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Technology News & Innovation in K-12 Education

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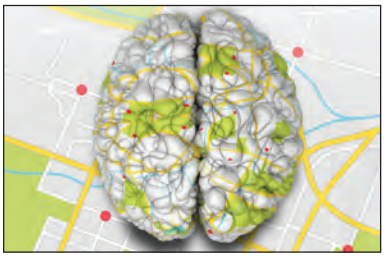

STEM support for teachers

Discovery Education's new resource expands STEM learning

BY LAURA ASCIONE
Managing Editor, Content Services

In January, Discovery Education debuted STEM Connect, a web-based supplemental K-8 resource, developed with the input of educators and curriculum experts, which helps educators create engaging STEM lessons that strengthen students' critical-thinking skills.

STEM Connect is built on a 4Cs STEM skills framework that helps students develop the creative, critical thinking, communication, and collaboration skills needed for success beyond graduation. Its flexible, modular learn-

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How to strengthen computer science education

BY LAURA ASCIONE
Managing Editor, Content Services

States are progressing toward a number of goals that aim to make computer science education a priority, but there is still more to do–especially when it comes to adopting K-12 computer science standards, according to a new report.

State of the States Landscape Report:

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Where will STEM education be in 5 years?

BY JOACHIM HORN

In 2015, there were nearly 8.6 million STEM jobs in the United States, and that number is growing every year. In fact, STEM job growth in the past 10 years is three times that of any other field, but by 2018, it is projected that 2.4 million STEM jobs will go unfilled. Yet, STEM education programs have not kept pace–calling into question whether there will be enough qualified employees available to take on these new positions.

Worryingly, only 16 percent of students graduating high school are proficient in STEM and also interested in a STEM career. The natural response to such a low percentage would be to prioritize improving STEM education efforts in the classroom. However, this is unfortunately easier said than done.

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Teach like the future depends on it.

Discovery Education STEM Connect is a cutting-edge interdisciplinary K-8 resource designed to enhance core curriculum and bring STEM to life in your classrooms. Our powerful 4Cs framework uses relatable scenarios that connect students to real-world challenges with each lesson. So your students don't just get a quality education, they gain valuable critical-thinking and solution-seeking skills for life.

Start Shaping the Future Today with Free 60-Day Access:
DiscoveryEducation.com/STEMConnect

Discovery EDUCATION | STEM CONNECT

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ing units give students an easy-to-follow experience using high-quality interdisciplinary resources that can be used in a wide variety of classrooms and across all subjects.

eSchool News sat down with Cindy Moss, vice president of global STEM initiatives at Discovery Education, to talk about some of the important motivating factors behind STEM Connect.

Were teachers asking for STEM curriculum resources? It's increasingly important for our students, but teachers don't always have access to high-quality resources.

Yes. Teachers say they know they need to teach STEM subjects and incorporate the 4 Cs, but they don't always know where to find resources that support those concepts. Originally, we weren't intending to create a STEM resource, because ideally, teachers would be able to create their own resources to tie in to local problems. But we quickly realized that teachers needed help. Our STEM Connect resources were created based on what teachers have asked us to provide for them.

Research has shown we need to attract kids to STEM topics in elementary and early middle school, because by high school, students—especially girls—tend to avoid STEM subjects and STEM extracurricular. Did any of that research guide you as you zeroed in on a grade range for STEM Connect?

We definitely looked at the research. National Science Foundation research says a student makes up their mind about STEM interest by the beginning of sixth grade. Experience tells us elementary school teachers know they need to be doing more with STEM, but many don't have a strong background in science or math. Plus, elementary teachers are universal soldiers—they teach everything. PreK, kindergarten, and first-grade students are not afraid to solve problems and are not afraid to get their hands dirty. We have already had high school educators asking us when we are expanding STEM Connect to high school.

There are glaring gender gaps in the STEM workforce. PreK-8 education is a critical time to get students, especially girls, interested in STEM. In STEM Connect we have projects, assignments, and learning experiences to support that interest. We want to help girls understand that when they have these STEM skills, STEM companies will come looking for them. It's really critical that we show girls what STEM can be for them.

Our STEM Connect resources were created based on what teachers have asked us to provide for them.

STEM Connect includes resources about STEM industries and careers. How important is it to go beyond classroom learning and show students how they can actually make use of (and make money from) the concepts they learn in school?

We know it's important from our work, and personally as educators, but we also know it from research. Companies are looking for informed employees; across the nation there are STEM jobs sitting unfilled because companies can't find qualified applicants. Companies want to communicate with schools. STEM Connect makes these needs easy for teachers to understand. Teachers need things presented to them in a way that meets the needs of their job. We know those careers are so important—if a student has one positive experience associated with a potential career, the experience can motivate the student to persevere through difficult classes and not quit.

Teachers have a limited amount of time in which they are often asked to accomplish the impossible. How does a resource like STEM Connect help teachers by respecting their time?

Teachers told us they needed a place to go to find resources that are already evaluated by a trustworthy expert. They want someone who knows what students at different grade levels are capable of, and what teachers at different grade levels need for their students. eSN

5 years

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The economic climate in the US has seen both budget cuts and increasingly diverse opinions among educators and administrators about where to spend the money made available to them. We must work to find ways of blending STEM education into all elements of the classroom, inspiring student interest at a young age.

Let's explore a few changes we're anticipating over the next five years that could make a real difference to the quality of STEM education teachers would be able to provide. If followed through, they could prove crucial to encouraging more students to engage with the subjects that will define our future.

1. Fueled by more effective teacher education, students will become fluent in coding

To prepare students for careers in growing STEM fields, we must increase the importance of programming literacy, or fluency in computer science and coding, in the same way that we did for reading and writing in the mid 20th Century. We need students to become as familiar with technology as they are with a pen and notepad. And it happens through hands-on experience.

However, it's difficult to achieve this kind of widespread programming literacy when it hasn't already been a part of most teachers' schooling. School districts, particularly administrators, must commit to providing the resources necessary to train teachers on STEM subjects that they may not have had the opportunity to learn before. Supporting teachers' personal education in this way will allow them to further integrate coding and computer science into the classroom curriculum, furthering the development of programming literacy.

2. Entertainment and education will converge

Today's kids are "digital natives," having grown up around computers and other technologies. Given their familiarity with modern technology, it would be safe to assume offering young students the use of certain devices, applications or hardware within STEM lessons would be a 'sure-fire' way to keep them engaged and excited. However, teachers are finding that this familiarity is actually breeding a sense of apathy among their students. It's ironically becoming increasingly difficult to present STEM lessons in a way that maintains student interest.

To generate excitement around STEM lessons, it's important to bake educational value into areas of technology that students are already engaging with on a daily basis, such as smartphones, tablets, video game consoles, and other devices. In the next five years, we will see a convergence of entertainment and education to occupy students' interest. For example, integrating educational content into mobile gaming will allow students to stay engaged and feel as though they are playing (when they are actually learning). With this kind of assimilation, mobile gaming and coding education can become one.

However, this is another area where a lack of teacher training becomes a roadblock. Teachers simply do not have consistent access to these new tools – or to the courses required to master them and weave them into the classroom. If we expect children to be given the tools to learn and further their STEM knowledge, we also need to give teachers equal–if not greater–time, resources and opportunities to learn.

3. The arts will change STEM to STEAM

Creating STEAM curriculum–science, technology, engineering, arts and math–is crucial to the success of student education in the next five years. When integrated into STEM, art and design give students the tools with which to think creatively and to solve complex problems. Countless studies have shown the value of art and design in a child's education, particularly because of their ability to foster creative thinking–a skill necessary in everything from theater to organic chemistry.

The addition of art and design instruction into traditional STEM education inspires students to think in a different way. Not only does this help children succeed in school, but it also builds a foundation for expanded creativity in math and science, promoting innovation.

In the next five years, we must work to incorporate a more creative approach to STEM education. This will be essential for molding the upcoming generation of students into the future engineers, scientists, mathematicians and creators that will shape our society through the next chapter of the technological revolution. Equally important, however, will be the focus on providing teachers with the right resources – such as basic computer science and coding training, and STEM and Arts integration training – to implement the lessons that will create these workers of the future.

It all starts in the classroom. eSN

Joachim Horn is the founder of SAM Labs. A mechanical engineering graduate from the Imperial College London and co-founder of the Imperial College Design Collective, he fused his passion for education, design, and tech to develop SAM Labs.

5 ways teachers can improve student learning based on current brain research

How students can better overcome language and reading problems thanks to the plastic brain and teacher know-how.

BY MARTHA BURNS, PH.D

The brain is an experience-dependent organ. From our very earliest days, the brain begins to map itself to our world as we experience it through our senses. The mapping is vague and fuzzy at first, like a blurred photograph or an un-tuned piano. However, the more we interact with the world, the more well-defined our brain maps become until they are fine-tuned and differentiated. But each person's map will vary, with some sensory experiences more distinct than others depending on the unique experiences and the clarity and frequency of the sensations he or she has experienced.

Educators can positively influence students' learning by understanding how the brain is shaped by their early experiences—and how it can be rewired and reorganized to work more quickly and efficiently.

The plastic brain and the critical period

Brain plasticity, or neuroplasticity, refers to the brain's ability to change with experience. In infancy and early childhood, a brain is so "plastic" that its structure is easily changed by simple exposure to new things in the environment. This time is sometimes called "the critical period," or "the sensitive period." [NOTE: the term 'critical period' although popular a couple of decades ago it is rarely used anymore because we understand plasticity better and realize new skills can be acquired long after the early developmental period, hence it is not really "critical".]

Consider, for example, how babies easily learn the sounds of language and words by listening to their parents speak. Inside the brain, what this learning looks like is the brain actually reorganizing itself to change its own structure and create new sound maps that reflect the sounds of their native language. These sound maps are then interconnected with other maps and nodes to form interconnected networks so sound can be linked to meaning.

Networks can be expansive. For example, the sound map needed to recognize the word "pen" might first be connected to the meaning connoting a writing instrument, but over time, "pen" might be part of a network for comprehending "pen" as a verb meaning to write, then part of a word referring to legibility, "penmanship" and perhaps later to farm regions, like a pig pen. Networks will also develop to allow words to be used in grammatical sentences then organized for reading.

Building neural maps and networks can be thought of like building cities: first, neighborhoods are mapped out and constructed then they become interconnected with other neighborhoods into towns and cities through a complex highway system.

Training the brain to form new maps and networks

A few decades ago, the prevailing scientific view held that the brain operated within a fixed scope of ability once the "critical period" had passed. But in the 1990s, through a series of experiments, Dr. Michael Merzenich, co-founder of Scientific Learning Corp., discovered that our brains can change well past the critical period—and throughout our lives.

However, learning that takes place after the early developmental period is no longer as easy. Children and adults must work hard to pay attention to the new information they wish to absorb and master.

The maxim commonly used to describe neural learning and reorganization is "neurons that fire together wire together." It is this "wiring together" that results in the corresponding structural changes in the brain. Timing is key to the process, with neurons that fire simultaneously wiring together to create the neural communication networks.

The space allocated to a neural map evolves over a number of stages. When learning is taking place, a relatively large space may be allocated to the map.

Once a skill is established, the mapped regions become so efficient that fewer neurons are needed, allowing some of the map space to be pruned and reallocated for new learning. This practical "use-it-or-lose-it" process allows us to continue picking up new skills without bumping into space limits in the brain.

As we develop mastery of a skill, our neurons not only become more efficient, but they begin to process information faster. With that faster processing interconnected neurons tend to fire together more readily, creating more efficient, clearer signal transmission. The clarity of those signals has a great deal to do with how easily the brain learns and remembers what the neurons have processed. The clearer the signal, the easier the information can be processed and remembered.

But what if there are gaps or inefficiencies in the maps that have been established?

Poverty and the brain

Decades of research show that poverty has a significant impact on the brain and its ability to learn. Back in 1995, Betty Hart and Todd Risley published their groundbreaking research that showed that, by age 4, children born into low socioeconomic families are exposed to 30 million fewer words than children from high socioeconomic families.

This means that the brain of a child in poverty has had 30 million fewer opportunities to wire itself for language. It also means that the child is not receiving the auditory neural stimulation required to establish distinct phoneme representations, build vocabulary, and develop age-appropriate oral language skills.

Language is not the only function in the brain that is affected by poverty; many other cognitive skills are, too. More recently, studies by researchers such as Kimberly G. Noble have demonstrated how poverty is tied to structural differences in the brain, with the largest influence observed among children from the poorest households.

For example, neuroscientists have identified differences in the frontal lobe, which affects cognitive skills like organization and self-control—and can impact a child's ability to pay attention, listen, and learn on demand. They have found differences in the occipital lobe, which is important for spatial skills. In addition, research findings have shown differences in working memory, which is critical for learning at any age and in any subject.

Working memory allows us to hold on to information for a period of time—long enough to do something new with the information, like take notes or solve a problem. For children, working memory is essential for learning language. Unlike vision, where we can often study an image as long as we need to, everything we hear occurs in time.

A speech signal moves very quickly: an average sentence is about 14 seconds long, an average single syllable word lasts only a quarter of a second, and the average consonant sound may last only 1/12 of a second.

Poverty is also associated with chronic stress, which can have a toxic effect on the brain. Neural pathways responding to stress such as fear and anxiety may overdevelop, while other pathways for things such as reasoning, planning, and learning develop more slowly based on the child's experiences.

Children from poverty—who now comprise 51 percent of all students in U.S. public schools—bring all of these differences with them to the classroom.

From the lab to the learner

These experiences and differences in brain maturation, however, do not determine a child's outcomes. Educators have tremendous power to influence positive brain changes every day. Here are a few ways to improve outcomes for your students:

1. Feed the brain. School meal programs and physical education set the brain up for success. Nutritious meals can boost a child's focus, attention, and memory. Physical exercise also promotes good blood glucose levels, oxygen intake, and levels of brain-related growth factors which benefit the brain and subsequent learning.

2. Build relationships. Teachers who form positive relationships with students can diffuse stress. A positive relationship with just one adult at school can turn toxic stress into tolerable stress, which improves a child's ability to learn.

3. Supplement instruction with neuroscience-based interventions. Teachers can measurably increase students' learning by building their cognitive capacity. Neuroscience-based interventions such as the Fast ForWord program target cognitive skills such as memory, attention, and processing speed, as well as language and reading skills. By working from the bottom up, using the principles of neuroplasticity, these programs remediate the underlying difficulties that keep struggling learners from making progress.

4. Give students intensive practice. Deliberate repetitive practice creates and strengthens connections in the brain. Relevant skills must be identified, isolated, and then practiced through hundreds if not thousands of trials on an intensive schedule. Technology-based programs can be particularly useful, as they can adapt to each child's level and provide as much or as little practice as needed in each skill.

5. Provide timely rewards. The brain secretes helpful neuromodulating chemicals like dopamine and acetylcholine when it gets rewarded. These brain regulators help lock in learning. Thus, to boost learning, brain exercises should immediately reward correct responses (e.g., with entertaining animations) rather than at the end of a block of trials or on a trial-and-error basis.

The brain is a malleable, experience-dependent structure. There are many ways educators can mediate the influence of negative factors, such as poverty or toxic stress, on children's learning and achievement. By improving children's brain development and function, we can help them overcome language and reading problems that not long ago were considered insurmountable.

As the author of more than 100 journal articles and multiple books, neuroscientist Martha S. Burns, Ph.D., is a leading expert on how children learn. She works as a consultant for the clinical provider division of Scientific Learning Corp., and for the past 15 years, she has served as Adjunct Associate Professor at Northwestern University. eSN

Discovery EDUCATION | STEM CONNECT

SPARKING AND MAINTAINING GIRLS INTEREST IN STEM

Two districts are leading the charge to ensure a bright future for girls in STEM careers

"…it's our responsibility to provide engaging and meaningful STEM programs to continue to show girls what they can be."

Author

Cindy Moss

Senior Director of Global STEM Initiatives

Discovery Education

What did you want to be when you grew up?

At the end of the last century, you wouldn't have been able to even name some of the top jobs of today: user experience developer, driverless car engineer, mobile app designer. Maybe that isn't even the right question anymore, and instead we should be asking kids, what kinds of problems do you want to solve?

In the words of Marian Wright Edelman of the Children's Defense Fund, "You can't be what you can't see."

Unfortunately, girls may have a harder time envisioning a wide-open future than boys do. They have traditionally been steered away from STEM due to stereotypes that girls naturally excel at social skills—collaboration, communication, problem-solving, and the ability to take multiple perspectives.

Our understanding is evolving, though: Not only are these skills and abilities not gender-specific, they are assets for any individual in the STEM disciplines. Employers know this. For their own futures and for generations to come, it's our responsibility to provide engaging and meaningful STEM programs to continue to show girls what they can be.

I have had the opportunity to see STEM programs in action around the globe and have been particularly inspired by some of the programs dedicated to engaging girls in STEM projects and maintaining their interest in the key disciplines. From Dubai to Finland to Egypt and back home to the United States, I've met educators who are working with each other and their students to ensure a bright future for girls and the societies they will serve in the coming decades.

Two educators leading the charge in the United States have had significant success. **Dr. Tina Plummer**, assistant superintendent for curriculum, assessment, and professional development in the Mehlville School District in St. Louis, MO, and **Dr. Candy Singh**, superintendent of the Fallbrook Union Elementary School District in Fallbrook, CA, are both innovators who find themselves, literally, at the table with students, mentors, and educators.

Discovery Education works regularly with these partners, but we took some time to focus on their initiatives to spark girls' interest in the STEM fields. Hopefully, pieces of our conversations will spark your own ideas for continuing to innovate in this critical area.

Project Lead The Way and Breakfast with the Experts in Mehlville

"Start young and give them opportunity."

Dr. Tina Plummer
Assistant Superintendent for Curriculum, Assessment and Professional Development
Mehlville School District, St. Louis, MO

Dr. Tina Plummer was not surprised when fewer girls than boys signed up for **Project Lead The Way** classes during the 2014–2015 school year. It was the school district's first year offering the engineering program. She knew that girls have been historically underrepresented in STEM fields, sometimes due to self-selection based on a complex matrix of factors.

But Mehlville School District made it a priority to make sure girls in the district know about STEM classes and opportunities. And in just three years, Plummer has doubled the number of girls enrolling by using two tools: information and food.

Every middle school hosted a **Breakfast with the Experts** event just for girls, showcasing STEM topics and allowing girls to interact with successful women in STEM careers. Once girls' interests were piqued, Plummer ensured that the actual courses were engaging and that her staff was prepared. They've added two new courses on the computer science path, giving students more voice and choice. And they've implemented a STEM Innovator program with Discovery Education, where staff participate in professional development and ongoing coaching, all focused on STEM education and career opportunities.

"Start young and give them opportunity," she said. "Get them connected to role models. Make those connections within the community. Create a STEM Advisory Board and get feedback. Do readings and watch videos on STEM topics, and find ways to change classroom instruction."

CyberPatriot Girls & STEM Inspiration Breakfast in Fallbrook

"STEM is not an add-on; it's not a robotics class."

Dr. Candace Singh
Superintendent
Fallbrook Union Elementary School District, Fallbrook, CA

Dr. Candace Singh recognizes that personal and cultural biases may influence people to inadvertently steer girls away from the STEM fields. To change the trend at a foundational level, she has lead her district in ensuring that every classroom, every teacher, and every student has equal access to great STEM opportunities.

Fallbrook students particiate in **CyberPatriot Girls**, a national youth cyberdefense competition that casts students as IT professionals tasked with addressing cybersecurity risks. Students work in teams to develop coding and cyberprotection skills they compete. The program is available to all middle school girls in Fallbrook, but the district also makes an effort to seek out and encourage girls who may not express an initial interest.

Like Mehlville, Fallbrook also hosts a yearly **Girls and STEM Inspiration Breakfast**. Girls from Grades 4 through 8 attend an event at the local state university for a morning of connection and inspiration. Fallbrook educators identify girls who display aptitude in STEM areas but may not traditionally be represented in STEM courses. Many of these students are the first in their families to attend college, and this program gives them the opportunity to develop a vision of college for themselves.

Fallbrook has also dedicated time and funding to professional development. One of the school's most effective decisions has been to have one site-based instructional coach in every school. It's a manifestation of the foundational belief in Fallbrook that every student should have access to rigorous STEM opportunities, and that starts with their educators.

Putting the "A" in STEAM education this school year

While there are many ways to integrate STEM into the classroom, it is important to emphasize the arts – the "A" in STEAM education.

BY RICKY YE

As more students head back to school, we will continue to hear about how educators can successfully incorporate STEM (Science, Technology, Engineering and Math) education into curriculums from as early as Kindergarten. Whether it's providing students with hands-on robotics tools where they can learn to code, program and design on their own, or using more in-class devices like Google Chromebooks that familiarize students with technology and problem-solving skills, there are many ways to integrate STEM into the classroom.

And no wonder: having a thorough understanding of STEM subjects is a vital component for success in the future workplace; reports reveal that nearly half of U.S. jobs could be automated in the next 20 years, so tomorrow's generation of employees must be acquainted with the technologies and new job functions that will exist when they enter the workforce.

However, as we put our efforts on fine-tuning these technical skills, we often lose sight of creativity.

To keep creativity at the forefront of the educational spectrum, while also fostering "hard skills" like STEM, it is important to emphasize the arts–the "A" in STEAM education. Whether students have an affinity for the arts or not, incorporating elements of creativity into STEM education has undeniable benefits, including making STEM more approachable and understandable.

In fact, there is scientific evidence of a positive correlation between music and spatial intelligence–a vital skill for solving math problems; it all comes full circle.

Let's examine why the arts are such an important component to STEM curriculum:

Because it allows for learning by design

There are many different ways to incorporate "learning by design" into the classroom, but one specific way that provides a hands-on, holistic education experience is the method of Project Based Learning (PBL). PBL provides students with responsibility for an assignment from top to bottom, holding them accountable for solving a real-world issue through their own process of trial-and-error, making it an interesting way to integrate STEAM education into the curriculum.

PBL tasks students with making independent decisions about what they want to create, why they're going to create it, and how. At the end of the process, students publicly present their project, prompting them to both develop a thorough understanding of it and to build something that they're proud of from the ground-up. The overarching goal of PBL is to foster critical-thinking and problem-solving skills.

For teachers, creating a PBL lesson is not easy–there are many moving parts and it can be difficult to streamline them all into understandable, actionable assignments for an entire class. However, PBL and STEAM education go hand-in hand.

For instance, teachers can have the class design a futuristic device like a robot; this type of project hit all facets of the STEAM model –

"S" for scientifically figuring out the electrical components required to make the robot function

"T" for technologically determining how to connect the robot to the Internet to make it move

"E" for engineering the pieces into an actual robot

"A" for designing how it looks, and

"M" for mathematically calculating and coding to get it to move

This is an example of a hands-on, physical project that addresses a complex issue (i.e., create a futuristic technology) and encourages students to do all the legwork in a way that's innovative, collaborative and rewarding.

Because it creates a well-rounded student

According to Research in the Arts (RAND), to develop students that are well-equipped for the future, educators and parents must nurture "soft skills" like creativity, persistence, communication and collaboration. Even in Silicon Valley, where companies seek top talent that specialize in various STEM skills, there's a significant emphasis on attaining applicants who are also proficient writers, bring creative ideas to the table, communicate professionally and are team players.

Just look at Google's ideal candidate. According to Laszlo Bock, Google's head of people operations, in addition to "general cognitive ability," they want applicants who display "emergent leadership: the idea there being that when you see a problem, you step in and try to address it. Then you step out when you're no longer needed." Bock also

mentions the importance of being a cultural fit and being able to admit when you're wrong. In today's modern workforce, it's no longer sufficient for computer scientists and engineers to sit behind a computer all day – collaboration with team members is key for success.

In order for today's younger generations to obtain this type of balance, it's vital for them to have a well-rounded academic experience in school. The "A" in STEAM doesn't strictly have to be the arts in this sense–whether it's joining a sports team, trying their hand at mock trial, or volunteering for community service, extracurricular activities will add another layer to students' already-vigorous academic work, helping to mold them into ideal job candidates for the future.

Because it allows for greater student satisfaction

Research shows that just 38 percent of students enjoy learning STEM subjects, so by implanting the arts into the model, the odds increase that more will take interest–and the more interested they are, the better they will perform.

At Boston Arts Academy (BAA), a student who's a dance major created an "electroluminescent costume" that she designed on her own from start-to-finish using modeling software and a 3D printer. BAA students and teachers alike appreciate the way STEAM education is infused into the school's learning style, as it allows students to gain skills like electrical engineering, industrial design and architecture through hands-on experiences with modern technologies.

Educators' goals should be to develop a graduating class of well-rounded students who have the tools necessary to thrive in the future workforce

At the same time, the work excites them because they're building something for an area they're passionate about.

As educators increasingly use technology to create customized lessons based on individual students' needs and learning styles, it's exciting to consider all of the unique ways that the arts will be incorporated into technical learning. Educators' goals should be to develop a graduating class of well-rounded students who have the tools necessary to thrive in the future workforce, achieved through creative, applied ways in school. eSN

Ricky Ye is the CEO of DFRobot, a robotics and open source hardware provider that is dedicated to creating innovative, user-friendly products that foster a strong community of learning. Ricky and his team are focused on home robotics, technologies and applications.

Computer Science

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State-Level Policies Supporting Equitable K–12 Computer Science Education also highlights key strategies and issues state leaders must address regarding computer science education.

So far, 7 states have adopted K-12 computer science education standards. States are considered to have fully adopted K-12 standards once they have met three criteria: the standards cover elementary, middle and high school; they are publicly accessible on the state's website; and they include computer science content at all levels.

Though relatively few states have addressed all the criteria, 8 additional states are currently in the standards development process.

The report outlines four strategies for states to consider as they work to strengthen computer science education and improve workforce success for all youth:

1. Build a broad base of leadership and ownership among key stakeholders
2. Develop short-, medium-, and long-term strategies, with a view to coherence and sustainability
3. Collect data to monitor progress, inform decision making, and drive continuous improvement
4. Use the growing talent pool of expertise in key organizations and in leadership states

It also highlights three critical issues that state leaders must address:

1. Raise the bar on both the scale of the effort and the quality of the CS learning opportunities available to students from kindergarten through the end of high school.
2. Commit to sufficient funding to achieve the goal. In most states, the level of funding currently available reflects an early-stage "testing the waters" approach.
3. Work toward continuous improvement by continuing to examine the CS education landscape and chart progress and challenges over time.

A group of leading computer science education organizations co-authored the report, with funding from BNY Mellon. The group includes EDC, Code.org, Education Commission of the States, NSF BPC Expanding Computing Education Pathways (ECEP) Alliance, Massachusetts Computing Attainment Network (MassCAN), and SageFox Consulting Group.

"Even with all of the progress being made, we have a long way yet to go," said EDC's Jim Stanton, executive director of MassCAN and the report's lead author. "A failure to act boldly and urgently will maintain the status quo, in which access to CS is available to only a fraction of the nation's K–12 students. Aggressively addressing the policy priorities described in this report will more quickly and effectively provide CS opportunities to a whole generation of students." eSN

How to use engineering practices for more effective STEM learning

Changing the way schools teach STEM is changing schools and students

BY PJ BOARDMAN

"What if schools could offer a different approach to STEM education that provided students with truly immersive learning opportunities?" That question came to Ethan Berman, founder of i2 Learning, after the experience of his nine-year old daughter, who liked school but loved solving problems and making things with her own hands, especially, as she put it, "if it was something useful."

That was what inspired Berman to found Boston STEM Week, which concluded its second successful year by replacing the usual curriculum for the more than 6,000 students and 300 teachers across 37 Boston middle schools. During this week, schools replace their usual curriculum with projects aimed at building lunar colonies, creating interactive monsters, designing digital games, and practicing surgical techniques.

STEM as an entry point to the heart and soul

Since its introduction, educators from across Boston have remarked on the program's ability to engage and empower students. Reminiscing on her experience from STEM Week 2016, Marjorie Soto, principal of the Hurley K-8 Dual Language School in Boston's South End, put it this way: "I saw kids who were wearing goggles and lab coats, working with models of the human heart to see how the blood goes through it. They were able to make connections and inferences based on what they saw, and connect it to what they had read. They not only experienced this learning, they owned it. For my sixth, seventh, and eighth graders, STEM Week was like finding the entry point into their heart and soul."

The inaugural STEM Week program was so successful that five Boston schools have signed onto a month-long pilot program that replaces their traditional sixth grade coursework through Thanksgiving week. Using a special curriculum co-developed with MIT that expands the Building a Lunar Colony learning module, these sixth graders will read and write science fiction, discover space exploration, and develop their own form of government in addition to constructing a sustainable colony.

Why middle school? And why engineering?

i2 focused on middle school students because research showed that this was the age at which boys and girls started to lose interest in science and math. "Our theory was if you change the way these subjects are taught, you can change that perception," said Berman.

The program's curriculum is based on the engineering design process; this iterative process teaches that it's okay to make mistakes as long as one is willing to learn from them.

According to Phil Thornton, school liaison at i2, "There are an awful lot of kids these days who are pretty risk averse. They actually don't want to start something until they have a pretty good idea that they're on the right path." Instead, students in the STEM Week program are encouraged to give something a try and, if it doesn't work, sit down and think about how it could have been better; then take another shot at it.

Of course, it's in the classrooms where the true test of this approach to STEM education takes place. Research conducted by The Center for Technology and School Change (CTSC) at Teachers College, Columbia University revealed significant differences in student perceptions pre- and post-STEM Week, including increased interest in STEM-related subjects and classes, increased comfort in working on projects, and increased interest in STEM-related careers.

"It is not an overstatement to say that this type of learning environment has the potential to change the trajectory of young people's lives," says Geoffrey Rose, principal at South Boston's Oliver Hazard Perry School. There was a sense of excitement, an atmosphere of accomplishment. The kids were so excited to show off their learning."

Principal's powerful stories

At Rose's school, a student who had been struggling with literacy gained enough coding proficiency over the course of the week that he created a digital game so challenging, no one could get through it. Rose was thrilled for the boy, "Now, he has a success that he can revisit and draw from when faced with other challenges."

Rose recalled watching one of his 7th graders demonstrate his digital monster to a kindergartener. "The boy had learned enough coding to get the monster to light up, and the younger kid was just full of questions that the older boy was patiently explaining and answering."

As STEM Week evolves into STEM month, Berman and Thornton are thinking about getting the idea in to as many schools in the city as possible. "We're thinking about what we call i2 month," says Berman, "because it's not just STEM; then maybe a conversation about doing a semester."

Soto is already way ahead of them; she saw how STEM Week changed her students, many of whom are Latino and from low socioeconomic homes. "It stayed with them for the rest of the school year," she says, "I want this program to start in the fifth grade," she says, "and I want it to last all year." eSN

PJ Boardman is the director of education marketing for MathWorks.

Tech giants commit $300M to STEM education

White House advocates for increased focus on, efforts to expand STEM education

BY MARISSA LANG AND TRISHA THADANI, SAN FRANCISCO CHRONICLE

The White House in September announced plans to spend $200 million a year on grants meant to boost STEM education in an effort to close a widening skills gap that, some say, has left Americans out of the running for scientific and technical jobs.

Bay Area powerhouses Facebook, Google and Salesforce have committed $50 million apiece to support these efforts–making up about half the $300 million commitment from the private sector. Other companies funding STEM education efforts include Amazon, General Motors and Lockheed Martin.

It was not immediately clear where the $200 million in federal dollars would come from, though the Trump administration emphasized that it would not be new funding, but rather existing money that would be redirected."

For tech companies like Salesforce, however, the monetary commitment is a new one.

Salesforce–whose philanthropic arm, Salesforce.org, also committed 1 million employee volunteer hours over the next five years to expand K-12 computer science education in the U.S.–has contributed $65 million to school districts since 1999.

The additional commitment would broaden the company's efforts, a spokeswoman said, not replace them.

"Nothing is more important than educating our nation's students and preparing them for the jobs of tomorrow," Salesforce CEO Marc Benioff said in a statement. "Through our longstanding partnerships with San Francisco Bay Area school districts, we've seen a big impact from our investments — not only in dollars, but employee time and expertise. I encourage every CEO, every organization and every individual to contribute to educating our youth and providing them access to computer science skills."

Ivanka Trump, the president's daughter and senior adviser, has been a driving force behind the push for greater STEM and technical education initiatives–especially for girls, who have also been the target of numerous Silicon Valley programs aimed at increasing the number of women in tech.

The funneling of federal funds into education and technical skills is nothing new.

President Barack Obama had made STEM education a priority for his administration and pledged in 2011 to

prepare 100,000 new math and science teachers by 2021 and secure $1 billion in private investments to further it.

Race to the Top, a competitive grant program created by the Obama administration, has awarded hundreds of millions of dollars to low-performing schools aiming to improve and emphasize technical education.

The Trump administration inherited other similarly focused grant programs like the Minority Science and Engineering Improvement Program, which awards colleges and universities money to "increase the flow of underrepresented ethnic minorities, particularly minority women, into science and engineering careers."

Over last summer, Ivanka Trump reportedly began seeking input on technical education and ways to improve it from Silicon Valley executives including Apple CEO Tim Cook, who has directly asked the president to require coding classes in American public schools, and Laurene Powell Jobs, who chairs the board of XQ: The Super School Project, a nonprofit aimed at "rethinking" how high school works.

Though Apple is not among the companies pledging financial backing for the Trump administration's new effort, the company offered praise to the administration's initiative.

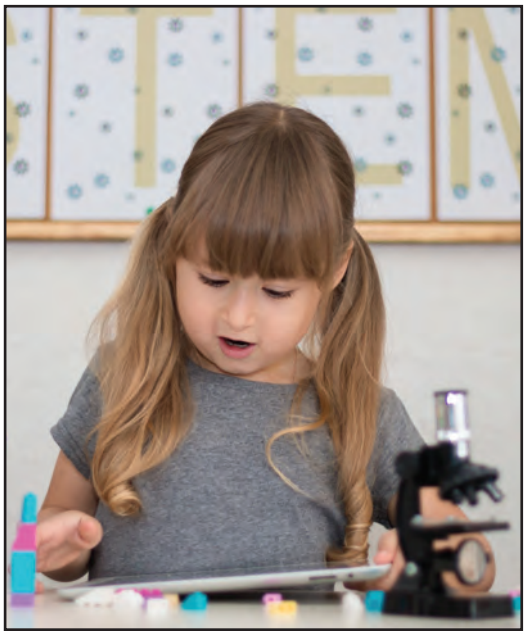
Several experts said giving schools money to support these kinds of programs is an effective way to create lasting change.

"With the impending explosion of new 5G technologies, the Internet of Things, and other innovations like autonomous vehicles, the U.S. must ramp up investments to ensure that the youth of today are prepared to innovate for our economy tomorrow," Tom Ferree, CEO of Connected Nation Inc., a nonprofit that promotes internet access and tech literacy for all, said in an email Tuesday. "We applaud the White House for prioritizing STEM education — and coding specifically — to ensure that the U.S. continues to lead the world in building a more connected society."

In July, the president announced that he was donating his salary for the second quarter of the year to the Department of Education. The $100,000 donation from Trump will be used to help fund a camp for students to explore science and math careers. But the announcement was met with anger by some education advocates, who found the charitable donation insulting while Trump was also seeking a $9 billion cut to the agency in his budget request. eSN

6 steps to strengthen early STEM learning

Report aims to help knock-down barriers to early childhood STEM education inclusion that are often pervasive in schools.



BY LAURA ASCIONE
Managing Editor, Content Services

Although STEM education is inarguably essential in today's economy, it is not always seamlessly incorporated into early childhood education–and the barriers to inclusion are more pervasive than many educators might realize.

"Just as the industrial revolution made it necessary for all children to learn to read, the technology revolution has made it critical for all children to understand STEM," according to the report.

After a 2013 STEM workshop targeted to early childhood educators, those who attended said they were excited by evidence-based STEM education practices and tools, but many also noted various barriers to implementation, including feeling limited by existing school structures and policies; the misapplication of new education standards; disconnects between preschool and elementary school practices; and an underprepared workforce.

The NSF-funded report, "STEM Starts Early: Grounding Science, Technology, Engineering, and Math Education in Early Childhood," is the product of an effort by the Joan Ganz Cooney Center at Sesame Workshop and New America to respond to those educators' concerns about STEM education and also to:

- Gain a better grasp of the challenges to and opportunities in STEM learning outlined in a review of early childhood education research, policy and practice
- Offer recommendations to stimulate research and policy agendas
- Encourage collaboration between pivotal sectors to implement and sustain needed changes

Along with teachers, families play a crucial role in forming young learners' early STEM concepts.

"Across the research literature, family engagement in the math and literacy education of young children (3–8 years) has a consistently positive effect on children's learning in those areas, and this relation is strongest when that engagement takes place outside of school," the authors note in the report.

But because many parents have anxieties around teaching science- and math-related concepts to their children, or because they themselves may have missed such learning opportunities, they need support in their efforts to encourage their children.

The report outlines five key findings gleaned from the researchers' examination of the STEM education landscape.

1. Both parents and teachers appear to be enthusiastic and capable of supporting early STEM learning; however, they require additional knowledge and support to do so effectively.

2. Teachers in early childhood environments need more robust training and professional development to effectively engage young children in developmentally appropriate STEM learning.

3. Parents and technology help connect school, home, and other learning environments like libraries and museums to support early STEM learning.

4. Research and public policies play a critical role in the presence and quality of STEM learning in young children's lives, and both benefit from sustained dialogue with one another and with teachers in the classroom.

5. An empirically-tested, strategic communications effort is needed to convey an accurate understanding of developmental science to the public, leading to support for meaningful policy change around early STEM learning.

It becomes clear, the authors note, that STEM education at the preschool level must be prioritized. Creating opportunities to inject STEM learning opportunities in early childhood education can be accomplished with a combination of small and large actions.

The report's recommendations include:

1. Engage parents: Support parent confidence and efficacy as their children's first and most important STEM guides.

2. Support teachers: Improve training and institutional support for teaching early STEM.

3. Connect learning: Support and expand the web of STEM learning "charging stations" available to children.

4. Transform early childhood education: Build a sustainable and aligned system of high quality early learning from birth through age 8.

5. Reprioritize research: Improve the way early STEM research is funded and conducted.

6. Across all these recommended actions, use insights from communications science to build public will for and understanding of early STEM learning. eSN

Gen Z women want to learn more STEM, innovative tech

BY LAURA ASCIONE
Managing Editor, Content Services

Female students say they feel less equipped to tackle future careers because they haven't necessarily learned about the new technologies shaping those future career fields, according to a new survey.

The Quizlet survey polled more than 1,000 Americans between the ages of 13 and 24 to ask them about their familiarity with the future of work and how they are learning about it in school.

The good news is that 95 percent of students know about the future of work and why it is important and relevant to their learning. But the survey also reveals some troubling differences between what male and female students know and wish they could learn.

One in three female students say they wish they learned more about innovative technologies in school, compared to one in four male students.

The survey wonders if it's possible that female students wish they learned more about emerging technologies because they are increasingly interested in STEM fields. Quizlet's own data indicates that 20 percent of study sets on Quizlet are related to STEM subjects, and female students using Quizlet are more likely than male students to study STEM subjects.

Both male and female students said they believe robots (47 percent), self-driving cars (46 percent) and artificial intellience (44 percent) will play a role in the future of work.

Sixty percent of students said they have learned about robots in the classroom. Broken down by gender, 70 percent of male students said they have learned about robots in school, but only 55 percent of female students have. The difference may come from different choices about extra-curricular clubs and activities, or may be a result of systemic issues surrounding how male and female students are taught.

And though artificial intelligence is rapidly gaining steam in both education theory and practice, most students don't really understand what it is. Four in 10 students said they haven't learned about artificial intelligence or machine learning in school.

Examining the STEM learning differences between male and female students has important implications in society.

A U.S. Chamber of Commerce study revealed that women hold approximately 50 percent of jobs in the country, but only fill just 25 percent of STEM jobs. That same study revealed that 17 of the top 20 highest-paying occupations require STEM skills.

With these gender disparities in mind, a collaborative research project between Carnegie Mellon University's CREATE Lab and the School of Computer Science, called the HEAR ME project, aimed to identify how students themselves feel about STEM education's importance, and how they think gender bias could, or already does, impact them.

"STEM education has been a very big movement in education, and as we focus specifically on STEM learning, one thing we want to make sure of is that the biggest stakeholder in this is being heard," said Jessica Kaminsky, project manager of the CREATE Lab at CMU and key researcher behind the HEAR ME project. "Who better to ask about what STEM learning looks like, if they're seeing a gender bias, than the students who are living out the STEM programs running in their schools?" eSN

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