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Focus: Update on STEM Education

This edition of the WSSDA Research Blast is an update on the state of Science, Technology, Engineering and Math (STEM) Education. The overview looks at STEM as an issue nationally and at recent efforts to promote STEM in the State of Washington. Four articles on the status of STEM follow the summary.

STEM education and employment

Many issues have been raised in recent education debates, and one of the most significant is what to do about science and math education. Technology and engineering are also entering this equation more frequently as STEM gains attention at the school district, state and national levels. Shortfalls in STEM readiness are becoming more prominent in major policy debates concerning science, education, the workforce, national security, and immigration.

According to a report by the Congressional Research Service, STEM Education refers to “teaching and learning in the fields of science, technology, engineering, and mathematics. It typically includes educational activities across all grade levels—from pre-school to post-doctorate—in both formal (e.g., classrooms) and informal (e.g., afterschool programs) settings.”

Discussion about STEM among education advocates has tended to focus on science and mathematics, with general agreement on the value of technology. However engineering is also starting to gain ground in K-12. In next year’s “the Nations Report Card,” students will be administered a new national assessment in technology and engineering. Engineering design has likewise been woven into the “next generation” science standards designed by the bipartisan organization Achieve. A total of 26 states have contributed to the new standards, which are being adopted by a growing number of state education agencies and coalitions.

Efforts are also underway to promote STEM more locally through statewide organizations. STEM education networks and councils have been launched in many states, including Arizona, California, Iowa, New York, and Washington. A national network called STEMx has formed to support and connect these networks. The network provides partner organizations a place to share, analyze and disseminate quality STEM education tools. Washington is participating in the network through the nonprofit Washington STEM.

Washington STEM is one of the primary drivers for STEM enhancement here. It provides training, support and policy documents to aid the spread of STEM to Washington's K-12 community. It recently conducted a statewide survey to gain an understanding of how people view STEM and perceive its progress in schools. Washington STEM's findings included the following:

- 92 percent of people in the state agree the next generation of Washingtonians will have more opportunities if they have strong STEM skills.
- 83 percent agree an increased focus on STEM education will improve the state's economy.
- 79 percent agree more companies would move to or expand to Washington if the state had a reputation for workers with great science and math skills.
- 78 percent agree STEM skills are in increasing demand in Washington's economy.
- 42 percent think the quality of STEM education in Washington is high.
- 56 percent think Washington colleges and universities are doing a good job of preparing students for careers in STEM fields.
- 77 percent agree computer science should count as a math or science credit rather than an elective course.
- 80 percent support Common Core State Standards.
- 68 percent support adopting Next Generation Science Standards.

Further outreach conducted by the organization suggests that Washington is ranked number one in the country in the concentration of STEM jobs. By 2018 there is expected to be a 24% increase in these jobs. However the mismatch between the skills required for available STEM jobs and individuals with those skills in Washington is growing faster than any state in the country aside from Delaware.

This isn't just a Washington phenomenon, however. By [one estimate](#), STEM occupations are expected to grow 17 percent between 2008 and 2018 nationally, versus 9.8 percent growth for non-STEM jobs. These jobs are also predicted to provide 26 percent higher wages. "The bad news: an estimated three million STEM-related jobs remain unfilled because of learning and skills gaps."

Some recent [studies](#) suggest a rising interest in STEM subjects and careers by young adults, including one that shows overall interest in the STEM subjects has climbed by 21 percent among high school students from the class of 2004 to the class of 2013. But results from other recent reports suggest that the gender gap may be growing once again, and that girls' interest in STEM has been in a state of decline since the class of 2010.

According to STEM educator [Sandi Reyes](#), the power of STEM is that it has the possibility to create classrooms that are "student-centered, problem-based learning environments where students are encouraged to create and innovate within authentic real world situations." Successful STEM programs require a commitment from administrators to the development of programs and curriculum, along with ongoing professional development and support for STEM teachers. These programs also require resources, both in terms of "things" and training to use new materials.

The good news is that educators and leaders are becoming more aware of these issues, and are seeking ways to close STEM gaps. The recent movement is also being driven by innovators, such as the Buford Middle School in Virginia where students are learning to craft speakers out of plastic papers, among other lessons, in 3-D printing classes. Another approach has been to encourage greater participation in out-of-school activities, such as the growing student robotics competition movement. But less traditional ideas are also surfacing across the country. For example Texas Instrument and The Science and Entertainment Exchange have developed a [new program](#) that allows students to use zombie science to learn about how diseases spread.

Funding for STEM programs through grants and other sources is also increasing. For example the U.S. Department of Defense Education Activity program is providing almost \$20 million in grants to public school districts serving military children. And the first "[Innovation Fund](#)" raised \$24 million in commitments from a coalition of private foundations, states, federal agencies, corporations, universities, school districts, museums, and other nonprofit organizations. Instead of a pool of money that is distributed by a central organizer, the network allows individual philanthropies to make their financial commitments, and then choose projects and proposals that they wish to fund from a list at the organization 100Kin10.

Though many challenges remain, several Washington school districts are making great STEM gains in their local schools. For example:

- West Hills Elementary in the Bremerton School District will be adding a STEM curriculum to its fifth and sixth grades this September.
- In Pasco, three new elementary schools will be opening in the next two years with STEM curriculum.
- Everett Public Schools has begun implementing the new National Next Generation Science Standards across the district, and its Inquiry-Based Science Program is going through a major transition to become a truly STEM program.
- In Cape Flattery School District, Neah Bay High School was a recipient of the 2011 STEM Award for a [project](#) to remove diesel from the ground soil of Tatoosh Island using fungi.

Science, technology, engineering and math education

In the spirit of this discussion, we have gathered four recent pieces of research on the state of STEM education.

- The first item is "STEM Education: A Primer," a Congressional Research Service report. The work outlines STEM broadly, discusses current STEM education programs at the federal level, and reviews some of the main challenges facing STEM education today.
- The second piece of research is "Vital Signs: Washington," a summary that measures the health of the K-12 STEM learning enterprise, state by state. The Washington overview looks at demand for and supply of STEM skills, what the state expects of

students, students' access to learning opportunities, and the resources schools and teachers have to do their work.

- The third research brief is "Effective STEM Programs for Adolescent Girls." This study focuses on the disparity between women and men's participation in STEM education and careers. The article focusses on three approaches to STEM in out-of-school time to develop opportunities for adolescent girls.
- The fourth item is a report by the Pathways to Prosperity Project at the Harvard Graduate School of Education. The project's main goal is to meet the challenge of preparing young Americans for the 21st Century. Part of this involves providing opportunities that guide young adults to the increasing number of positions in STEM fields nation-wide. Dr. Ronald Ferguson, one of the authors of the report, will be a keynote speaker at the 2013 WSSDA Annual Conference.

Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer

Congressional Research Service, By Heather B. Gonzalez and Jeffrey J. Kuenzi

The report provides a far-reaching introduction to STEM education policy issues and programs. It is broken down into three major parts:

- 1) Assessments of the federal STEM education effort
- 2) The condition of STEM education in the United States.
- 3) An analysis of the most important policy issues in contemporary STEM education.

The appendices of the report contain links to some of the most recent STEM education data, and to major legislation in federal STEM education policy history.

<http://www.stemedcoalition.org/wp-content/uploads/2010/05/STEM-Education-Primer.pdf>

Vital Signs: Washington

Improving teaching and learning in STEM, By Change the Equation

This analysis on the state of STEM compares Washington State to the national average over a range of benchmarks. The report looks at:

- Overall student improvement in math
- The status of racial and ethnic achievement gaps
- Gaps in the STEM pipeline from high school through college
- The STEM degree/certificate gap between women and men
- Teacher preparation
- Availability of resources needed to teach and learn STEM subjects

Overall, the report recommends easing the transition between high school and college, improving teacher preparation and support, and inspiring greater attainment of STEM degrees by Washington's students.

http://vitalsigns.changetheequation.org/images/vs_newsletter/washington.pdf

Effective STEM Programs for Adolescent Girls

Afterschool Matters, By Harriet S. Mosatche, Susan Matloff-Nieves, Linda Kekelis, and Elizabeth K. Lawner

Women's participation in math and physical science continues to lag behind that of men, but the disparity is much greater in engineering and computer science. Results from studies cited in this report identify some of the reasons for this:

- More boys than girls perform at the very highest levels in spatial reasoning and math ability, including on so-called "gatekeeper" tests such as the SAT-M and GRE-Q
- Girls who have high math abilities are more likely than boys who have high math abilities to also have high verbal abilities, giving them more choices of careers to pursue
- Women who have high math abilities are more likely than men with high math abilities to choose careers in non-math intensive areas

The report shares the experiences of girls who participated in several engineering-focused out-of-school time programs. The intent was to find strategies that make STEM activities appealing for girls and to develop more STEM opportunities for teen girls. The authors find that successful programs create an engaging and relevant curriculum, explore STEM in depth and long term, inspire career exploration, expose participants to role models, and enhance the program through field trips.

<http://files.eric.ed.gov/fulltext/EJ1003839.pdf>

Pathways to Prosperity: Meeting the Challenges of Preparing Young Americans for the 21st Century

Pathways to Prosperity Project, Harvard Graduate School of Education

The Pathways to Prosperity Project addresses the challenges between an evolving, more demanding U.S. labor market and the gap in qualified young adults. According to the project's report, challenging conditions include:

- A growing skills gap among young adults
- Over the past third of a century, all of the net job growth in America has been generated by positions that require at least some post-secondary education
- The lifetime earnings gap between those with a high school education and those with a college degree is now estimated to be nearly \$1 million

- By some projections, nearly two-thirds of job openings between now and 2018 will require at least some post-secondary education

The solution they say is to develop a career-focused system that spans the last years of high school and at least one year of post-secondary education or training, and that allows multiple pathways for every student. This involves work-linked learning, more involved career planning with young adults, and greater connection between educational programs and regional labor market demands.

Most importantly, the project calls for a new social compact with America's youth. This compact's overarching goal "should be that by the time they reach their early 20s, every young adult will be equipped with the education and experience he or she needs to lead a successful life as an adult."

[http://www.gse.harvard.edu/news_events/features/2011/Pathways to Prosperity Feb2011.pdf](http://www.gse.harvard.edu/news_events/features/2011/Pathways_to_Prosperty_Feb2011.pdf)