Successful learning through massive open online courses

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"Let noble thoughts come to us from all sides," says the Rigveda, one of the ancient Indian collection of hymns called *Vedas*. Interestingly, the meaning of *Veda* in Sanskrit is knowledge. Currently, with the introduction of massive open online courses (MOOCs), we are able to advance our knowledge by attending courses available from reputed universities around the world. Since 2012, in MOOCs offered through reputed providers, such as edX (http://www.edx.org), Stanford Online (http://online.stanford.edu), Coursera (http://www.coursera.org), Udacity (http://www.udacity.com), iversity (http://www.iversity.org), and FutureLearn (http://www.futurelearn.com), thousands of enthusiastic students around the world have participated with great interest and anticipation.

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According to the class-central.com website, the collective number of users in edX and Coursera is more than 44 million, and they currently offer more than 3,800 courses. This growing trend provides insight into comparing the traditional mode of learning with online learning. In addition to flipped classrooms and blended learning, MOOCs have generated new trends, such as small private online courses (SPOCs), microdegrees, nanodegrees, and micromasters.

It is important to note that most of the MOOCs originated in developed countries and have the power to influence students, teachers, educators, and policy makers around the world. Considering the low success rate in MOOCs, in this article, I explore the general skills necessary for course completion and how to be successful in a MOOC. The lessons provided in this article have been compiled following my successful completion of more than 100 MOOCs since 2012. I also describe the advantages of taking MOOCs seriously and provide a comprehensive comparison of MOOCs versus time-tested educational practices.

MOOCs versus time-tested practices

Only a small fraction of students worldwide are currently able to access high-quality education. Despite the efforts of many international and United Nations (UN) organizations, there are still 750 million illiterate adults around the world, more than half of whom are women. A 2017 UN Educational, Scientific, and Cultural Organization (UNESCO) report estimates that more than 617 million children and adolescents are not achieving minimum proficiency levels in reading and mathematics.

Having some form of education is better than no education at all. Obviously, it is difficult for everyone to secure an opportunity to take an undergraduate course from reputed institutions such as Harvard University or the Massachusetts Institute of Technology (MIT). And it is nearly impossible for someone in a remote corner of the world, without solid financial support, to access those classrooms for free.

For those halfway across the world, a MOOC is a valuable tool that can't be replaced by either financial or material gains. Completing a MOOC successfully requires effort, time-management skills, patience, and interest along with a stable Internet connection. The financial burden is low. Currently, most MOOC providers require only a nominal fee for earning verified certificates. MOOCs are nearly stress free for professors, and students have the option of listening to the same content repeatedly without being physically present in the classroom. This helps the students to review lectures at convenient times.

Because MOOCs are flexible in terms of location and time, they have the potential to reach geographically challenging regions and learners with physical disabilities. Moreover, teachers don't have to worry about student attendance rate. Teachers have opportunities to interact with those students who are genuinely interested in discussing the topics mentioned in a MOOC/SPOC with greater interest in blended learning classes. Blended learning provides options to combine the advantages of both online learning and traditional classroom practices. In flipped classrooms, a type of blended learning model, students listen to lectures at a place of their convenience (usually online), and the classroom is used for problem solving, homework discussions, and interaction with teachers. In other words, MOOCs facilitate teacher–student interaction at a higher level than what occurs in physical classrooms.

The experience of traditional modes of education is both wonderful and bitter. Because the traditional mode of education is localized, teachers and professors usually adhere to local standards and textbooks. There are also cases where students experience anger, disappointment, contempt, sympathy, and passion from teachers and/or fellow classmates. Extracurricular activities also take a role in the overall learning experience.

In contrast, a MOOC provides an entirely new set of experiences. For example, in MOOCs, one needs to use either computers or mobile phones to watch or listen to teaching materials. The homework and tests are submitted online. Learners can hear opinions from thousands of classmates, although the opportunities to contact the teacher in person are limited.

In the traditional mode of learning, students are inspired by teachers, parents, or fellow learners. There are also awards, rewards, and honors for high-achieving students. Students are encouraged to perform better consistently in universities, and parents also hope for the success of their children. However, learning in MOOCs sometimes becomes isolating, with less support for encouragement. There are also very few extracurricular activities. Distractions are also higher and may include unnecessary Web browsing, playing computer games, and chatting online. As a result, success in a MOOC is entirely based on one's individual learning attitude. The deadlines for homework submissions are not flexible, even though self-paced MOOCs removed this barrier. Procrastination is also much higher in MOOCs, and the peer pressure is minimal.

Other than computers or smartphones, some courses may also need special hardware or electronic devices. For example, an edX MOOC, Embedded Systems–Shape the World, from the University of Texas at Austin, requires learners to buy

a special hardware kit. Similarly, some specialized courses may ask the student to buy a book or tools to completely experience the course and finish it successfully.

Some courses ask learners to make a video or audio presentation and record it for grading. In a Harvard course, students are required to describe their final project and submit a video. Different courses may demand varying hardware or software tools to complete the course. Some MOOCs are also credit-bearing courses. One such example is the English Composition course from Arizona State University available through edX. Currently, edX also lists several upcoming online master's-level courses in partnership with reputed universities, such as the Georgia Institute of Technology.

MOOCs have the capability to provide genuine, world-class, and low-cost education to all. There is little discouragement, bias, or discrimination in terms of age, language, ethnicity, and region from teachers, peer learners, and MOOC providers. This model makes sense for digital learners around the world.

MOOCs should strive to be more individual rather than replicating the experience of one-on-one tutoring on a large scale. There are chances to learn from multiple teachers and courses from different universities in different countries. Every teacher is unique, someone who can provide an experience that is different from others. A MOOC may have multiple teachers, interview sessions, simulations, animations, or movie clips.

Overall, they provide text-based content in a mature, interactive, and entertaining style with positive digital experiences. A learner does not have to wait to check their progress in a MOOC until the end of the term or semester. Generally, as soon as an assignment is submitted, the progress bar shows the improvement toward successful completion.

Strategies for success in MOOCs

I successfully completed 107 MOOCs between 2012 and 2017 and obtained certificates from 40 universities and 11 organizations in 14 countries. Thirteen certificates were received from Harvard University alone. All 107 certificates can be verified online (for example, see https://verify.edx.org/cert/4c8adc61177d4426b0e57e9bc21c3b6d). The total number of full-time, on-campus courses I completed in my four-year undergraduate course was 61 (including 21 courses related to laboratory exercises), in contrast to the 107 MOOCs I finished in five years.

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The overall success rate in MOOCs around the world is less than 7%. For example, in Harvard University's Introduction to Computer Science I course, only 1,388 out of 150,349 who registered for the course received a certificate, meaning that the completion rate was below 1%. By contrast, 703 out of 706 students (99.6%) completed the same on-campus course offered by the same instructor. From edX, among the 841,687 students enrolled at Harvard and MIT, only 5% earned such a certificate.

The Harvard University Introduction to Computer Science I MOOC was my most difficult undergraduate course. Even after earning bachelor's, master's, and Ph.D. degrees in a related discipline, one needs to spend considerable time and effort to complete the assignments. The course contents, step-by-step support, and additional help to solve the highly challenging homework through video lectures, walkthroughs, and shorts are fascinating.

Although Harvard University claims that it is enough to spend just 3–4 h/week on the Introduction to Computer Science I course, one needs more time, even after having the background knowledge. Sometimes it seems that the course materials are too long and videos are longer than expected (the size of the complete course contents is more than 50 GB).

The MOOCs with strong assessment methods are challenging but also provide a rewarding experience after completion. Table 1 lists the sample edX MOOCs taken for analysis with such details as course length, assessment methods, minimum score to pass, and scores that I earned. The stronger the assessments, the lower the flexibility to complete the course, irrespective of the discipline. Figure 1 shows the progress bar of an edX MOOC with six lab exercises, 26 problem sets, a final project, and a final exam. It is worth noting that all of

TABLE 1. Sample MOOCs, course durations, and assessment features.

DISCIPLINE	LENGTH (WEEKS)	ASSESSMENT METHODS (UNITS)	MINIMUM TO PASS (%)	OBTAINED SCORE (%)
Economics	14	Activities (five), discussions (12), quizzes (33), self-graded essays (10), and final essay (one)	60	66
Medicine	Seven	Homework (33) and final test (one)	50	60
History	Five	Quizzes (27), final tests (five), and discussions (six)	75	95
Engineering	Four	Quizzes (five) and final test (one)	50	100
Education	Six	Completion checklists (seven), activities (two), and quiz (one)	60	94

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these assessments required an average of more than 5–10 h of effort to complete successfully.

After registering for more than 200 courses, I was able to finish 107 courses successfully within the span of five years. (And I am currently teaching university-level courses.) The successful completion of a MOOC means the learner received a passing grade and a certificate from the offering university or organization. In addition to earning certificates, I became a MOOC researcher. University of California, Berkeley, Professor Armando Fox (who happens to be a MOOC instructor for a course that I successfully completed) noted that MOOCs may be more effective than traditional textbooks at "teaching the teachers." The following are several recommendations to successfully complete a MOOC.

- Register for a course (instead of attempting multiple courses!) that is important for your career or that is genuinely interesting to you.
- Read and follow the instructions regarding the learner requirements, prerequisites, time to spend per week, course completion requirements, policies, and rules and regulations.
- Show consistent interest from beginning to end, and complete all of the tasks without missing deadlines. Note that deadlines may not exactly match with local times as they are based on different time zones.
- In case of difficulties, share your doubts online, or you may even contact teaching assistants if required.
- Prepare to deal with common problems, such as Internet breakdown, power failure, unloaded lecture videos, and instructor supremacy over lecture contents. (*Instructor supremacy* means that learners need to stick to instructor resources and teaching style. In some MOOCs, the teaching contents, homework, and assignments are directly derived from teaching materials or textbooks written by the instructor.)
- Don't underestimate the homework and assignments. Although it is easy to answer some of the multiple-choice questions and interactive assignments online, simply attempting questions without solid preparation may result in a lower score.
- Study the course structure and assessment details and develop early familiarity with software or hardware tools used in the course. Sometimes students need to acquire the custom-made software skills for successful submission of the assignments.
- Keep an eye on course updates. There are frequent changes in the assignment submission or the ways in which the homework is handled.
- Take full advantage of the course, such as Google hangouts, live webinars from instructors, providing feedback to instructors, and interacting with learning communities.

In MOOCs, students have full control over the learning environment. They can choose different universities, teachers, and courses from various disciplines. Those who have missed opportunities earlier in their lives have the ability to upgrade their knowledge and skills. For the working population, whose learning needs are very specific in terms of content, MOOCs offer an excellent

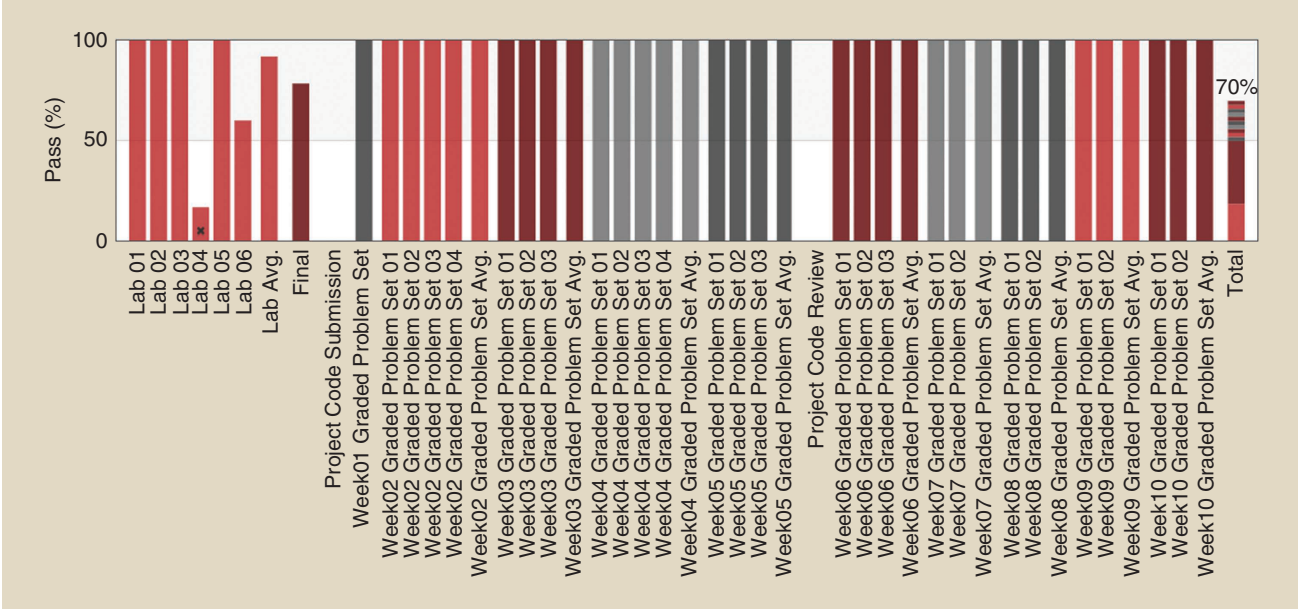

FIG1 The progress bar in an edX MOOC. Avg.: average.

alternative for training and continuing education. They are an excellent supplementary resource for teachers in traditional classroom settings. The knowledge gained by interacting with thousands of learners online is much greater than what is available in physical classrooms.

The greatest reward after completing a MOOC is learner satisfaction. MOOCs create a chance for every enthusiastic learner to listen to professors from the world's leading universities entirely free of charge or with a nominal fee. The professors' skills also help students compare their full-time localized learning experience to an online experience. Learners are able to receive support from thousands of peers around the world. From the beginning, edX offered courses entirely free of charge, including certificates. The free certificate is provided either as a PDF file or an image file. Authenticity of these certificates can be verified online with a single mouse click. This also provides a new dimension for employers to easily verify the legitimacy of such certificates.

A MOOC certificate from MIT or Harvard is not a substitute for a degree or course offered by these universities, but the certificates provide a form of prestige or credential to the learner. The mixed learning experience from combining both local and international teachers will eventually help the learner studying in a remote village to compete on a global scale.

Skepticism and challenges

There are a few challenges with MOOCs. First, the role of teacher as a mentor or adviser may diminish. The hierarchical role of teachers and sharing personal experiences with their pupils in a face-to-face manner is at stake. Universities that follow a traditional style of curriculum and rules may have to bow a little with the growing interest of their students in MOOCs. Students may no longer place much emphasis on physical classrooms, and teachers' lecture styles may face competition from MOOC teachers. This moves teachers to increase their ability to educate in a more attractive style than MOOC teachers and encourages the creation of new styles of teaching that blend MOOCs with traditional time-tested practices. However, students must use numerous mouse clicks to navigate courses and may feel distracted by the additional links provided by the instructors. In developing and underdeveloped countries, such issues as low bandwidth, lack of computer literacy, and access to better computers are growing challenges. Watching chunks of information may seem boring for serious learners, and this poses challenges to gamification. (Here *gamification* means that the learner is obtaining points after watching a video or completing an assignment. The fundamental idea of gamification is to engage students in MOOCs, making it fun, so that retention rate is high. However, serious learners can become bored with this kind of overemphasis on gamification because watching a few short videos or answering several multiple choice questions may not be viewed as serious learning practices.)

MOOCs from top institutions are cutting edge, valuable, prestigious, and challenging. However, skepticism still exists regarding the satisfactory learning experience, seriousness of testing methods, online pedagogy, peer evaluations, high dropout rate, plagiarism, validation, copyright of contents, and so forth. Peer grading may be good way to deal with thousands of assignments. However, it may not provide as credible of an evaluation as what occurs in the traditional mode of learning.

For many, MOOCs are a total disruption in higher education and its standards. The instructors may focus on profit-making strategies through marketing their MOOCs. The students may forget the beauty of writing using a pen and paper and working in a physical environment. The high drop rate shows a lack of student engagement and complete participation during courses.

MOOC providers have not addressed situations where websites or social-networking sites have limited access in some regions. MOOCs may not be suitable for areas of study such as medicine or chemistry, which require practical exposure for a student to qualify as a doctor or chemist. There are also reports regarding how MOOCs are failing to reach the poor or disadvantaged, and students with higher socioeconomic resources were more likely to earn a certificate. Recent surveys show that 80% of MOOC participants already have a college degree, which also reveals that MOOCs are still failing to reach a significant population beyond developed countries.

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MOOCs are an excellent supplement to existing teaching resources, but they do not entirely replace a university education. MOOCs are still in the stage of prototyping. In the past, brick-and-mortar campuses not only produced great academics but also Nobel Prize winners, cutting-edge research centers, and start-ups. Can MOOC students create such centers of innovation in the near future? Will those centers remain virtual or physical? Only time will tell.

Conclusion

MOOCs are essential to higher education and education in general. They have plenty to offer to students, educators, and policy makers in the developing world. There is a wide range of courses available, and the methods used in assessments are very different from traditional modes, which promote more engagement with learners. MOOCs are only a danger to those who are afraid of losing tuition fees. MOOC

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learners also pose a threat to college graduates who have mastered outdated knowledge through rote learning and the skill of answering tailor-made questions. MOOCs relieve financial pressure and help students avoid taking extra classes or paying tuition beyond the normal course of instruction. They challenge teachers to focus on more than just delivering talks within the prescribed time period.

It is essential to keep some of the traditional educational approaches by integrating them with modern practices. In the education sector, it is extremely difficult to bring radical change and completely acquire innovation in pedagogy. New practices are useful, and they contribute to the process of learning.

As per UNESCO, learning to read and write is a fundamental right. When it comes to the developing world, the benefits of MOOCs are enormous, and they will contribute to positive social change. The education ministries of all countries should take steps to improve their virtual infrastructure as well as provide free Internet access for MOOC learners. MOOC providers should also make their course materials easily downloadable (or locally available) and accessible and focus on methods to maximize study offline rather than online.

Read more about it

- D. Shah, "By the numbers: MOOCs in 2017," Class Central, Jan. 18, 2018. [Online]. Available: https://www.class-central.com/report/mooc-stats-2017/
- A. Fox, "From MOOCs to SPOCs," *Commun. ACM*, vol. 56, no. 12, pp. 38–40, Dec. 2013.
- UNESCO Institute for Statistics, "Literacy," 2018. [Online]. Available: http://uis.unesco.org/en/topic/literacy
- UNESCO Institute for Statistics, "More than one-half of children and adolescents are not learning worldwide," 2017. [Online]. Available: http://uis.unesco.org/sites/default/files/documents/fs46-more-than-half-children-not-learning-en-2017.pdf
- L. Rai and D. Chunrao, "Influencing factors of success and failure in MOOC and general analysis of learner behavior," *IJIET*, vol. 6, no. 4, pp. 262–268, Apr. 2016.
- P. Compeau and P. A. Pevzner, "Life after MOOCs," *Commun. ACM*, vol. 58, no. 10, pp. 41–44, Oct. 2015.
- A. H. Hashmi and C. W. Shih, "The edX student," *Harvard Crimson*, May 30, 2013. [Online]. Available: https://www.thecrimson.com/article/2013/5/30/the-edX-student-international/?page=2
- E. Randall, "Harvard's online classes sound pretty popular," *Boston*, Oct. 15, 2012. [Online]. Available: https://www.bostonmagazine.com/news/2012/10/15/harvards-online-classes-sound-pretty-popular/
- L Rai, N. Sun, and C. Deng, "Assessment methods in honor-code MOOCs and learner flexibility," in *Proc. 9th IEEE Int. Conf. Ubi-Media Computing and Workshop on Advanced E-Learning*, 2016, pp. 309–313.
- L. Rai, Z. Yue, T. Yang, R. Shadiev, and N. Sun, "General impact of MOOC assessment methods on learner engagement and performance," in *Proc. 10th Int. Conf. Ubi-Media Computing and Workshops*, 2017, pp. 1–4.
- J. D. Hansen and J. Reich, "Democratizing education? Examining access and usage patterns in massive open online courses," *Science*, vol. 350, no. 6265, pp. 1245–1248, 2015.
- J. Daly, "80 percent of MOOC students already have a college degree," EdTech, Dec. 4, 2013. [Online]. Available: https://edtechmagazine.com/higher/article/2013/12/80-percent-mooc-students-already-have-college-degree

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