Winding Up STEM

by William E. Dugger, Jr.

In the past few years, the integration of science, technology, engineering, and mathematics (STEM) has gained importance in education in the United States, partly because of increased emphasis on STEM by the NSF and federal funding of STEM activities. Some states and localities have begun to include the “T” and “E” in STEM by teaching “Technology and Engineering.”

STEM Is Gaining Importance in the U.S.

Increasing graduation rates and reducing dropout rates are important goals in education because those numbers are directly tied to the nation’s economy. As reported in the Spring 2013 issue of the Virginia Tech Magazine, between 2008 and 2018, the number of STEM jobs is expected to increase 17%, compared to 9.8% growth for non-STEM jobs (U.S. Department of Commerce, 2011). The mean annual wage for all STEM occupations was $77,800, and only four of the 97 STEM occupations had mean annual wages below the U.S. average of $43,460 (U.S. Department of Labor, Bureau of Labor Statistics, 2009).

There is a disconnect in the education arena, however. Rodger Bybee, Executive Director Emeritus of Biological Sciences Curriculum Study, National Academy of Engineering, says the following about the lack of relevant education in technology and engineering in our schools today: “For a society so deeply dependent on technology and engineering, we are largely ignorant about technology, engineering concepts, and processes, and we have largely ignored this incongruity in our educational system” (Bybee, 2000).

A snapshot of parent perceptions of STEM education in the U.S. was released recently following a survey conducted by Public Agenda titled, Are We Beginning to See the Light? (Johnson, Rochkind, & Ott, 2010). Parents surveyed said they would like to see their local schools spend more money on up-to-date and well-equipped science labs (70%), more equipment for hands-on learning (69%), and more equipment to help students learn computer and technology skills (68%). Half or more of parents with children in Grades 6–12 said they want to see more emphasis in their child’s school on STEM topics, such as computer programming (65%), basic engineering principles (52%), and statistics and probability (49%).

Integration Versus Isolation for STEM Disciplines

There are a number of ways that STEM can be taught in Grades PK–12. One is to teach each of the four STEM disciplines individually. Some refer to this as “S–T–E–M,” or teaching each discipline in a “silo,” as an independent subject with little or no integration. Another way is to teach each of the four STEM disciplines with more emphasis going to one or two of the four (which is what is happening in most U.S. schools today), for example, “S–T–E–M.” A third way is to integrate one of the STEM disciplines into the other three being taught. For example, engineering content can be integrated into science, technology, and mathematics courses.

A more comprehensive way is to infuse all four disciplines into each other and teach them as integrated subject matter or “iSTEM.” This is accomplished best by a STEM licensed or credentialed teacher.

There are many delivery models and teaching strategies that can be used in teaching STEM. However, more work and research needs to be done as to which model or strategy works best in a given school or community.

Summary

In many respects, STEM is in its infancy in the U.S. Currently, there is considerable effort underway by the federal government, many states and localities, professional associations, and educators on what STEM is and how it can be best implemented in schools.

The dominance of science (S) and mathematics (M) in STEM education and the tendency to say STEM but really mean science and/ or mathematics is contrary to fully-integrated STEM. The S, T, E, and M are separate and not equal. Currently only science, technology, and mathematics have national standards; however, the Next Generation Science Standards (National Research Council, 2013) will include both technology and engineering in their structure.

The success or failure of the STEM movement will depend on the acceptance and buy-in that schools and teachers give to the integration of these four disciplines in an already crowded curriculum. As Friedman writes in The World Is Flat, “The world may be flat but our educational system is as mountainous as ever” (Friedman, 2005).

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