

Innovative Pedagogy at Massive Scale: Teaching and Learning in MOOCs

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Abstract. This paper looks at the implications for pedagogy of education at a massive scale. It begins by looking at educational approaches designed or adapted to be effective for large numbers of learners: direct instruction, networked learning, connectivism, supported open learning, and conversational learning at scale. It goes on to identify benefits and the challenges of teaching and learning at scale. A grounded approach was used to analyse data from 18 MOOCs run on the UK-based FutureLearn platform. This identified benefits and challenges for learners, for educators and for society as a whole. These need to be addressed in two ways, through learning design and through platform design.

Keywords: MOOCs, pedagogy, massive scale, open learning.

1 Introduction

By definition, MOOCs are intended to offer effective online learning that is also open and massive. It has previously been difficult to achieve these three aims simultaneously: learning through mass public media is limited in its effectiveness, and successful large-scale online education is expensive to produce and deliver. A report for the Becta agency [1] on technology-assisted learning identified 17 essential learning practices that might be delivered or supported by technology. These include: expository, reflective, networked, tutored, case-based, problem-based, inquiry-driven, game-based, and constructive. Most have only been tested in computer-supported classrooms or in small-scale online courses. Which of these could succeed at massive scale, and can they be integrated into a coherent MOOC offering?

2 Literature review

Literature relating to pedagogy at massive scale mainly comprises empirical accounts of attempts to design and run large-scale learning systems, ranging from a study of a mobile live video system for large-scale learning [2], to a data analysis of communications by 87,000 individuals on a MOOC course [3]. The theoretical framing has come from discussion of the Network Effect [4] applied to learning. In brief, the

Network Effect postulates that the value of a product or service increases with the number of people using it. For example, the telephone system becomes more valuable to users as more people are connected, offering more opportunity to make and receive calls. There are related disadvantages of large-scale networks, notably the effect of congestion from too many interconnected communications.

Also relevant is the effect of two-sided networks in which there are two distinct but inter-connected user groups. In the case of education, these would be educators and learners. Each needs to gain benefit from scale. Consider learners as points in a communicating network. As the number of learners increases, the number of opportunities to connect directly with other learners increases much more rapidly (with the square of the number of learners). The network becomes increasingly difficult to keep under central control. For a MOOC with 10,000 learners, there are 50 million ways that pairs of them could connect directly. If the learning is to be successful, then ways must be found to manage this profusion of communication, to offer opportunities for direct teaching, mentoring and effective peer support.

The Network Effect was originally formulated to describe interconnections between computers. However, as Downes [5] points out, humans engage in meaningful communication, not just in data connection. There is value to be gained from the semantic relevance of these communications. Downes also indicates that a best set of connections cannot be determined in advance of the network being activated – it will depend on the abilities and contexts of the participants as they are revealed while a course is in progress.

The effects of scaling can also be explored in relation to pedagogy. Which teaching and learning methods are not sensitive to scale, and which may benefit from the effects of large-scale participation? There is over 70 years of evidence that exposition and instruction through educational radio and television can bring learning benefits to millions of people [6]. However, as Tyler indicates, “no broadcast is entirely self-sufficient” and its value depends on how it is used in context. For example, in the case of interactive classroom radio [7], a radio instructor provides lessons, prompting responses from the radio audience, and providing pauses for audience participation. Typically, a classroom teacher mediates this learner participation. The equivalent in MOOCs is to provide teaching by video, with opportunities for learners to pause the presentation and reflect or respond vocally, and for educators to embed formative quizzes into the video. The problem is that, while direct instruction by lecturing works at massive scale to engage learners and introduce big topics, this is a less effective approach to teaching than more active and collaborative pedagogies [8].

By contrast with direct instruction, networked learning is a process of collaborative meaning making through mutual support and interaction amongst learners [9,10]. This approach is also scalable to mass online participation. Sites such as StackExchange, with 4.9 million users¹, are networked communities that share expertise through organised clusters of questions and answers. Automated methods of reputation management and reward, through “liking” of postings and “badging” of people who have made valuable contributions, add a layer of community-defined value to the

¹ <http://stackexchange.com/about>

contributions. An example of a successful large-scale community that combines networked learning with reputation management is iSpot². Over 40,000 people make observations of nature – including birds, mammals, plants and fungi – and post photographs online, with a brief suggested identification where possible. Other members of the community respond with further detail and identification. A reputation management system rewards with badges those who make many observations, have observations confirmed by others with high reputation, and provide accurate identifications [11].

Networked learning, and its close relation, connectivist learning, formed the educational basis of the original MOOCs developed by Siemens and Downes [12]. Connectivism views learning as distributed within a network, social, technologically enhanced and associated with recognizing and interpreting patterns. Knowledge transfer is achieved by adding nodes and thus expanding the network [13]. While these pioneered the MOOC concept, connectivist MOOCs require learners to direct their own learning and to have a high level of critical literacy in order to navigate web resources and engage with peers [14].

There is a fourth approach to online learning that has shown to be sustainable at large scale. This is the “supported open learning” model adopted by The Open University³, whereby teaching materials and assessment are delivered online, allowing students to work at times and locations convenient to them. A network of local tutors provides additional support including marking assignments, giving feedback, and offering help to students. Over 200,000 students at The Open University learn by this method, but it is costly to recruit, train and employ the tutorial staff, so the approach is only viable on paid-for courses.

Therefore, a central challenge for massive free and open online courses is to develop innovative pedagogy that provides: the power of rich interactive media; benefits of active, reflective and collaborative learning; incentives through management of reputation; and opportunities for tutorial intervention and guidance – all capable of being deployed to tens of thousands of learners on a course, sustained over time. Other pedagogies, such as case-based, problem-based, inquiry-driven, and game-based learning may work at massive scale, but this is yet to be proven in practice.⁴

3 FutureLearn – designing for innovative large-scale learning

One organisation seeking to develop a pedagogy that works at massive scale is FutureLearn. This is a company owned by The Open University that is currently in partnership with 26 universities, the British Museum, the British Library and the British Council, to deliver free online courses. The company has developed a new MOOC platform based on scalable web technology.

² www.ispotnature.org

³ <http://www.open.ac.uk/about/main/the-ou-explained/teaching-and-learning-the-ou>

⁴ Arguably, game-based learning has been shown to scale through multiplayer “edutainment” games such as Sim City, though the launch of that game was beset with problems, see <http://www.bbc.co.uk/news/technology-25715010>

The FutureLearn management team made a decision early in the formation of the company to develop a MOOC platform and proposition that would support a social-constructivist pedagogy, based on the Conversational Framework [15,16]. In brief, this is a general theory of effective learning through conversations, with oneself and others, about the immediate world and about abstract concepts. To engage in successful conversations, all parties need access to a shared representation of the subject matter as well as tools for commenting, responding and reflecting.

The advantages of this framework include that it is derived from a theory of learning rather than instruction, it was devised originally to include interactions with and through technology, including large-scale “pervasive media” [17], and it embraces direct instruction and networked learning, as well as other types of learning, such as reflection and inquiry. Developing a MOOC platform around this framework led to some specific design decisions, outlined below.

The screenshot shows a learning element on the FutureLearn platform. At the top, it says 'THE SECRET POWER OF BRANDS UNIVERSITY OF EAST ANGLIA'. Below this is a video player with a play button and a progress bar. The video title is 'The world's favourite brands' and it has 1463 comments. Below the video, there is a text prompt: 'From London to Tokyo to Rio, you'll see people from all over the world talk about the brands they love.' This is followed by a discussion prompt: 'Think about the range of brands they choose. Are there any surprises? What other brands would you suggest? And think about the reasons people give: some very functional, others about emotion or even nostalgia. What do you think is the common link between the brands people love?' There is a 'Use the comments to discuss your responses to the ideas we see here, do you agree? If not, why?' section. Below this are navigation buttons for 'PREVIOUS', 'NEXT', and 'DOWNLOADS'. A 'Mark as complete' button is also visible. On the right side, there is a 'COMMENTS' section with a 'Most liked' filter. The first comment is from Mike Sharples, followed by Alyona Kuanalyeva, Darren Winter, Lizzy Nicholson, and Sunny A-Angelus. Each comment includes the user's name, a 'Follow' button, and a 'Like + Reply' button.

Fig. 1. Typical FutureLearn learning element (‘step’) showing the associated comments and replies. The flag indicates that 1463 comments have been added to the step.

Each teaching element (or “step”) is associated with a free-flowing discussion, which is intended to emulate a “watercooler conversation” about the immediate content (see Fig. 1). Each learner can see contributions from other learners and add a brief comment or reply. In terms of the Pask-Laurillard conversational framework, this is a conversation at the Level of Actions where discussion is directed towards interpreting the learning materials. Some FutureLearn content elements have attracted over 6,000 comments, so the approach will not scale if learners feel overwhelmed or obliged to read all the contributions. For this reason, the discussion is initially hidden

and only revealed by clicking a button; it is structured as a simple flow with only one level of embedded replies; and learners can filter contributions to those that are most “liked” by others.

A distinctively different type of conversation can occur at the Level of Descriptions where the discussion explores differing perspectives on a more abstract topic or claim. This is implemented in FutureLearn as a Discussion Step and will also be supported through structured small-group discussions. These are designed to scale around those learners who are available online, through a “discussion bus” approach. As learners select the “small group discussion step” they are added to the discussion. Other learners join until the “discussion bus” (with room for around 20 people) is full. The discussion can start before the group is full. In these structured discussions, learners respond to a claim or question and are expected to read all the other contributions before replying. This approach should benefit from scale: with a larger pool of learners, there will be more people online at any time, so each “discussion bus” will fill more quickly. There will also be a wider variety of perspectives, from differing cultures, backgrounds, and abilities. In FutureLearn, peer review is offered as a formative learning activity, rather than as a method of assessment. This has also been designed to improve with scale. A learner is given a short, structured assignment. When the assignment is submitted, it is added to a pool and the submitter is sent an assignment that has not yet been reviewed. When the review is submitted, the writer of the assignment is alerted by email and can immediately read the review. The reviewer is offered an opportunity to read another assignment and submit a further review. The more learners there are online, the shorter the average wait for a review. Data from FutureLearn courses show a mean wait time of one to two hours (depending on the course), from submission of an assignment to receiving a first review.

4 Implications of scale

Media discussion and promotional hype around MOOCs have focused on “massive” in terms of the very large numbers of students enrolled on these courses. “Massive” is presented in terms of potential economic benefits – huge numbers of people can be exposed to the same curated set of high quality resources and can gain access to teaching materials assembled by globally respected universities. Fewer trained educators are, potentially, required in order to educate greater numbers of learners.

In this section, we examine some of the other implications of massive for both learners and educators, as well as for MOOC designers and for society as a whole. In order to do this, we examine data from the 18 courses that started their first presentation on FutureLearn between 14 October 2013, when the first MOOC was offered on the platform, and the date of writing, 3 February 2014. Fourteen different UK universities were responsible for these courses. The data that were analysed consist of the course materials, course emails and course discussions that were available to anyone who enrolled in these open online courses, as well as associated activity in social media.

The terms and conditions of FutureLearn state:

7.11 Any Learner Content that is published on the public discussion areas of the Website (for example, the forums or areas where posts are made) will be subject to a Creative Commons Licence (Attribution-Non Commercial-NoDerivs; BY-NC-ND).

For this reason, the authors of all direct quotations used within this paper are named and are not anonymised or assigned pseudonyms.

This paper addresses the research question

What are the implications for pedagogy of teaching and learning at massive scale?

In order to identify emergent themes within the data, we adopted a grounded approach to analysis. The intention was not to offer a comprehensive analysis of these MOOCs, but to address our research question using a large dataset including contributions from many thousands of people who were experiencing massive online teaching and learning for the first time. Some of the themes identified here were found many times within the dataset; some only once or on only one course, but each has the potential to impact on a pedagogy of teaching and learning at scale. The themes that emerged can be grouped under two headings: “Advantages of massive pedagogy” and “Challenges of massive pedagogy”. The following sections explore these themes in more detail and provide illustrative examples from the dataset.

5 Advantages of massive pedagogy

Literature relating to education identifies many advantages to learning together, including collaboration, cooperation and co-construction of knowledge. However, these advantages are not necessarily scalable; cooperating with ten thousand people is unlikely to be better than cooperating with ten. In addition, the pedagogic underpinnings for learning design are rarely made explicit within course material, and so these benefits of learning together are not foregrounded within the dataset. Grounded data analysis brings to the fore a set of advantages associated with engaging thousands of learners from all over the world. These can broadly be grouped as: advantages for learners, advantages for educators and advantages for society.

5.1 Advantages for learners

Massive participation gives learners access to support from a wide range of other learners, to resources provided by those learners in the form of discussion and links, and to a range of diverse cultural perspectives.

As MOOC learners can outnumber educators by 1,000 to one or even more, the importance of other learners in providing support is clear. Tim Lenton, lead educator on the “Climate Change” MOOC emailed learners early on:

Even before the course begins you can get in touch with your fellow students by using the hashtag #exClimate on Twitter – start the conversation about climate change now!

And, as soon as the course began, he emailed:

I will be encouraging you to take part in online discussions with your fellow learners as the course progresses. Use these discussions to ask questions if you're struggling, and help other people if they're stuck.

These discussions were not confined to the FutureLearn platform. Online, learners took the initiative and set up Facebook groups to discuss courses, including “Richard III” and “Forensic Psychology”. Teams from dental practices signed up together to work through “Dental Photography” and groups of teachers signed up to work through a MOOC together “to use the resource in staff meetings and as part of their professional development” [Helena Gillespie, Teaching Computing].

As well as educators, many learners were positive about the opportunities for discussion. Postings on the last day of the “Ecosystems” course included:

Thanks to David and team for a very interesting and enjoyable introduction to a subject I will certainly be pursuing on OpenLearn and elsewhere. Thanks also to fellow students for some very informative and helpful discussions. [Tom Strathdee]

Surprised to find that I really enjoyed the discussion board; some great postings and links. Also good to have your position and understanding challenged. Thanks to all! [Andrew Revell]

Thanks also for all the links to interesting websites, both from the course team and from fellow students. [Julia McDougall]

Within MOOCs, learners provide and swap perspectives on content that are informed by their experience and their cultural background. A discussion of brand names on the “Secret Life of Brands” was enriched by contributions from different countries.

To me the ultimate brand recognition is when the brand name has actually become the name of the product like Hoover for vacuum cleaner, Frigidaire in French for a fridge. [Delphine Lemaire]

one of the strongest brands in the UK is “Orange.” However, people still go to buy a “mobile Phone” and not an Orange! (er, if you see what I mean). Talking of Orange, it is a great example of localised branding messaging. “The Future’s Bright, The Future’s Orange” was their message for many years in the UK - but NOT in Northern Ireland where that would have alienated a huge section of the community! [Joss Sanglier]

In Ukraine they call pampers all disposable diapers as it was the first brand in the market and it still stays the strongest. [Natalya Dubois]

In some cases, the perspective from another country could cast a new light on an entire subject. A discussion on “the potential uses of dental photography in your practice” focused mainly on aspects such as records, analysis, treatment, planning,

practice and legal concerns. A post from Paraguay opened up another range of possibilities with the potential to expand dental photographers' view of the role and importance of their specialised skill:

I'm one of the very few photographers in an area twice as big as Scotland (the Paraguayan Chaco), where 8 different cultures live together. There's no record-keeping or proper research done with regards of dental treatment, specially among the most remote areas on the country. I believe there's huge opportunities to enhance the dental service through the powerful medium that photography provides, by providing material for research and education. Mainly to inform central and local government and other decision makers, about the realities the region faces, but specially to educate patients (elderly and children) dental workers and other professionals, that sometimes have to travel hundreds of kilometres on very bad roads, in order to reach a small town with no proper facilities but where people in need of proper treatment live. [Elias Adan Gimenez Feliu]

5.2 Advantages for educators

Educators identified affective benefits of teaching in MOOCs; they also saw opportunities for increased access to resources, and a motivation to develop their teaching practices.

Educators' blogs and weekly emails to enrolled learners provided opportunities for them to express their feelings about teaching such large groups. A sense of pride and excitement emerges from these messages, and a sense of joy that it is possible to share personal passion and enthusiasm with learners worldwide.

I am very passionate about the study of language based on naturally occurring speech and writing. So getting more people to know about it and be able to do it is my goal! [Tony McEnery, Corpus Linguistics]

Here in Stratford we're immensely excited to see how the discussions are shaping up, and to welcome such a range of online learners from all around the world [...] It is very exciting to have such a rich and diverse online community thinking about Hamlet and comparing notes about it with one another and with us. [Michael Dobson, Hamlet]

I have learnt that people all over the world have engaged with the work. I've seen discussion responses from places such as India, Indonesia, USA - that has been very exciting, to see such world-wide participation. [Harriet Jones, Preparing for Uni]

The scale of interest in MOOCs means that educators and others involved in developing courses sometimes have opportunities to develop bigger budget resources than would otherwise be possible. For example, the team responsible for "Forensic Science" was able to make a mini-series of a case study, bringing the techniques under discussion to life with a narrative that kept learners engaged right up to the final cliff-hanger verdict on the last evening of the course. Resources from external providers were used to enrich courses, including readings to support lectures, "donated by

publishers including Bloomsbury, Edinburgh University Press and Routledge” [Tony McEnery, Corpus Linguistics]. Other courses were able to include interviews and discussions with external experts. “Hamlet” included interviews with Jonathan Slinger and Pippa Nixon from the Royal Shakespeare Company. “Corpus Linguistics” included conversation sessions with leading academics. Course lead Tony McEnery commented, “What about the ‘in conversations’? I must now confess a guilty secret – I have really, really, really enjoyed doing these”. The size of MOOCs mean some are also able to attract sponsorship and collaboration – the “Teaching Programming” course, which relates to a recent change in England’s National Curriculum for schools, was supported by both British Telecom and by the Computing at School organisation.

Learning wholly online is a new experience for most people, and a massive cohort offers the possibility of sharing learning skills and experience of higher education, as well as subject knowledge, with large numbers of learners.

I have tried to make sure that the experience you have is as close to being at University, in spirit, as possible. The University is a place of thought, discussion and lecture. That is what, I hope you will agree, the MOOC is when you start to study it next year. [Tony McEnery, Corpus Linguistics pre-course email]

Much of this is implicit in educators’ work; but in some cases it is foregrounded. “Fairness and Nature” included study skills as a part of the course, focusing on preparing to learn, listening and reflecting, making notes and communicating with others. Lead academic Tim Lenton’s Climate Change blog begins, “Practise what you preach, as they say. So I have decided to do some reflective learning and blog about my experience with our Climate Change MOOC.” In many cases, this was a two-way exchange of ideas, with educators not only sharing tips about how to learn in MOOCs but also receiving feedback about subject matter and approaches to teaching that work well in these environments. Such feedback was sometimes explicit, in the form of comments, and at other times implicit, in the form of engagement and withdrawal. It could also take place outside the platform and before or after the course start. One pre-course email stated,

Looking at those of you who follow me on Twitter has proved to be very influential in shaping the course – we really want to provide a course on which you will find some real value. [Tony McEnery, Corpus Linguistics]

5.3 Advantages for society

The extended reach of MOOCs offers the potential for far-reaching effects. These courses can be used to develop tools and resources for use in other contexts; they can be used to change professional practice, can increase access to education and are seen to have the potential for global impact.

When FutureLearn was launched in 2013, the UK Universities and Science Minister, David Willets, said, “I encourage all our institutions to explore the opportunities

offered by new modes of technology, such as MOOCs. This will keep the UK ahead in the global race to deliver education in worldwide markets.”⁵

Educators leading the MOOCs also have an interest in teaching and learning with worldwide impact:

I am particularly keen for the MOOC to reach audiences that don't have access to the learning experience we provide here at Leeds – such as those in Nepal, which features prominently as one of our case studies. [Jon Lovett, Fairness and Nature]

In the case of professionally focused MOOCs, such as “Dental Photography” and “Teaching Programming”, courses can provide continuing professional development (CPD) for many thousands of professionals in a short period of time. These training opportunities can extend beyond course boundaries as learners set up local groups and social media groups to continue conversations and build on what they have learned. The University of Southampton already has a LinkedIn group that is designed to keep MOOC alumni in touch with each other after the end of a course.

The resources created for and within MOOCs can also be used and repurposed outside the course environment, and some course teams encourage this to take place:

You are free to repurpose its content as long as you follow the licence conditions. You don't need to ask our permission, although we would like to know! And our Flickr site, Scoop it site and Delicious site will all stay open. [Sarah Speight, Sustainability, end-of-course email]

“Ecosystems” students contributed hundreds of images to the iSpot nature identification site, while “Dental Photography” students created a shared resource of images on Flickr. Extensive user testing at scale of the AntConc concordancing software used on the “Corpus Linguistics” MOOC enabled the development of a new version of this freeware tool, thus upgrading the toolset available to everyone working in this field.

6 Challenges of massive pedagogy

In many cases, the challenges of teaching and learning are the flipside of the advantages. In an environment with tens of thousands of people, where a discussion may contain over 6,000 contributions, both learners and educators face the challenge of navigating and filtering resources. Learners gain access to support from a wide range of other learners, but they need ways to ensure that they receive good quality, well-informed support. They can see a wide range of resources and perspectives but, at the same time, require ways in which to filter and make sense of these resources.

The flowing discussions alongside the course materials in FutureLearn offer an easy way to see and add to the immediate responses of other learners, but some learners report being disorientated by the large number of contributions. A similar problem of disorientation was reported in the early days of the worldwide web. The “lost in hyperspace” phenomenon “can refer to any of the following conditions: users cannot

⁵ <http://www.bbc.co.uk/news/business-24109190>

identify where they are; users cannot return to previously visited information; users cannot go to information believed to exist; users cannot remember what they have covered; and users cannot remember the key points covered” [18].

When MOOCs are regarded as an innovative approach to teaching and learning they can inspire and excite educators, but educators need ways to maintain these positive feelings when the courses repeat and the novelty wears off. Increased access to resources requires time both to locate and embed these resources. Developing effective teaching practice in new environments is challenging to do in full view of an audience of thousands, and requires time and effort that may not be accounted for in institutions’ workload planning.

Many of these challenges need to be addressed at platform and institutional level. Others relate to accessibility, particularly in relation to age, location and disability. Many MOOCs act as university showcases, designed to attract potential students. This means that a large number of MOOC learners are teenagers, which raises issues related to suitable content and to child protection when taking part in online activities. The “Forensic Science” course posted a warning each week:

Warning: Some of content presented in this program may be distressing to individuals, particularly younger learners. Notwithstanding, the material is representative of that encountered by forensic scientists and we have presented it in an objective and professional manner.

“Forensic Science” encountered a different set of accessibility problems when using Google Hangouts to support live interaction on the course.

I'm not sure I can participate live -- the timing is difficult (time difference I'm in Canada and will be working. [Jean Read, Forensic Science]

In theory, those unable to attend live should have been able to replay the event on YouTube but, once again, location denied access to some participants

Not able to click YouTube in China. What a pity ! [Yue Shi, Forensic Science]

Disability also poses accessibility challenges at scale. Start-of-course and end-of-course surveys on one FutureLearn course received responses from around 10% of learners. These surveys suggest that 14% of learners had some form of disability. Subdivisions of this dataset are small, so may be misleading, but 0.4% of respondents to the start-of-course survey stated that they were blind, and more than 1% stated that they were dyslexics. On a course with 10,000 learners, this would equate to 40 blind learners and 130 dyslexic learners on every presentation of the course. This raises the challenge of making courses and their assessment accessible to all learners.

7 Discussion

Analysis of these 18 courses shows that massive pedagogy requires more than an underpinning framework. Conversational learning can and does scale; the

FutureLearn discussion forums are bustling with activity, and around a third of learners are actively contributing to these discussions, alongside those who are benefiting by reading and reflecting on these contributions. However, until all the benefits and challenges of learning at scale are actively addressed, there will always be room for improvement on any MOOC platform. Addressing these elements requires a twin-pronged approach, planning for them in both the learning design and the platform design.

A course with thousands of registered learners has the potential to offer them access to support from a wide range of peers. In order to do this, its learning design needs to take into account the points at which learners are likely to need support; needs to build in opportunities for asking questions, raising concerns and asking for help, and needs to build in motivation for offering help to others. This will not be possible unless the MOOC platform not only provides opportunities for learner communication, but also includes ways of judging which people are offering helpful and reliable advice. Such judgments cannot be made without contextual information. “Online we use social factors (rating and voting) to assess reliability, the user’s profile and badges to demonstrate competence” [19] and these are all tools which the platform can provide to support an effective learning design.

A massive course can go far beyond any traditional course in providing access to a huge range of resources and a global range of perspectives provided by those registered on the course. Again, the learning design needs to build in opportunities to make use of these benefits. MOOC learners are often fitting their learning in around many other activities; they need resources and perspectives that will extend their understanding of the course, rather than ones that distract their attention. When will these resources and perspectives be solicited, and how will learners use them? The platform design has a role to play here. Likes, ratings, tags and analytics can help both learners and educators to sort through contributions and to locate the ones that will be helpful for their learning or teaching.

For educators, MOOCs can offer affective benefits, but initial excitement will wear off if there is nothing to sustain it. Learning design has a role to play here as well; it is possible to build in points where learners share stories of success or raise difficult problems that the network of learners can work to solve together. In terms of platform design, there is no need to leave educators siloed in their individual MOOCs. Forums, discussion areas and chances to meet up both online and offline would offer opportunities to extend and share practice, to share possibilities for creating or accessing resources that are not available when working at a smaller scale, and to build on success. These areas would also offer opportunities for another benefit of massive – the impetus to develop new teaching practices.

In terms of society, one of the great benefits of MOOCs is the opportunity to open access to higher education to people who would be excluded from study at traditional universities. In order to achieve this goal, the learning design needs to be constructed so that none of its elements unnecessarily exclude people on the grounds of disability, age or location. From a platform perspective, attention to detail – for example, always including alternative text for pictures and ensuring that PDFs can be read in full by screen readers – will help to keep MOOCs not only massive but also open. More

broadly still, massive education offers the opportunity to address “wicked problems” like climate change, which cannot be resolved by one individual, one organisation or even one country. From a learning design perspective, this involves thinking big when setting the learning outcomes for a course. From a platform perspective, this involves building in opportunities to scale even further, so that a variety of courses from different universities can deal with aspects of the same problem, can develop learning outcomes together and have opportunities to share and pool the knowledge that they generate.

8 Conclusion

This paper has looked at the implications for pedagogy of learning at scale. With MOOCs now regularly attracting tens of thousands of learners, it is important that educators are able to make use of forms of teaching and assessment that benefit from high student numbers. Four approaches that were in use before the emergence of MOOCs, and that have been designed or adapted to scale are direct instruction, networked learning, connectivist learning and supported open learning. However, each of these raises challenges. Direct instruction is not as effective as other approaches to teaching. Networked learning can be overwhelming when learners have to deal with too many interconnected communications. Connectivist approaches require learners to direct their own learning and to possess a high level of critical literacy. Supported open learning is an expensive option on courses that are provided free of charge. A fifth approach is being developed specifically for MOOCs, exemplified by FutureLearn, and is based on a well-established theory of effective learning through conversations with oneself and others. Other pedagogies, such as game-based, problem-based, and inquiry-led learning still need to be adapted and demonstrated for massive scale.

Analysis of MOOCs on the FutureLearn platform has identified advantages and challenges of teaching and learning at scale, which should be taken into account in learning design and from a platform perspective. For learners, scale offers access to support from a wide range of other learners, to resources provided by those learners, and to a range of perspectives. For educators, scale offers affective benefits, opportunities for increased access to resources, and a motivation to develop teaching practice. For society, scale offers potential to develop tools and resources for use in other contexts, to change professional practice, to increase access to education and to achieve global impact. The challenges of scale include the need to navigate, filter and make sense of resources, and for learners to be able to access good quality, trustworthy support. MOOCs offer the potential to open up education for those who were previously excluded but, in order to do so, must take on the challenges associated with disability and disadvantage.

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