

The Future of Educational Technology

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"Books...will soon be obsolete in the public schools. Scholars will be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed inside of ten years."

—Thomas A. Edison, in *NY Dramatic Mirror*, July 9, 1913

"Prediction is difficult, especially when dealing with the future."

—Danish Proverb

If you were to ask someone in the 1930s what the future of education and educational technology held, they would possibly mention radio or film, but would have no concept of television, and "computers" were people, not machines. A person in the 1960s might have some idea about computers, but would have no idea about networking, and even the idea of personal computers was years away. The internet as an integral part of the K-12 landscape would be unfathomable.

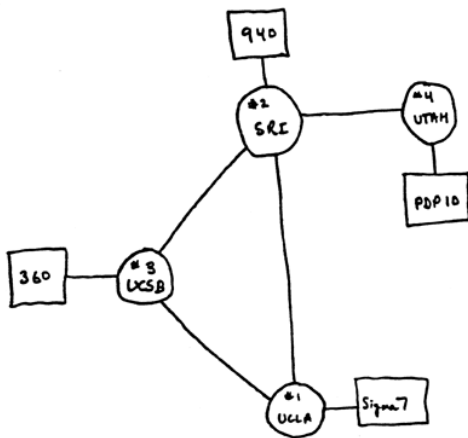


Illustration 1: Original sketch of the 4-node ARPANET, the beginnings of the internet, 1969. (Internet History Museum)

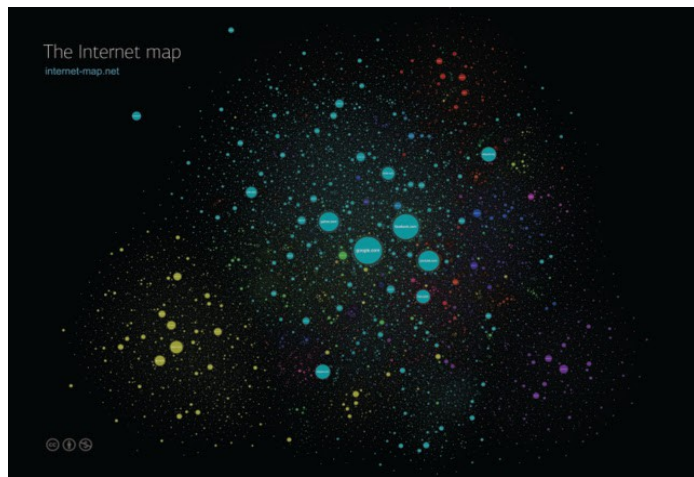


Illustration 2: An extremely high-level map of the top 350k sites on the internet in 2012. The largest dot is Google.com, which is visited by nearly half of all users. (The Internet Map)

Technology is changing at a rapid pace, one that appears at times to be accelerating. Attempting to predict the technology itself more than a few years into the future is to invite fiction into the science. What we can do is look at the application of existing and emergent technologies to see how students are engaging with new methods of learning, and perhaps predict how that engagement might be increased.

To that end, this paper will discuss four current trends in educational technology: 1) blended learning, 2) the Bring Your Own Device movement and 1-to-1 computing models, 3) decentralized learning such as Coursera and Khan Academy, and 4) the increasing use of gamification in education.

Blended Learning

Over the last few years, there has been an open and rapid shift in focus from producing primarily printed texts to building more digital editions. Whether it is through computer-based learning platforms like Pearson SuccessNet, or through iPad apps, education companies and textbook publishers have made digital content a priority. Online, Pearson offers the "Pearson Virtual School", a blended learning venture that offers schools the opportunity to "go all online, or combine your own custom mix of web-based and traditional classes creating hybrid programs for the best balance of blended learning." (Pearsonlearningsolutions.com) One example of this blended learning strategy can be found at ASU, where college math courses are taught using a blend of ASU's own Knewton platform and Pearson's Learning Studio and myMathLabs products. (Knewton, 2011)

"Brick-and-mortar" schools will likely never go away completely. Face-to-face instruction provides socialization opportunities that online instruction can lack, and we still "primarily rely on interaction with each other to establish social relations," which "plays a fundamental role in the process of cognitive development." (Li, Porter, & Saunders, 2013) Online socialization does occur, but at a remove, and so functions differently than face-to-face. Blended learning allows the student to have direct interpersonal relationships, while still retaining the flexibility and choice available in online learning. Incorporating internet sites such as social networking can allow additional opportunities for blending learning with socialization and cooperation (Li, Porter, & Saunders, 2013)

"Bring Your Own Device"

In August of 2013, the Los Angeles Unified School District began to implement their \$1

billion iPad initiative, which was to provide iPads for use to all of their 650,000 students on 47 campuses. They paid more than retail price, with partially-completed educational software. (Blume, 2013a) In less than a week, students had managed to break the security restrictions on non-school usage, and were using the iPads to play games and utilize social networking. Less than a month after the first iPads were given out, the district halted home use. -The mobile technology was chained to the classroom like any other school computer. (Blume, 2013b)

In January of 2011, school board members and school administrators were given iPads in Limestone County, Alabama. It was thought to be part of a move towards a "paperless classroom." (Cuthbert, 2011) In July of 2012, the Huntsville school district gave out 22,000 iPads to students, with iPads going to grades K-3, and laptops to grades 4-12. The devices are equipped with several security measures, including an embedded internet filter and anti-theft protection. (Bonvillian, 2012) By January of 2013, the "Digital 1:1 Initiative" in Huntsville was being viewed as a potential model for adoption by other school districts in other states. Students have all digital textbooks, and a district-level collaborative network called Edmodo, which can also be accessed from personal machines. (Bonvillian, 2013)

It is important, when we're looking at the future of mobile computing as a solution to educational access and engagement, we look at both LA and Huntsville for cues in what to do...and what not to do. In Los Angeles, it appears that little planning was done beyond "give iPads to kids". The "hacking" of the iPads involved deleting the personal profile information, which unlocked the iPad. (Blume, 2013c) School officials later discovered that the standardized tests students were to take on the iPads could not be taken without additional equipment, as the onscreen keyboard covered the questions. Wireless keyboards were not part of the original budget. (Blume, 2013b) Alabama's move to digital learning seems elegant by comparison. Giving the administrators access to iPads well before students had access gave them the time to become familiar with the devices. Security features were studied, and implemented in ways that could not be so easily broken. Knowledge of the technology enables success, though it does not guarantee it. Lack of knowledge leads to mistakes.

Administrators approve the purchase of technology for their schools, and principals may be

the driving forces behind technological upgrades. However, if they do not have sufficient training themselves, they may find themselves “barriers to successful...implementation” of the technology. (Clarke & Zagarell, 2012) Teachers require training and support in order to successfully implement any new technological initiatives, so there must be budget for training, and a willingness on the part of administration to use it. Teachers must be willing to pursue continuous training opportunities. Many teachers today are familiar with the internet and digital technologies, but “have no deeper understanding of how technology works.” (Clarke & Zagarell, 2012) If students have that deeper understanding, it puts teachers at a significant disadvantage, which can discourage them from utilizing the technology to its fullest capabilities.

Use of mobile devices (laptops, smart phones, tablets) has increased greatly, even in the last few years. According to Common Sense Media (Rideout, 2013), between 2011 and 2013, the number of kids who had used mobile devices had increased from 35% to 72%. Mobile device use by lower-income (<\$30k per year) families increased as well, with 46% having access to high-speed internet. But that compares to 86% of higher-income (>\$75k per year) families. The “digital divide” is something that will need to be addressed by any plan to make mobile learning ubiquitous.

This is one of those problems whose solution may, in retrospect, seem like something we would deem “science fiction,” but there are some attempts to address issues of access for lower-income families:

- [In 2010, the Indian government began to develop a tablet that they hoped would be a possible solution. The tablet, called “Aakash”, is a 7-inch Android tablet that has a processor and memory equivalent to the iPad, but retailed for \$40. (Wadhwa, 2013)
- [Google’s “Project Loon” proposes creating a network of balloons that would fly in the stratosphere at about 20 kilometers, and would beam wireless access from a local internet provider, through the balloon network, and to specialized internet antennae. (Project Loon)
- [One noble attempt that has not met with success is a project called Outer-net, which proposes to gather free information (news, open source content) and educational

materials, beam that information to satellites, which would then transmit to an Outernet receiver anywhere in the world, which then acts as a WiFi transmitter. (Outernet Explained, 2014) Outernet is a 501c3, and is attempting to crowdfund the development costs. Their first attempt failed to meet their goal, but they recently restarted with a lower goal. Crowdfunding psychology is a bit beyond the scope of this paper, but the strategy of lowering the goal with no details on what changed between attempts, is somewhat questionable. Still, the idea is a forward-thinking one, and one which may yet be realized.

Decentralized Online Learning

The movement of educational content online means that where you learn may be, to varying extents, made irrelevant. Today, there are already many schools that offer programs entirely online, from K-12 up through graduate programs. Arizona has schools like the Arizona Connections Academy and Primavera Online High School that offer online courses. However, while the courses are available from a wide variety of different sources, students may be forced to choose schools simply because they are local.

State-level educational standards have allowed for benchmarking of student performance within a state's borders, but in a global economy, and a global educational environment, states "must look beyond America's borders and benchmark their education systems with the best in the world." (Benchmarking for Success, 2008) Common Core standards were an attempt to enable students to achieve success regardless of geographic location or the political leanings of that location with regards to educational content. Unfortunately, the rollout of Common Core seems to have stumbled, with some educators "[expressing] reservations about the lack of funding, training, and support needed to prepare for implementation." (DelGuidice & Luna, 2014) Additionally, some state-level government officials have objected to what South Carolina governor Nikki Haley called "[relinquishing] control of education to the federal government" and "[ceding] it to the consensus of other states." (Banchemo, 2012)

If we value the idea of a nationwide educational framework, in which students can learn

from any teacher, anywhere, then a comprehensive national set of standards is necessary.

Common Core may have been tainted by a clumsy rollout, inadequate preparation, and political pressure, but the concept of a common framework is one that will not disappear quietly.

While the standards debate rages, online learning continues to develop independent of the traditional school systems. Learning, after all, is not simply about school. Massive Open Online Courses (MOOCs) are, as one might guess, courses offered online that are open to anyone who can access them. MOOCs provide a free education for people who may have no other means of acquiring it through traditional means "in markets 'where the alternative is nothing.'" (Regalado, 2012) Sites like Coursera and edX (a Harvard/MIT collaboration) offer real university courses taught by university faculty. While they are unable to offer degrees, they may offer completion certificates for some courses. The Republic of Trinidad and Tobago has taken this one step further, at least for adult education. Knowledge.tt is a partnership between Trinidad and Tobago and educational companies like Khan Academy (which provides educational videos on YouTube and their own site) and Coursera to offer online courses to supplement regular education or learn new skills. (Knowledge.tt: About Us)

MOOCs for K-12 education are a relatively new addition to the MOOC world. edX has created a High School Initiative with (as of November 2014) 44 courses covering basic High School subjects as well as AP Exam preparation courses. (edX.org) A pilot program in Massachusetts offered credit, but no grade, to 13 students who took courses from the edX site. (Jackson, 2013)

MOOCs can provide a low-cost alternative to cash-strapped schools, allowing them to provide canned courses for basic subjects that students can take at home. In 2012, there were 80 million people in the US enrolled in some level of education, and over 700,000 taking full-time online courses. (Regalado, 2012) If that continues to shift further towards online education, it may change how we look at education as a whole. If a student can show that they have taken a standards-based course, and can pass any standardized tests required by law, whether that course was taken in a classroom or on a MOOC may come to be considered irrelevant. MOOCs and other online classes can be taken at home, in a private setting not significantly unlike

homeschooling, which *is* recognized as a valid school model. It is likely that states would want to have some kind of regulatory power over MOOCs, as Minnesota did when they tried to block Coursera from offering courses to Minnesota residents, as it was not licensed in Minnesota. (Goldstein & Ferenbach, 2013) While they opted not to pursue regulation at that time, there will almost certainly be an attempt at regulation at some point. If there is regulation, there is the possibility for accreditation, and then a move towards state adaptation (as occurs with standard print and digital texts), or a move away from state-specific standards altogether.

Gamification of Education

According to the Knewton "Gamification of Education" infographic, "As a planet, we spend 3 billion hours a week playing video and computer games." (Knewton, 2012) Young people account for a majority of that time. Kids love video games. And yet, there is often resistance to video games by parents, who view them as an obsession or a time sink. However, games are increasingly being used as teaching tools, and this trend seems likely to continue.

Gaming (in general, not necessarily electronic terms) can be creative, collaborative, and can drive players to succeed. When video games were still in their infancy, pen-and-paper role-playing games (RPG) like Dungeons and Dragons (D&D) provided these for the young people who played them. While D&D was never intended as a learning tool, it did provide incidental learning, as it "gives the players an avenue to improve skills such as reading and writing, basic mathematics, critical thinking, problem solving, and teamwork that otherwise are lost in day-to-day life." (Krebs, 2014)

Video games can offer a far more immersive experience for students, as well as a tailored educational outcome. Skyrim, a video game RPG whose game world is (in relative terms) the size of a real world city like San Francisco, contains hundreds of hours of game play. Minecraft, on the other hand, has a relatively simple storyline, but offers users the ability to build anything they can imagine (in blocky form), in a game world whose volume is over 26 quadrillion blocks. (Peel, 2013)



Skyrim



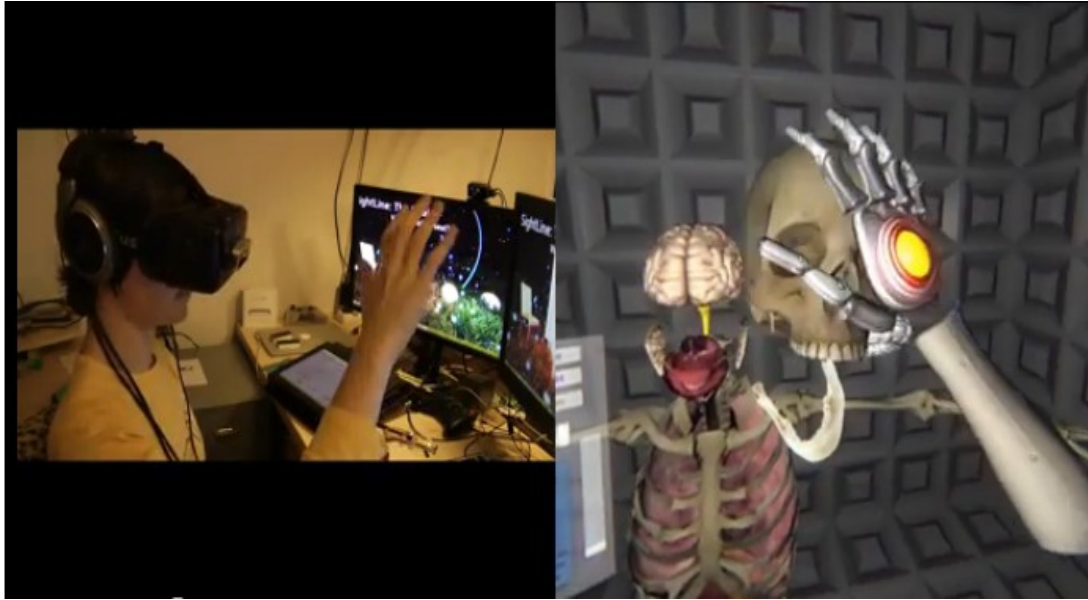
Minecraft

In fact, Minecraft is already being developed as an educational tool. Mojang, the company that created Minecraft, developed a variant designed for use in schools, partnering with Google, ASU's Center for Games and Impact, and others. MinecraftEdu is driven by teacher needs, simplified for teacher and student use, and supported by activities created by teachers. It supports use for STEM, Art, History, and more. (MinecraftEdu)

Classcraft applies RPG-style gaming to classroom learning. Students choose characters and character classes (Healer, Mage, Warrior), and work in teams of 5 to 6. Being in a team makes socialization and cooperation goals for each student. In-class real-world events have consequences in the game, and vice versa. Students who excel in the class can do more in the game, and succeeding in the game can be rewarded with real-world perks like being able to eat in class. The game is laid on top of a classroom structure, so assignments can be worked on and tracked in the system. One major difference between this and many other educational games is that it is not specifically teaching the kids anything, apart from the aforementioned socialization and cooperation. Classcraft is meant to augment the teacher's lessons, rather than replace them. (Classcraft.com)

One school in the Czech Republic is taking what may be the first steps in the next great frontier in both gamification and decentralized learning. Students were presented with Oculus Rift virtual reality headsets specially adapted for this experiment. Instead of a regular classroom, students were placed into an immersive virtual classroom environment. Students had a biology and anatomy lesson that involved a virtual body that they could interact with and manipulate

using a device called the Leap Motion controller.



Virtual reality technology is still in its infancy. While the Oculus Rift technology has been available for developers, a consumer-grade model is not expected until 2015. Still, there is already a list of games that have announced Oculus Rift support, and the company was recently purchased by Facebook for \$2 billion, indicating support for this technology could stay strong. (Associated Press, 2014; Wikipedia, n.d.)

Gamification is becoming more popular in education because it involves goals that are intrinsically motivating, such as competition, achievement, and status. Because most gaming is done using digital devices, educational games can also be tied into reporting tools and data collection. (Gamification.org Wiki, n.d.) If game activities can be aligned to standards, then performance in the game could be analyzed, and translated into mastery reports. As development continues, the line between educational games and traditional games may become blurred, or disappear entirely.

While we may not be able to predict the future with a great deal of clarity, there are some things we may accept as reasonable speculation. First, technology will increase in complexity and ubiquity. Second, we will always be able to find ways to use technology to further our goal of teaching our children to the best of our ability. And finally, I believe there will always be a need for real, human teachers to facilitate any educational technology, no matter how complex, or how

multi-functional it may be. There will be no robot teachers, no virtual schools, without a live educational backbone supporting it. Technology is a tool, and requires a user to give it value. This, I suspect, will be as true ten, a hundred, even a thousand years from now, much as was ten, a hundred, or a thousand years ago.

"I don't think that technology can/should replace teachers. The best technologies are the ones that get integrated thoughtfully into social environments. Teachers need to be able to help students make sense of their experiences with technology, abstract them and apply them. Peers are needed to help develop ideas. They might displace some teaching practices, but I think that frees up teachers to do other important activities."

—Eric Klopfer, MIT Professor, Reddit "Ask Me Anything"

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