

# Digital STEM Learning and the High School Student

High School



## Introduction

“It was a red letter day for STEM education,” said Joseph Cuenco. “Everyone was in awe — there are just no other words to describe it.”

Cuenco, executive director of the Pinellas Science Center in St. Petersburg, Fla., was referring to high school students from Pinellas County Schools participating in the center’s downlink with NASA event, during which high school students had the opportunity to ask astronauts questions and learn about science and technology through hands-on and demonstration experiments.

The Pinellas Science Center is conveniently located in Pinellas County Schools’ backyard — but the center doesn’t stop at sparking STEM (science, technology, engineering and math) learning with only local students. The center educates more than 22,000 students through field trip classes and education courses, offers spring and summer workshops, and holds science showcases and science fair workshops.

The science center also offers a 15-week cyber-security education program to prepare students for testing in industry-recognized certifications. The “real-world learning

methodology” of the center features blended learning systems and a student-centric learning model. Students who complete the cyber-security program qualify for credits towards a two or four-year degree in Network Security from St. Petersburg College.

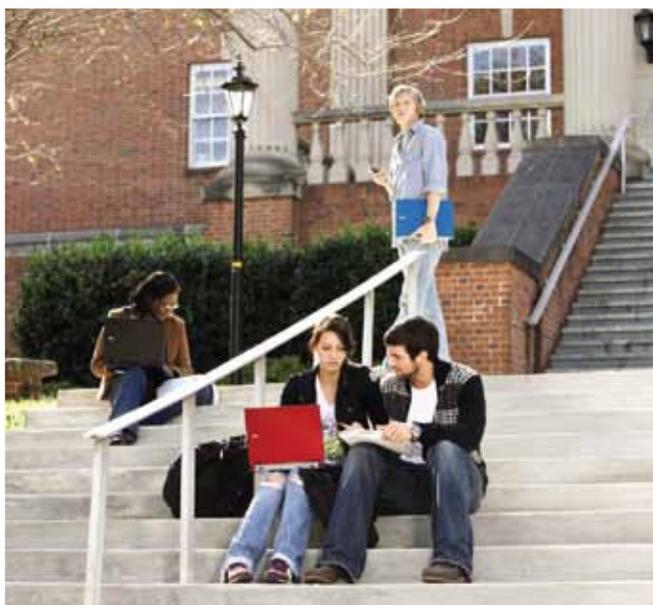
“Preparing students for the high-tech jobs and careers that will support the 21st-century global economy is both a national and local priority,” says Bill Lawrence, director of Advanced Studies and Academic Excellence for Pinellas County Schools. “The Science Center of Pinellas County and its business partners are a key component to the development of new courses of study in our secondary schools.”

## Last Call for STEM

High school is a critical point in a young person’s life. A student’s high school graduation launches the journey of pursuing higher education goals and future career paths, determining the course his or her life will take. If an appreciation and interest for STEM-related curricula has not materialized by the time a student completes high school, the odds are high that they never will.

Tomorrow’s workforce will be dominated by STEM occupations. The Bureau of Labor Statistics estimates that employment in science and math occupations will grow 70 percent faster than the overall growth for all occupations.<sup>1</sup> With over 3 million students expected to graduate from high school in 2011, the stakes are high to ensure that we are providing a pipeline of students for the future workforce who are effectively trained with the tools to succeed.

Integrating technology and digital tools into high school curricula is critical to creating classrooms and environments that spur student interest. Pinellas County Schools, having previously struggled with high school drop-out rates, has made it a priority to retain students and prepare them for college. The school has leveraged technology to keep students in school. In addition to participating in events with the Pinellas Science Center, the school district recently completed an e-reader roll-out for over 2,100 students at Clearwater High School.



The e-readers have allowed the high school to offer more STEM opportunities for students. Students have access to the Web, where they can view any math, science or technology-related website. Students are also able to access their math books and a supplemental science book on their e-readers.

“Our goal is to get the kids enthused about literacy through technology,” says Clearwater High School Principal Keith Mastorides. We believe by using this technology, we are tapping into their interest.”

The district’s focus on integrating technology seems to be working to increase student interest and lower drop-out rates. The district’s graduation rate has increased by 12 percent in just two years and on a recent Friday night, over 1,000 district students were not at a movie, a sporting event or out with friends. They were on an online school discussion forum — by choice.

## National STEM Initiatives

Pinellas is not the only district that has struggled with graduation rates. Nationwide, 7,000 students drop out every day and only about 70 percent of students graduate from high school with a regular high school diploma.<sup>2</sup> U.S. Rep. George Miller may have said it best: “The crisis we’re seeing in our nation’s high schools is real, it’s urgent, and it must be fixed.”<sup>3</sup>

U.S. high school students are lagging behind their peers internationally. According to a ranking by the Organization for Economic Cooperation and Development, U.S students finished 19th in math and 14th in science out of 31 countries. Barely 18 percent of 12th-grade students perform at or above the proficient level in science.

In today’s globally competitive marketplace, lagging behind the pack is no longer acceptable. Not only do we have to strive for higher graduation rates but we need to keep our students engaged and excelling in the most challenging subjects — STEM.

The Obama Administration has made STEM one of its top priorities, announcing three overarching goals:

- Increasing STEM literacy so all students can think critically in science, math, engineering and technology;

- Improving the quality of math and science teaching so American students are no longer outperformed by those in other nations; and
- Expanding STEM education and career opportunities for underrepresented groups, including women and minorities.

To meet these end goals, schools need to ensure the last few years of a student’s K-12 experience is met with the open arms of STEM. This is literally the last chance school leaders have to introduce students to STEM fields as potential career choices. Many behind-the-scenes STEM careers do not get much air time on digital media venues, making it vital that students recognize these underrepresented areas as fertile ground for growing their interests. However, before students skyrocket to their professional STEM careers there is a need for sound technological infrastructure on the ground in every district, school and class that creates, connects and communicates this digital learning environment.

## Stepping Up STEM

In September 2010, President Obama announced the “Educate to Innovate” campaign to “raise American students to the top of the pack in science and math achievement over the next decade.” It wasn’t the first STEM initiative by the Obama administration. The president also made STEM a part of the stimulus plan’s \$4.35 billion Race to the Top program and announced in September 2010 a goal of recruiting 10,000 STEM teachers over the next two years and preparing 100,000 STEM teachers over the next decade.

The attention on STEM education is warranted. To compete in a globalized world, the United States must have citizens who are prepared to work in high-tech careers. We need scientists and engineers to drive innovation.

The use of technology in the classroom can stimulate and promote the kind of project-based, collaborative investigations in which students make observations, synthesize data, draw hypotheses and present findings. These skills not only reinforce math, science and engineering concepts, but they also

## Got STEM Competition?

This website provides educators with competitions involving everything under the Sun. Engage students with these out-of-this-world contests:

<http://stemology.wordpress.com/stem-competitions/>

You might not win a new car, but you can design a fuel efficient dashboard:

<http://www.fuelourfuturenow.com/>

utilize technology to crunch numbers, assemble data, share findings within a team and eventually create meaningful presentations. Doing repetitive math problems out of a textbook does not cut it anymore. Not only does this kind of learning not engage students, it does not align with the skills students will need to thrive in their future careers. STEM educational improvements start with creating a fun and collaborative learning atmosphere where learning tools and curricula leverage hands-on and interactive games to expose students to concepts.

### Engineering Success at Pueblo County High School

The School of Engineering and Biomedical Science at Pueblo County High School maximizes the potential technology can bring. Principal James Gradishar does not turn down any willing student who wants to work hard. He estimates that 80 percent of his students pursue STEM careers — and, with a graduation rate of 100 percent, everybody wins.

“When students see a purpose with what they are learning, rather than rote memorization, they see an outcome ... the projects are individually based and they just run with it,” he says. Projects at Pueblo include working on syringe robots, conducting flight simulations, and designing rockets on a 3-D plotter and laser cutter.

Pueblo District No. 70 has created a list of how laptops have transformed ordinary curriculum into technology-rich lessons:

- Easy and efficient access to Web-based content for both the teacher and the student
- Web-based research
- Real-time information
- Online collaboration
- Virtual classrooms that allow students to manage and communicate information
- Self-directed learning
- Distance and distributed learning that expands the classroom
- Individualized learning with opportunities for problem solving and higher-order thinking skills
- Project-based learning within a multi-media environment that promotes information literacy skills

### K-necting in North Carolina

Project K-nect, a two-year pilot program in North Carolina, addressed the need to increase the math skills of at-risk ninth graders through the use of wireless technology. The students used smart phones to access math class materials at home, connect with tutors after school hours and collaborate with each other on assignments. Math scores increased by 20 percent and overall test scores were higher in the classrooms that used the mobile devices to aid curriculum.<sup>5</sup> Most importantly, using the smart phones was a preferred method by students, which in turn got them excited about a topic that was otherwise not interesting to them.

### Digital Learning is Integral to STEM

To high school students, technology is a way of life. They wake up to music on their MP3 players, check their schedules on their smart phones and log on to their laptop before heading to school, so why should this routine stop once a student enters the classroom? Students are asked to “power down” all of their mobile devices as they step into the class-

room — but school leaders need to recognize that these technologies can enhance the 21st-century classroom rather than detract from it. STEM workplaces are all about powering up and the sooner education embraces this reality the more in sync the 21st-century classroom will be with the 21st-century work environment.

When STEM concepts are introduced at the high school level, the range of ability — as well as the digital divide — will become apparent at lightning speed. Challenging digital content in these fields necessitates that students work at their own pace and in their preferred learning style — whether it be through auditory content, visual content or a combination of both.

To enter a classroom in which information is static, from a single source and in a one-size-fits-all arrangement can cause many students to disengage and is not representative of the speed of business. Successful STEM programs are reshaping classroom pedagogy to adjust to these multi-media realities. They take into account that over the past several decades the instructional paradigm has shifted through more innovative uses of technology.

## STEM Benefits from a Student-Centric Approach

Traditionally, learning has been teacher-centric where the focus is on the content delivered to a classroom, but the digital age demands that this model be transformed to a student-centric and personalized approach focused on the specific learning needs of the students. A teacher-centric model is an efficient way to deliver knowledge when access to content is limited and the teacher is the primary vehicle with which to deliver information in the classroom. Alternatively, a student-centric model is an efficient way to customize easily obtainable content through open source portals and purchase STEM curriculum tailored to suit the needs of a student while the teacher provides educational guidance and learning support.

We have arrived at the busy virtual intersection of the “guide on the side” versus the “sage on the stage.” Which way we turn can often depend on whether a school has developed a culture where technology is appreciated and incorporated into daily lesson planning rather than pushed from the top down. This same philosophy can be applied to the high school student — students are eager to learn when they are brought in as a learning partner.

Teacher-Centric Learning	Student-Centric Learning	STEM-Focused Learning
<ul style="list-style-type: none"> <li>• Students absorb information delivered by teachers</li> <li>• Students complete assignments and activities that are assigned by and designed by the teacher</li> <li>• Students work in groups only when assigned by the teacher</li> <li>• Teachers are responsible for tracking student learning</li> <li>• Teachers focus on the delivery of content</li> </ul>	<ul style="list-style-type: none"> <li>• Students are active participants</li> <li>• Students construct and build on new knowledge and skills</li> <li>• Students work in collaborative environments</li> <li>• Students monitor their own learning and are motivated by their own progress</li> <li>• Teachers teach to different learning styles</li> </ul>	<ul style="list-style-type: none"> <li>• Hands-on experiments, lab rotations</li> <li>• Backyard experiential learning</li> <li>• Team-based collaborative gaming</li> <li>• STEM competitions to motivate students</li> <li>• STEM mentors to augment teacher knowledge</li> </ul>



It's important to note that although schools are increasingly integrating technology into the classroom, studies show that a disparity remains between what schools think they are providing — and what students think they are getting.<sup>6</sup> According to a recent study, although 18 percent of teachers say they have fully integrated technology into their classrooms, only 9 percent of students agree. Additionally, although 60 percent of students acknowledge that their teachers use technology to teach, only 26 percent of students say they can use technology to learn. It appears that although students use technology in every facet of their lives, they themselves still might not see it as a learning tool. For STEM careers, it is even more vital that students use these technology tools in high school — they'll be the ones engineering the next generation's toolbox.

At Pinellas County Schools, technology leaders seem to have found the key to integrating student-centric tools — and getting students and teachers to take full advantage of them. In addition to replacing textbooks with e-readers and deploying thousands of netbooks, the district also utilizes visual interactive technologies and software tools like Moodle while encouraging students to bring in their own laptops. No technology is turned away if used appropriately and in the name of education.

John Just, assistant superintendent at Pinellas, says that using myriad devices is not a problem for students. “Unlike you and me,” he says, “the new generation of students has no problem with lots of devices that don't interact.” Principal Keith Mastorides adds, “The 21st-century learner needs to be engaged through technology. We have seen a positive increase in test scores and class grades when a greater emphasis is placed on the use of technology.” Correlation is not causation, but common sense tells us that higher grades might just lead to more graduates.

Like many other school districts Pinellas faced funding shortages, but even while under tight budget constraints, district leaders realized they could repurpose textbook money and apply it toward technology resources to enhance learning opportunities for their students. The district is now using a new learning platform and leveraging digital content from online courses, particularly in challenging STEM areas to supplement classroom instruction. Technology now works for them instead of them working for the technology.

## STEM Distance Learning

High school can be a big adjustment for many students and because every student learns differently, the traditional high school setting may not be the most effective route. A virtual school setting — whereby the majority, if not the entire curriculum, is delivered online and from a remote site — is a popular alternative for many students who for various reasons find physical school attendance either undesirable or impossible. Not all schools have the STEM capabilities for advanced courses that require more in-depth knowledge. Many school districts are offering their own virtual schools to retain students who may otherwise choose an alternative setting outside the district.

District leaders are finding that technology is creating an increasingly fluid definition for what a “classroom” actually is. Many districts are using online learning to allow students — particularly those deemed ‘at-risk’ — to pursue outside interests while remaining engaged in learning. Students can

become more inclined to take advantage of education opportunities when they are not constricted by brick and mortar buildings.

Antelope Valley Unified High School District in California has recently begun offering online options, including a summer option as well as a 5th-year option for students who need additional credits to graduate. The online options have proven to be a great alternative for students to catch up to their classmates and have given them the ability to work at their own pace. The school district is in the best position to support those students through an online program that is tailored to individual student needs.

## Conclusion

Effectively preparing high school students for the future workforce is crucial. Using technology to increase students' interest in STEM fields not only helps students succeed in their careers, but benefits the nation as a whole. Now more than ever, it is critical to start transforming high school curriculum to fit into the

digital age. Students will become more engaged when learning is conducive to their lifestyle. Educational technologies will excite students and provide more relevant learning experiences for them. Schools that can best match students' needs with modern learning technologies will produce the best educational outcomes. In an ideal world, the content areas STEM represents are no longer part of the educational minority.

Learning with technology allows students to progress through school at their own speed and extends the typical classroom day. When technology is integrated into the high school student's day — whether in class or at home — learning is constant. When students complete high school and see themselves as lifelong learners, confident in technology use instead of viewing education as a necessary means to an end, challenging subjects like STEM become more accessible. The new 21st-century educational equation will be access + technology = responsibility and opportunity.

## Endnotes

1. [http://www.tap2015.org/news/tap\\_2008\\_progress.pdf](http://www.tap2015.org/news/tap_2008_progress.pdf)
2. <http://edlabor.house.gov/newsroom/2009/05/high-school-dropout-crisis-thr.shtml>
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5. <http://www.projectknect.org/Project%20K-Nect/K-Nect%20Summary%20.html>
6. <http://www.convergemag.com/classtech/Tech-in-Class-Report.html>



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