Reich, J. and Ruipérez-Valiente, J. A. (2019). The MOOC Pivot. ***Science 363(6423)*****, pages 130-131.**

DOI: 10.1126/science.aav7958

http://science.sciencemag.org/content/363/6423/130

Science
AAAS

Post-print Manuscript.
Original: http://science.sciencemag.org/content/363/6423/130

The MOOC Pivot: From Teaching the World to Online Professional Degrees

Authors: Justin Reich[1], José A. Ruipérez-Valiente[1]

Affiliations:

[1]Massachusetts Institute of Technology.

Abstract: When massive open online courses (MOOCs) first captured global attention in 2012, advocates imagined a disruptive transformation in postsecondary education. Video lectures from the world's best professors could be broadcast to the farthest reaches of the networked world, and students could demonstrate proficiency using innovative computer-graded assessments, even in places with limited access to traditional education. But after promising a reordering of higher education, we see the field instead coalescing around a different, much older business model: helping universities outsource their online master's degrees for professionals. To better understand the reasons for this shift, we highlight three patterns emerging from data on MOOCs provided by Harvard University and Massachusetts Institute of Technology (MIT) via the edX platform: The vast majority of MOOC learners never return after their first year, the growth in MOOC participation has been concentrated almost entirely in the world's most affluent countries, and the bane of MOOCs—low completion rates—has not improved over 6 years.

One Sentence Summary: MOOCs pivot from teaching the world to online professional degrees.

Main Text: In 2012, advocates for massive open online courses (MOOCs) imagined a disruptive transformation in post-secondary education. Video lectures from the world's best professors could be broadcast to the farthest reaches of the networked world, students could demonstrate proficiency using innovative computer-graded assessments, and new global onramps could expand access to education. Coursera, edX, and later FutureLearn attempted to build online course catalogs that reflected the full disciplinary breadth of universities, from STEM subjects, to the humanities, to the professions (*1*). Coursera co-founder Daphne Koller described their business model as a "blue ocean strategy" (2): they would sustain a new global service by converting non-consumers of higher education—especially in places with limited access—into online learners at the world's best universities (3,4,5). MOOC providers would make learning materials freely and widely available, and they would earn revenue from a portion of learners who purchased the opportunity to earn verified certificates and credentials.

That didn't work at Coursera or any other MOOC provider, and the field is now coalescing around a well-established business model: helping universities outsource instruction, technology, and marketing for online Masters degrees.

In October of 2018, edX became the last of the major MOOC providers to announce partnerships with universities to offer fully online professional Masters degrees (*6*), five years after Udacity made the first such partnership with Georgia Tech. EdX's move into online professional education follows their May 2018 decision—mirroring earlier decisions by Coursera and Udacity—to begin building paywalls around their previously freely available content (*7*). Rather than expanding free learning around the world, MOOC providers will now compete with well-established for-profit companies in helping universities outsource their online degrees.

For two decades, a class of companies called "online program managers" or "school-as-a-service" companies—Pearson Embanet, 2U, Wiley Education Services—have supported colleges in creating online degrees (*8*). These school-as-a-service providers offer services ranging from marketing and recruitment, admissions, online course management, curriculum design, or course instruction and assessment, and then universities choose how much of the total student experience to outsource to these providers. School-as-a-service providers typically earn revenue by taking a fraction of the tuition of each student enrolled.

MOOC providers are reorienting their efforts to compete directly with these existing companies in one market segment: professional Masters degrees, credentialed by near-top universities, in fields with well-established "return on investment": business, computer programming, data science, and related fields. The primary competitive advantage of MOOCs relative to established school-as-a-service providers involves cutting labor costs through automation. Many "traditional" online programs include small class sizes, synchronous sessions with instructors, and human-graded assignments. Degrees offered by universities with the technology and support of Coursera and edX will be one-half or one-quarter as expensive as typical American professional online credentials, with the bulk of savings coming from a combination of larger class sizes, fewer or no synchronous sessions, reduced contact with instructors, and more autograded assignments (9).

After six years of heralding themselves as a disruptive force in education, why would MOOC providers find themselves competing directly in a well-established service on familiar terms with for-profit publishers and consultants?

Typically, the operations of for-profit school-as-a-service providers are opaque. Their business model involves educational institutions outsourcing their core competencies to for-profit operators, so both online program managers and universities are usually eager to avoid scrutiny. In the case of edX, however, the founding partners—Harvard and MIT—make data about their MOOC courses available to researchers, so we can investigate patterns of global participation in HarvardX and MITx courses over the past six years to better understand the challenges of the "blue ocean strategy" and the reasons for focusing on professional Masters degrees.

The data that we analyze in this paper comes from all MITx and HarvardX MOOCs taught on edX from the start of the initiative to May 2018. The dataset includes 565 course iterations from 261 different courses with a combined 12.67 million course registrations from 5.63 million learners. Data from other edX partners or MOOC providers might reveal different dynamics, but we have a detailed view of two of the largest course providers. In reviewing these data, three patterns are newly salient: the vast majority of MOOC learners never return after their first year, the growth in MOOC participation has been concentrated almost entirely in the world's most affluent countries, and the bane of MOOCs—low completion rates (10)—have not improved over six years.

MOOC researchers realized early on that most MOOC registrants leave soon after enrollment. Of those who register for a course, 52% never enter the courseware (Table S4), and attrition typically remains high in the first two weeks of a course (*10*). We see similar patterns looking at engagement over multiple years. In Figure 1, we show the year-to-year enrollment of learner

cohorts defined by their year of first activity. New unique learners increase for the first four years but have declined since. The largest initial cohort was in year 4 (2015-2016) with 1.1 million unique learners, but only 12% of those learners took an additional HarvardX MITx course in the following year. Cohorts since 2015-2016 have been half the size of largest cohort. Second year retention rates have declined with every cohort, from 38% in the first cohort to 7% in the year 5 (2016-2017) cohort. A growing global demand for ongoing learning from MOOCs that might have maintained a blue ocean strategy never materialized.

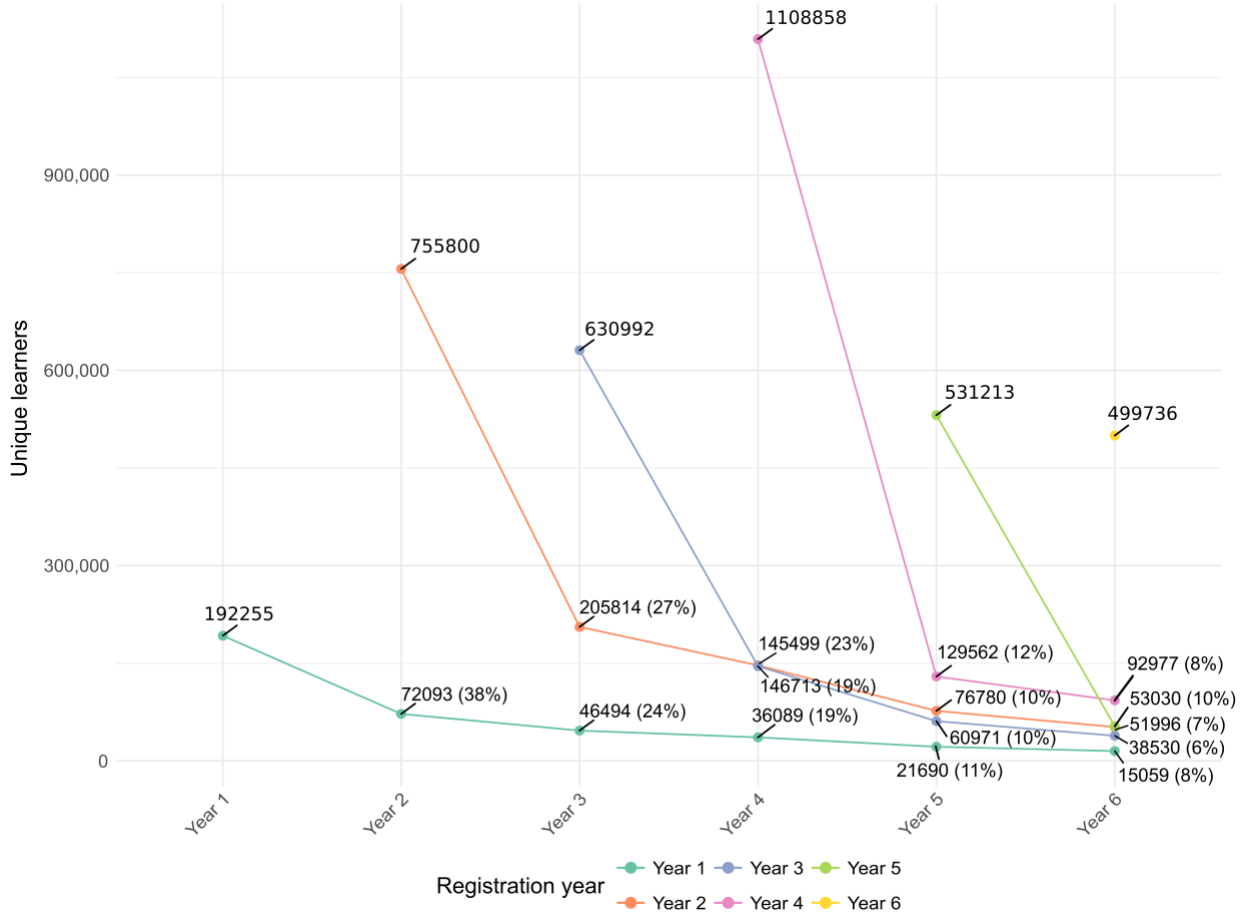

Figure 1. Churn rate of unique learners by registration year. Parenthesis shows percentage retained from initial cohort size.

It was clear from the first few years of MOOC research that MOOCs disproportionately drew their learners from affluent countries and neighborhoods, and markers of socioeconomic status were correlated with greater persistence and certification (*11*,*12*). With six years of data, an additional trend comes into view: nearly all of the growth (and subsequent decline) in new registrations and certifications came from the world's most affluent countries. In Figure 2, we show the number of registrants and certificates per year divided into quartiles based on the UN Human Development Index (HDI) rating of each registrant's home country. Rather than creating new pathways at the margins of global higher education, MOOCs are primarily a complementary asset for learners within existing

systems.

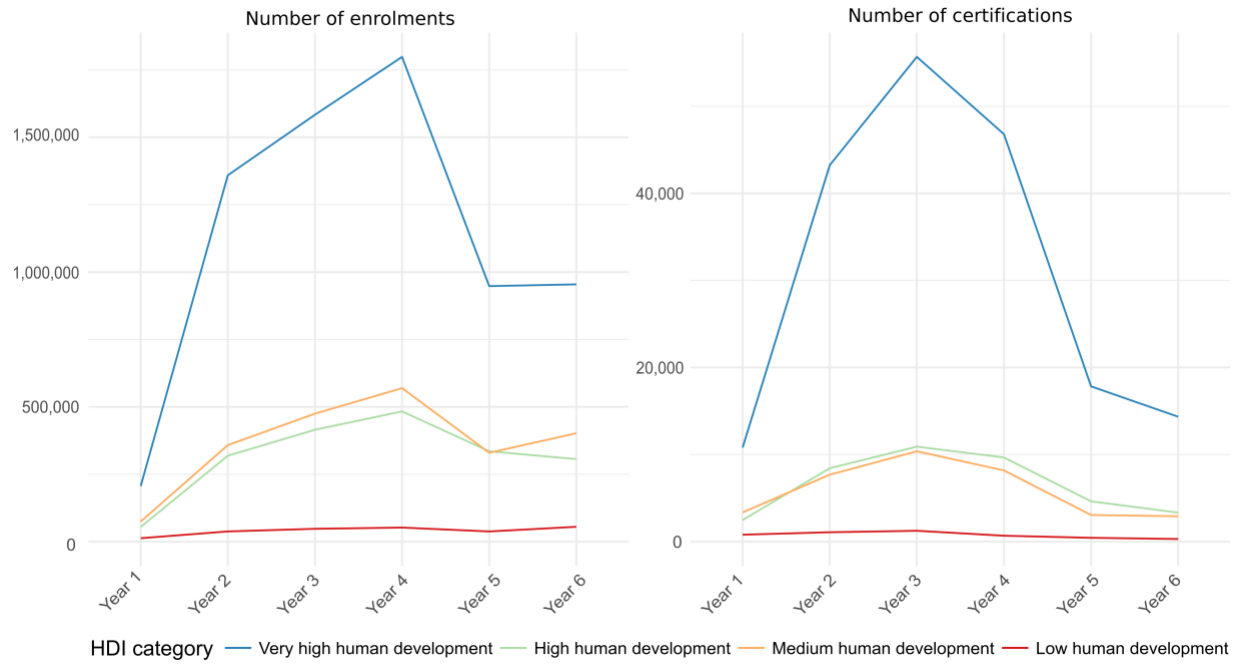

Figure 2. Number of enrolments and certifications by year separated by Human Development Index category.

Finally, the bugaboo of MOOCs, their low completion rate (*10*), has not budged in six years. In Figure 3, we show completion rates for three non-exclusive groups: the rate for all course participants, for all learners who indicate on a survey that they intend to complete a course, and for all learners who pay for a verified track. Six years of investment in course development and learning research has not produced meaningful improvements in these figures (*13*, *14*). A blue ocean strategy that depends on bringing new learners into higher education cannot succeed if educational institutions cannot support learners in converting their time and financial investment into a credential with labor market value.

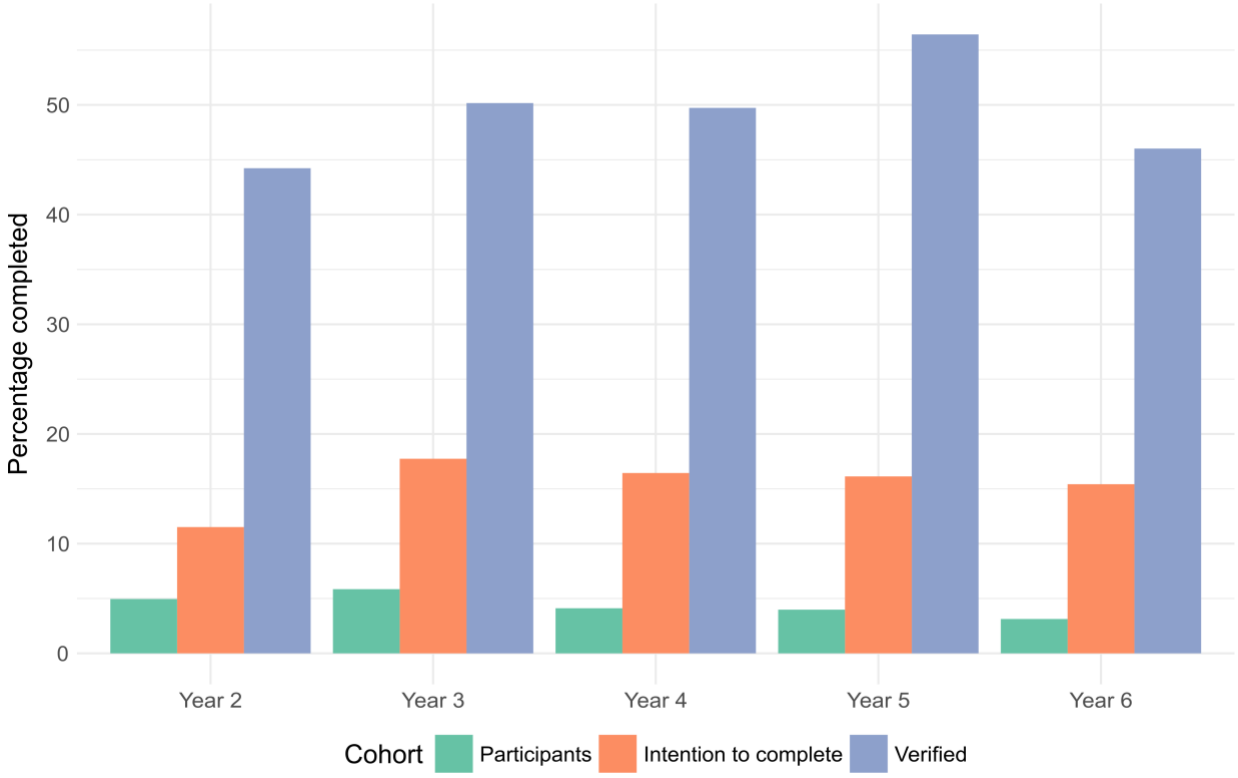

Figure 3. Percentage of course completion by year and cohort of learners.

If MOOC growth is stagnant, if most learners never return after signing up for a course, if growth is concentrated in the wealthiest parts of the world, and if course completion remains relatively low even among those paying for courses, then financial sustainability for MOOC platforms may depend upon reaching smaller numbers of people with greater financial means that are already embedded in higher education systems rather than bringing in new non-consumers from the margins. MOOC providers are on a pathway to focus on already-affluent, already-educated learners in the developed world who can afford a $21,000 online Masters in Accounting from Indiana or a $22,000 online MBA from Illinois. After promising to disrupt higher education, MOOC providers may settle for cutting costs through automation.

For universities that joined the MOOC movement with a mission-driven goal of expanding free access to education, those faculty and leaders will need to revisit whether the current direction of MOOC platforms is aligned with that mission.

As MOOC platforms support programs that look more like "traditional" online higher education, the literature on online learning can provide useful guidance. By most indications, students typically do worse in online courses than in residential courses, and the challenges of online learning are particularly acute for the most vulnerable populations of first-generation college students, students from low-income families, and under-represented minorities (*15*). If low-cost, MOOC-based degrees end up recruiting the kinds of students who have historically been poorly served by online degree programs, student support programs will be vital. Some recent research has explored online and text-message-based interventions for supporting these students (*16*), but

most established research suggests that human connections through advisors, tutors, and peer groups provide the most important student supports (*17*, *18*), and these human supports will push against lower tuition costs. MOOC-based degree providers may find that highly effective online learning for diverse populations costs about the same to provision as highly effective residential learning (9).

MOOCs will not transform higher education, and they probably will not disappear entirely. Rather, they will provide new supports for specific niches within already existing education systems, primarily supporting already-educated learners. The six-year saga of MOOCs provides a useful cautionary tale and framing device for education policymakers facing down whatever will be the next promoted innovation in education technology, be it artificial intelligence or virtual reality or some unexpected new entrant. New education technologies are rarely, perhaps never, disruptive; rather they are domesticated by existing cultures and systems (*19*). Dramatic expansion of educational opportunities to underserved populations will require political movements that change the focus, funding, and purpose of higher education; they will not be achieved through new technologies alone.

References and Notes:

1. Chuang, A. Ho. HarvardX and MITx: Four years of open online courses--fall 2012-summer 2016 (2016).
2. W. C. Kim, R. Mauborgne, *California management review* **47**, 105-121 (2005).
3. D. Koller, A. Ng. The online revolution: Learning without limits. In Proceedings of the 20th International Conference for Online Learning (2013). Review retrieved from https://sloanc2013.wordpress.com/2013/11/21/moocs-the-blue-ocean-strategy/ ; Slides from similarly named talk retrieved from https://www.wiche.edu/info/walf/meetings/annual2013/meetingMaterials/kollerOnlineRevolution.pdf.
4. M. Trucano. MOOCs in Africa. EduTech: A World Bank Blog on ICT Use in Education. (http://blogs.worldbank.org/edutech/moocs-in-africa).
5. Terwiesch. Introduction to Operations Management: Conclusion (https://www.youtube.com/watch?v=igEx_DQ4D5c&feature=youtu.be)
6. Agarwal. Fully Online, Top-Ranked Master's Degrees Now Available on edX. edX blog (https://blog.edx.org/fully-online-top-ranked-masters-degrees-now-available-edx, 2018).
7. A. Agarwal. Furthering the edX Mission, Forging a Future Path. edX blog (https://blog.edx.org/furthering-the-edx-mission, 2018).
8. P. Hill, *Educause Review* **47**, PP (2012).
9. P. Hill. Coursera CEO Interview: Betting on OPM market and shift to low-cost masters degrees. *E-literate (https://mfeldstein.com/coursera-ceo-interview-betting-on-opm-market-and-shift-to-low-cost-masters-degrees/)*
10. J. Reich. MOOC Completion and Retention in the Context of Student Intent. *Educause Review.* (https://er.educause.edu/articles/2014/12/mooc-completion-and-retention-in-the-context-of-student-intent)
11. J. D. Hansen, J. Reich, *Science* **350**, 1245-1248 (2015).
12. R. F. Kizilcec, A. J. Saltarelli, J. Reich, G. L. Cohen, *Science* **355**, 251-252 (2017).
13. J Reich. *Science*. **347,** 34-35 (2017)
14. J Reich. *NAE Bridge*. ***46(3)*** 29-37 (2016)

15. D. Xu, S. S. Jaggars, *The Journal of Higher Education* **85**, 633-659 (2014).
16. B. Castleman, Behavioral Insights for Federal Higher Education Policy. Urban Institute (2017).
17. S. Scrivener, M. Weiss, A. Ratledge, T. Rudd, C. Sommo, H. Fresques. Doubling graduation rates: Three-year effects of CUNY's Accelerated Study in Associate Programs (ASAP) for developmental education students. MDRC (2015).
18. D. Xu, S. Solanki, P. McPartlan, B. Sato, *Educational Researcher* **47**, 435-450. 0013189X18778559 (2018).
19. L. Cuban. *Teachers and Machines.* Teachers College Press. (1986)
20. G. Lopez, D.T. Seaton, A. Ang, D. Tingley, I. Chuang. Google BigQuery for Education: Framework for Parsing and Analyzing edX MOOC Data. Proceedings of the Fourth ACM Conference on Learning@Scale, 181-184. (2017).
21. United Nations. Human Development Indices and Indicators: 2018 Statistical Update. http://hdr.undp.org/sites/default/files/hdr2018_technical_notes.pdf (2018)

Acknowledgments: Funding: No specific funding sources supporting this essay; **Author contributions:** Reich conceptualized the paper, wrote the original draft, and revised. Ruiperez-Valiente conceptualized the paper, conducted data analysis, and revised the paper. **Competing interests:** Authors declare no competing interests; **Data and materials availability:** MITx and HarvardX learner data are treated as student data meriting FERPA protections. MITx data can be requested at http://web.mit.edu/ir/mitx/ and HarvardX data at https://vpal.harvard.edu/vpal-research-request.

Supplementary Materials:

Materials and Methods

Tables S1-S4 and Figure S1

Science
AAAS

Supplementary Materials for

The MOOC Pivot: From Teaching the World to Online Professional Degrees

Justin Reich, José A. Ruipérez-Valiente

Correspondence to: jreich@mit.edu

This PDF file includes:

Materials and Methods

This supplementary section describes the materials and methods that have been used to produce the research and how to access instructions to reproduce the analysis presented. If you have any additional questions, do not hesitate to query directly the authors of this work.

Context and Data Collection

EdX was created in May 2012 by faculty from MIT and Harvard universities with the objective of expanding education from the best universities in the world worldwide. EdX currently have more than 100 partners that are producing and teaching courses on their platform. Additionally, the software known as Open edX that runs the platform is open source and has become a global collaborative initiative used by multiple institutions around the world.

The data collection that we analyze in this study comes from all the MOOCs taught on edX by the founding partners MITx and HarvardX from the start of the initiative to May 2018. An overview of the dataset includes 565 course iterations from 261 different courses that have summed more than 12.67 million course registrations from over 5.63 million learners that generated over 4.4 billion events and invested more than 48 million hours in such courses. We organize these courses into annual cohorts running from June to May. (Note that in some previous HarvardX/MITx research, annual cohorts are organized from September to August.)

EdX collects all the click-stream data from their learners which them we process using *edx2bigquery* (*20*) framework to build up a person-course dataset with over 60 variables that describe the interaction of the student with every course they enrolled to. We also use the Human Development Index (HDI) and Category provided by the United Nations (UN) for 2017 (see http://hdr.undp.org/en/content/human-development-index-hdi).

Variables:

HDI: It is a country composite measure provided by the UN based on three dimensions: health, knowledge and general quality of living.

Course enrollments: Number of learners that registered for a course.

Unique learners: Number of different learners independently of how many course enrollments they did.

Participants: Learners that registered and viewed the course.

Explorers: Learners that viewed at least half of the chapters of a course.

Completers: Learners that achieved a passing grade at the end of a course.

Verified: Learners that paid to enter the verified certificate track.

Certified: Learners that achieve a passing grade and received a verified certificate.

Registration year cohort: We create a cohort for each year with the learners' that did the first registration for a course during that year.

Percentage retention: Percentage of learners from a registration year cohort that registered for a course during that year.

Intention to complete: Self-reported measure as part of the pre-course survey regarding students' intention to complete the course.

Reproducing the analysis:

We have prepared a GitHub repository (https://github.com/jruiperezv/MOOC_Pivot) with instructions on to reproduce the analysis that contains:

1. How to access the data: MITx and HarvardX learner data are treated as student data meriting FERPA protections and thus cannot be released publicly. MITx data can be requested at http://web.mit.edu/ir/mitx/ and HarvardX data at https://vpal.harvard.edu/vpal-research-request.
2. Specific dataset, fields and courses needed to reproduce the analysis.
3. Additional data needed with course and country metadata.
4. Description of all data fields.
5. IPython notebook with the code to reproduce the data from tables S1-S4 presented in these supplementary materials which are the basis of the analysis presented in this study.
6. RMarkdown script to reproduce raw visualizations of Figs. 1 to 3 based on the csv files.

Table S1.

Aggregate data of Figure 1: Churn rate of unique learners by registration year.

Registration year cohort	Year	Unique learners	Percentage retention
2012-13	2012-13	192255	100
2012-13	2013-14	72093	37.5
2012-13	2014-15	46494	24.18
2012-13	2015-16	36089	18.77
2012-13	2016-17	21690	11.28
2012-13	2017-18	15059	7.83
2013-14	2013-14	755800	100
2013-14	2014-15	205814	27.23
2013-14	2015-16	146713	19.41
2013-14	2016-17	76780	10.16
2013-14	2017-18	51996	6.88
2014-15	2014-15	630992	100
2014-15	2015-16	145499	23.06
2014-15	2016-17	60971	9.66
2014-15	2017-18	38530	6.11
2015-16	2015-16	1108858	100
2015-16	2016-17	129562	11.68
2015-16	2017-18	92977	8.38
2016-17	2016-17	531213	100
2016-17	2017-18	53030	9.98
2017-18	2017-18	499736	100

Table S2.

Aggregate data of Figure 2. Number of course enrollments and certifications by year separated by HDI category.

Year	HDI Category of Human Development	Number of enrolments	Number of certifications	Percentage enrolments within year	Percentage certified within year
2012-13	Very high	205955	10798	59.28	61.98
2012-13	High	54483	2476	15.68	14.21
2012-13	Medium	74395	3351	21.41	19.24
2012-13	Low	12616	796	3.63	4.57
2013-14	Very high	1359191	43235	65.55	71.55
2013-14	High	318683	8429	15.37	13.95
2013-14	Medium	357971	7685	17.26	12.72
2013-14	Low	37780	1075	1.82	1.78
2014-15	Very high	1583635	55674	62.82	71.2
2014-15	High	414912	10903	16.46	13.94
2014-15	Medium	474704	10373	18.83	13.27
2014-15	Low	47543	1244	1.89	1.59
2015-16	Very high	1798426	46790	61.95	71.66
2015-16	High	483046	9659	16.64	14.79
2015-16	Medium	569422	8174	19.62	12.52
2015-16	Low	52073	675	1.79	1.03
2016-17	Very high	947969	17827	57.44	68.71
2016-17	High	335067	4626	20.3	17.83
2016-17	Medium	329609	3056	19.97	11.78
2016-17	Low	37632	436	2.28	1.68
2017-18	Very high	954426	14341	55.58	68.7
2017-18	High	305950	3325	17.82	15.93
2017-18	Medium	401982	2912	23.41	13.95
2017-18	Low	54975	298	3.2	1.43

Table S3.

Aggregate data of Figure 3. Percentage of course completion by year and cohort of learners. The first cohort represents all participants. All cohorts are participants, the second cohort is learners that report intention to complete and the third cohort are learners that paid to enter the verified track. Cohorts two and three are not mutually exclusive.

Year	Cohort	Size of cohort	Number of completions	Percentage completion
2013-14	Participants	1219030	60285	4.96
2014-15	Participants	1333780	78085	5.91
2015-16	Participants	1958222	80495	4.13
2016-17	Participants	1097759	43726	3.98
2017-18	Participants	980589	30650	3.13
2013-14	Intention to complete	178909	20593	11.51
2014-15	Intention to complete	191578	33986	17.74
2015-16	Intention to complete	209333	34416	16.44
2016-17	Intention to complete	74116	11952	16.13
2017-18	Intention to complete	42005	6478	15.42
2013-14	Verified	6790	3003	44.23
2014-15	Verified	27490	13792	50.17
2015-16	Verified	52384	26051	49.73
2016-17	Verified	47362	26725	56.43
2017-18	Verified	46326	21321	46.02

Table S4.

Mean, median and standard deviation of the percentage of participants, explorers and certified by course (N = 565).

Year	Mean	Median	Std. Deviation
Percentage participants	48.02	51.01	15.49
Percentage explorers	25.59	19.84	19.54
Percentage certified	5.03	2.88	6.04

Fig. S2.
Boxplot visualization of the percentage of participants, explorers and certified by course.