EDUCATION

Open Learning at a Distance: Lessons for Struggling MOOCs

Support for nontraditional students, team-based quality control, and assessment design are critical.

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Free education is changing how people think about learning online. The rise of Massive Open Online Courses (MOOCs) (*1*) shows that large numbers of learners can be reached. It also raises questions as to how effectively they support learning (*2*). There is a timeliness in the introduction of MOOCs, reflecting the right combination of online systems, interest from good teachers in reaching more learners, and banks of digital resources, predicted as a "perfect storm of innovation" (*3*). However, learning at scale, at a distance, is not a new phenomenon. Seeing MOOCs narrowly as a technology that expands access to in-classroom teaching can miss opportunities. Drawing on decades of lessons learned, we set out aims to help spur innovation in science education.

Education based on gathering people together into a physical location is limited to those who can afford it and who make it past the filters that attenuate participation in higher levels of education. Those filters are inevitable on cost grounds; to meet global needs "would require four major campus universities … to open every week" (*4*). The arrival of MOOCs highlights that there are alternatives. With courses enrolling over 100,000 students, MOOCs can reach students who have breaks in study, change where they study, mix study with work, and take at least part of their study online. Such students are now the majority, forming more than 70% of those in U.S. post-secondary education (*5*).

Recommendations for Open Learning

We ought not behave as if learning at scale is unexplored territory and that there is no previous experience in being massive, open, or even online, upon which to build. Distance universities, such as The Open University (OU) established in Britain more than 40 years ago, from their inception, ran courses for thousands of learners, accepted open entry, and led the move into online methods of teaching and learning. In each case, they provide lessons likely to apply in the new context of MOOCs.

Build on distance-learning pedagogy. Some of the steps taken toward "massive" classes simply follow the observation that a lecture presented to a few hundred students can be viewed by many more once put on the Web. But numbers of views and downloads of PowerPoint do not mean learners have engaged. Effective distance-learning pedagogies that lead the learner through tasks have been applied across all subject domains at scales that cannot be achieved in face-to-face classes. A classic challenge for distance learning is "could you teach surgery?" The University of Edinburgh now does just that (*6*). Support built into OU materials, together with support from tutors and assessment, has enabled 1.6 million people (*7*) to complete university level courses without the need to meet initial entry requirements. Teaching at a distance combines media to motivate and enthuse, including television programs broadcast through the BBC, experiment kits both physical and virtual, and online simulations and case studies. "Exploring Science" introduces science to 4000 students each year with virtual field trips, and the Open Science Laboratory builds a collection of tools to combine remote access, virtual experiments, and citizen science (*8*) into the curriculum.

Advice: Interactions between student-teacher, student-student, and student-materials all can act to support learners (*9*). Paying attention to the content, and building materials that do the teaching (*10*), allows direct contact between teacher and learner to be reduced. Structured tasks guide the learner. Working online offers the chance to build in interactivity. Presentation using video or broadcast is adjunct and motivates; it is not the core. On the other hand, carefully constructed text-based material can feel to the student as if it is speaking to them. Then, using multimedia can build further ways to engage learners in science.

Plan to help learners who need support. "Open" is not the same as "free." Openness means accepting those who want to learn as well as those ready to learn. Learning is challenging, so helping students is essential. Some people will manage on their own, but that is not enough for genuinely inclusive education. The self-paced, location-independent properties of online learning make it attractive to the marginalized and those with disabilities (*11*). Rapid fall-off identified in many MOOCs (*12*), where only 10% of those who register may complete the course, reflects retention challenges. How we approach support for learners influences retention. Early contact with a tutor prevents drop out, and student attitudes toward the tutor matter (*13*). For large-scale operation, tutors focus on effective and timely feedback to learners. Support is particularly important as activities start; submission of the first assignment predicts eventual success with a course.

Advice: A vital step in coping with accessibility is to recognize the importance of support and the feeling of being supported. The human touch can operate at a distance. For example, the Mechanical MOOC allows

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(semi-)automated contact. Synchronous events and analytics can let learners know how they are performing. Assisting those who have difficulty learning requires skills and is hard to achieve at no cost; focus attention on initial support and feedback for greatest benefits.

The power of well-designed assessment. Once online, assessment often becomes the main driver and route for feedback to students, offering pacing and control. With the appropriate approach to assessment, online education need not be a lonely activity. Rather, it offers ways to work collaboratively and benefit from peer interaction (*14*) and offers scope to take part in real-world activities. Such authentic assessments (*15*) can also provide evidence that can be shared. For example, the Evolution MegaLab and Cosmic Genome Project provide both learning opportunities and new sources of data across a large, global scale.

Advice: Place as much importance on designing the assessment as developing instructional content. Leading with questions and helping learners understand what makes a good answer will shape their approach to learning and path through content. Build in responses that give feedback designed to ensure understanding, and feed-forward that helps the learner face the next challenge. Marking achievements—for example, with badges (*16*)—gives ways for learners to value the experience; even if they cannot continue, there is no need for them to feel that they have failed. Learners can be encouraged to act as real scientists. Recognizing and supporting the increases in skills and gains in reputation that they make in the science community will then help them engage and sustain interest.

Ensure quality by working together. Building courses in the open means that mistakes happen in public. Quality assurance is essential. One technique for quality, imported by the OU from a long-term relationship with the BBC, is that material is "fit for broadcast," applying editorial consistency measures and validation of content. Another technique, a multidisciplinary team approach, ensures scrutiny from a range of views, with media and educational technology specialists who design the learning experiences working alongside academic specialists who bring the knowledge of science teaching. As technology or pedagogy is added, it is tested and checked against usability and accessibility requirements. These aspects are incorporated into the design and approval process (*17*). The team-based approach is being recognized by those from campus-based roots, including innovative approaches to include graduate students in development (*18*).

Advice: Quality measures are expensive and under pressure to change as courses become shorter and the half-life of latest information and tools is reduced. The overall model, though, is robust: Set quality levels, work in teams, and test before your learners do. These can be adjusted, with increased speed leading to increased risk. Steps to simplify content, minimizing rather than removing quality checks, and allowing feedback after release, help speed the process (*19*).

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The Future for Open Education

Classic models of education cannot meet all our needs. Simply transferring those models online is not the most effective approach to open education. We need new approaches that can operate at low cost in the open. The current generation of MOOCs are already providing some benefits, their global reach finding enthusiastic learners. But MOOC providers have been criticized for their elite model, lack of reliability, low proportions of learners completing courses, and overall pedagogy (*20*).

Distance education has tackled the challenges of learning science at scale through techniques such as simulated practical work and access to remote laboratory facilities. The emergence of "citizen inquiry" activities is promising, leading to ideas of crowd learning (*21*), combining elements of inquiry learning and cyberscience (*22*). The challenges are to make such opportunities for informal learning bring lasting benefits.

Our advice on implementation of open online courses should help build large-scale open learning. Completely open operation online also brings new aspects. For example, using effective open licenses, such as Creative Commons, allows us to share the ways we develop teaching, as well as giving clear permissions to learners. We need to study these new contexts to find out more about motivations for participants, how to scale up to genuinely massive access to learning, and how best to assess learning. The opportunity for experimentation gives us the chance to learn more ourselves, as well as to educate others.

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