MOOCs: so many learners, so much potential....

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Abstract—MOOCs have exploded onto the scene, with the promise to satisfy a world-wide thirst for a high-quality, personalised and free education. We explore where they fit within the e-learning and AIED landscape. MOOC platforms are just beginning to emerge and are changing quickly. We discuss some of the ways that they can benefit by drawing upon the many lessons learnt about diverse aspects of AIED and broader education. Large bodies of research and practice have honed our understanding of how to create high quality learning objects and materials and how to personalise learning. They have much to offer teachers to help with the many onerous and challenging tasks of creating a course that provides high quality learning experiences. For the new frontiers in supporting massive numbers of learners, there is a solid foundation of research that will help in exploiting the huge amounts of data from learner’s digital footprints. The MOOC is one more example of the flat world that enables teachers anywhere to address learning needs anywhere; and it is fertile ground for deploying AIED research.

Index Terms—MOOC, large scale elearning, learner modelling, educational data mining, learning analytics

1 WHAT IS EXCITING ABOUT MOOCs?

MOOCs, Massive Open Online Courses, if true to their name, are defined by three elements. Their openness means that they are available to anyone who wants to use them to learn. This logically implies that they are free, removing any financial barrier for even the poorest student. Being online means they are available on the internet. In providing courses, MOOCs represent a major shift in scale beyond open learning objects1. They operate at the level of a whole course (or subject) – they provide a coherent learning sequence, with integrated learning materials and formative assessment, all created and managed by outstanding teachers from the world’s top institutions. If a course is of high quality, free (open) and readily accessible (online), it follows that massive numbers of students will grab the chance to get a first rate education for free. This creates scalability challenges. There is solid understanding of how to tackle the engineering of web sites that gracefully handle huge numbers of users. The much less well understood scalability issue is for the teaching, learning and assessment models. The MOOC approach meshes with the acknowledged importance of social interaction among learners [1] as a MOOC can call upon its large community of learners to play two key roles: supporting learning, via discussions, and assessment, based on peer-review.

There is a delightful idealism and altruism in the words of many of those driving the MOOC movement. We all agree that quality education is important. We all know that there is a huge gap between the educational opportunities of the most privileged and the most disadvantaged learners. MOOCs are presented as a means to help close this gap. We can conjure up images of students from the developing world, and the most disadvantaged groups in the first world, as well as lifelong learners with changing learning needs, all quenching their thirst for knowledge, by learning at the feet of the intellectual giants of the world’s leading research institutions. This is an example of Friedman’s flat world [2]. The wide availability of inexpensive networked computers makes it possible to cater for a large unmet need.

Beyond the excitement of the learning opportunities of the actual MOOC courses, a different dimension of promise is in MOOCs as open platforms, built by a new and energetic open source community. Perhaps this will be a revolution in software for authoring and delivering high quality learning opportunities.

2 WHAT IS A MOOC?

Despite the name, there is really no clear definition of exactly what is and isn’t a MOOC. Contributing to the confusion around the term, MOOC had had a recent shift in meaning. Although 2012 saw highly publicised MOOCs, such as Coursera and Udacity, the term had actually been in use since 2008. It described online courses run by people like George Siemens, and was a very different kind of online course. Siemens suggested that there are in fact two entirely separate types of online course sharing the name MOOC, and offered new
terms to distinguish them - cMOOCs and xMOOCs. xMOOCs, are the new and well publicised MOOCs that move a traditional university learning paradigm into the online learning space - a teacher teaching a student. cMOOCs, or connectivist MOOCs, are the older kind of MOOC as developed by Siemens. They are based around social learning, inspiring creativity and the belief that knowledge exists in the collective of the students. Rather than assessable content, students are provided with content designed to encourage discussion and debate. While these terms have gained some traction, the recent media tent designed to encourage discussion and debate. While these terms have gained some traction, the recent media

test to understand them is in terms of xMOOCs. With a new and fast-changing phenomenon like the MOOC, a good start to understanding them is in terms of some exemplars. Table 1 does this, in terms of some of the better known MOOC platforms. We chose these because they represent a diverse set of some of the better known MOOC platforms.

- edX and Coursera represent the new, widely publicised MOOCs - funded and provided by large universities. These focus on video lectures, with an important innovation being their use of integrated quizzes. These break up the traditional lecture into much shorter parts, ending each lecture snippet with a self-test short answer question that is automatically graded so there can be immediate feedback to the learner. These do the main content delivery, and the platforms tend to be light on other quizzing capabilities.

- Google Course Builder is a platform made open source after the company used it to teach their “Power Searching With Google”. It requires significant technical work and skill to setup and run a course.

- Class2Go is an open-source platform currently under very active development by a Stanford team. It is similar in design to edX and Coursera, but stands out for its openness. This makes it particularly interesting for the AIED community.

- Udemy is distinguished in that it truly provides a platform for anyone to teach. Notably, it also allows instructors to charge students for access to their courses. It has no ability to assess or quiz students.

- Lernanta is included as an example of a cMOOC. It powers P2PU, a site for social learning. It has no quiz or video functionality, and focuses on peer assessment and discussion.

Comparing the attributes of each MOOC platform in Table 1, it becomes immediately apparent how different these MOOC platforms are. Even for platforms that do support video, they differ in terms of where they are hosted, and whether they have integrated discussions or quizzes. Despite their quite minimalist quiz capabilities, there is already fracturing in terms of question types supported. In particular, while many offer a “short answer” style question, they differ quite drastically in the ways to mark these answers. This ranges from peer assessment to automated assessment, which may be based on regular expression matching to testing the student’s input for an exact match against a list of “correct” answers. When it comes to capture of data for analysis of learner activity, all of the systems currently have quite rudimentary facilities. The student can see rather simple information about their marks and progress. The teacher facilities are very limited. Perhaps in the spirit of making use of existing tools, they do not extend beyond exporting CSV files of raw data, or using general website analytics, like Google Analytics. Here is a place where there is exciting potential to introduce AIED tools and techniques into MOOCs.

From our small, but carefully selected, sample of MOOC platforms, it is clear that even those available at this early stage show diversity in terms of the forms of learning supported and the features for assessment. This highlights how difficult it is to determine what is a MOOC platform, and what is not. Nor is it clear how deep the differences are between MOOCs and the widespread Learner Management Systems.

We now consider the more general picture that seems to be emerging. Figure 2 shows a high level view of the teacher and student view of MOOCs. The teacher needs to design the curriculum, perhaps taking account of formal learning goals for accreditation and certification or broader ones that learners have for lifelong learning, on demand, at the times that they recognise the need for new knowledge and competencies. With this foundation, the teacher needs to design and create the learning materials that the students will actually see and interact with. For the current breed of MOOCs, this involves making video snippets, short pieces with the lecturer’s face visible and other supporting material such as their annotations of materials. The lecturer needs to create the self-test formative quiz questions as well as the larger assessment asks. There are design decisions for the role of the discussion forums and for the operation of grading and assessment. For example, the lecturer may create rubrics or questions for use in self- and peer-assessment. The remaining part of the big picture is the lecturer’s use of data about the learning. Some of this is classic management of marks. Another dimension is to reflect on student’s progress and use that to refine the materials and course. AIED has much to offer for all of these stages and elements and we will discuss some examples after we have explored some of the challenges.

2. MOOCs are really a platform, http://www.elearnspace.org/blog/2012/07/are-really-a-platform/


4. See sidebar IS AN LMS REALLY A MOOC PLATFORM?
3 SO MANY LEARNERS.....

Exciting as MOOCs are, if we want to exploit their potential, there is much to learn from AIED and broader educational research. We do know a good deal about the real challenges of distance learning and about the work that a teacher must do to create effective learning contexts. We now consider these and how AIED work can provide foundations for MOOCs to help more teachers enable more learners to learn more things, more deeply.

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### The student

What does it take to be a successful MOOC student? On current evidence, the successful MOOC student is not your average student, who has decided they need to learn. Indeed, that sort of a student may be a rare phenomenon. While it is too early to provide more reliable numbers, a 5-10% pass rate seems to be rather typical for the current first generation MOOCs. For instance, in a truly massive course run by MIT, only 7157 of initially over 150,000 students who signed up passed\(^5\). There is no doubt that 7157 is a very large class group. But a 95% dropout rate is also large. We clearly cannot treat this fallout rate of 95% as directly comparable with fallout rates in university courses or training courses, because even the little research so far available on student demographics and motivation indicates that a high percentage of those signing-up is just the curious\(^6\). But even for the students who go beyond the initial “snooping” phase and are motivated to complete a course, we have a great deal of education research that makes it quite clear that it will not be easy for most learners to stay the course. Essentially, the MOOC student is in the same situation as a distance learning student, with all the challenges such students face, such as managing their time. The literature on these challenges and on the kind of support that teaching organisations need to provide is extensive\(^3\), and this has stayed stubbornly consistent over time. The new generation’s life-long access to technology does not address the problem. Even the widely claimed generation-related increases in technical competence of the digital natives has proved to be largely a myth\(^4\).

How might AIED make important improvements to student’s staying power and success in MOOCs? In terms of competencies required, self-guided learning and time-management skills seem essential. Despite the more or less strict regimen a typical MOOC imposes on students as regards handing in assignments, what happens between assignment dates needs to be self-managed. As we know from psychology, self-regulated learning involves a complex interplay of cognitive, meta-cognitive, and motivational regulatory components\(^5\). According to recent theoretical approaches, ideal regulatory activities during learning include orientation, in order to get an overview of the task and resources, planning the course of action, evaluating the learning product and monitoring and controlling all activities. Research has revealed that successful learning corresponds strongly with the learner’s regulatory activities\(^6\). However, such learning strategies are displayed only by a few; most of us need prompting and rewards to engage in them\(^7\).

Dispositions are hard to change, but learning strategies can be mastered fairly quickly. Keeping a learning journal, if not a more formal learning portfolio, and going beyond the requested assignments by reflecting on one’s learning is another element that could be likely contribute to success in MOOCs\(^8\). In addition, organising small learning groups in the context of a MOOC is a good strategy. The mass collaboration that MOOCs are build on is important, but it is different from the cognitive and motivational support we get from communicating with a small group of people we trust and whose interests we share\(^9\). In addition to social networking sites, e-portfolios are a recommended kind of tool for planning and documenting learning, reflecting on one’s learning, and sharing learning and reflections with others\(^10\). Related to this, competence-oriented open learner models are an emerging approach to supporting self-guided, life long learning\(^11\).

### The teacher

MOOCs seem so far to build on the assumption that there are “great teachers” out there, and that getting them on video (plus a couple of assignments and quizzes) is largely sufficient for establishing pedagogical quality in MOOCs. No doubt there are great teachers out there, but as MOOCs proliferate (assuming for the sake

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of the argument that they do proliferate) this approach will not suffice. Not every MOOC lecturer will be rhetorically gifted or trained, and “customers” will become more critical about quality. Great researchers are not necessarily also great teachers, and great teachers may not necessarily produce great on-line learning experiences. MOOC lecturers/authors will need to be supported in several of the elements in our table to ensure that can be effective in instructional design and course development, and in monitoring learning.

To support technical course development (e.g., video capturing and editing, assignment specification), one can build on a good many years of research on, and experience with, developing course-ware tools and e-learning software [12]. Supporting the instructional design process on the pedagogical-conceptual level is no less challenging, as it has proven difficult to capture pedagogical rationale and to formalize it in a manner that is conducive to sharing and continuous improvement [13]. Important conceptual foundations come from work on learning design patterns [14]. On the practical side, numerous tools have been developed to support educators in designing for (on-line) instruction and some progress has been made in providing shared repositories for learning designs7. In short, the subject specialist creating a MOOC has much to gain from the body of knowledge on how to create effective online materials and ways to nurture effective learning experiences for their students. And, happily, there are already some MOOCs for that!8

To monitor the learning activities of potentially thousands of students, e-learning platforms are providing increasingly valuable reporting tools. To some extent they are also appearing in MOOC platforms and we can anticipate refinement and development of these. For the case where one needs to monitor learning activities across platforms and tools, the emerging field of Learning Analytics [15] can be expected to help provide solutions.

Assessment issues are notoriously complex, not only in a technical sense. First generation MOOCs are fairly simple-minded about assessment, following the US undergraduate model of quizzes and assignments. While quizzes can be automatically assessed, more comprehensive assignments are dealt with by peer assessment. But assessment should be formative as well. And that goes beyond simple self-test questions at the end of each lecture segment. That is, formative feedback should provide information that can guide learning. In this respect, neither quizzes nor peer-assessment suffice. Eventually, MOOC course and platform developers will need to engage with the substantial challenges of online formative and summative assessment.

4 SO MUCH POTENTIAL …..
Emerging MOOCs have the potential to improve, by exploiting diverse results and techniques from AIED. MOOC platforms also create new opportunities for new AIED research. They are in particularly interesting for computer scientists working in fields such as Educational Data Mining [16] and Learning Analytics [15]. Not only can learning-related data from MOOC courses be truly “big” (provided the fallout rate is suitably managed), the open nature of MOOCs seems likely to provide a very heterogeneous student body signing up. These students may interact in ways that are not further structured by established social contracts and roles, making MOOCs an ideal vista for applying Social Network Analysis methods in particular.

Methods from educational data mining and learning analytics can in general be applied for knowledge creation (learning more about learning and interaction, and relevant technologies). They can also serve applied purposes: supporting students, teachers, educational institutions and systems. A rather obvious applied challenge, in light of the mentioned attrition rate, is the automatic identification of students at risk of failing. Similar techniques can be used to “nudge” students who need it, as well as for course- or cohort-based monitoring [17]. We can expect the growth of large collections of learning data, similar to the PSLC Datashop9. This can provide a new scale in test-beds for EDM researchers. We can then expect to see more innovative uses of learning data to improve teaching as in the elegant system to generate hints [18] for students, by drawing on historic data from the paths taken by successful and unsuccessful students.

Pedagogic interface agents are one of the current hot topics in AIED. These anthropomorphic conversational characters have been shown to give real benefits for learning [19]. While one might expect this effect to be short-lived, being of limited value once the novelty has worn off, recent results indicate that interface agents may actually help people stay the course over the long term [20]. They seem to offer promise of a valuable role in MOOCs.

In addition to the general opportunities for research on how to support (on-line) learning with technical means, MOOCs might provide a particular fruitful arena for research on e-portfolio systems, competence management (including assessment), and technical support for lifelong learning (including open learner models).

The quality, timing and form of feedback is critical to effective learning. MOOCs currently rely heavily on self- and peer review. These forms already have a recognised place in higher education [21]. However, they are more effective if students are explicitly taught how to do it, a valuable role for AIED systems.

Another key form of valuable feedback can be provided for learning contexts for high quality assessment

9. https://pslcdatashop.web.cmu.edu/
can be automated. There are many systems already for this in domains like programming, mathematics and physics. And AIED research has produced many systems that have been able to give high quality feedback in these classes of well-defined learning domains such as mathematics, physics, and computer programming.

These classes of MOOCs can also be part of a hybrid model. For example, many developing countries have a large unmet need for skilled IT professionals, where the learning need involved well-defined technical skills. The most recent MOOCs already have several attractive offerings in this space. This creates the opportunity for employers to create a a learning environment where the MOOC delivers content and basic formative assessment. The employer can complement this by nurturing learning communities. They can conduct summative assessment that determines employment options, a significant motivator for students. the motivator of summative assessment conducted by the employer.

More recently, AIED has moved to ill-structured domains [22]. Notable among these are lifelong generic, particularly the meta-cognitive skills that are a key to success in MOOCs. AIED has demonstrated success in explicit teaching of these skills.

The rhetoric about MOOCs refers to personalised learning, with reference to Bloom’s classic 2-Sigma paper about one-to-one tutoring [23]. However, current MOOCs come nowhere near trying to achieve that level of personalisation. One key to the success of AIED systems is in the nature of the personalisation, which is based on a learner model. Indeed, some have argued that very core of AIED is the role of learner model [24]. This core notion of creating an explicit learner model could be readily integrated into MOOCs. Open learner models [25] have been demonstrated to improve learning and they could be a fundamental means for learners to monitor their progress and plan their learning.

It is hard to conceive of MOOCs as having any lasting impact on (higher) education without concern for how the single MOOC event (course) gets integrated into individual career planning and personal development as well as into an comprehensive certification framework [26]. Hence, research on how to support the integration of learning events on the individual as well as the societal level will be crucial. The excitement around MOOCs is justified, both in terms of the potential value they offer and the quality of the players who have launched them. What a great opportunity to integrate the lessons, techniques, methods and tools of AIED!

ACKNOWLEDGMENTS

This work was partly funded by the faculty of Engineering and Information Technologies, University of Sydney, Australia.

SIDEBAR - LEARNING OBJECTS AND OPEN EDUCATIONAL RESOURCES

Learning objects are described by the IEEE WG12 as “any entity, digital or non-digital, which can be used, reused or referenced during technology supported learning”. The working party aimed to “enable learners or instructors to search, evaluate, acquire, and utilize Learning Objects”. Work on learning objects was championed by Hodgins [27] at the time of the emergence and growth of the web. The vision was to make greater use and reuse of high quality learning resources by making them open and available to all. For example, WG12 describes one of their goals as being to “enable computer agents to automatically and dynamically compose personalized lessons for an individual learner”. The choice of object in their description reflects the programming notion, with its associated possibilities of reuse. There was considerable work to define standards around learning objects to enable their description and subsequent reuse and many learning object repositories were created. Criticisms of the whole notion of learning objects and their reuse [28], [29] highlight the problems of reuse, particularly when a teacher needs to adapt a learning object to fit the context and needs of their students.

Another landmark initiative that aimed to make high quality learning resources publicly available was OER, Open Educational Resources. A review of this movement [30] described it aiming to “Sponsor high-quality open content... Remove barriers ... Understand and stimulate use.” Its flagship outcome was the MIT OpenCourseWare Project, was described as “a very successful, compelling, living existence proof of the power of high-quality open educational resources .... a pioneering project that has now become a catalyst for a nascent open course-ware movement in service of both teachers and learners”. There is a strong similarity between these sentiments and the current visions presented for MOOCs.

Sidebar end:

SIDEBAR - IS AN LMS REALLY A MOOC PLATFORM?

Since Sebastian Thrun’s artificial intelligence course in 2011, there has been a boom in the number of platforms from which a MOOC can be taught. Many of these platforms share common characteristics, including a focus on short video lectures and questions integrated within those videos. It is these features that appear to identify a platform as a MOOC platform.

However, these new platforms have a lot in common with their conceptual ancestors - Learning Management Systems (LMS). Like MOOCs, LMSs are designed to move learning online. However, they differ in key underpinnings - a LMS is designed to assist a classroom, whereas a MOOC is designed to replace one. In general, LMSs are older, being already widely established in learning institutions. They are more advanced, especially when it comes to quiz/assignment design. They have
many features that are not (yet) found in most MOOC platforms. Indeed, the only feature MOOC platforms really possess that isn’t found within an LMS is the integration of questions within videos - something that could easily be added to and bettered by many LMS platforms, given their superior assessment capabilities.

The recent emergence of MOOCs is already starting to effect the LMS space. For example, Blackboard Inc., creators of Blackboard Learn, a leading LMS, have recently launched CourseSites - a hosted version of their popular Blackboard Learn software. Interestingly, despite it being described as MOOC platform, CourseSites appears to make no attempt to emulate features of other popular MOOC platforms - videos are still poorly implemented and are clearly not the focus of teaching. This different, perhaps confused, interpretation results in a product that was not designed to entirely replace face-to-face learning attempting to do so - blurring the line between the LMS and a MOOC.

This line is also being blurred from the other side. Some universities have begun adapting MOOC platforms to run in-house courses as a flipped classroom. In this model, content such as lectures is delivered outside the classroom, so that more class time may be spent on activities such discussions. For example, in early January this year, a course begun at The Cultural Complexity and Digital Humanities department at The University of Western Ontario. It used a modified version of the open source openMOOC platform. All lectures and prescribed readings were delivered via the platform, allowing actual class time to be dedicated solely to discussions and tutorials.

Sidebar end:

REFERENCES


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His current research focuses on pervasive computing systems, middleware for long term user modelling and innovative user interfaces. Recent work includes the Personis system for user and context modelling and “Keep-in-Touch”, an appliance system for family communication.
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| Additional Files and Features | Subtitles | Subtitles | Subtitles | Subtitles | Video & slide Mashup | N/A |

| Quizzes | Are There Quizzes Outside Videos? | Yes | Yes | Yes | Yes | Yes | N/A |
| Question Types: | Multiple Choice | ✔ | ✔ | ✔ | ✔ | No | N/A |
| | Short Answer | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |
| | Numeric | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |

| Discussion Forums | Can Posts be rated? | Positive | Positive | N/A | None | None | None |

| Grading and Analytics | Student's View of Progress | Raw Marks with Graph | Raw Marks | None | Raw Marks | Progress Percentage | Progress Percentage |
| Teacher's View of Progress | Unknown | Unknown | CSV Export Google Analytics (CSV) | Multiple Types of Detailed CSV Reports | N/A | Can see and edit progress |

Table 1.