participating in the

2012 Programme for International Student Assessment (PISA) study (Organization for Economic Co-operation and Development, 2014). Arguably, comparison of PISA test scores between countries is not comparing apples to apples. However, the National Assessment of Educational Progress (NAEP), our nation's report card, shows similar trends at the national level, with an overall 26% math proficiency level in 2013 and average Grade 12 math test scores showing no change between 2009 and 2013 (National Center for Education Statistics [NCES], 2013). During the same period, science scores increased marginally, which was primarily attributed to the widespread introduction of hands-on activities in the classroom (NCES, 2013). According to 2013 ACT results, just 44% of ACT-tested high school graduates met mathematics college readiness benchmarks, and only 36% met benchmarks for science (ACT, 2013). Our educational system is consistently criticized for failing to produce students with STEM skills or the interest and ability to pursue advanced STEM degrees. In 2009, the percentage of U.S. college graduates with undergraduate degrees in science and engineering was 36.4% (Gonzalez & Kuenzi, 2012). Even among those who do pursue a college major in the STEM fields, only about a third of those graduate work in a related career (Langdon et al., 2011). The situation is compounded by the fact that a large segment of the existing STEM workforce is approaching retirement and that the country's past reliance on foreign STEM workers has been tempered by increasingly restricted immigration (DOL, 2007). In response, the government is making efforts "to increase the supply and quality of 'knowledge workers' whose specialized skills enable them to work productively within the STEM industries and occupations" (DOL, 2007, p. 1) by targeting STEM education reform and fueling the STEM pipeline. The goal is to create a STEM-literate populous and a diverse STEM-competent workforce at a variety of skill and knowledge levels.

Fiscal Year 2015 STEM Education Investments

The President's budget for FY15 includes specific provisions for education: "Americans must be prepared with the skills and knowledge necessary to compete in the 21st century economy. Expanding educational opportunities is critical to equipping all children with these skills and positioning them to succeed as adults" (Executive Office of the President of the United States, Office of Management and Budget, 2014, p. 23). The overall goal is to deliver STEM education to more students and teachers with increased effectiveness. The FY15 budget includes key investments, as part of the President's 5-year strategic plan, which lists the main priorities as: "improving | pre-kindergarten-through-grade-twelve (pre-K-12) STEM instruction; increasing and sustaining youth and public engagement in STEM; enhancing the STEM experience of undergraduate students; better serving groups historically underrepresented in STEM; and designing graduate education for tomorrow's STEM workforce" (ED, 2014, p. 1).

The FY15 budget for the U.S. Department of Education (including discretionary and mandatory funds) is \$82.3 billion, which represents a 45% increase in funding compared to FY14 (ED, 2014). The key investments in STEM education proposed for FY15 are outlined in Table 1, totaling \$600.1 million (ED, 2014). Figure 1 shows the distribution of funds across STEM education programs at the pre-Kindergarten through Grade 12 (P-12) and postsecondary levels.¹

¹ Please note that the Upward Bound program, which is represented in Figure 1 by dashes, is the only program that spans high school through college and, thus, has been included in discussions of both P-12 and postsecondary education funding.

Table 1
President Obama's FY15 Budgetary Investments in STEM Education (ED, 2014; White House, 2014)

Program Name	Structure	Support to	Target goal(s)	\$ Million	Education level served
STEM Innovation Networks	Competitive awards	LEAs in partnership with IHEs, NPOs, public agencies and businesses	<ul style="list-style-type: none"> Transform P-12 teaching and learning Support more STEM focused high schools and districts Connect school districts with local, regional and national resources 	110	P-12
Effective Teaching and Learning: STEM (formerly Mathematics & Science Partnership Program)	Grants	States	<ul style="list-style-type: none"> Complement to STEM Innovation Networks to improve STEM teaching and learning at state level Implement comprehensive, evidence-based state plans Provide professional development Support comprehensive STEM instruction on grades and schools with highest need 	150	P-12
National STEM Master Teacher Corps	Program	Teachers	<ul style="list-style-type: none"> Transform excellent STEM teachers into national STEM leaders Improve STEM teaching and learning nationwide Disseminate and share promising practices in schools, districts, and states 	20	Teachers professional development P-12
STEM Teacher Pathways	Competitive grants	Incoming teachers	<ul style="list-style-type: none"> Recruit, prepare, and place effective STEM teachers in high need schools Prepare 100,000 excellent STEM teachers in next decade 	40	Teacher training P-12
Upward Bound Math/Science Program (part of TRIO program funding)	Project funding	Program	<ul style="list-style-type: none"> Prepare high school students from disadvantaged backgrounds for post-secondary education leading to careers in math and science fields 	43.1	High school to college (transition/bridge)
Minority Science and Engineering Implementation Program	Discretionary grants	Minority Institutions	<ul style="list-style-type: none"> Implement long-range improvements in science and engineering education Increase participation of underrepresented ethnic and racial minorities in scientific and technological careers 	9	Undergraduate
Hispanic-Serving Institutions STEM and Articulation Program	Student aid	Students	<ul style="list-style-type: none"> Increase number of Hispanic and low-income students attaining degrees in STEM fields Develop agreements between 2- and 4-year HSIs in STEM fields 	110	Undergraduate
National Science Foundation	Competitive grants	IHEs	<ul style="list-style-type: none"> Prepare 1 million more STEM graduates in next decade Improve undergraduate STEM education Improve retention of undergraduates in STEM fields Improve undergraduate teaching and learning in STEM subjects 	118	Undergraduate

Note. The following are abbreviated in this table: local education agency (LEA), institute of higher education (IHE), nonprofit organization (NPO), and Hispanic-serving institution (HSI). Total FY15 budget for STEM education = \$600.1 million. Total FY15 budget (mandatory + discretionary) for U.S. Department of Education = \$82.3 billion. Total FY15 budget outlays for all sectors = \$3,901 billion. Investment in STEM education represents 0.73% of FY15 education budget and 0.015% of total FY15 budget.

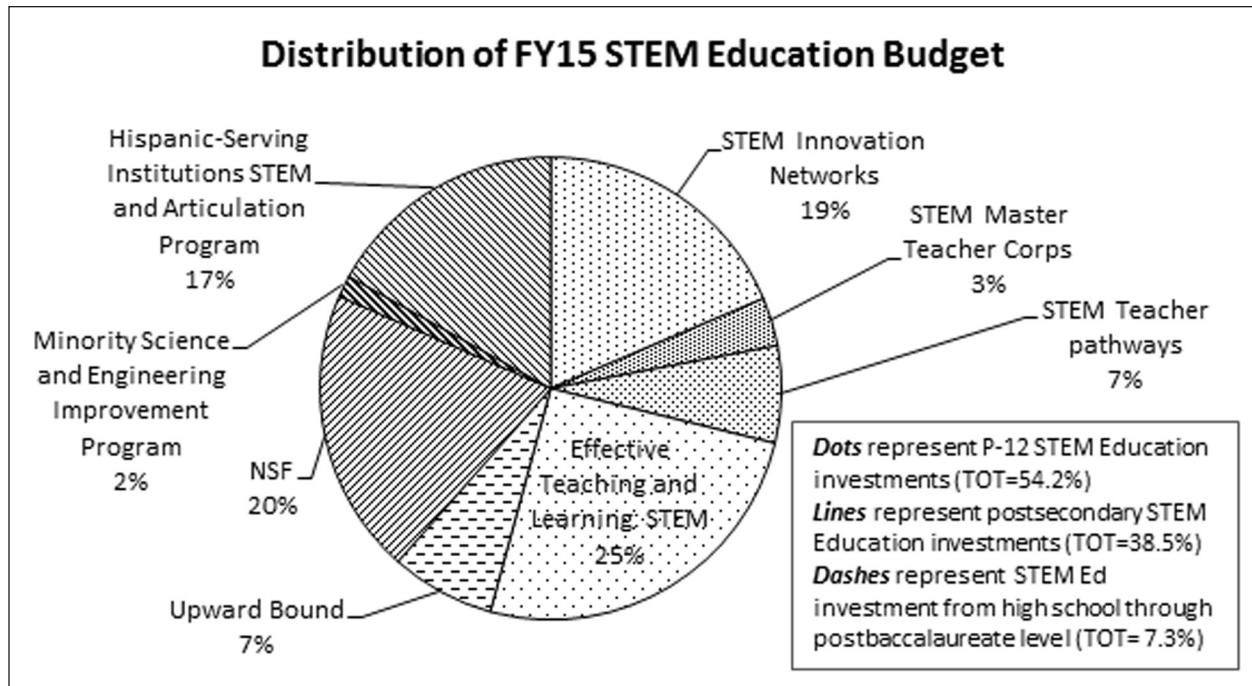


Figure 1. Distribution of FY15 STEM education budget across programs at P–12 and postsecondary levels.

Almost 62% of the proposed STEM education budget for FY15 is aimed toward improving P–12 STEM teaching and learning (see Figure 1). Figure 2 shows how the funding is distributed among P–12 STEM education programs. The STEM Innovation Proposal seeks to inject \$170 million of new funding to train STEM teachers and improve STEM learning at the K–12 level (ED, 2014). The key programs of this proposal include STEM Innovation Networks, STEM Teacher Pathways, and a National STEM Master Teacher Corps. STEM Innovation Networks will

provide competitive awards to educational agencies (LEAs) in partnership with institutions of higher education (IHEs), nonprofit organizations, other public agencies, and businesses to transform STEM teaching and learning by accelerating the adoption of practices in P–12 education that help increase the number of students who seek out and are effectively prepared for postsecondary education and careers in STEM fields. Projects will develop and validate evidence-based practices . . . and implement them across broader, regional networks. (p. 1)

The National STEM Teacher Corps program will help transform thousands of excellent STEM teachers into national STEM teacher leaders who help improve STEM teaching and learning nationwide . . . Through participation in the Corps, teachers would . . . [lead professional development opportunities], identify and share promising practices [in STEM with other teachers] in [their] schools, districts, and States, [and] participate in . . . STEM policy forums, while taking on coaching and mentorship roles in their schools and communities. (p. 1)

The STEM Teacher Pathways program “will provide competitive grants to recruit, prepare, and place effective teachers in high-need schools” (p. 2).

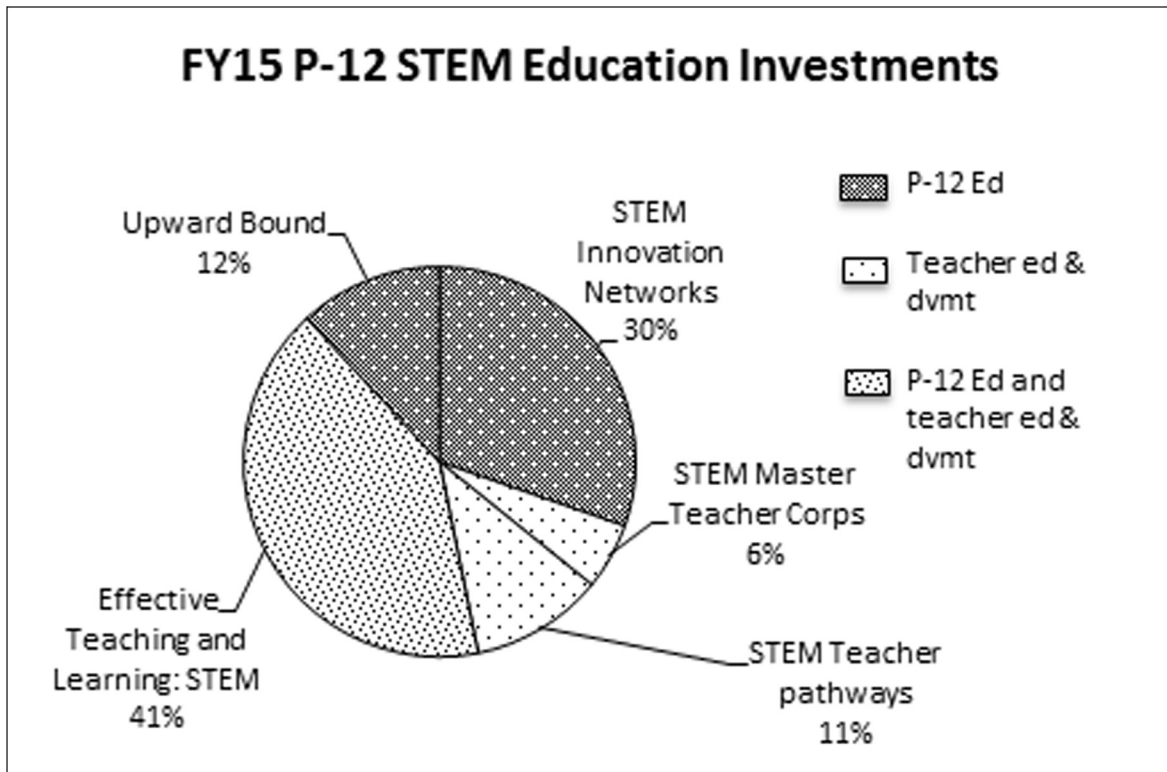


Figure 2. FY15 STEM education investments at the P–12 level by target sector teacher training and professional development and P–12 education.

In addition to this new P–12 STEM Education funding, the FY15 budget includes continued funding (\$150 million) for Effective Teaching and Learning: STEM, formerly known as the Mathematics and Science Partnerships program (ED, 2014). This will complement the STEM Innovation Networks program by funding partnerships between schools and institutes of higher education to “improve teaching and learning in STEM subjects and fields” (p. 2). In 2015, it will become a part of the STEM Innovation Networks, and “support state implementation of comprehensive, evidence-based plans; professional development . . . [related to] high-quality STEM instruction; and for subgrants . . . to support comprehensive STEM instruction in the grades and schools with the greatest needs” (p. 2).

Almost 46% of the FY15 STEM education budget is earmarked for programs to support STEM at the undergraduate level and beyond, with emphasis on underrepresented groups, to improve retention and interest in STEM (see Figures 1 and 3). The Upward Bound Math/Science Program (\$43.1 million) falls under the TRIO programs (ED, 2014).

The Federal TRIO Programs (TRIO) are Federal outreach and student services programs designed to identify and provide services for individuals from disadvantaged backgrounds . . . [including] low-income individuals, first-generation college students, and individuals with disabilities[,] to progress through the academic pipeline from middle school to post baccalaureate. (Office of Postsecondary Education, U.S. Department of Education, 2016, para. 3).

Upward Bound specifically “supports projects designed to prepare high school students from disadvantaged backgrounds for postsecondary education programs that lead to careers in the fields of math and science” (ED, 2014, p. 2). The Minority Science and Engineering Improvement Program (\$9 million) is aimed at “predominantly minority institutions to make long-range improvements in

science and engineering education and to increase the participation of underrepresented ethnic and racial minorities in scientific and technological careers” (p. 2). The Hispanic-Serving Institutions STEM and Articulation Program (\$100 million) “is designed to increase the number of Hispanic and other low-income students attaining degrees [in STEM fields] and to develop model transfer and articulation agreements between 2-year and 4-year HSIs [institutions of higher education] in such fields” (p. 2). The FY15 budget also includes funding to the National Science Foundation (\$118 million) toward improving STEM education at the undergraduate level (Executive Office of the President of the United States, Office of Management and Budget, 2014, p. 143). Specific goals include retention of undergraduates in STEM fields and improved teaching and learning in STEM subjects.

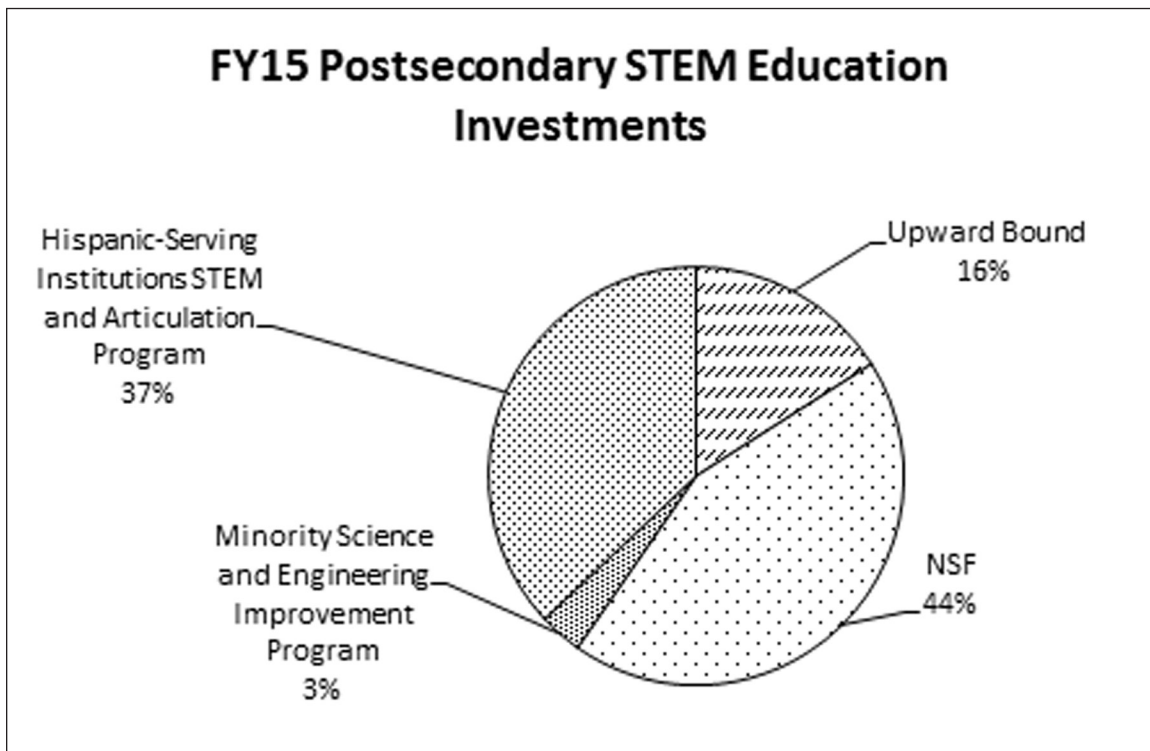


Figure 3. FY15 STEM education investments at the postsecondary level.

These investments are intended to fuel the STEM pipeline, which should ensure a steady supply of STEM workers and a STEM-literate populous. The country needs high-level researchers and innovators, but it also needs technicians and citizens who are able to function effectively with newer, ever-changing technologies.

Return on STEM Education Investments

With any investment comes an expected return on investment (ROI). For STEM education, the anticipated ROIs include improved P–16 STEM instruction and learning, increased youth engagement in STEM in academic and informal settings, greater retention of students in STEM through post baccalaureate levels, increased participation in STEM from traditionally underrepresented groups, and a generally more prepared and effective STEM workforce.

The largest investment within the STEM education portfolio, equivalent to 54% of the overall STEM education budget (Figure 1) or 88% of the P–12 STEM education budget (Figure 2), is to improve P–12 STEM instruction and teaching. The relative investment implies the perceived highest impact and importance of these areas. President Obama has promised “100,000 excellent new K-12 STEM teachers by 2020” (National Science and Technology Council, Committee on STEM Education [NSTC], 2013, p. 9) and funds to support existing STEM teachers. Teacher training will be funded through STEM Innovation Networks, STEM Master Teacher Corps, STEM Teacher Pathways, and the Effective Teaching and Learning: STEM programs, and development of effective STEM pedagogical approaches will be funded through STEM Innovation Networks and the Effective Teaching and Learning: STEM program (ED, 2014).

In the short-term, the forecasted return on this investment will include more individuals incentivized to teach STEM and attend STEM teacher prep programs. This would include new teachers (recent high school or college graduates) as well as workers in STEM industries. More STEM-focused teacher training programs like the National Math and Science Initiative, a rigorous hands-on STEM teacher training program, are anticipated, as well as joint undergraduate degree programs that train students in STEM fields while providing teacher training. For example, Virginia Tech offers a Mathematics Education option through the Department of Mathematics, which is a 5-year program leading to a BS in Mathematics after 4 years and an MA in Teaching & Learning after 5 years (Virginia Tech, n.d.). “The program is designed to prepare future teachers of mathematics in secondary grades 6 - 12” (para. 1). Similar UTeach programs are rapidly being introduced in universities across the country, including Drexel University, Florida International University, Oklahoma State University, the University of Alabama at Birmingham, and the University of Maryland at College Park (Bidwell, 2014) that simultaneously award undergraduates with STEM degrees and teaching credentials. The end result will achieve the goal of producing more teachers with advanced training in STEM fields.

More active STEM education research and evaluation will be needed to build evidence of promising practices and program effectiveness. Universities are likely to be the initiators and leaders in this endeavor because they have the infrastructure and personnel to conduct such evaluations, but partnerships with the private sector and industry leaders and school systems are also likely to form. Small-scale programs and modules will be designed based on existing successes and pilot tests will be used to assess effectiveness. The most likely format will be informal learning environments such as after school programs, summer camps, and interactive museum exhibits. Successful programs already in place, such as the Virginia Initiative for Science Teaching and Achievement in Virginia (VISTA), FUSE: Interest Driven STEAM Education, and CREATE (Creating Relevant Education in Astronomy Through Experience), will likely focus on assessment to produce evidence of their success before broader scale implementation.

In the midterm, with the introduction of the \$20 million STEM Master Teacher Corps, it is likely that a more concerted and intentional introduction of STEM programs throughout schools will occur with potentially faster responses to new STEM educational developments (teaching methods) and initiatives because schools will have access to an expert coordinator and leader in STEM who is part of a nationwide network. STEM teachers will also have better opportunities for professional development through these Corps teachers, ensuring up-to-date instructional approaches and the possibility for being inventive and creative because the Corps teachers would be assigned on the smaller scale (county, district, or school) and would have more autonomy

to implement ideas at this scale. Teachers in this regime are more likely to feel like they are a contributing part of a network and, therefore, more important and valued, which is critical to improve retention rates in STEM education.

Increased availability of STEM professional development opportunities through the STEM Master Teacher Corps and the Effective Teaching and Learning: STEM program, which are designed to continually improve instruction and expose teachers to new approaches in teaching, would keep teachers motivated and interested as well as empowering them to try new things. This would lead to better instruction, interested students, and higher quality learning. Ultimately, it will also lead to STEM teacher retention.

The development and testing of evidence-based STEM instructional approaches on the small scale, in individual schools or districts, or through informal learning venues are anticipated to prevail in the midterm with support from the Effective Teaching and Learning: STEM program. Many successful STEM education programs already exist, and resources such as the NSF-funded Center for Advancement of Informal Science Education website (www.informalscience.org) make searching for projects, reference materials, and evaluations easy. The new funding and focus on innovation provides an opportunity to test creative programs in mainstream classrooms. This could be an exciting time for the STEM classroom, when some truly innovative approaches could be tested and proven effective enough to become permanent. With the added importance of finding effective STEM educational strategies, this implies that greater class time might be devoted to these subject areas, which will be a challenge in the midst of the NCLB math and language arts focus.

As evidence-based practices for STEM teaching are validated, they will be introduced in broader settings or scaled up at the national level and will then be subjected to further validation and assessment. President Obama's goal is to get effective instruction into the classroom quickly; therefore, after methods are proven, we presume that they will be rolled out quickly with less lag time between phases. The broader introduction of effective approaches will lead to consistency in STEM instruction at the regional level.

In the long-term, the \$40 million STEM Teacher Pathways program will ensure that high quality STEM teachers are placed in all schools across the nation, especially high-need schools, and expand effective STEM instruction. STEM education will become a regular part of the P-12 educational landscape, sharing equal importance with math and language arts. Schools will have dedicated STEM teachers and possibly even STEM centers. Meaningful STEM education practices will spark the interest of younger students, making them want to continue in STEM and prepare them for higher level math and science in high school. More students will be interested in pursuing STEM fields or majors at college.

A complete revamp of STEM education, including assessment, and a greater focus on interventions that work is to be expected. After further validation at the regional level, accompanied by increased funding, states will implement comprehensive, evidence-based plans for STEM education. Truly successful approaches will have the potential of being introduced even further afield, with the help of the STEM Master Teacher Corps. This will be supported by continued assessment of existing and research into additional effective STEM teaching approaches.

With improved opportunities and quality of STEM instruction, we anticipate that more students are excited about STEM and pursuing higher level math, technology or engineering, and

science courses in high school. This would lead to more students graduating high school and community college with STEM life skills and more students choosing STEM tracks or majors in post-secondary technical training programs, community college, or college and persisting to degree termination. This will result in more students possessing technical skills, which would enable them to work at all levels of STEM workforce from technicians to researchers. With more students making it through the pipeline, the ultimate realization should be more students choosing STEM careers after completing training or schooling.

One of the President's goals is to increase youth engagement in STEM with "a 50 percent increase in the number of U.S. youth who have an effective, authentic STEM experience each year prior to completing high school" (NSTC, 2013, p. 9). Considering that STEM is not currently a mainstay in many classrooms, particularly at the elementary level, this should be attainable. Funding to support this will primarily come from the STEM Innovation Networks program (\$110 million). In the short-term, schools and private entities will likely offer more informal STEM learning experiences, particularly after school and as summer camps. These can be introduced quickly without navigating the bureaucracy associated with mainstream education. Based on funding structures, it is expected that there will be more collaboration between schools and private or industry leaders to develop programs to reach a broad array of students and provide a variety of STEM experiences. With improved instruction and access to STEM, we anticipate that, in the mid- to long-term, more students will take higher level math and science classes in high school, which will prepare them for STEM majors in college or working in STEM fields after high school.

Another of the President's goals is to "graduate one million additional students with degrees in STEM fields over the next 10 years" (NSTC, 2013). At the undergraduate level, with greater exposure, generated interest, and preparation in high school and more incentives to pursue STEM degrees (including financial assistance for qualified college students who choose to pursue STEM majors), greater student enrollment in community college STEM courses and undergraduate STEM majors is anticipated. With funds available to bolster bridges between 2- and 4-year institutes of higher education, we should expect to see growth in the community college sector, which would then feed more STEM students into 4-year institutions. Colleges at large will likely offer more remedial courses to ensure student success and retention, which is critical considering that currently "only 43 percent of students entering as a STEM major in a four-year university graduate with a STEM degree. Worse, only about 14 percent of community college students who declare a STEM major on entry are still in a STEM field at the time of their last enrollment" (NSTC, 2013, p. 10). In addition, cocurricular activities (such as learning communities and summer bridge programs) and internships, research, and other more applied, real-world applications will likely become more mainstream to support proven "pedagogies, curricula, instruction materials, peer or mentors and other academic and cultural supports, resources, and tools to engage students in the classroom and support their learning" (NSTC, 2013, p. 27). With these interventions, we should expect to see more postsecondary students persisting to graduation with STEM degrees, "increasing the retention of STEM majors to 50 percent would generate approximately three quarters of the targeted one million STEM graduates over the next decade" (NSTC, 2013, p. 27).

Renewal and development of vocational training programs, such as those offered through community colleges, will result in more associate degree and certificate holders with life skills and technical skills which will enable them to fill technical positions. "A recent NSF report found that two-thirds of workers with science and engineering degrees are employed in positions that are only

somewhat or not at all related to their educational expertise” (DOL, 2007, p. 5). By increasing the number of STEM literate and competent graduates, we will produce more qualified individuals available to satisfy STEM workforce needs.

A largely untapped resource in STEM is the historically underrepresented population in STEM fields, which includes women, ethnic minorities, and low-income students. “Women make up nearly half of the total workforce, but they constitute only 24 percent of STEM jobholders” (NSTC, 2013, p. 32). “Ethnic and racial minority groups are projected to become America’s majority in the next 30 years. Currently, however, they account for only 28 percent of STEM workers” (p. 32). To achieve a million STEM graduates in 10 years, these underserved populations must be tapped. Upward Bound, which targets students in this demographic, has proven to be such a successful national program that it receives separate government funding (\$43.1 million; ED, 2014). In the short-term, we should expect to see a rise in the localized programs offered that specifically target underserved groups to introduce them to and get them interested in STEM. For example, the comprehensive pre-engineering program offered at the University of Akron, which offers underrepresented high school minorities, targeted hands-on learning experiences, tutoring, mentoring, access to STEM professionals, bridge programming, and other support until college entrance (Lam, Srivatsan, Doverspike, Vesalo, & Mawasha, 2005). During the reporting period, 94% of program participants attended college, and 66% pursued STEM majors (Lam et al., 2005).

In the mid-term, based on program support and the anticipated increase in retention rates, more students from disadvantaged backgrounds will become interested and prepared for postsecondary STEM programs that lead to STEM careers, ultimately resulting in an increase in the number of underrepresented ethnic and racial minorities and low income students attaining degrees in STEM and pursuing scientific and technological careers. With increased numbers of underrepresented minorities working in STEM fields, we anticipate that those communities will become more supportive of such pursuits, students will be empowered by role models, and any stigmas associated with STEM will be removed, thereby encouraging more underrepresented minorities to pursue STEM.

Integrative STEM Education and Return on Investment Expectations

Full-scale involvement of teacher educators, community college educators, administrators, and most importantly P–12 practitioners is necessary to realize the goals and ROI expectations set forth by the President and Congress. Utilizing evidenced-based school models, building amenable teacher preparation programs, ensuring equitable access for students, and promoting student engagement and aspirations will prove to be a cooperative effort beginning with meaningful educational structure and classroom experiences. School-based integrative experiences provide for purposeful, authentic, experiential, and active learning within STEM education (McCulloch & Ernst, 2012). “Integrative STEM education signifies the intentional integration of science and mathematics with the processes, content, and procedure of technology and engineering education (Sanders & Wells 2010)” (McCulloch & Ernst, 2012, p. 13). Though there is an apparent need for opportunities for students to participate in integrative STEM education experiences, designing such experiences for classroom use, however, is quite difficult. This difficulty arises from imposed school parameters pertaining to format, sequencing, and subject-specific examinations. Although significant STEM learner progressions are well documented in integrative and experiential

formats (Clark & Ernst, 2010; 2013; Ernst & Clark, 2010; Hansen & Gonzalez, 2014), adoption and incorporation of integrative practices are vastly underutilized at the expense of learning. Fortunately, through prioritization and investment resource, integrative practices are gradually becoming more prevalent. This ultimately builds student acclimatization that is reflective of authentic STEM practices while building problem-based habits of mind, applied skillsets, as well as content and process knowledge. The proposed STEM Innovation Networks encourage innovation and improved teaching methods, with a fast track to implementation for proven pedagogies. In addition, the FY15 discretionary budget for the U.S. Department of Education (Executive Office of the President of the United States, Office of Management and Budget, 2014) includes investments in “a new program to redesign high schools to focus on providing students challenging, relevant learning experiences” (p. 23) that teach students real-world skills, which can arguably be provided through an integrative STEM curriculum, and “create more innovative schools that personalize teaching and learning for students” (p. 67). This is an opportunity for integrated STEM education to become part of mainstream education.

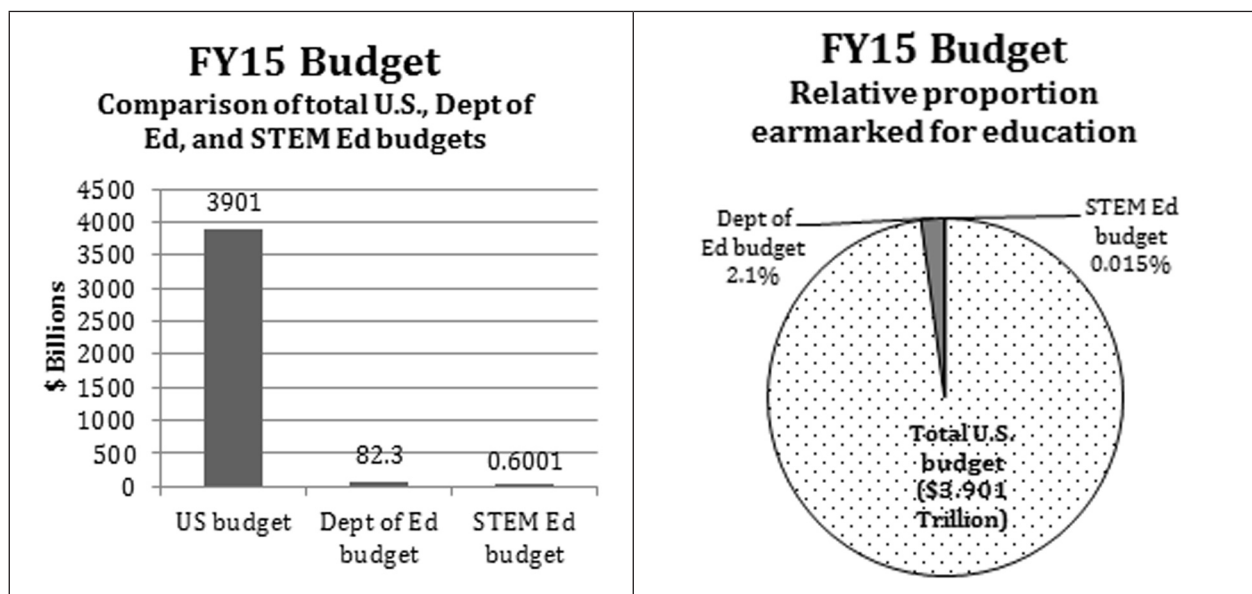


Figure 4. Comparison of FY15 budgets: the total U.S. budget, the U.S. Department of Education budget, and the STEM education budget.

Conclusions and Implications

As STEM educators, we will be held responsible for engaging and inspiring students in STEM areas and providing them with effective instruction. Along the way, we will develop more meaningful accountability, stronger and more cohesive infrastructure for delivering STEM education, and more coordinated STEM programs. With more cohesion we could expect to see cost savings, leveraging of resources, assets and information, reduced duplication, shared resources and information, faster reaction time and implementation times. The public will then better understand what STEM means and value its importance and place in the educational system.

STEM education is constantly highlighted as a critical area of education that will determine the future global positioning of our country. The purported importance and acclaimed monetary support for STEM is particularly encouraging for educators in these areas. After all, the government

has placed STEM education in the spotlight and proposes spending \$600.1 million to improve its delivery across the educational spectrum. This is definitely a good start, but, as shown in Figure 4, this “priority” funding represents less than 1% of the U.S. Department of Education budget and only 0.015% of the country’s overall budget (White House, 2014).

Some difficult questions need to be asked that will greatly affect the immediate and long-term future of STEM education: Is the trajectory of proposed funding enough to train 100,000 qualified and effective STEM teachers in the next decade? Will this be adequate in assisting STEM educators to graduate one million new STEM professionals armed with the skills necessary to be successful in the 21st century? Is the funding in line with the implied value and importance of these goals and the means to achieve them? Is STEM education truly a priority in the United States? The answers to these important questions have vast implications on the overall outlook of a nation.

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