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Can We Replace All, or Mostly All, In-Class Teaching With Educational Games?

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Many people are wondering whether we can replace in-classroom teaching with educational games. In this column are my thoughts on this possibility.

Now that we have done the great big Zoom experiment during COVID-19 with teaching, we all now know that we don't necessarily need classrooms, that we can do almost everything over the wire with teaching in either synchronous or asynchronous fashion. We likely don't even need synchronous teaching as many of our students this last year have been stuck in China, India, and other places overseas, on a different time zone, due to a xenophobic U.S. government policy of demanding that students not physically in classrooms stay out of the United States. There is no better way to make enemies and feed the maw of the military–industrial complex for conflict dollars.

And because of this, there is no better time to reopen the trope of can we replace all, or almost all, in-person teaching with educational games? And the answer is, of course we can, but there is some work to be done and some issues to be resolved and some lucre that must be obtained. Let's start out a bit with respect to Zoom and move on from there.

What we know from the last year and a half of Zoom teaching experience is that a large number of our students were perfectly fine with just looking at the recorded Zoom lectures at their leisure. While many attended the Zoom online attempt to simulate the in-classroom experience, many others just watched the lectures when they had time instead of 3 a.m. time in China. There did not seem to be any difference in learning outcomes between the students that watched synchronously versus those that

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rescheduled the show for a later, more appropriate time. I believe this means that while universities want students in the classroom using their real estate stock, that the students could learn just as well from the recordings with the only issues being in-class presentations by students, the need for students to meet in person for group projects, and the need for students to have their questions answered, which is well solved by iMessage, WeChat, text-messaging, Slack, and even their grandfather's tool of email. We have ways to ask and answer questions that do not require that an entire room of a hundred students wait while one student queries the instructor. Udemy, Coursera, and others of that ilk already know this, and those of us in universities now know this because of our last year and a half on Zoom.

And we see other evidence that classroom instruction is not necessary as students of this generation are well skilled in using the Internet, Google search, and YouTube as learning platforms—even my four-year-old granddaughter seeks out the right YouTube video when she wants to know how things work, like how to perform an oil change and how squirrel highways can be made. So we have lots of asynchronous, self-directed learning happening that is oppositional to the way of thinking of the education–real-estate–industrial complex.

So, do we need interactive, educational games for our spawn? I believe the answer is yes, if those educational games are well built and sufficiently entertaining with the educational bits slid in as collateral learning. Collateral learning is the learning that happens by some mechanism other than formal teaching.[1]

WHEN DID I START THINKING ABOUT GAMES FOR EDUCATION?

In 1997, Col. Rick Satava, M.D., created the virtual reality for medicine program for the Defense Advanced Research Projects Agency (DARPA) and gave a presentation where he indicated that "digital-game natives" were being found to be better surgeons than their nongame-playing cohorts. He even gave them the name *Nintendo surgeons*. It turned out that these Nintendo surgeons also displayed exceptional business skills, is what he indicated at that time. Then, it became clear that creating a science of games—a scientific and engineering method for building educationally imbued games and understanding and analyzing game play—had become essential.[1] It, unfortunately, never happened, but it got a lot of us thinking.

From May 2000 to March 2004, I directed the development of the America's Army game at the Naval Postgraduate School. Our team built this wonderful AAA-title that became one of the top five online games when it came out in 2002. The 2.0 version came out in October 2003 as well with lots of new, great features and experiences. Here is a quote from an article I drafted in 2005:

> *Six to nine months after its (America's Army's) release, mothers would meet me and complain that "my son is playing America's Army five to six hours a day, seven days a week. What is going to become of him?" I would usually answer that these children would be twice as likely to consider a career in the US Army as those who didn't play the game, something the Army counts on with respect to the game's recruiting mission. When I asked the mothers if their children knew a lot about the US Army, the mothers usually responded that "they know everything about the Army, having learned it from the game. Wouldn't it be nice if playing games could teach them something more useful?"*
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> *These comments led us to wonder how much of K–12 science and math education could be taught via games and how we might exploit students' capability for collateral learning. Ultimately, we wondered if we could incorporate all K–12 science and math education in a highly immersive, highly addictive game—we called this our "first-person education" grand challenge, a play on the phrase "first-person shooter."*[1]

Another experience from America's Army convinced me that game-based education was there in spades with the 2.0 version of the game. In that game, we built a classroom in 3D with an instructor and other students, all of whom you could irritate and interact with (Figure 1).

If you sat down and paid attention, the instructor presented the first three lectures of basic combat lifesaving via in-game PowerPoint (Figure 2), followed by a multiple-choice test exactly like the one used in the U.S. Army (Figure 3). If you scored the same passing score as in the real world, then you got to act as a combat medic in the game and heal yourself and friends.

Now, when I first saw this, I thought, "No one is going to watch PowerPoint in a game—it's too boring." But it went into the game and when that version was shipped, the Army found that some 50% of the people that played the game did the course and passed the test. This is

COMMENTS?

If you have comments about this article, or topics or references I should have cited, or you want to rant back to me on why what I say is nonsense, I want to hear. What I'm going to do is every time we finish one of these columns, and it goes to print, I'm going to get it up online, and maybe point to it on my Facebook (mikezyda) and LinkedIn (mikezyda) pages so that I can receive comments from you. Maybe we'll react to some of those comments in future columns or online to enlighten you in real time! This is the "Games" column. You have a wonderful day!

great because during that year, the U.S. Army received a letter from an America's Army game player indicating that they had passed an accident scene and that they had used their combat medic skills to help out and save an accident victim. So, if that is not inspiration for game-based education, then nothing is.

SO, THE MISSION

So, my career took a turn at that point, and I decided to go to the University of Southern California (USC) to create the games program and a research program on games so that we could perhaps solve some of the hard problems in creating games for education and ended up crashing into a wall. Everyone I met in the U.S. government and various foundations was just interested in the small—no one had funding for a grand vision. We really needed something the size of a university affiliated research center (UARC). Even a most distinguished foundation came out with a weak program to provide small money, US$50,000 if I recall correctly, to study an existing game for its ability to educate—completely unimaginative! DARPA was completely absent without leave on this as well, again as it was too grand a vision and couldn't be demoed 90 days after the start of funding.

We don't have comprehensive games for education in this country as we don't have the will to fund their development—we would rather spend US$2 trillion over 20 years to replace the Taliban with the Taliban.

ON THE ROAD

Many people that I met with in starting on this mission indicated to me that I should just approach the entertainment games industry and see if it would consider making games for education. In 2005, a staff member of the White House Office of Science and Technology Policy (OSTP) asked me to put together a workshop during Electronic Entertainment Expo in a hotel near the Los Angeles Convention Center—they asked me to invite senior leadership from some of the largest game companies in the world. In fact, the first company I called was Electronic Arts (EA). I spoke with an EA vice president who I knew well and asked if he could come to this workshop. He immediately said that he would first have to chat with EA's attorneys! Wow! Just to come to a

FIGURE 1. America's Army basic combat lifesaving class.

FIGURE 2. America's Army instructor teaching basic combat lifesaving.

FIGURE 3. America's Army soldiers taking the in-game test.

workshop. He got back to me a few days later and said that no one from EA could attend, that attendance by an EA employee could potentially provide a signal that EA was considering moving into the games for education space and could potentially initiate shareholder lawsuits over such a move. I was disheartened. I got the same answer from all of the other large companies I asked. I was able to get some good researchers to come to the workshop, but this was the White House OSTP and just not high enough above the fear of shareholder lawsuits to attend a meeting on a potential future direction for the country.

SO HOW MUCH WOULD IT COST IF WE COULD GET PEOPLE TO THINK ABOUT THIS AT ALL?

In February 2009, I found myself invited to speak at Educational Testing Service (ETS) in Princeton, New Jersey. I was told there would be an audience of some 500 teachers and that the topic was replacing standardized testing with game-based testing. I decided to give a provocative talk titled "How to Replace All Teachers With Game-Based Education." And what really was in my mind was that we would build game-based education for the standard math and science, and then the teachers could become tutors for some of the parts that required in-person one-on-one help or questions. The talk went well.

I started out explaining that many of my students in 2006 had gotten into World of Warcraft (WoW) and that some of those students would then suddenly disappear and not attend class for three to four weeks. They would come back sheepishly and explain they had become addicted to WoW and that the rest of the world disappeared. This got me thinking, and I later saw an article that a typical WoW player would spend some 288 h in the game over six months!

I began thinking of how much time a typical K–12 student spent each day on math and science education. I hypothesized 45 min per day on math and 45 min on science, 1.5 h total per day. The Los Angeles Unified School District has 180 school days per academic year, and if we multiply that by 1.5 h per day, that is 270 h of math and science per academic year. That is just about how long children were spending in WoW in six months. So I thought that if we use information theory and a fantastic team of game designers and subject matter experts, then the cost for one year of game-based math and science education will be about the same cost as developing WoW, about US$100 million in 2005 dollars. So to build all of K–12 math and science education into an engaging game with collateral learning would be about US$1.3 billion, not a big number, about 1,538 times lower than we spent on Afghanistan. We could fund this by a small tax on the US$200 billion annual of revenue of the game industry.

BRAIN SENSORS FOR GAMES FOR EDUCATION!

Another detour I took over a period of seven years was to be an advisor to the startup Emsense. Emsense made a low-cost hybrid electroencephalogram (EEG) device that appeared to have promise in the educational space. Their sensors measured several biometric signals such as EEG, blood oxygen, and motion. These signals came off the sensors via Bluetooth link and provided a number of human emotion state vectors—mental engagement, physical engagement, surprise/response (how much response there is to new material or events), relaxation, valence (like/dislike), learning/not learning and at what difficulty level, eye blink, breathing rate, and pulse rate, among others. Their sensors could also tell you when the student guessed at an answer, so if they got it right, you could tell them, "Yes, you got it right, but you guessed. Here is why that is the right answer." I totally loved what this sensor could do. Unfortunately, as with many startups, Emsense went out of business in 2011. I am sure other sensor companies will eventually follow this path. The largest issue with brain sensing and education is, of course, privacy and the issue of how we would socialize and approve the use of such technology for the classroom.

COMMERCIAL COMPANIES IN THE GAMES FOR EDUCATION SPACE

In the educational games space, there are many small companies that are developing games for education. These companies tend to specialize in a small range of age groups. An example of one company that has great software is Age of Learning. Age of Learning specializes in pre-K through early elementary age children, which is a great start but a long way from providing education for all K–12. There is even a list online of some 1,255 startups in the educational games space! So, maybe if you took all of the best ones and pushed them all together, perhaps we could achieve our educational goal.

CHINA AND GAMES FOR EDUCATION

I have not attempted to research the global market for the development and deployment of educational games. One country, China, stands out as one to watch. Since 2018, the Chinese Ministry of Education has been focusing on funding artificial intelligence technology for the development of educational games. The focus of the ministry has been on tools that can be utilized by teachers to build games for their specific lesson plans. One notable startup, Muoee (Shenzhen), is testing its toolset in a school system of 20,000 students and 1,000 teachers. Muoee has caught the eye of the Chinese Academy of Science; that academy is looking to provide scientists and testing plans for the efficacy of the utilization of the Muoee toolset. For full disclosure, I am an advisor to Muoee—primarily, I cheer them on and help them meet venture capitalists in China.

In 2018, China additionally froze the approval of new entertainment games on the market until each game company could provide a plan for how it could develop games for the educational space. In September 2021, China

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has again frozen the approval of new entertainment games, as the government there is worried about "gaming addiction" for its youth. Phrases like "spiritual opium" appear in news articles describing their government's concern. We will see where this all goes! We hope there is no impact on the educational games sector.

Anyway, this column has been about my thoughts on if we can replace in-classroom education with educational games, and the answer is a qualified "maybe if we have the right designers, the grand scale focus that such a national/international effort requires." With the COVID-19 lockdown this past year and a half, classroom education has seemed a quaint paean to the yesteryear of our parents and grandparents. We are back teaching in classrooms now with the option for students attending on Zoom, and we are seeing 35% of the students opting for that and many just waiting for the recordings to be posted so they can learn at a time more appropriate for their home time zone.

REFERENCE

1. M. Zyda, "From visual simulation to virtual reality to games," *Computer*, vol. 38, no. 9, pp. 25–32, Sep. 2005, doi: 10.1109/MC.2005.297.

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