Everywhere and Anytime, Here and Now:
Digital and Residential Education at Harvard

Alan M. Garber, Provost, Harvard University[1]
Cambridge, Massachusetts, October 2015

Launched in 2012, in parallel with Harvard and MIT's joint announcement of the edX online learning platform, HarvardX has served as an organizing force and a testbed for emerging approaches to teaching. Since its founding, HarvardX has expanded considerably, engaging much of the University community and yielding informative and encouraging results—and new avenues for exploration.

Throughout Harvard's long history as an institution of higher learning, it has pursued multiple goals, often in conflict with one another. Two Harvard presidents who did much to shape the University of the 20th century, for example, had differing views of the educational mission. Heavily influenced by the models of

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German universities of the late 19th century, Charles W. Eliot emphasized advanced study and research, perhaps at the expense of the classic liberal arts curriculum. A. Lawrence Lowell, his successor, saw more promise in the British model. He sought to place undergraduate education securely at the center of the University, establishing the residential house system and promoting a liberal arts orientation. Tensions between specialization and generalism are among the many conflicts that have not disappeared or even waned. Indeed, they are very much part of who we are as a research university.

As has been true throughout Harvard's history, we have tried to have it both ways. The residential house system, for example, was intended to create the connectedness and sense of community of a small liberal arts college in the setting of a large research university, with its resources and plethora of curricular and extracurricular opportunities. We have long strived to find a path forward that draws from the best aspects of competing visions and goals. It is *precisely* our unwillingness to be satisfied with partial success —our insistence on "both/and" rather than "either/or"—that enables Harvard to grow, to adapt, to improve.

Innovations in educational technology are opening up new avenues for universities to advance learning. The introduction of massive open online courses, commonly referred to as MOOCs, has been heralded as a disruptive change, garnering praise and provoking anxiety. Would expanded access herald a new age of higher education unbound from brick-and-mortar campuses? Would well-funded institutions render other colleges and universities obsolete? Could the in-person experience be replicated, or at least closely approximated, online? Could the real and the virtual complement and strengthen one another—or would learning and teaching be unrecognizable fifty years hence?

Speculative extremes often become less compelling with the passage of time and the benefit of experience. Perhaps the introduction of the elective system and the case method, two educational innovations created at Harvard, were met with the same combination of excitement and skepticism. Yet they have become so much a

part of how we think about teaching and learning that it is difficult to envision this university—or any other, for that matter—without them.
HarvardX and our other initiatives in digital learning have similarly begun to change how we think about teaching and learning today. How can we use new tools to reach a variety of learners? How are the needs and motivations of students on our campus similar to and different from the needs and motivations of students elsewhere? How can faculty be supported in their work as we seek to understand even more about how people learn?

These questions and others have guided our pursuits, even as those pursuits have seemed to take us in different and sometimes competing directions. As we considered how we might approach the opportunities that technological advances presented for improvements in teaching and learning, we were confronted with two basic questions: was our goal to improve teaching on our campus, ensuring that Harvard College and our graduate and professional programs would offer the most compelling residential educational experience possible, or was our goal to improve the learning opportunities for anybody anywhere in the world with an interest in the subjects we teach? How would we know whether our approach to online learning had accomplished either of these goals?

We realized that courses narrowly targeted toward Harvard students were unlikely to attract the largest group of learners worldwide to our MOOCs. But if we wanted to improve residential learning, many of our online and hybrid learning experiences—and their components—would need to be compatible with our faculty's approaches to teaching Harvard students face-to-face. The rationale for focusing on either educating the world or educating students on our campus — rather than trying to serve both audiences at the same time—was strong. But our mission required us to do more. As has been true so often in our history, we chose to move forward with a commitment to serve *both* audiences.

Thus, we are committed to improving education on our own campus and, at the same time, offering high quality learning experiences to students who may never enter one of our classrooms. Such openness must be balanced by the need to limit

enrollment in some courses and to tailor content to match the varied needs of learners. We are also committed to discovering whether our efforts are successful, and more generally to exploring how people learn. The commitment to research is fundamental to our identity as a university dedicated to producing new knowledge, and we are inspired by the possibilities that MOOCs, along with newer classroom environments, offer for research into learning.

And so we find ourselves at a moment of "both/and" as we pursue our learning and research mission in the digital age. This is a challenging yet enviable position. Harvard is, as former University of California President Clark Kerr once noted, "both the oldest and the newest of American universities," celebrating its past and continually examining, questioning, and exploring in its quest to build a better future.

Executive Summary

Since the founding of edX and HarvardX in 2012, Harvard has made substantial investments in online learning in order to advance three goals:

- **Expanding access to knowledge**
- **Improving teaching and learning on campus**
- **Advancing our understanding of how people learn**

These goals reflect our mission as a research university: to create and disseminate knowledge and to educate talented students from around the world.

Expanding access to knowledge

The growth in the number of active learners in HarvardX courses offers some of the most striking evidence of our progress in increasing access to high quality teaching. HarvardX registrations numbered more than 3 million as of October 2015. Our faculty have experienced the extraordinary reach of online courses, teaching many more students in a single instance of a HarvardX course than they could have expected to teach in a classroom over their entire careers. Their achievements, which reflect their talents as teachers as well as their extraordinary dedication, are a source of gratification and pride for our community.

Many of our peer institutions are working toward the same goal, and the breadth and quality of educational opportunities that MOOCs on edX and other platforms offer at no charge is perhaps unprecedented. Among these efforts, Harvard's contributions are notable for their quantity, the diverse subjects they represent, and their high quality. We can and will do more to expand our reach, but there can be no doubt that we have already accomplished much.

Improving teaching and learning on campus

The production of a HarvardX course resembles the development of a traditional lecture course: both require careful planning and preparation of course materials, assessments, lectures, and group activities like sections. But the technical capabilities of the online platform, along with professional support, encourage faculty to rethink their approaches to teaching. Faculty report that the very act of

creating an online course changes long-held assumptions about how to organize teaching and how best to advance the learning of our students.

Much of our experience to date supports the belief that blended learning—the combination of online lectures and classroom experiences—will be important in the future. But even though courses using the blended approach are sometimes less resource-intensive than traditional instruction, they often demand more attention and time from both students and faculty, particularly during early iterations of a course. Our experience reinforces the importance of measuring outcomes and using research to guide our approaches to teaching.

Advancing our understanding of how people learn

The interest in MOOCs has drawn new attention to a large body of existing research about how people learn, and it has made possible new research about online learning. Most of our early research about MOOCs is descriptive, and some of the results have been revealing. We've learned who enrolls in the online courses and who completes them; we've learned about their behaviors; and we've learned how to use frequent, well-designed assessments of student progress to promote educational objectives.

Our research on online learning has generated considerable interest: our reports have been widely referenced and downloaded, and our research team and affiliates have published dozens of articles in peer-reviewed journals and conference proceedings. Furthermore, we have supported learning research by publicly releasing what continues to be the only privacy-protected, de-identified MOOC dataset. The dataset has been downloaded almost 4,000 times. This research is not without its challenges. Methods of data collection raise privacy and ethical concerns, the implementation of research findings into educational practice is seldom straightforward, and taking full advantage of the research opportunities requires a substantial investment. But the potential benefits are great.

Looking ahead

During the past three years of investment and experimentation, we have made substantial, but uneven, progress toward each of our goals. We now face the challenge of building on what we have learned and accomplished to make considerably more progress. At this point, three areas stand out as deserving special attention in the years to come: economic sustainability, research on learning and teaching, and the translation of that research into improvements in learning, especially in the residential setting.

Although we expect most HarvardX courses to continue to be free and open, our online learning efforts cannot rest solely on the support of generous donors and unrestricted University funds. Like nearly every university producing MOOCs and other online course materials, we have begun to experiment with approaches to earning revenue from our online offerings. These opportunities range from fee-based, non-credit credentials to higher-touch professional programs.

Even though we have only begun to take advantage of the research opportunities that it presents, HarvardX has taught us much about online learning, and about learning more generally. We expect to discover more as a growing body of experience enables our research efforts to reach more rigorous, more definitive conclusions. Those conclusions, in turn, will guide the design of our educational efforts in the coming years. We have more to learn about designing both purely online and blended courses.

Implementing research findings is often surprisingly difficult, yet we have unusual opportunities to do so. First, our role in edX, along with the roles of partner universities, helps ensure that new features whose value is supported by research findings will be become priorities in further development of the platform. The deep involvement of our faculty in all aspects of HarvardX, including the design and conduct of research, makes it likely that the research will be of practical value, and that it will inform their approach to teaching, online and on campus. Second, thanks to HILT (The Harvard Initiative for Teaching and Learning), the Bok Center, and other programs focused on innovation in residential learning, we have learned

how to build momentum on campus for new teaching approaches. This capability will be crucial as we translate research results into practice.

Online courses and digital learning more generally do not, in and of themselves, constitute a strategy. Instead, they offer a set of powerful tools that can be incorporated into a strategy to advance Harvard's teaching and research mission. We are still learning how to use such content and approaches best, and there are compelling reasons to continue the effort. We have the potential to shape learning by discovering how traditional modes of education and the most modern innovations can be combined in powerful, effective ways.

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Three years after the first HarvardX classes launched, it is time to take stock of our accomplishments, identify lessons learned, and articulate our priorities for the coming years. The purpose of this white paper is to report on our progress to date, and to generate discussion within our community about next steps.

What We Set Out to Do

Our efforts in online education should be understood in the context of Harvard's history of educational advances (see sidebar). Long before HarvardX and edX, Harvard had been a pioneer in the use of digital tools for learning. For example, Harvard faculty were among the early and most prolific sources of university lectures on YouTube, years before the term "MOOC" was coined. Harvard also launched one of the earliest iTunes U channels.

A Tradition of Teaching Advances at Harvard

- In 1885, the College instituted the elective curriculum, defining the undergraduate experience across the country, with President Charles William Eliot referring to the change as "the most generally useful piece of work which this university has ever executed."
- President Eliot also led the introduction of more rigorous science education in the first two years of medical school, 40 years before it became the norm across the U.S.
- In the late 19th and early 20th centuries, Harvard Law School (1870) and Harvard Business School (1920) pioneered the application of the case method of teaching in professional schools.
- This spirit of educational innovation inspired one of the first undergraduate computer science degrees (1984) and a groundbreaking medical education curriculum which used small-group tutorial instruction and a problem-solving approach to prepare physicians for lifelong learning (1985).
- More recently, the FIELD program (2011) has taken MBA education international by immersing future business leaders in hands-on projects based in emerging global markets.

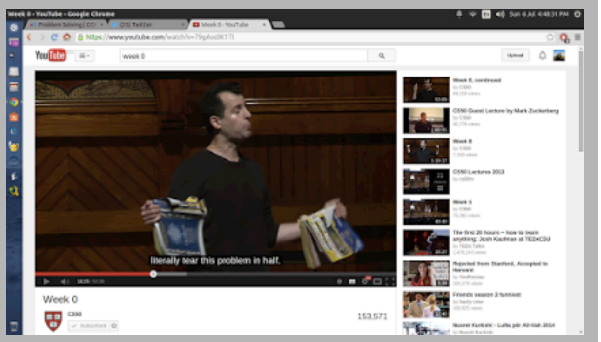
The Division of Continuing Education and executive education programs from throughout the University have offered hybrid, distance, and online programs to learners worldwide for decades. Other programs that are dedicated to advances in learning have an on-campus focus. They include the Derek Bok Center for Teaching and Learning at the Faculty of Arts and Sciences, the C. Roland Christensen Center for Teaching and Learning at Harvard Business School, and SLATE (Strengthening Learning and Teaching Excellence) at the Harvard Kennedy School.

These programs seek to integrate time-tested best practices with the latest technologies in order to make learning more active, more focused, and more engaged. Often they do so by integrating video content into on-campus courses, and, in some cases, using technology to enhance real-time group engagement and interaction in the classroom itself.

Innovation in Action

Harvard and other institutions have not been standing still; they have been updating their approaches to teaching and supporting individual faculty pioneers who push the boundaries of teaching.

MIT's OpenCourseWare effort, which put the institute's undergraduate and graduate course materials fully online, dates back to 2002.



Harvard's David Malan began to place videos from his popular introductory computer science course, popularly known as CS50, on YouTube around 2008.

These efforts, however, were limited by bandwidth and the features of technology delivery platforms, as were distance learning and online executive education programs. Interactivity and engagement, hallmarks of quality residential teaching, were difficult and expensive to incorporate and deliver to large audiences of online learners.

The establishment of the Harvard Initiative for Learning and Teaching (HILT) nearly four years ago represented an opportunity to "catalyze innovation and excellence in learning and teaching at Harvard."

Made possible by a generous gift from Gustave and Rita Hauser, HILT was designed to support faculty and instructors by encouraging education-focused research, faculty-initiated pedagogical experimentation, conferences of Harvard and international experts, and much more.

Through its conferences, publications, and numerous other activities, it has brought together a community of scholars interested in teaching on our campus and beyond. HILT has spurred the adoption of new technological approaches and tools, and provided funding to initiate many research and assessment projects.

An early HILT grant, for example, led to the widely read University-wide electronic newsletter about pedagogy, "Into Practice." Under the leadership of Erin Driver-Linn, HILT has supported nearly 100 projects that involve thousands of students in hundreds of courses. HILT works closely with HarvardX, ensuring that our online learning efforts advance broader pedagogical goals.

The Harvard Initiative for Learning and Teaching (HILT)

HILT's mission is to **catalyze innovation and excellence in learning and teaching at Harvard**. Four sub-goals were developed in HILT's inaugural year:

- Building on Harvard's strengths in teaching and learning;
- Meeting the educational needs of students (both technological and pedagogical);
- Strengthening the science of learning;
- Developing a robust network at Harvard around teaching and learning innovation.

The Launch and Evolution of edX and HarvardX

During my first year as Provost (2011-12), conversations with colleagues at Harvard and MIT revealed that our institutions shared a sense of excitement about the potential of online learning and that our goals were similar as well. We also recognized that we needed to improve support for our faculty in their teaching efforts, and for learners themselves, whether they were located on our campuses or half a world away. Those conversations, which grew to include many faculty at both Harvard and MIT, and soon the University of California at Berkeley as well, led directly to the creation of edX, an open source platform for online learning delivery.

EdX differed in important ways from other prominent MOOC platforms launched just before it, such as Coursera and Udacity. EdX was not-for-profit and open source, so its platform could be used as a shared resource. It focused not only on the development of better online teaching, but also on how innovations in online teaching could improve learning on campus. Furthermore, as research universities, Harvard and MIT recognized that the data generated by edX could yield valuable insights into the ways that people learn, which in turn could help educators everywhere teach more effectively.

The HarvardX Mission

In parallel with the original edX goals, HarvardX's mission is three-pronged:

- Reach: Global access
- Residential learning: Recirculation on campus
- Research: Online and offline

and is informed by high-level principles:

- Impact
- Quality
- Disciplinary breadth
- Rigor

Thus edX was launched with the imperative to conduct and facilitate research on learning.

In parallel with edX, we announced HarvardX, a University-wide initiative for the creation of online learning experiences (for both residential and online use) and for research in online pedagogies.

Conceived from the start as a faculty-driven effort, through the leadership of Robert Lue, the faculty director, and two faculty committees, HarvardX was intended to be a nimble organization with pedagogical, research, production and technical expertise.

Collectively, our online learning efforts have focused on three goals:

- **Expanding access to knowledge**
- **Improving teaching and learning on campus**
- **Advancing our understanding of how people learn**

Today HarvardX is not the only program that produces online educational materials at Harvard. Other important initiatives include Harvard Business School's HBX and the online programs of the Division of Continuing Education, whose responsibilities include the Extension School and the Summer School. Although most HarvardX courses are created specifically for the edX platform, there are exceptions; delivering open online courses for edX is only one part of the mission of HarvardX.

HarvardX builds on the premise that online education complements, rather than competes with, the teaching we do in our classrooms and labs. From the outset, HarvardX was intended to advance learning both on and off campus and to set a standard for excellence in the production of online courses. All along, its success has depended upon the commitment of faculty members. Reflecting the University's intellectual diversity, HarvardX courses are distributed among the humanities, social sciences, health sciences, and natural and applied sciences. Through HarvardX we are also able to share Harvard's museum and library collections (see Images 1 & 2) by using new digital tools and by embedding content into our open online courses.

Image 1. An annotatable image and page viewer was developed, in collaboration with the Harvard Libraries, Stanford, and many others, to allow learners (on-campus and online) to zoom into objects such as art, artifacts, and books, especially rare books that cannot leave collections.

Image 2. Students taking "The Book," a modular MOOC developed through HarvardX, receive unprecedented digital access to Harvard's collections. Among the holdings is a 39-inch scroll from the 15th century (shown above). Led by faculty member Jeffrey Hamburger, "The Book" is a collaboration among more than a dozen faculty members.

HarvardX has introduced a team-based approach to supporting faculty who want to incorporate technology into their teaching. In our quest to produce high-quality content (see Images 3 & 4), we have drawn lessons from entertainment and other industries.

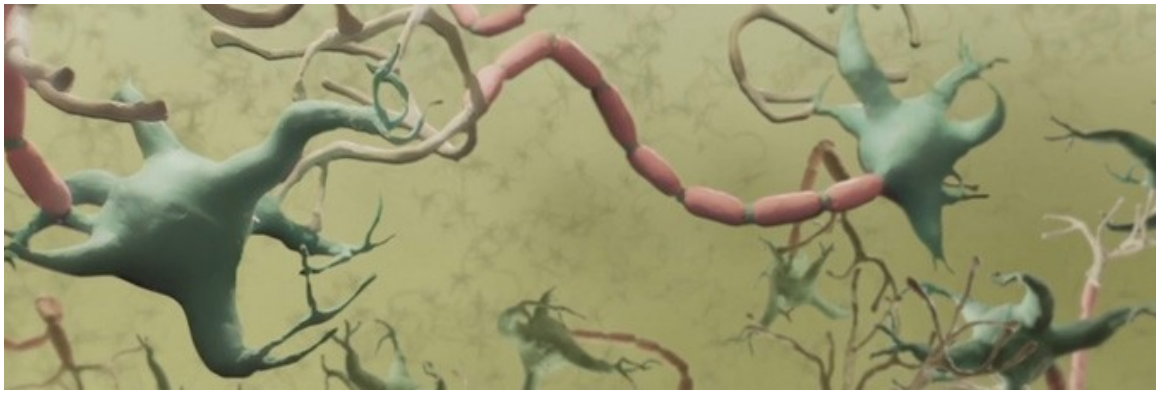


Image 3. MCB80x, "Fundamentals of Neuroscience," features claymation to explain anatomy.

Image 4. "ContractsX" from Harvard Law School uses illustrated animations to explain case law.

Image 5. "Innovating in Healthcare" featured a lead faculty member from the Business School, a faculty collaborator from the Harvard John A. Paulson School of Engineering and Applied Sciences, and health professional guest lecturers. Portions of the course relied upon the Harvard Business School case method, a technique incorporated into other HarvardX courses in public health and law.

Our experience has reinforced the importance of focusing relentlessly on the needs of our learners to make a great course. To do so requires diverse expertise. At HarvardX, teaching is a group effort (see Image 5).

Our focus on quality reflects our belief that improvements in the design and execution of online courses and modules will lead to better learning outcomes. Although professional video production quality and other technical aspects of the online materials can make online courses more attractive and engaging, our efforts emphasize content and the ways that assessments and other elements of the online experience come together to promote learning. We expect to experiment and improve our offerings over time, yet we cannot put out a product that falls short of our standards with the hope that we will simply improve on it with the next release.

As President Drew Gilpin Faust has reminded us: "I feel [HarvardX] is a magnificent opportunity, but it is also a big responsibility for us to set a standard for online learning that upholds the most important aspects of higher education and its values, and allows Harvard to play a leadership role in shaping how education changes in the years to come." In recent years, as the interest in teaching and learning grew, so too did the possibility that HarvardX, HILT, and Harvard's many other online and on-campus efforts to improve learning would become fragmented. To help coordinate such activities across the University, in September 2013 I appointed Peter Bol as the first Vice Provost for Advances in Learning. Under Bol's guidance, this institution-wide framework allows us to share ideas and best practices among Harvard's schools and to address fundamental questions raised by new models of education. With that in mind, the next section explores what we have begun to learn from our HarvardX activities in particular.

Early Lessons

We set out to conduct a series of experiments when MOOCs were still a novel concept. These experiments have helped us make tangible progress toward all three of our goals—increasing access to learning, improving teaching on our campus, and developing research capabilities that advance our understanding of how people learn.

Soon after the end of the first year of edX and HarvardX, I described what we had learned from our early experience ("Reflection on the first anniversary of HarvardX and edX - May 2013").

We found that:

- Many Harvard faculty are interested in experimenting with new online technologies, and have been eager to participate in HarvardX and edX.
- Online teaching is only one aspect of faculty commitment to learning and teaching at Harvard and beyond. They have much to say about the future of higher education more generally.
- Building a high-quality online learning experience requires substantial effort and time.
- MOOCs, as they are conventionally understood, are only part of what HarvardX does and will do. Discrete learning objects, such as laboratory and mathematical simulations, other learning tools, and topic-specific modules, may be used more widely in the future as components of courses and as stand-alone approaches to learning.
- Participants have diverse motivations for taking HarvardX courses, from the enhancement of current formal course work and the acquisition of work-related skills, to the desire to engage with others, to the quest for continuing intellectual growth.
- HarvardX holds great promise for transforming the learning experiences of students on our campus.

These observations were based upon a small number of active courses at a time when edX and HarvardX, and MOOCs as a whole, were new and changing rapidly. The expansion of HarvardX enables us to deepen our understanding of the impact of MOOCs and online and blended learning more broadly. Stories from learners and faculty, and examples of how these efforts are influencing residential education, provide additional perspectives on our experience.

HarvardX by the Numbers (as of October 2015)

- 90 Harvard faculty supported (as course leads) at 10 schools
- 225 individuals (faculty, undergraduates, graduates, technologists) engaged at one given time in developing content, conducting research, blending courses
- 60+ online courses and modules offered to date
- 7+ small private (limited enrollment) online courses
- 17+ blended on-campus courses: 6 in 2013-2014; 11+ in 2014-2015
- 63 projects in active support (involving 69 lead faculty)
- 95 HarvardX-related research publications
- 3 million+ course registrations / 2 million+ engaged learners

Lessons from our learners

When MOOCs were first launched, we knew little about the learners. Our research program focused first on understanding who online learners were, how they engaged with courses, and what motivated them.

A January 2014 Harvard-MIT study presented one of the first comprehensive pictures of MOOC participants. Based on 16 Harvard and MIT open online courses offered on the edX platform in the two previous years, the research team discovered that:

- The majority of MOOC students are male (63% of students who reported their gender), but the gender composition varies by course and by nation;
- MOOC learners tend to be college graduates and often have other advanced degrees;
- the median age of a MOOC learner is 26, but many are teens and many others are senior citizens;
- almost three quarters (72%) of registrants are from outside the United States;
- about one-third (35%) of registrants simply register and do not participate in the courses in any substantial way (they never watch videos, complete assessments, or engage in forums).

Beyond the demographic data, research on MOOC learners also showed that:

- Enrollment figures can give an exaggerated picture of interest in online courses, since not everyone who enrolls intends to set aside the time and effort to view presentations and carry out assignments. That is one reason why such a small percentage of enrolled students successfully complete courses. However, completion rates may not measure the full impact and

potential of open online courses, because some learners intend to pursue some but not all of a course;
- the likelihood of completing a course spikes after students actively participate for two weeks;
- so many people enroll in MOOCs that even small percentages (of completions, for example) represent large numbers of students.

One picture clearly emerged from these early findings: learners come to edX courses with widely varying backgrounds and motivations, and they use open online learning content in ways that best meet their distinctive needs. And yet, even in this new, seemingly boundless environment, the traditional view of a learner—a millennial ensconced in a bucolic campus—has been difficult to shake.

In an op-ed for *The Atlantic*, two of the Harvard-based authors of the benchmark study, Andrew Ho and Justin Reich, wrote:

> As this research effort continues, our hope is that our frames of reference for MOOCs can change. The story of MOOCs is not going to be told with conventional statistics borrowed from brick-and-mortar classroom models. Rather, our research describes an emerging learning ecosystem, one where enrollment can be casual and nonbinding, learning happens asynchronously, and registrants come from all countries in the world, with diverse intentions and patterns of learning. The metrics we choose should respect their intentions and encourage their learning.

As of October, 2015, HarvardX had more than 3 million course registrations worldwide. Such numbers include many casual visitors along with dedicated learners. At this scale, there can be no doubt that HarvardX has expanded the learning opportunities available to diverse learners throughout the world.

Open online courses provide new opportunities—sometimes the only opportunities—for learners from around the world to take advantage of Harvard's educational resources and have led some to pursue traditional certificate and degree programs.

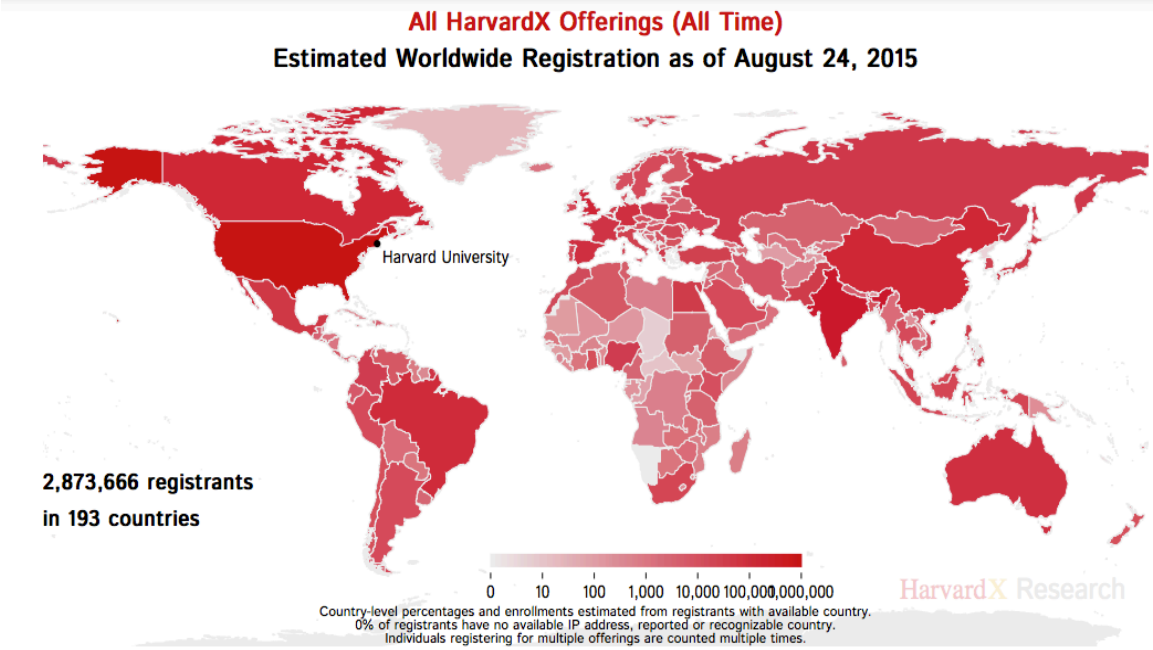


Image 6: A map of the geographic origins of HarvardX learners. 65% of learners come from outside of the U.S.

For example, the primarily online masters of public health in epidemiology at the Harvard T.H. Chan School of Public Health is a new kind of degree program that takes advantage of online technology to meet a contemporary need: accommodating serious learners who cannot easily relocate or set aside normal work hours over a period of months to complete a traditional residential degree program.

Online learning is often portrayed as a solitary activity, but it can also bring learners together. Communities have formed around online courses, whether guided by course leaders or organized by enrollees themselves. Staff at a hospital in India, for instance, decided to take a HarvardX public health course as a group, and a job re-training start-up used an introduction to computer science course as the basis for their curriculum to teach non-coders how to write software.

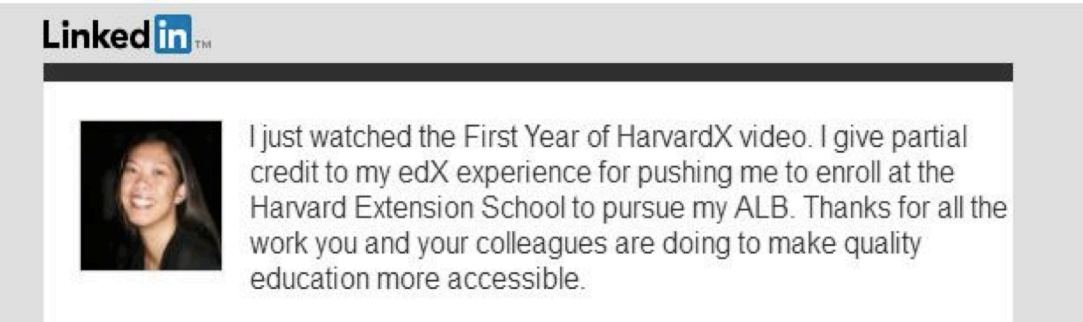
Liberating Learners

From personal growth or gaining the confidence to take on a degree program, to leveraging a MOOC into a career change or even using the materials as a way to train a group of employees, learners use open online content in surprising ways.

A parent of an autistic child taking "Fundamentals of Neuroscience" wrote: "I can hardly believe it, but today I think I've made a major breakthrough in getting my son to communicate better via this course! He is basically non-verbal and very shy about communicating accurately. Yesterday and today I and his teacher actually got him to answer four of the interactive questions not only accurately so we could clearly understand his answers, but correctly as well!"

A professional blogger from *GERM Magazine* enthused about ChinaX: "Professor Bol, I very much hope to sit down with you one day and talk about Lao Tzu … I am here to tell you that you are a rock star. You are touching many people's lives and reminding them that there are no limits to learning. And there are no boundaries to learning communities."

Beyond seeking a community of learners, some are seeking to return to the classroom. A HarvardX learner, so taken by her experience with a HarvardX course, decided to pursue a degree at Harvard Extension School:



According to bbc.com, Pablo Philipps, who worked at a Trader Joe's grocery store, parlayed a Harvard computer-science course on the edX platform into a junior application developer position at St Louis-based Fusion Marketing.

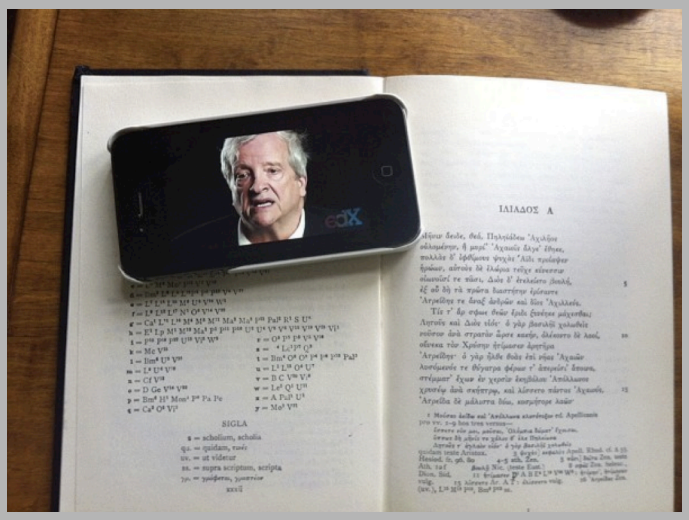
Finally, workers at Piramal Life Sciences—a company based in Mumbai, India that develops pharmaceuticals and medical devices—signed up for the Harvard T.H. Chan School of Public Health courses offered through edX.

The company is using these courses to train its medical personnel, including "Health in Numbers: Quantitative Methods in Clinical and Public Health Research" and "Fundamentals of Clinical Trials" (offered jointly with Harvard Medical School).

Lessons from our faculty

Why do faculty make the time to teach online courses? Among the motivations, they tell us, is the opportunity to expand the reach of their scholarship. In addition, by opening up their classrooms to the world, faculty have an opportunity to share their own pedagogical insights and practices, akin to how they might share research findings.

Remixing Courses



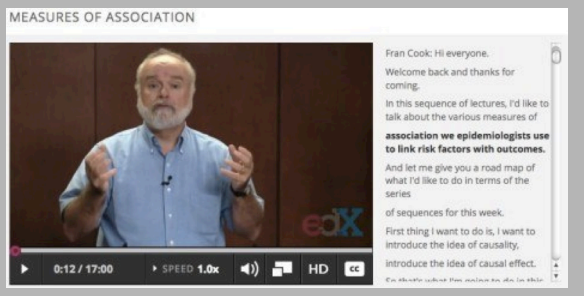
For "The Ancient Greek Hero," Professor Gregory Nagy saw MOOCs as a new channel to share his scholarship in the classics. As of today, Nagy has created a blended version of his campus course using components from his HarvardX course (now in its third iteration); a related book; and for-credit versions through the Division of Continuing Education.

Nagy also drew upon his past students from his on-campus course to serve as teaching fellows in the discussion forums.

Law Professor William "Terry" Fisher, for example, sought to attract a global audience when he created CopyrightX. Unlike many MOOCs, CopyrightX limits enrollment, to 500 learners at any time. That is a modest number for a MOOC, but enough students to qualify as one of the largest courses at Harvard.

Fisher felt that smaller discussion groups were necessary to conduct a case-based course with the quality of a Harvard Law School experience. Now in its third iteration, CopyrightX has pioneered the limited enrollment, open application course model through HarvardX and hosted on edX, an approach also followed by the Harvard Kennedy School's "National Security" course, taught by Graham Allison and David Sanger, the second time it was offered. CopyrightX has generated 18 affiliated but independent satellite learning communities on 4 continents and connected global learners with the on-campus course in regular live discussion sessions. In a similar manner, Regina Herzlinger of Harvard Business

Reassessing Assessments



Teaching a MOOC inspired PH207x professor E. Francis Cook to rethink his approach to teaching:

"I think the 'chunk and test' method we used—in which we present a small amount of material in a few minutes and then provide a few problems or homework sets for the students to gauge their understanding of the material before moving into the next topic—is a great way of teaching … I had believed that the 'brick and mortar' classroom setting—where we sit in a lecture hall and absorb the pearls being cast at us—was the superior experience. Now I see that a good course can be delivered in another way."

School developed "Innovation in Healthcare" to train and connect learners who could join together in global teams to take on major healthcare challenges.

It was an unusually "high-touch" course; Herzlinger spent countless hours developing content and interacting with learners in a much more direct manner than is characteristic of MOOCs.

She tried to bring some of the Business School's focus on learning and results to this worldwide group of learners and succeeded, as she discovered when several of the teams submitted fully realized, credible, business plans.

Perhaps unsurprisingly, by teaching online—and at a scale that dwarfs traditional courses taught even in large lecture halls—faculty are rethinking their teaching methods more broadly. For CS50, for example, David Malan has integrated features developed specifically for the online course into the residential version. Every video tutorial and interactive assessment he developed also supports Harvard undergraduates in his on-campus course. The software, which he designed to give students instantaneous feedback on the quality of their code, is as useful to students on campus as it is to those online.

Likewise, "Visualizing Japan," a collaborative MOOC from Harvard and MIT, offers an early perspective on what residential students find appealing:

> This fall, MIT Professor Shigeru Miyagawa flipped his classroom as he taught two versions of "Visualizing Japan" to two distinctive audiences at the same time. A student comparing the classroom with the MOOC experience calculated that in the lecture classes, the professor spoke 80 percent of the time, while in the flipped classes, he spoke less than 50 percent of the time. The difference wasn't just quantitative; the flipped class increased student participation and led to a qualitatively richer and more immersive educational experience. "I don't think I can ever go back to a pure lecture-style teaching," says Miyagawa. (MIT News)

Blended courses, such as "The Einstein Revolution" (taught by Peter Galison in the spring of 2015) and "Science and Cooking" (first taught by Michael Brenner, David Weitz, and Pia Sorensen in the Fall of 2013), may shed new light on the role of online materials in classroom instruction, since these efforts were designed by faculty from the ground up to be run in hybrid modes.

Humanities & Hip Hop

Lisa New, who developed "Poetry in America," found the digital tools to be liberating, allowing her to shoot at poets' homes and in the places where they wrote and visited. She was also able to bring guests, including former President Bill Clinton, the rapper Nas, and other public figures and celebrities, to read and comment on the poetry. New sees MOOCs as a way to infuse energy into the humanities: "We have to stop beating ourselves up about how the humanities are dying and instead ask, 'How do we reach all those intelligent people who love language, all those kids who delight in the rhymes of hip hop?'"

Lessons from our research

Much of our early research was descriptive and focused on understanding what kinds of people enrolled in MOOCs, and why. As research on open online learning has matured, our questions have probed more deeply.

A Harvard-MIT study published in March 2015 focused on "participants," excluding the growing percentage of users who register for courses but never enter them, thereby reducing upward bias in widely used estimates of the active MOOC population.

Key insights included the following:

- Overall participation in HarvardX and MITx open online courses has grown steadily, while typically course participation declines after the first time a course is given, and then stabilizes.
- Only a slight majority of MOOC participants seek certification. In a survey, 57% of HarvardX learners who responded indicated their intention to earn a certificate of completion. Although overall MOOC certification rates are low, those learners who *intend* to complete a course do so in much higher numbers.
- Many participants are teachers. Of 200,000 participants who responded to a survey about teaching, 39% self-identified as a past or present teacher.
- Those opting for fee-based ID-verification (confirms that a participant has verified his/her identity through a photo and ID) earn certificates at much higher rates. On average, 59% of learners who made a small financial commitment when they registered for a course earned a completion certificate.

These findings led the research team to identify several strategic opportunities for institutions engaging in MOOCs and related online learning opportunities. If increasing access is a priority, then demographic information about learners can provide a useful baseline (see Image 8) to understand how well, for example, underrepresented and underserved groups are engaging in (and completing) courses and programs.

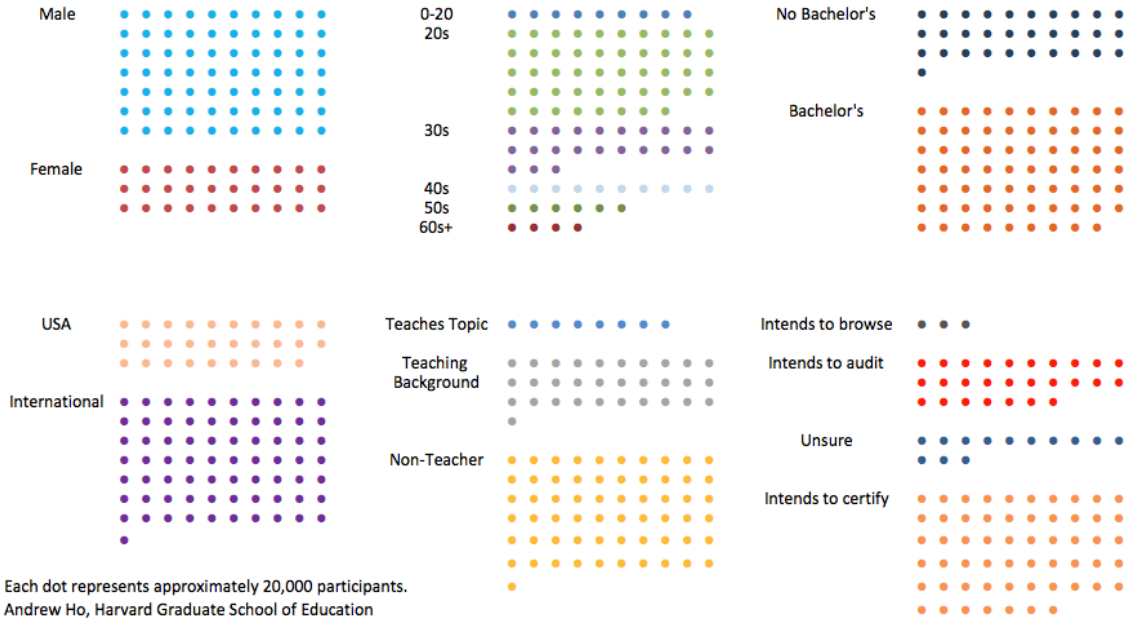


Image 8. If 100 HarvardX and MITx learners sat in a classroom… A visual way to represent MOOC learners, by demographics and intentions.

Harvard's research activities are reflected in online learning scholarship. Our major reports on MOOCS have been widely referenced and downloaded. We have supported learning research by publicly releasing what continues to be the only privacy-protected, de-identified MOOC dataset. The learner dataset has been downloaded almost 4,000 times. Our research team and affiliates have published dozens of articles in peer-reviewed journals and conference proceedings. And a weekly research colloquium started by HarvardX draws between 20 and 40 people from across the university and beyond to discuss the latest findings in data science and online learning research.

The arc from research to practice can be long, but through platform advances, the insights of our research committee, and the support of the entire HarvardX community and our peers at other institutions, we expect to make steady progress. Crucially, our foundation of innovative research and practice in residential education – built by HILT, the Bok Center and others in parallel to our online efforts – has prepared us to translate our online research into improved campus learning in the years ahead.

Looking Ahead

During the past three years of investment and experimentation, we have made substantial, but uneven, progress toward each of our goals. There can be no doubt that we have expanded access to knowledge through our online course offerings, and that we have taken significant steps toward improving teaching and learning on campus. Furthermore, with the development of research capabilities and results of early studies in hand, we have begun to advance our understanding of how people learn. These goals remain as relevant to our mission as they were when we first articulated them, and they continue to guide our decisions. We now face the challenge of building on our experience to make considerably more progress toward our goals. Three areas stand out as deserving special attention in the years to come: economic sustainability, research on learning and teaching, and the translation of that research into improvements in learning, especially in the residential setting.

Supporting Harvard's online learning efforts

Most of Harvard's online course offerings, including HarvardX courses, are free and open, and I do not expect that to change. For students who seek enhanced or personalized experiences that are inherently more costly to produce, we also offer online courses and blended learning experiences that charge tuition. As we continue to pursue our goals for HarvardX, we must keep in mind the diversity of circumstances and aspirations of people who seek online learning experiences as well as the need to sustain our efforts. We have been able to offer free HarvardX courses and modules thanks to the support of generous donors as well as unrestricted University funds, which cannot be sustained indefinitely at current levels. Like nearly every university producing MOOCs and other online course materials, we have begun to experiment with approaches to earn revenue from our online offerings.

Among the approaches that we and other universities are exploring are paid options for learners seeking qualifications, from non-credit credentials (like the ID-verified certificate of completion that edX offers for a nominal cost) to higher-touch

(and higher cost) professional programs. Many online offerings are available in both free and fee-based enhanced versions.

In the past three years, certificate revenue at edX, and within HarvardX, has grown. In addition, online courses are sometimes customized and licensed to institutions and individuals, giving them paid access for teaching purposes. Throughout the University there are already many different approaches to making online content available for a fee. HBX and the Division of Continuing Education, along with executive/professional education offerings, typically charge tuition, as is the case for a predominantly online masters program offered by the Harvard T.H. Chan School of Public Health. Financial aid is available for some of these online courses and programs. Because we and other institutions are just beginning to gain relevant experience, the ways we attract revenue will evolve.

The economic consequences of online learning for Harvard derive not only from the costs we bear in producing online materials and the revenues we receive from them. A full picture of the economics of online learning at Harvard must also include the impact on the costs of on-campus teaching, and the investments of faculty time spent in producing online materials. Although the value of the time and effort of both teachers and learners does not typically appear in formal budgets, it can be substantial. MOOCs, when adapted into blended learning settings, often demand more time from both learner and faculty, as additional or more complicated materials and assessments are introduced, and teachers spend more time managing a multi-modal course. Understanding these costs will be an important part of our research efforts.

The possibility that "learning at scale" would drive down the cost of high-quality education —both online and on-campus—stimulated much of the initial excitement about MOOCs. Those savings remain a possibility; furthermore, online learning and related resources have shown promise in re-allocating faculty and learner time (for other purposes like active learning) and could also alleviate the need to limit class size and accommodate scheduling constraints (more sections, more flexibility for learners). But in education, as in other contexts, technological

innovation does not inevitably reduce expenditures. Much depends on the setting in which it is introduced, and on the goals of those who make use of the technology. The experience to date suggests that MOOCs and related applications of new online learning technology are capable of reducing educational costs, but as some institutions and individuals focus on costs while others place more weight on a diversity of course offerings and improved learning, the economic consequences are likely to vary greatly.

Research in the service of educational innovation

Research is critical to the ultimate success of our experiments in online learning, and at the core of our mission as a research university, but it is all too easy to underestimate both its difficulty and its importance. The edX platform, and our own internal capabilities to conduct research, have matured considerably in the past few years, and now we are poised to approach more ambitious and challenging research designs and topics.

Today the edX platform offers robust support for experimentation and data collection, and many faculty and course production teams have intentionally designed courses to accommodate research. Instructors can use surveys, academic progress dashboards, and analytics to learn immediately where students are stymied and where they are having little difficulty. Faculty can perform randomized "A/B tests" to learn whether one type of assessment, delivery mode, or organization of content is superior to another. More than 20 of these tests have been conducted to date, and more are planned. The large number of students, along with their diverse interests, backgrounds, and goals, facilitate formal and informal experimentation that may be more straightforward and more informative than when conducted in the traditional classroom setting. Popular HarvardX courses like "Science & Cooking," "Introduction to Computer Science" (CS50x), and "Justice" have used such feedback to make major changes in content and learning objectives, both in the online and well-established campus versions.

We realize that we need to do much more. We are optimistic that our efforts will move forward more rapidly with the recent creation of a dedicated research group,

under the auspices of the Vice Provost for Advances in Learning Peter Bol and led by Professor of Government Dustin Tingley. The research group will promote the use of evidence-based research to improve learning design and teaching practices, both on our campus and online. This group will help ensure that our research efforts address important questions with rigor and sophistication, and that they meet the highest standards of ethics, including those concerning privacy protection as well as consent.

Implementing research findings is often surprisingly difficult, yet we have unusual opportunities to do so. First, our role in edX, along with the roles of partner universities, helps ensure that new features whose value is supported by research findings will be become priorities in further development of the platform. The deep involvement of our faculty in all aspects of HarvardX, including the design and conduct of research, makes it likely that the research will be of practical value, and that it will inform their approach to teaching, online and on campus. Second, thanks to HILT (The Harvard Initiative for Teaching and Learning), the Bok Center, and other programs focused on innovation in residential learning, we have learned how to build momentum on campus for new teaching approaches. This capability will be crucial as we translate research results into practice.

Never grow complacent

From the moment we contemplated joining with MIT in creating edX, we knew that any serious commitment to online education would include a commitment to keep improving our technology and our teaching. Our wish list for new and better features – technological and otherwise – for our online offerings is long. For example, we need to improve the mobile learning experience, so that students can make full use of our courses wherever they happen to be. And we need to make it easier for individual learners to pursue courses at times of year of their choosing, freeing up the need to synchronize, if only approximately, with the conventional academic calendar. We need to accommodate students with different backgrounds and abilities, improving assessments of student progress and finding ways to tailor the learning experience to the individual student better. As we add features, we will think of more, and we will think of new ways to approach our teaching. EdX as an

organization, and the open source nature of the platform, facilitates constant improvement, but the effort required will be substantial.

Much of the online learning infrastructure that the University and its Schools have created is cutting edge—for example, HBX is able to conduct a real-time virtual class, teaching by the case method, in which the students have video connections that enable them to see not only the instructor but each other. But technology and its uses in education are likely to evolve rapidly and in unpredictable ways. In a decade, or even in five years, we will surely approach learning in new ways. Harvard faculty will be among the pioneers who create and implement innovations that genuinely transform learning.

We face the future with creativity and excitement, confident that we will continue to improve education at Harvard and beyond, making choices informed by our research, and making judgments informed by the wisdom and values of our community. Our success will be measured by our progress in achieving the goals we laid out: to expand access to knowledge, to improve teaching and learning on campus, and to advance our understanding of how people learn. We have made an excellent start, and now we must continue in pursuit of every one of these goals. They are in tension but not in conflict, because they sit at the very core of Harvard's mission.

I welcome your comments on this white paper and on Harvard's approach to learning and teaching more generally. Please send your reactions and suggestions to provost@harvard.edu.

Words of Thanks

I am deeply grateful to the Harvard faculty, students, staff, and leaders who have devoted their energy and creativity to exploring new approaches to teaching and learning; to our partners at MIT; and to all of our learners who inspire us to keep improving and innovating. Special thanks go to Peter Bol, Erin Driver-Linn, Samantha Earp, Andrew Ho, Dan Levy, Rob Lue, Anne Margulies, and Dustin Tingley for their efforts in guiding the advancement of learning. I also wish to acknowledge the work of Gary Roberts and the editorial efforts of Amy Fantasia and Michael Patrick Rutter, and to thank the faculty and staff who contributed time and expertise to this effort, sharing their experiences, hopes and concerns. They include Graham Allison, Bharat Anand, Fran Cook, Terry Fisher, Julio Frenk, Evelyn Hammonds, Regina Herzlinger, David Hunter, Bill Kirby, Katie Lapp, David Malan, Cherry Murray, Greg Nagy, Lisa New, Nitin Nohria, Marcello Pagano, Jim Ryan, and Mike Smith, among many others. We also owe a great deal of thanks to many people over the past three years who have supported Harvard's online learning efforts, including:

The leaders who established edX: The presidents of Harvard and MIT at the time, Drew Faust and Susan Hockfield, and MIT's then-provost and now President, L. Rafael Reif. Their passion for the possibilities of online learning has helped move the entire field forward. Anant Agarwal, Eric Grimson, Bob Iuliano, Katie Lapp, Anne Margulies, Greg Morgan, Israel Ruiz, Mike Smith, Ian Waitz, and Jim Waldo also played key roles from the beginning.

EdX board of directors and officers (past and present): Anant Agarwal, Manali Bettendorf, Jeff Bussgang, Wendy Cebula, William Eric Grimson, Michael W. Howard, Chris Kaiser, Katie Lapp, Kathleen McCartney, Tena Herlihy, L. Rafael Reif, Israel Ruiz, James Ryan, Sanjay Sarma, Marty Schmidt, James H. Sheehan, Mike Smith, Alan Spoon, Ian Waitz, John Wilton.

HarvardX faculty committee: Bharat Anand, Peter Bol, Suzanne Cooper, David Golan, David Hunter, Gary King, Ian Lapp, Henry Leitner, Robert A. Lue, David Malan, John Manning, David Roberts, Michael Sandel.

HarvardX research committee: Joseph K. Blitzstein, Andrew Dean Ho, Thomas Kane, Gary King, Dan Levy, Bridget Terry Long, Xiao-Li Meng, VG Narayanan, Fernando Reimers, Daniel Schacter, Margo Seltzer, Judith Singer, Dustin Tingley, and Christopher Winship.

Many others on campus, especially staff at HarvardX and Harvard University Information Technology, have contributed to the effort in central ways. It has been a privilege having such a talented and dedicated team to help the University wrestle with some of the most fundamental issues about the future of higher education.

Finally, President Drew Faust has been unwavering in her support of the efforts reported here. Her vision and commitment have fostered an environment of innovation and inspired an ever stronger community dedicated to teaching, learning, and research.