CHAPTER 3

Teaching and Learning at Scale: Futures

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In this chapter, Rebecca Ferguson considers recent work toward the vision 'Teams can successfully teach any number of students at a distance', showing how a substantial body of TEL research work can be built up over time, responding to changes in society. In particular, she demonstrates how continuing work towards this vision relates to the emergence of massive open online courses (MOOCs) and, more broadly, to teaching and learning at scale. She shows how the different elements of the Beyond Prototypes framework, and its emphasis on bricolage and persistent intent, can be used to support the development of a research agenda that supports practice worldwide. She also looks at current and future work in this area, identifying key areas where work is still needed – learning design, educator teams, widening access, approaches to assessment and accreditation, and new forms of pedagogy.

Introduction

In 2015, world leaders attended a United Nations Sustainable Development Summit in New York, where they formally adopted a new sustainable development agenda, setting goals to transform our world. One of these goals is quality education, and a target to be achieved by 2030 is to 'ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university'.

This is an ambitious goal, particularly in the light of the numbers involved. Three years before the world summit, Daniel looked at the rapidly increasing demand for education in a world where, today, more than a quarter of the population is aged under 15 (The World Bank, 2018)

> *there are 165 million people enrolled in tertiary education […] Projections suggest that participation will peak at 263 million […] in 2025. Accommodating the additional 98 million students would require more than four major campus universities (30,000 students) to open every week for the next 15 years.* (Daniel, 2012)

This hasn't happened. Major campus universities aren't opening every couple of days. However, a phenomenon that grabbed the world's attention seemed to be the answer – massive open online courses (MOOCs). What had begun as a Canadian experiment in teaching and learning (Cormier, 2008), suddenly hit the headlines. These online courses, often from top-ranked universities, were openly available, which typically meant that they could be accessed free of charge by unlimited numbers of learners. The *New York Times* declared 2012 The Year of the MOOC, observing that 'more than 150,000 signed up for Dr Thrun's "Introduction to Artificial Intelligence" last fall, starting the revolution that has higher education gasping' (Pappano, 2012).

The stated aims of early MOOC providers related to the challenge of extending access to education. The original MOOCs had been designed to increase participation in lifelong learning (McAuley, Stewart, Siemens, & Cormier, 2010). The mission statement of the Coursera platform was 'to empower people with education that will improve their lives, the lives of their families, and the communities they live in'. The founder of the Udacity platform was

> *against education that is only available to the top one per cent of all students. I am against tens of thousands of dollars of tuition expenses. I am against the imbalance that the present system brings to the world. I want to empower the 99 per cent'* (Leckhart & Cheshire, 2012).

World-class teaching available, free of charge, for everyone, everywhere in the world? It seemed too good to be true – there had to be a catch.

In fact, there were several. The most widely publicised was the drop-out rate. The percentage of enrolled students who completed a MOOC varied widely but, typically, about seven students of every eight who signed up for a course did not reach the end (K. Jordan, 2015). This isn't necessarily a problem – a MOOC can be regarded as a resource, like a newspaper, that most people will never complete (Downes, 2014). However, the wide variation in completion rates – from a low of less than one student in forty to a high of more than half of students – suggested that there were other factors at work (K. Jordan, 2015).

There were other problems as well. Problems with funding – good quality MOOCs turned out to be expensive to produce. Problems with revenue generation – even the original low-budget MOOCs based on connectivist principles required server space and staff time. Problems with pedagogy – enormous class sizes hit the headlines but offered no clear benefits for learners. Problems with technology – even in the affluent west, not everyone has access to personal computing devices and the Internet. In fact, there were problems to be addressed that related to every element of the *Beyond Prototypes* framework: policy context, environment, funding, revenue generation, educator community, technology community, learner community, researcher community, ecology of practices, technical context, pedagogy and technology (Ferguson, Sharples, & Beale, 2015; Scanlon et al., 2013).

It was apparent that MOOCs – or, more broadly, learning at scale – didn't offer a magic pill that could quickly remedy a chronic shortage of access to higher education. In fact, it wasn't clear that this was the vision that was guiding the development of most MOOCs. Universities were more interested in using them to enhance the reputation of the institution, to develop staff skills, or to add value to accredited courses (White, Davis, Dickens, León Urrutia, & Sánchez-Vera, 2015). In addition, studies of the first wave of MOOCs suggested that learners were mainly people with prior experience of higher education, and found little evidence that MOOCs were widening participation for those distanced from education (Cannell & Macintyre, 2014).

From the perspective of The Open University, MOOCs had the potential to align with its mission to be 'open to people, places, methods and ideas'. They also promised to be a way of achieving its goals of promoting educational opportunity and social justice. The vision that 'Teams can successfully teach any number of students at a distance' was already an intent that the university had been pursuing persistently for decades. Making the connection with this intention meant that researchers at The Open University were able to build on previous work, using MOOCs as a way of working towards that goal.

Persistent intent

'Teams can successfully teach any number of students at a distance' was initially a vision for one university. The scope of the vision expanded as increasing numbers of learning institutions worldwide adopted online and distance learning. The possibilities opened up by new technologies led to further expansion, taking into account the growth of open educational resources, social media, and open learning on platforms such as YouTube and iTunesU.

This experience meant that researchers at the OU did not approach MOOCs as a completely new phenomenon. Instead, they were able to engage in a process of bricolage, bringing in their experience of investigating open learning, large-scale citizen science projects, and the use of data to support learning and

teaching. The new feature offered by MOOCs was not that they were open, or online, or courses. The new feature was that they were massive.

'Massive' needs some explanation in the context of a university with decades of experience of teaching many thousands of students on the same course at the same time. MOOCs were massive in that they were designed to be accessed by unlimited numbers of students. In some cases, tens of thousands enrolled, and in some cases only tens, the 'massive' label was determined by design rather than by enrolment figures. Platforms and media tended to present this scale in terms of potential economic benefits. Large numbers of people could be exposed to the same curated set of resources and gain access to teaching materials assembled by well-known universities. Fewer trained educators were, potentially, required to educate greater numbers of learners (Sharples & Ferguson, 2014).

This brought a new perspective to the vision that 'teams can successfully teach any number of students at a distance'. Previous research in this area had focused on distance education at university level, in a context where students either paid for their education, or had that education paid for. Taking on more students meant taking on more staff to act as tutors, mentors, facilitators, assessors, and examiners. In a setting where learners could complete a course free of charge, new approaches to pedagogy were required, as well as attention to learner and educator communities, and the ecology of practices around MOOCs.

Pedagogy at scale: conversational learning

Many approaches to teaching and learning – such as sports coaching and personal tuition – are designed to work with a limited number of learners and do not scale. Only a few pedagogies can be used with cohorts that may range from tens of learners to tens of thousands. Lecturing is one such approach. As long as learners are able to hear the lecturer and see the presentation, the experience is broadly similar for any number of students. However, students gain little by being part of a large cohort and are unlikely to be able to ask questions to increase their understanding.

Another approach is the OU's model of supported distance learning (Price & Petre, 1997). As learners work through their studies, they are supported by many teams of academic and administrative staff, as well as by associate lecturers who provide personalised study support and feedback. This model scales successfully, and opens up opportunities for collaborative and social learning, but providing this level of support is expensive.

An alternative approach is conversational learning. This not only works at scale, the conversations become richer as more learners are involved.

The FutureLearn MOOC platform was set up in 2012–13, based on a conversational learning pedagogy that draws on decades of work within the OU. Learning through conversation relates to the theory of how learning takes

place that was developed by Pask (1976). Pask provided a scientific account of how interactions enable a process of coming to know by reaching mutual agreements. This is more than an exchange of knowledge – it is a process in which participants share and negotiate differences in understanding with the aim of constructing new knowledge and reaching agreements. These conversations may involve other learners or may take the form of internal reflections. In order for either to happen, 'learners must be able to formulate descriptions of their reflections on actions, explore and extend those descriptions, and carry forward the understanding to a future activity' (Sharples & Ferguson, 2019).

Laurillard (2002) built on Pask's work when she developed her influential Conversational Learning framework. Discussions take place at two levels: actions and descriptions. Learners need to agree on clear goals and objectives at both levels.

- At the level of actions, discussion relates to a practical activity or model of the world. Learners ask 'how' questions, sharing their experiences and interpretations.
- At the level of descriptions, learners ask 'why' questions, putting forward and questioning interpretations in order to reach agreement.

The educator plays an important role throughout the process: suggesting goals, designing relevant activities and models, facilitating discussions, and encouraging reflection.

These understandings of how learning takes place, and how it can be enriched at scale, were built into the FutureLearn platform from the beginning and continue to inform technical and organisational developments. For example, a distinctive element of the platform is that, except in the case of assessment, every piece of learning material has an associated area for conversation. Because conversation takes place alongside content, it becomes part of the learning materials, rather than a separate activity that requires extra work to access and is likely to be disregarded. Some steps are designed as discussions, providing opportunities for learners to explore differences in conception and reach agreements. These discussions can be set up by educators in ways that encourage learners to share perspectives, synthesise new knowledge, and reach agreements.

Pedagogic research community

Using decades of research to support the development of a platform that currently has more than ten million registered learners worldwide was a very positive outcome for this line of work but was not the end of the process. More research was needed – and with learning taking place on a grand scale, a larger pedagogic research community was needed to support and develop the process. This requirement led to the formation of the FutureLearn Academic Network

(FLAN), an association of people carrying out MOOC-related research at FutureLearn's partner institutions (by mid-2019, FutureLearn had more than 160 partners around the world, including universities, specialist organisations, and centres of excellence).

A 2016 review of research work by a sub-section of these – FutureLearn's UK university partners – covered 109 publications and identified priority areas for future research. These included:

- develop educator teams
- identify and share effective learning designs
- support discussion more effectively
- widen access
- develop new approaches to assessment and accreditation
- develop appropriate pedagogy for learning at scale.

The following sections consider each of these research areas and relate them to the vision that 'teams can successfully teach any number of students at a distance'.

Develop educator teams

The educators responsible for leading work on MOOCs are typically university faculty members. Despite their expertise in research and in face-to-face teaching, they may have little or no experience of teaching at a distance, online, or at scale. Nevertheless they are faced with a series of difficult educational decisions and need research evidence that can help them to make decisions about issues as diverse as assessment, engagement, motivation, design, and accreditation.

While tackling these questions, educators are also adapting to a new role. They are likely to become increasingly aware that their traditional role has been 'unbundled' and that the tasks of designing a course, locating resources, presenting a course, assessing students' work, and supporting the students are carried out by a variety of people with different skills. Research-based evidence has the potential to help them make that move from lone educator to part of a distributed team.

Broadly speaking, teaching roles on FutureLearn fall into three broad categories: educators, mentors and collaborators (Papathoma, 2019).

- **Educators** typically work in academic roles at a university. Whatever their substantive job, they are likely to be involved in a MOOC because of their subject-matter expertise.
- **Mentors** are sometimes described as facilitators. This is a role that is often assigned to doctoral students. There may be an assumption that mentors have less experience and less subject matter expertise than educators. They

are likely to be involved in a MOOC in order to engage in learner discussion in some way.
- **Collaborators** support learning activity but are not expected to be directly involved with learners. Collaborators are typically not faculty members but are likely to work in academic-related jobs as, for example, learning designers, librarians, or managers of learning teams.

Each group brings different skills and perspectives to their teaching role on the MOOC and faces different sets of challenges. Ideally, individuals in each role work together seamlessly, drawing on each other's expertise. However, this way of working does not come automatically and is difficult to develop when time is limited, and team members do not necessarily meet each other or interact frequently.

Teams involved in course development need access to both practical and academic expertise. They must be aware of the team's responsibilities and the constraints under which both it and its individual members are working. To develop a course effectively, teams have to be willing to agree ways to negotiate these constraints. This means that professional learning 'is a critical component of the ongoing improvement, innovation and adoption of new practices that support learning at scale' (Papathoma, Ferguson, Littlejohn, & Coe, 2016, p1).

Successful teams involved in teaching on MOOCs (Papathoma, 2019) give explanations for aspects of teaching, developing shared vocabulary and understanding of the teaching process. They reflect on the process and explain aspects to each other, building new, shared knowledge that can be structured and recorded to support the development of subsequent MOOCs. If these opportunities are not built into the process, individuals have to deal with uncertainty and are forced to spend their time solving problems, searching for individuals with relevant expertise, and looking for helpful examples of previous practice.

Identify and share effective learning designs

Previous practice in learning design is an aspect of professional knowledge that can be shared between academic departments and institutions. As Chapter 7 will explain in more detail, learning design provides a way of sharing teaching ideas in order to improve student learning, helping educators to become more effective in their preparation and facilitation of teaching and learning activities. Design patterns provide a way of showcasing successful learning activities and design innovations, as well as making clear which approaches do not work.

Design patterns also provide ways of sharing solutions to problems that are commonly encountered when designing MOOCS. For example, Wintrup, Wakefield & Davis (2015) note that dropout is a concern with MOOCs, and that there is a need to identify measures that can be put in place to reveal what aspects of a course engage learners, and how particular activities engage

different types of learner. Part of the solution might be to make an up-to-date recap of each MOOC available at any time so that new joiners can catch up with others (Nazir, Davis, & Harris, 2015). Another part of the solution might be to minimise distractions that do not support design objectives by organising resources, enabling creative expression in tasks, automating mundane tasks, supporting scale and sustainability, and focusing on learning (Celina, Kharuffa, Preston, Comber, & Olivier, 2016).

A review of published research from FutureLearn partners in the UK (Ferguson, Coughlan, Herodotou, & Scanlon, 2017; Ferguson, Herodotou, Coughlan, Scanlon, & Sharples, 2018) identified design patterns that appeared promising or had proved successful in the context of MOOCs. Some of these were brought together by Wintrup and her colleagues: providing guidance about ways to apply new knowledge to 'real world' problems can be helpful in deepening and sustaining understanding and promoting creativity, including and eliciting learners' own ideas and projects is also a way of developing greater involvement, games provide a useful way of introducing difficult concepts to learners (Wintrup et al., 2015).

Liyanagunawardena, Kennedy and Cuffe (2015) organised a series of workshops to explore MOOC design principles. In particular, they considered the challenge of promoting peer discussion and interaction when the size and diversity of a cohort and its patterns of participation mean that discussions become difficult to navigate and are likely to remain superficial. They identified seven design narratives that captured and interpreted the experience of MOOC designers. They then drew on these narratives to create design patterns that offered solutions to challenges commonly encountered when designing MOOCs. For example, the 'Look and Engage' design pattern provides a solution to the problem of 'How to structure peer communication and collaboration to support the sharing of ideas to stimulate meaningful dialogue and interaction among large, diverse groups' (p12). The pattern involves creating 'an individual collaborative task around a digital artefact to stimulate meaningful dialogues among large, diverse groups' (p10). 'Look and Engage' draws on three design narratives that deal with scaffolding interaction, easy co-construction, and sharing views.

Hatzipanagos (2015) went a step further, not only identifying design patterns used in MOOCs but also relating these to patterns used elsewhere, beginning to build the links between designs that can reveal underlying similarities between courses. For example, he related the pattern 'Computer-mediated communication media (fora)' to a previously identified 'crowd bonding' pattern, summarised as 'forming discussion groups to facilitate interaction for learning'. By making connections in this way, he demonstrated ways in which patterns could be used to access previously developed guidelines, advice, and practical examples.

Work on identifying and sharing effective learning designs demonstrates how TEL innovations are built over years, pulling together available resources

in a process of bricolage. Educators around the world face similar challenges. How can dropout be reduced? How can peer communication be structured to support meaningful dialogue? They explore solutions in different contexts with different student populations. Researchers identify and publish solutions, but these are distributed across a wide range of literature and not easy to access. Research groups, such as the FutureLearn Academic Network, then work to pull together the challenges and solutions.

A different stream of work, on learning design, provides a way of structuring these challenges and solutions as design patterns that can be brought together and shared. At the same time, work on opening up research and education makes it increasingly acceptable to share work openly, rather than restricting it to journals hidden behind paywalls. As a result of these separate strands of work, the European bizMOOC project was able to create and openly share its *MOOCBook,* which brings together 50 key lessons, 25 key recommendations, and 20 good practices derived from extensive empirical research (BizMOOC, 2019).

Support discussion more effectively

One of the challenges when designing MOOCs is how to provide effective support for discussion. This is crucial when a course design is based on conversational learning. It is also more broadly applicable. The earliest distance education courses, which relied on published or posted material, offered little or no opportunity for discussion. They were based on a transmission model of education, which assumes an existing body of knowledge that can be transferred from one person to another, with assessment providing opportunities to check that the transfer has been completed successfully.

One problem with relying on a transmission model alone is that separating learners and teachers in time and space creates a space of potential misunderstanding, or 'transactional distance' (Moore, 1973, 1993) as noted by McAndrew in Chapter 2. The possibilities for reducing this space for misunderstanding increased when new communication technologies made it possible for distance learners to interact with each other and with educators. Most of this interaction was asynchronous, with no expectation that participants in a discussion would all be engaging at the same time. These new technologies, such as forum discussion, opened up opportunities for learners to engage in the active construction of knowledge together, as well as working to understand existing content.

However, online and offline interaction are not the same. Some types of interaction that commonly take place in the classroom are much rarer online, even though they shape learners' expectations of how interactions with teachers will take place. For example, a typical exchange between teacher and student in a face-to-face classroom involves initiation, response, and follow-up (Sinclair &

Coulthard, 1975). The teacher asks a question, students recognise that this is not a request for knowledge but a test of their own knowledge, one or more of them responds, and the teacher evaluates or extends those responses. Learners who expect educational discussions to take this form often struggle to see the value of conversations in forums or MOOCs where there is no teacher evaluating or extending their contributions.

Conversations in online environments share several characteristics that distinguish them from face-to-face conversations. Some of these are negative. It isn't necessarily clear who is taking part in the conversation, who is reading without posting, how much of the conversation any one person has read, and in what order they encountered it. Some students find online discussion intimidating and are nervous about contributing (Ferguson, 2010). On the positive side, asynchronous communication offers time to reflect before contributing, a transcript of the entire discussion, interaction at a distance, and opportunities to share direct quotations, references, and links to external resources (Ferguson, 2009).

With research on the benefits and challenges of social learning and online discussions already in place, MOOC researchers were able to focus on the practicalities of involving people in discussions. As a significant percentage of learners in any MOOC will not have studied online before, it's important to encourage good practices through providing guidance and examples. Good practices include the use of inclusive language, treating different viewpoints with respect, and encouraging social interaction that will support learning (Murray, 2014; Wintrup, Wakefield, & Davis, 2015; Wintrup, Wakefield, Morris, & Davis, 2015).

More detailed work is now being carried out to investigate ways of supporting interaction. The large number of comments posted in many MOOC discussions can disguise the fact that relatively few meaningful conversations are taking place. Many learners receive no response to their comments, which means they are unable to take part in the development of shared understanding. To some extent, the likelihood of response is based on the time of posting and on the nature of discussion. However, keyword analysis has shown that there are also linguistic factors at work. Posts that receive responses are often phrased as questions. They use non-specific pronouns such as 'anybody' or 'anyone'. They also hedge rather than making definitive statements, using words such as 'perhaps' and 'seems' (Chua, 2018). Work like this can be used to support guidelines for MOOC participants, and the models of interaction provided by MOOC educators.

Adult learners and educators typically have extensive experience of how educational interactions work in a face-to-face environment but may have little or no experience of how this can be done effectively online. Different strands of work, relating to appropriate pedagogies, learning design, and discussion can be combined to develop best practice, based on research and experience.

Widen access

Best practice is needed, because MOOCs do not currently provide learning opportunities that are suitable for everyone. Although we are making good progress towards the goal, 'Teams can successfully teach any number of students at a distance', more work is needed on inclusion and accessibility. This is particularly important, given that the original vision for MOOCs was that they could open up high-quality education to groups who had previously had no means of accessing it.

One aspect of widening access is reaching learners in areas that currently offer few opportunities for higher education. However, online learning is not necessarily the answer when some four billion people around the world still do not have access to the Internet. Global access would need to include regions that have poor infrastructure, low digital capability, unreliable electricity supplies, limited digital capability, and that currently lack capacity to train all teachers to a high standard. It would also have to take on the challenge of providing equal access to resources in countries that have multiple official languages and diverse ethnic communities (Littlejohn & Hood, 2018).

These are not new problems. Two long-term projects have investigated some potential solutions. The Teacher Education in Sub-Saharan Africa (TESSA) project launched in 2005 at the request of teacher education institutions throughout the region, and its success led to the creation of a sister programme, TESS-India. Both projects have at their heart resource banks of materials to support teacher education. These take into account the cultural diversity of the regions involved, and are available in multiple languages, in both printed and digital formats, online and offline (Wolfenden, 2008).

The TESS-India MOOC, which ran on the EdX MOOC platform, was able to build on more than a decade of research and experience. It was designed to introduce the idea of open educational resources (OER), and particularly the TESS-India OER to teacher educators. The rationale for working with this group was that these professionals have the opportunity to initiate significant changes in teaching and learning across the region if they have access to relevant training and resources (Stutchbury, 2016).

Due to the low bandwidth for internet connections across much of India, the TESS-India MOOC was not run wholly online. It included weekly contact classes in all the project's target states. This face-to-face contact supported the development of local communities of practice (Stutchbury, 2016). As a result, community members were able to support each other to extend and implement what they had learned. The learning design was also successful in supporting retention. The MOOC ran in English in late 2015 with over 10,000 people registered. Of these, 51% completed the course, with 81% of completers from the states where face-to-face support had been available. A second iteration the following year in Hindi attracted over 33,000 participants, of whom 52% completed the course (Wolfenden, Cross, & Henry, 2017).

Even when MOOCs are available in a relevant language, culturally appropriate, and suited to available technology and infrastructure, problems remain. MOOCs offer few opportunities for personalised interaction with an educator, which means that most people who sign up for MOOCs are responsible for regulating their own learning. Self-regulation requires a set of skills that take time to develop – many of which students are typically not expected to demonstrate until university level. These skills include time management, help seeking, strategic planning, goal setting, reflection, and self-evaluation. Most people initially find it challenging to apply this set of skills to their learning. This is particularly true when they are used to a teacher doing much of this work for them and they have not been supported to develop these skills for themselves.

Some of the variety of learning behaviours of MOOC participants relates to their ability to regulate their own learning (Littlejohn, Hood, Milligan, & Mustain, 2016). For example, those who score low on a measure of self-regulated learning focus their goals on traditional performance measures such as passing assignments and completing the course, while those who score higher are more interested in developing relevant knowledge and expertise. Participants with low scores are likely to be focused on the MOOC and its requirements, while those with higher scores for self-regulation are more interested in how they will use what they have learned (Littlejohn et al., 2016). This suggests that if teams want to be able to 'successfully teach any number of students at a distance' then they need to make sure that those students are prepared to take an active role in regulating their own learning.

They also need to make sure that the courses they offer are accessible. There are four key aspects to MOOC accessibility: learning design, technical elements, user experience, and overall quality (Iniesto, McAndrew, Minocha, & Coughlan, 2019). Universal design, an approach that considers how to meet the needs of all learners through design, provides a helpful starting point (McGuire & Scott, 2006). Technical accessibility can be shaped using the Web Content Accessibility Guidelines (WCAG) published by the World Wide Web Consortium, the main international standards organisation for the Internet. These guidelines focus on whether material is perceivable, operable, understandable, and robust. From a user-experience perspective, the activities within any MOOC need to be feasible for learners with a range of accessibility needs. More broadly, a quality audit can be used to scrutinise accessibility in terms of staff and student support, as well as curriculum design, course design and delivery, and assessment (Iniesto et al., 2019). Accessibility more generally in educational technology is discussed in the next chapter.

Develop new approaches to assessment and accreditation

Assessment and accreditation have a role to play in widening access to education, so they are important aspects of supporting learners in large-scale

environments. MOOC participants who already have degrees or even post-graduate qualifications may enjoy informal study for the love of learning, but some form of accreditation for study is particularly important for those who do not already have the qualifications that will help them to acquire a job or develop a career.

In order to cover costs, many MOOC providers now charge for credentials and certification and do not make the entire learning experience freely available. This modified approach retains an open element – MOOC participants have the opportunity to study material without charge – but credit for that study comes as an optional extra that requires payment. Another shift away from openness is that the major MOOC platforms now offer courses that are only available to those who pay, challenging notions that an open course offers access for all or free education (Littlejohn & Hood, 2018).

Following a review of research by MOOC-providing institutions across the UK, Ferguson and her colleagues (2017) recommended that MOOCs should provide transparent information about accreditation to learners, institutions and employers; that MOOC providers should consider ways of supporting credit transfer; and that providers should also supply guidance to MOOC learners for recognition of non-formal learning, as awareness of the available options is currently limited.

Badging is one way of supporting the route from assessment to accreditation (Law & Law, 2014) without a charge to the learners. Open badges have two elements: an online image containing a hyperlink to course criteria, and online evidence that these criteria have been met (Cross, Whitelock, & Galley, 2014). Badges can be used as incentives to continue study, as a way of marking progress, as an informal means of accreditation, or as staging posts on the journey to more substantial learning goals (Hauck & MacKinnon, 2016). They can be used to reward achievement at marked points on a learning journey, to reward effort in terms of hours put in or activities completed, or they can reward exploration and deeper learning (Cross & Galley, 2012). Not simply a means of accreditation, badges can function as motivator, meaning maker, signifier of learning objectives, low-cost or low-effort option. They can be used as a way of valuing certain forms of engagement, a symbol of identity, a means of association, or an element of empowerment. They also have roles to play in encouraging engagement and limiting withdrawal (Hauck & MacKinnon, 2016).

Closely associated with accreditation is assessment, which plays a crucial part in learning and teaching. Expert feedback is a valuable part of the learning process, but it takes effort to produce. Skilled assessors come at a cost and their availability is limited. Together, these factors make assessment a particularly challenging aspect of learning at scale. Producing high quality feedback is not an activity that scales easily. MOOCs therefore need to make use of the full range of computer-based assessment options. These currently include selected responses (such as multiple-choice questions); constructed responses (in which learners construct their own responses); essays and short-answer

questions; peer assessment; and online tools that can be used to showcase work, including e-portfolios, blogs and wikis (Jordan, 2013). None of these options is new, but as these forms of assessment play an important part in learning at scale, more work is needed to explore how they can best be implemented and validated.

Peer review offers a way of providing feedback on student work that cannot be assessed automatically. It also provides a learning experience for the reviewer, who has to think carefully about the criteria and how they are applied. However, work on supporting and structuring peer review at scale in an international context is still in its early stages (Meek, Blakemore, & Marks, 2016; O'Toole, 2013).

Another form of assessment that is commonly used in MOOCs is the multiple-choice quiz. These can be helpful in providing formative assessment and helping learners to assess their understanding, as long as educators are skilled in their design and implementation. However, unless multiple-choice questions are underpinned by extensive question banks, there is the danger that answers will be shared online, making them unsuitable for summative assessment. There is a need to build on what we already know about e-assessment (Jordan, 2013), so that appropriate forms can be built into pedagogy at scale.

Develop appropriate pedagogy for learning at scale

As learning at scale is taken up more widely and in new contexts, appropriate pedagogies are required to support this work. Conversational learning is one pedagogy that has already been incorporated within MOOC teaching and MOOC platforms, but there are other pedagogies still to be explored, including adaptive teaching, experiential learning, game-based learning and inquiry-led learning (Sharples & Ferguson, 2019).

One reason for developing new pedagogies is the increasing use of MOOCs to support workplace training, job readiness, and continuing professional engagement. Workers are looking for forms of personalised learning that align with their specific learning needs. They also need to develop skills and strategies that enable them to deal with the ill-structured problems under various levels of uncertainty that they are likely to encounter in their workplaces (Littlejohn & Hood, 2018).

Pedagogies that have been developed in other contexts and could be adapted for use at scale include: social learning to share workplace knowledge, coached team learning to develop and practise skills, case-based learning for problem solving and decision making, experiential learning to capture and reflect on shared experience, and competency-based learning to achieve and demonstrate mastery. Once again, there are opportunities to build on extensive previous work and to make use of recognised good practice.

Conclusion

'Teams can successfully teach any number of students at a distance' is one of the visions that has guided educational research at The Open University for the past forty years. As this chapter and the previous one have shown, over that time great progress has been made towards that vision. Online courses at The Open University and other institutions have successfully taught hundreds, even thousands, of students on formal courses for over two decades. Over the last fifteen years, the availability of open educational resources, and informal learning opportunities such as OpenLearn and iTunesU, have increased their scale and scope. Citizen science projects involving hundreds of thousands of people run on an international scale, providing opportunities to learn about the scientific method and to put it into practice to generate new knowledge.

The arrival of MOOCs on the scene was part of this expansion of educational opportunities, and researchers were immediately able to start making connections between this new format and previous decades of experience. The landscape of learning at scale continues to change. New providers emerge, their business models associated with new challenges and opportunities. By looking beyond the different formats and models to a vision of what can be achieved in the future, it is possible to identify and work towards objectives that make that vision achievable, focusing on teams, learning design, access, assessment, accreditation and, perhaps most important, the pedagogy that shapes these opportunities.

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