# Implementing STEM

STEM in the virtual environment

Florida Virtual School
CELEBRATING 15 YEARS of INNOVATIVE EDUCATION

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# Introduction

"Science, Technology, Engineering, and Mathematic (STEM) fields have become increasingly central to U.S. economic competitiveness and growth" (U.S. Department of Labor, 2007) and are a way for the American economy to rebound from the latest recession. However, there is a deficit of qualified STEM professionals in the Kindergarten to grade 12 education field. Roughly "75 percent of U.S. 8th graders are not proficient in mathematics when they complete 8th grade" (U.S. Department of Education Institute of Education Science, 2009), and the percentages of students proficient at science are even lower. There is a deficit in the knowledge, skills, and proficiencies necessary for the U.S. to be globally competitive (Friedman, 2005). Knowing these statistics, the Committee on Highly Successful Schools or Programs in Kindergarten-12 STEM Education and the National Research Council has listed the following as top priorities for STEM education:

1. *Expand the number of students who ultimately pursue advanced degrees and careers in a STEM field and broaden the participation of women and minorities.*

2. *Expand the STEM-capable workforces and broaden the participation of women and minorities in the workforce.*

3. *Increase STEM literacy for all students, including those who do not pursue STEM-related careers or additional study in the STEM disciplines.*

Although the definition for STEM varies, most researchers, educators, and STEM supporters agree on the components that make up a quality STEM-education program. STEM is not just science, technology, engineering, and mathematics. STEM is a way of "thinking, doing, and being" (Davis, 2011). STEM is a common language that an institution uses to prepare students to be college and career ready, including preparing students to be successful at jobs that have not yet been thought of. Additionally, a successful STEM program engages students beyond science, technology, engineering, and mathematics. For many in the STEM field, the meaning of STEM is:

- Students engaged in experiences solving real-world problems with research scientists, college and university faculty, business leaders, etc., in order to positively impact local, state, national and global challenges;
- Successfully preparing students for college and careers that have yet to be imagined;
- Building 21st Century Skills through learning and applying content standards while working with others in challenging situations (critical thinking, global collaboration, financial literacy, media literacy, entrepreneurship);
- More than a Memorandum of Understanding (MOU) between like-minded organizations, it is deep meaningful partnerships where everyone is creatively finding solutions to problems faced today;
- Personalized instruction;
- Problem- or Project-Based Learning (PBL);
- High expectations; and
- Engagement in web 2.0 and social media.

# Current Issues with STEM Education

According to the Committee on Highly Successful Schools or Programs in K-12 STEM Education and the National Research Council, "[e]ntry into STEM related careers and making good choices as citizens and consumers also requires applying and using STEM content knowledge in other settings besides tests" (2011). Participation in internships, job-shadowing experiences, or other hands-on experiences in research labs, museums, and zoos are used to help students determine their interests and increase their content knowledge while "on the job." Frequent hands-on instruction through job shadowing, service learning, guided-study tours, and cross-curricular research projects increases students' achievement levels and helps them to build the confidence they need to continue pushing the boundaries of their imagination (Committee, 2011). One of the biggest challenges is finding time in the academic calendar to incorporate these experiences without detracting from the content. Most teachers find that these are extras; things a teacher does if they have time, money, and resources, however critical it may be. STEM is about incorporating these into the curriculum seamlessly in order to inspire students into careers.

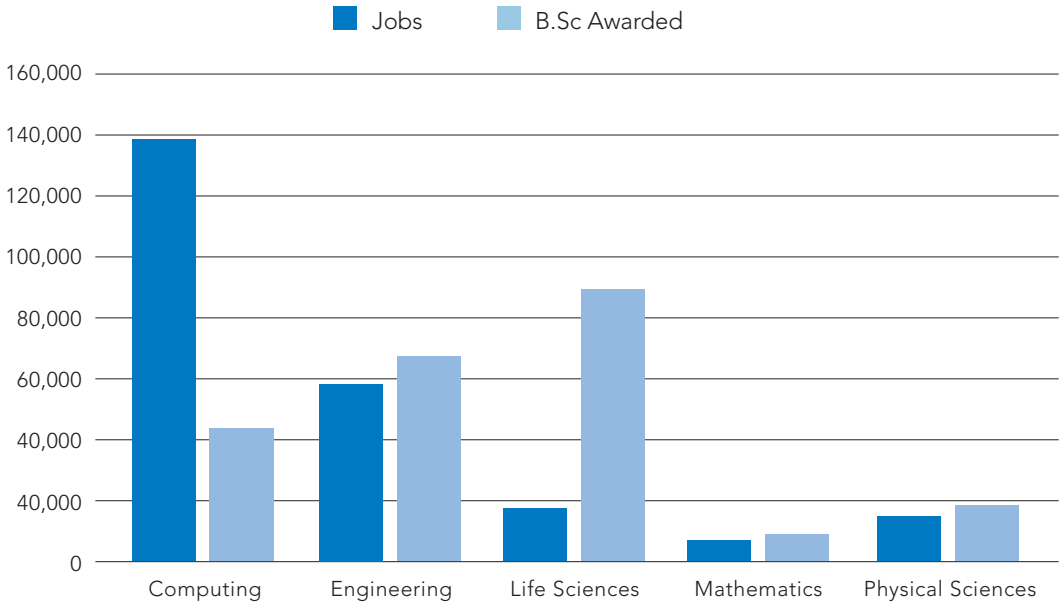
It has been suggested that students "whose teachers connect the content across different STEM courses are more likely to complete STEM majors than their peers who didn't report these experiences" (Committee, 2011). The more successful and inclusive STEM schools "encourage problem-solving skills [and] interpersonal skills, [giving students] the resilience they need to succeed in a rapidly changing and competitive world" (Committee, 2011). This "curriculum brings together modern technology, community partnerships, problem-solving, interdisciplinary instruction and global perspectives in a student-centered, collaborative project based community" (Committee, 2011).

## STEM Education at Florida Virtual School®

Traditionally, successful STEM schools usually target the specific population of gifted or minority students. More time is devoted to STEM instruction with higher quality teachers dedicated to providing the best instruction for these students (Committee, 2011). However, all students should be offered the opportunity to engage in high quality education with a STEM focus. In support of this idea, Florida Virtual School® (FLVS®) has crafted a multi-pronged approach to STEM education through course offerings, extra-curricular clubs, and assignment activities. For many of the courses, students are asked to apply their knowledge of lesson concepts to develop projects. The H.O.P.E. (Health Opportunities through Physical Education) course uses Project-Based Learning to allow students to use their creativity in assessment options. The students complete their work product using 21st century web tools.

In the eighth grade FLVS Mathematics course, students complete a culminating activity in which they must research how math is used in a scientific career. First, the students are given the opportunity to play a math and science career trivia game to pique their interest. Next, the students answer application problems that combine math and science topics. Finally, they are given free rein to research how math is used in a science career of their choice. Allowing students to choose what field of science interests them helps to develop ownership investment in the STEM career, so that they can visualize themselves in that role. This activity shows that math and science are not isolated subjects, but interwoven tools best learned and applied in unison.

## Annual STEM job openings vs. College Graduates in the United States through 2018




**Data sources:** *US-BLS Employment Projections, 2008-2018 (http: //www.bls.gov/emp/ep_table_102.pdf), National Science Foundation Division of Science Resource Statistics (http://www.nsf.gov/statistics/nsf08321/tables/tab5.xls), and National Center for Education Statistics (http://nces.ed.gov/programs/digest/d08/tables/dt08_286.asp).*

FLVS course development teams are making a deliberate effort to embed natural STEM Career Connections so students can see how the science content they are learning is linked to technology, engineering, and mathematics. The Career Connections are highlighted within a lesson and details are provided about the profession, the educational pathways, and real-world scenarios that are relevant to students' lives. According to the data compiled by Joel Adams, the vast majority of future STEM-related job openings will be in computing.

The future of STEM is digital; all STEM fields increasingly rely on computer-mediated animations, simulations, and visualizations as well as routine data processing. Although computer science is often overlooked as a common denominator among the STEM disciplines, FLVS has mounting evidence that interest in computer science is a gateway to a wide variety of STEM careers. Over 95% of the FLVS students taking an introductory programming course report they intend to major in a STEM field. STEM students recognize that they need an understanding of computer science because it helps them connect the dots among science, technology, engineering, and mathematics.

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Each year, approximately 1,000 Florida high school students take the AP®* Computer Science (APCS) course, the equivalent of an introductory college-level computer science course. Obtaining a score of 3, 4, or 5 on the AP exam qualifies a student for college credit at most post-secondary institutions. As the 2011 APCS exam results indicate, Florida Virtual School is a leader in preparing students to pursue college-level course work in computer science. Table 1 shows that for the 2011 APCS exam, 13.1% of all Florida students taking the exam were FLVS students. Out of all Florida students taking the exam, 48.2% of the top scoring students were from FLVS (see Table 1).

## Table 1: FLVS AP Computer Science Exams Results

| | No. of Testers | Average Score | Qualifying Percent |
|---|---|---|---|
| **Nation** | 21139 | 3.10 | 63.7% |
| **Florida** | 1017 | 2.59 | 49.5% |
| **FLVS** | 133 | 4.38 | 94.7% |

Given the growing importance of computer science in every STEM discipline, FLVS also offers a unique introductory programming course, Computer Programming 1 (CP1), which teaches the Python and Java programming languages using robotics and media computing, respectively. The goal of this course is to increase the number of students prepared to successfully complete AP® Computer Science (APCS). Results indicate that CP1 students who transition to the APCS course have a higher average score and are less likely to withdraw than students who begin APCS with no prior programming experience. Clearly, FLVS is successfully preparing students for careers that require computer science and are among the highest paying STEM jobs.

Effective instruction also capitalizes on students' early interests and experiences, identifies and builds on what they know, and provides experiences to engage them in practices of science to sustain their interest (Committee, 2011). In addition to the course offerings, FLVS provides a wide variety of clubs, such as the Beta Delta Sigma Math Club, the Science Club, and the Science Honor Society, in which students have the opportunity to experience real-world problem solving that encourages further investigation of their interests with others.

The FLVS Virtual Science Fair offers an opportunity for students to proudly display their experiments and hard work to the rest of the school and faculty. Components of the project include an informational meeting, a required participation form and summary, the submission of a science project via PowerPoint presentation, an online project display, a mandatory online presentation, a judging session, and awards for participants. Students are also encouraged to submit their projects to the Google Science Fair. Students in grades 6 – 12 can participate in the Virtual Science Fair if currently enrolled and active in at least one FLVS course.

When students engage in learning activities around their area of interest, schools have more opportunity to expose them to STEM career-building activities such as national STEM challenges. More than 20 FLVS middle and high school students competed in the 2012 National STEM Video Game Challenge and more than 30 mentors worked with these students supporting their efforts. In addition, FLVS works with the Florida Department of Education to present STEM career fairs to students across the state, once again giving students exposure to STEM professions.

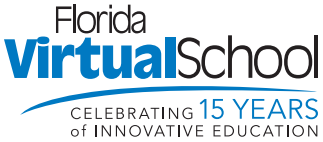
*AP and Advanced Placement Program are registered trademarks of the College Board, which was not involved in the production of, and does not endorse, this product.

Recognizing that college graduates are spending hundreds of thousands of dollars on their education but are unable to get jobs, FLVS is working to bridge the gap between available jobs and the skills needed to be successful. Monthly STEM Power Hours introduce students to various professionals working in fields in which many students may not have had exposure to before. Featured speakers for these events have included a sonographer, a video game designer, the Hillsborough Chief medical examination officer, and an IT designer working in the music industry. Recorded links to the sessions are posted on the FLVS student activities website page located here: http://www.flvs.net//myflvs/get-involved/pages/stem.aspx.

STEM education is more than a passing trend. Florida Virtual School has found many ways to expose students to this important field beyond courses and assignments. Partnerships with organizations and the Florida Department of Education are allowing FLVS students to experience STEM in a whole new way with the hopes that these students will find an interest in science, technology, engineering, or mathematics and will choose to pursue a career in one of these areas.

# About Florida Virtual School

Florida Virtual School (FLVS) is an established leader in developing and providing virtual Kindergarten through Grade 12 education solutions to students nationwide. A nationally recognized e-Learning model, FLVS, founded in 1997, was the country's first state-wide Internet-based public high school. In 2000, the Florida Legislature established FLVS as an independent educational entity with a gubernatorial appointed board. FLVS is the only public school with funding tied directly to student performance.
Access the school at **www.FLVS.net**.



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