From IoT to Wearables

THE TOP TECH TRENDS IN COMPUTER SCIENCE EDUCATION

sparkfun EDUCATION

From IoT to Wearables: The Top Tech Trends in Computer Science Education

BY MEGAN HEMMINGS

Programming. Makerspaces. Electronics. Computer science and technology are taking education by storm, in the best possible way. In today's world, technology is inescapable, and in the future this trend will continue at an even faster rate.

It is predicted that by 2022 "jobs in computer and mathematical occupations will increase by 18 percent" (Gallup, 2015) but that there will be a shortage of 1 million STEM workers to fill these jobs (Norup, 2016). In order to help prevent this shortage, it is imperative to introduce students to technology at younger ages. Studies have found that one in five students who choose to major in or focus on STEM in college made the decision by middle school and that four in five decided to study STEM in high school or earlier (Harris Interactive).

Additionally, integrating technology into the classroom can have wide-reaching effects. A 2015 Gallup survey found that "students with more exposure to technology are also more confident in their skills in fundamental areas of learning, such as math, science, reading and writing, as well as other skills foundational to computer science learning, such as designing and creating things and figuring out how things work."

Educators are taking notice and increasingly integrating technology and coding into their instruction. To go along with this momentum, here, in no particular order, are the top trends expected to emerge in technology education over the next few years: Internet of Things, wearables, micro:bit and 3D printing.

INTERNET OF THINGS

The Internet of Things (IoT) is a concept that is taking the tech world by storm, and doing so quickly. One report states that, as of 2015, there were 5 billion devices and IoT sensors in use, a figure that is expected to rise to 75 billion by 2020 (Nilsson, 2015). That's a 14 times increase in just five years!

While it may take a little longer to catch on in the classroom than in the commercial world, there are so many things students can learn from IoT projects. IoT combines electronics and programming with data collection to create projects that will engage students and keep them coming back for more.

IOT IN THE CLASSROOM

IoT projects can be a great way to learn about weather and climate through remote monitoring. A variety of weather station kits — including the micro:climate kit from SparkFun, which uses the micro:bit (see below for more information on this trend) — allow students to assemble a weather station that monitors what they are interested in knowing. Things like relative humidity, temperature, wind speed, barometric pressure and more can all be monitored remotely through IoT. A device placed in the field can transmit data back to the classroom for student analysis.

Other fun ways to study weather using IoT include creating "weather clouds" that reflect the outside conditions through LED lighting and fake thunderstorms. Bosch, a leading global supplier of technology and services, even took this idea one step further by turning an image of Albert Einstein into a visual representation of the weather — "when the temperature or air changes, so does Einstein" (Augur, 2016). "The Einstein would notify both students and teachers about minor changes in the atmosphere; then, they could adjust their conditions to be more ideal for better focus. Minor shifts in weather can drastically alter the mood. Furthermore, the Einstein actively taught students about climate and even gave them a chance to get involved."

In addition to being a fun way to learn about the world around them, IoT is highly relevant to students' potential careers.

Some classrooms raise baby chicks, and a large part of successfully raising them is ensuring they have the proper environment for each stage of growth. Especially critical is the temperature of their habitat. An IoT temperature monitor can be built that will both track the temperature throughout the day and alert you when it either drops too low or rises too high (Huang, 2017). For classrooms that don't raise chicks, this same concept can be used to track the HVAC swings throughout the day to see if it really is colder right after lunch.

Common fitness trackers log the wearer's activity levels throughout the day via IoT. This same concept can be used to create trackers for almost anything you can think of — sleep, soil moisture levels, a motion sensor for your dog and more.

THE FUTURE OF IOT

In addition to being a fun way to learn about the world around them, IoT is highly relevant to students' potential careers. The business world is rapidly adopting IoT into their everyday practices, affecting how they approach everything from hiring to data collection to which devices are used and the processes in place to get work done. The only thing standing in companies' way of using IoT even more extensively is "a lack of IoT skills and knowledge among employees and management" (Kaufman, 2015). This finding puts IoT at the top of valuable skills students will need for future careers.

WEARABLES

Wearables can be used in the classroom to bring electronics to life for students. By creating a project they are able to wear as they go about their daily activity, students will get to experience the possibilities of electronics on a deeper level.

There are so many applications of wearables popping up in the tech world that it's no wonder they are starting to see adoption in classrooms. From fitness trackers to biomedical devices to smartwatches and light-up sneakers, wearables is "a fuzzy term that refers to any device you can wear" (Nield, 2015). This opens the door for broad applications for lessons in any content area.

HISTORY OF WEARABLES

While the wearable trend may seem like something new that has been brought on by technology, wearables actually have a long history. Tech wearables started as early as 1961 when two MIT math professors put a computer inside their shoes in order to cheat at roulette (Meola, 2016). A little over a decade later, the first calculator wristwatch hit the market, and people have been wearing technology ever since, most recently in the form of fitness trackers and smartwatches (Meola, 2016).

The approachable nature of wearable products makes them a logical entry point for many who are just starting out with electronics. After all, what's easier to show off than a project you can wear? While there are many options for wearable tech in the classroom, two that are gaining steam are the LilyPad line of sewable electronics and the ESP8266, which is actually an IoT board but is included here due to the number of wearable applications.

The approachable nature of wearable products makes them a logical entry point for many who are just starting out with electronics. After all, what's easier to show off than a project you can wear?

LILYPAD

Designed by Leah Buechley while pursuing her Ph.D. in computer science at the University of Colorado, Boulder, and launched commercially in 2007, the LilyPad microcontroller merges the worlds of technology and clothing. "The diminutive microprocessor, designed to be incorporated into apparel or other soft goods, has easy connectors that integrate with a range of sensors and actuators with conductive thread. This combination opens a new platform for technology and fashion, allowing for easy projects like embedded LEDs, or more advanced projects like motorized, moving components that react from environmental conditions" (Einarson, 2013). Using LilyPad, electrical connections can be made via conductive thread or by soldering wires in place, allowing for the ultimate design flexibility. LilyPad boards have been used to create everything from light-up earrings and a musical pillow to a light-reactive dress and a glove that creates music based on finger taps. The approachability of the LilyPad line makes it a great introduction to e-textiles and wearable projects for the classroom. Boards range in size and programming capabilities, making them accessible to both novice and expert makers and programmers.

ESP8266

The ESP8266 board takes wearables a step further by combining them with Internet of Things (IoT) capabilities. This combination moves student projects closer to the commercially produced wearables people commonly think of (fitness trackers and smartwatches) by creating an electronics project that can be worn and can transmit data to an internet-connected device such as a smartphone or computer.

Each year for National Youth Science Day in October, 4-H features a different STEM-related activity designed around prevailing tech themes. For 2017, the 4-H National Youth Science Day theme is “Incredible Wearables” and features a fitness tracker project using an ESP8266 board (4-H). The available kit includes everything kids need to build their very own fitness tracker, and to log the data using the ESP8266’s IoT capabilities.

USING WEARABLES IN THE CLASSROOM

Wearables can be used in the classroom to bring electronics to life for students. By creating a project they are able to wear as they go about their daily activity, students will get to experience the possibilities of electronics on a deeper level. It’s important to remember that the term “wearables” doesn’t only refer to creations such as fitness trackers, but can also be something as playful and expressive as light-up sneakers. Any electronics project that is designed to be worn can be considered a wearable, leaving lots of room for innovation and project ideas that fit the needs of any classroom.

MICRO:BIT

Another approachable technology with limitless applications, including weather monitoring and robotics, is the micro:bit. At around $15 each, the micro:bit is one of the most affordable ways to add computer science to the classroom. This powerful microcontroller offers a 5x5 grid of LEDs, two programmable buttons, an accelerometer, a compass and a large number of access ports for additional sensors and actuators. The micro:bit doesn’t require any software installation and can be programmed via Bluetooth or a USB connection, making it perfect for use with Chromebooks, iPads and mobile phones.

One of the biggest reasons so many educators are excited about the micro:bit’s introduction to North America earlier this year is a combination of how easy the board is to use and the number of programming options available.

HISTORY OF MICRO:BIT

The micro:bit was released in the United Kingdom in 2016 and took the nation by storm when every student in year seven of school, the equivalent of sixth grade in the United States, was given a micro:bit upon its debut (British Broadcasting Corp.). Developed as a collaboration among 29 partners, the micro:bit was created with the express purpose of helping the United Kingdom combat the technology skills shortage it is facing. Earlier this year, micro:bit officially became available in North America, and the Micro:bit Foundation has an aggressive goal of putting the micro:bit “into the hands of 2 million elementary and middle school students in the U.S. and Canada by 2020” (Micro:bit Foundation, 2017). Based on early buzz around the product, the foundation is well on its way toward achieving that goal.

CLASSROOM ADOPTION

One of the biggest reasons so many educators are excited about the micro:bit's introduction to North America earlier this year is a combination of how easy the board is to use and the number of programming options available. The micro:bit does not require software installation for programming and can be programmed in multiple languages. Students can progress in their learning from block-based coding in Microsoft's MakeCode to text-based programming with MicroPython or JavaScript.

In addition to all of these features, the Micro:bit Foundation has worked hard to build a community of educators creating projects using the micro:bit. The foundation's website, microbit.org, offers a variety of lesson plans for integrating the micro:bit into any classroom, as well as project ideas ranging from adding the micro:bit to 3D-printed projects to counting baseball pitches.

Another major contributor to high levels of micro:bit adoption in education is the ecosystem of expansion kits and boards recently developed by SparkFun Electronics. These kits cover everything from weather tracking to robotics to gaming, as well as basic programming and electronics skills. In addition to expanding the capabilities of the micro:bit board, SparkFun (sparkfuneducation.com) offers project ideas, tutorials and professional development around the kits and micro:bit in general.

3D PRINTING

Patented in 1986 by Charles Hull, stereolithography, now called 3D printing, is a great way to get students excited about engineering design. The ability of a 3D printer to bring students' designs to life helps engage them in what they are learning and makes them excited to test revisions and ideas. This technology can "guide students all the way through the manufacturing process — from concept to completion — and reward them with an object they could hold in their hands" (Peterson, 2015).

The ability of a 3D printer to bring students' designs to life helps engage them in what they are learning and makes them excited to test ideas and revisions.

When starting a makerspace, the first item many schools purchase is a 3D printer. But once they have one, they struggle with how to use it. There are so many projects and 3D files that can be downloaded from websites such as Thingiverse that finding an educational way to use a 3D printer can be a challenge.

In order to truly serve an educational purpose, students need to design their own files to be printed, allowing them to learn design, problem solving and prototyping skills.

Luckily, both educators and 3D printer manufacturers are starting to figure things out. Lesson plans for 3D printers can now be found from manufacturers such as MakerBot, Dremel and Stratasys, and educators are sharing their stories of how they have fit 3D printing into virtually every subject, including history, Spanish and mathematics.

3D PRINTERS IN USE

At one school, American History students “used scans from the Smithsonian Institution to print replicas of life masks taken of Abraham Lincoln: one mask made at the time of his inauguration and the other just before his assassination” (Peterson, 2015). This process allowed students to feel the deepening wrinkles on Lincoln’s face, which “[conveyed] the toll the war took on him” much better than a picture ever could.

At the Future of Education Technology Conference (FETC) in 2017, Crystal Cleveland gave a presentation about using 3D printing in her Spanish class (Cleveland, 2016). Through this activity, her students learned about Spanish history and improved their vocabulary by creating and 3D printing game pieces inspired by history.

To prove that 3D printing can be used at any age, two fourth grade teachers, Wendy Whittle and Allison Capone, in New Jersey challenged their students to design boats that could actually float, even while carrying extra weight (Krassenstein, 2015). Through this project, the students learned about geometry while designing their boats and acquired the skills to create a 3D-printed model. “The students were fascinated and completely engaged,” said Allison Capone. “They were amazed to see that what had once been a picture on the screen became something they could actually hold and touch” (Krassenstein, 2015).

Examples such as these show that 3D printers can be used for so much more than printing a phone case or keychain. As 3D printers become less expensive, they will be even more appealing for schools. One day soon, every classroom may even have its own 3D printer, or two.

COMPUTER SCIENCE AND BEYOND

Each of these trends will shape the world of electronics education in the years to come. Some, such as 3D printers, are already finding a strong foothold in the classroom, while others, such as IoT, are just beginning to catch on. The most exciting thing about all four of these trends is their ability to apply to a wide range of projects and subjects, allowing computer science to be brought into almost any lesson.

The reach of these trends extends far beyond the classroom into current business practices as well as the job market of the future, making them critical skills for students to learn. As teacher Richard Osman, who introduced 3D printers into his district, put it, “If you put the right equipment in students’ hands at the right time, you can give them a glimpse of where the future is going” (Peterson, 2015).

REFERENCES

4-H. (n.d.). 4-H National Youth Science Day. Retrieved from http://4-h.org/parents/national-youth-science-day/

Augur, H. (2016, December 13). IoT in education: The internet of school things [IBM IoT Web log post]. Retrieved from https://www.ibm.com/blogs/internet-of-things/iot-education/

British Broadcasting Corporation. (n.d.). Make it digital: The BBC micro:bit. Retrieved from http://www.bbc.co.uk/programmes/articles/4hVG2Br1W1LKCmw8nSm9WnQ/the-bbc-micro-bit

Cleveland, C. (2016, January 26). Build games using 3D printing and laser cutting to teach tough curriculum concepts. Retrieved from http://fetc.eventshowcase.com/LRP/public/events/fetc/app/event.html#&ui4nvh!eyJuYXYiOiJhcHAuZXZlbnQudmlld1Nlc3N-pb25EZXRhaWxzIizEh3JnxKM6WyI3MmE0NzBkNC04ZTNlLTQ4OWLEtTY1xLkyMjUzYjRhYTY0OWUiXX0=!ui4nvh

Einarson, E. (2013, January 2). Go bionic with these wearable Arduino projects. *Wired.* Retrieved from https://www.wired.com/2013/01/wearable-arduinos/

Gallup/Google. (2015). Searching for computer science: Access and barriers in U.S. K-12 education. Retrieved from https://services.google.com/fh/files/misc/searching-for-computer-science_report.pdf

Harris Interactive/Microsoft. (n.d.). STEM perceptions: Student & parent study — Parents and students weigh in on how to inspire the next generation of doctors, scientists, software developers and engineers. Retrieved from https://news.microsoft.com/download/archived/presskits/citizenship/docs/STEMPerceptionsReport.pdf

Huang, B. (2017, April 6). Internet of chickens: IoT intersects with the backyard chicken movement [SparkFun Education Web log post]. Retrieved from http://blog.sparkfuneducation.com/the-internet-of-chickens-where-iot-intersects-with-the-backyard-chicken-movement

Kaufman, S. (2015, November 18). How do we integrate IoT skills into the classroom? [PTC Web log post]. Retrieved from http://blogs.ptc.com/2015/01/28/how-do-we-integrate-iot-skills-into-the-classroom/

Krassenstein , E. (2015, February 25). 4th graders in New Jersey design and 3D print boats that float in order to learn geometry. *3DPrint.com.* Retrieved from https://3dprint.com/46986/4th-grade-geometry-class-3dp/

Meola, A. (2016, December 19). Wearable technology and IoT wearable devices. *Business Insider*. Retrieved from http://www.businessinsider.com/wearable-technology-iot-devices-2016-8?IR=T

Micro:bit Foundation. (2017, June 20). Small-board computer launches in U.S. & Canada to inspire next generation of students. Retrieved from http://www.businesswire.com/news/home/20170620005599/en/Microbit-Small-board-Computer-Launches-U.S.-Canada-Inspire

Nield, D. (2015, July 28). Wearable technology in the classroom: What's available and what does it do? *The Guardian.* Retrieved from https://www.theguardian.com/teacher-network/2015/jul/28/wearable-technology-classroom-virtual-reality

Nilsson, B. (2015, November 20). Is your school an internet of things smart school? [Extreme Networks Web log post]. Retrieved from https://content.extremenetworks.com/extreme-networks-blog/is-your-school-an-internet-of-things-smart-school

Norup, K. (2016, April 28). The shortage of STEM workers in the US. Retrieved from http://www.talentwave.com/the-shortage-of-stem-workers-in-the-us/

Peterson, T. (2015, January 13). 3D printers add a new dimension to classrooms. *EdTech: Focus on K–12.* Retrieved from https://edtechmagazine.com/k12/article/2015/01/new-dimension