

## Scalable Online Education

We are already in the age of MOOCs. Have you ever heard of them? They are the disruptive technology that has been biting at the heels of the established education industry since 2012.

A MOOC is a Massive Open Online Course. You probably know what all those words mean, but may still be wondering what exactly it is, or why it is a disruptive technology. After all, we have had online courses for decades now, so why is this new breed any different?

The key word here is scalability—that is the *massive* part. Platforms like Coursera, edX, Udacity, Udemy, XueTangX (Chinese!), and Frontline are providing online courses that are scalable because increasing the number of students enrolled only results in a very small cost increase for the provider. To get an impression of why that is important, let's look at an example.

One of the courses that Coursera offered out of the gates is Machine Learning. It was created by Stanford Professor and Coursera co-founder Andrew Ng (who is now Chief Scientist at Baidu). The content of the course is virtually the same as Ng's Stanford class on machine learning but on Coursera, 100,000 people concurrently took the class, whereas at Stanford, only 400 people can take the class every semester.

Now, there is significant up-front cost for an institution to digitalize a course in a way that meets Coursera's standards. But once that work is done, the institution can offer the course to an essentially unlimited number of people without adding cost. This means that 100,000 people were freely taking the same class for which 400 Stanford students pay a hefty fee.

At this point, you might be thinking that the Stanford students aren't getting a very good deal. And you might be wondering why you haven't heard of MOOCs before or wondering why you haven't taken any. If the latter, go online and register for one right now. No matter what your interests, you will find high quality material from some of the world's top universities and best companies available either for free or a small fee. All you will need is the will to study and good study habits.

For the others, rest assured I am not going to try to convince that this new form of online learning spells the end for traditional universities. What I am going to do is try give you a good impression of what MOOCs are and I hope you will indulge me as I try to make some guesses as to how they will fit into our society.

The first point is to separate MOOCs from traditional forms of online learning and distance learning. This is a relatively simple thing to do: traditional distance learning doesn't feature a scalable grading system. In a MOOC, a sophisticated computer program will automatically grade not only multiple choice questions, but also mathematical derivations, scientific models, and even (other) computer

programs. Computers, unlike teachers, do not get tired and can give feedback nearly instantly. For softer sciences, MOOCs have implemented a system of peer review that has been quite successful. This means that multiple other students will grade your writing and you will also help grade other students' writing. Some studies have shown that peer review tracks professor assigned grades (see Daphne Koller @ 2012 TEDGlobal).

The point about instant feedback because of computer grading leads us to another next advantage of MOOCs: since there are so many students taking the courses, discussion forums for courses feature extremely low response times. There is often someone else, somewhere in the world, working on the same problem as you. Study groups form online and many people even meet in groups to work on courses together (see Anant Agarwal @ 2014 TED).

One thing that I really like about learning online is that information is usually broken up into 8-12 minute videos with embedded quizzes and downloadable lecture notes. That is *very* different from the traditional one hour lecture so common in universities today. The short presentation helps keep knowledge digestible. The fact that it is a video means I can pause, repeat, and watch at high speed. And I can do all that anytime, anywhere, so I don't need to get up and get dressed for a 9am lecture about Greek pottery! Embedded quizzes mean that while learning, every student (not just the brown-noser in the front) must use the information as it is presented, improving long-term recall. Finally, I don't need to scribble a hundred words per minute because I can just re-watch the video or look at the provided lecture notes. Before moving on, I have to mention that most videos have subtitles in multiple languages (Chinese subtitles are often available).

Last, other than being scalable, extremely convenient, and providing high quality material at a low price, MOOCs are data driven in a way that learning has never before been. Every click, every comment, and every answer is recorded and can be analyzed. That means that if you look at a later iteration of a course, it is often the case that many improvements will have been made. Explanations will appear where many students had previously gotten hung up. This means that we now have the potential to radically improve the learning process.

According to Mark Twain, "Knowledge has traditionally passed from notebooks of teachers to the notes of students, without passing through the minds of either". This is, of course, a characteristic quip, but it gets at an important point: that we haven't made any changes to the way people are educated in thousands of years. Compare this to transportation, communication, and healthcare. In those industries, today we are leagues ahead of where we were even a hundred years ago, so why hasn't education changed? Well, thanks to MOOCs, it is finally happening.

What does this mean for traditional schools? First, because, currently, the vast majority of MOOC content is university level, K-12 education should not see much impact. Could this change? Yes, absolutely, but without substantial

advancements in virtual reality, MOOCs cannot provide the behavioral education in person-to-person relationships that often happens at schools. So, please, don't take your son or daughter out of school just because there is a new MOOC related to his or her major.

Second, and this is my opinion, I believe universities will become more process oriented. A relevant term here is the flipped classroom, in which students learn new content for homework and apply it in class under the guidance of a teacher. With the internet becoming increasingly accessible, regurgitation of facts is becoming less and less of a desired skill. With MOOCs, the teacher's job will shift from presenting theories to guiding students in the application of theories.

There are some well-known facts about MOOCs that are often considered negative. The most oft cited is that they have a very high drop out rate. In MIT's first Electrical Circuits class, 155,000 students signed up but only 7,200 passed. This is by all accounts, a low completion rate, but it is not hard to counter this point. MIT can only teach this material to 80 people per semester, so it would take 45 years to teach 7200 students. Today, many MOOCs have rolling admissions and new sections start every week or every month.

Personally, I have been studying Computer Science on Coursera and edX since 2013. Being a philosophy major, I started from scratch. I only studied when I felt like it, but now I can make websites, write programs to solve puzzles and make my life easier, and, most important, understand programmer humor. I am not by any means finished. To me, learning is a life long process and MOOCs are allowing me to learn new things while working and living abroad. I have recently discovered XueTangX and I can now study in Chinese. These opportunities have been invaluable to me and I hope others can benefit from MOOCs too.