MOOCs — A Preliminary Report for CEIC/IMU/ICMI

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To quote Wikipedia[1], a Massive Open Online Course (MOOC) is an online course aimed at large-scale interactive participation and open access via the web. They usually do not charge fees, nor offer credit. In addition to traditional course materials such as videos, readings, and problem sets, MOOCs provide interactive user forums that help build a community for the students, lecturers, and teaching assistants.

MOOCs developed from distance education, with the term being first used in 2008 to describe a type of Open Educational Resource.

The three big players today are *Udacity*, *edX* and *Coursera*. Wikipedia (10 June, 2013) gives the following information.

Coursera evolved from the first course offered by Stanford in 2011—a course on AI which grew to 160 000 students. It is a FOR-profit organisation and now includes Princeton, University of Michigan, and University of Pennyslvania as well as Stanford. *Coursera* has offered about 325 courses, with 30% in the sciences, 28% in arts and humanities, 23% in information technology, 13% in business, and 6% in mathematics (Waldrop, 2013). *Coursera* intends to work with textbook rental company Chegg to offer free online texts available only for the duration of the course using Chegg's e-reader.

Later in 2011, *edX* began as MITx, a NOT-for-profit free online course, shortly joined by Harvard and UCBerkeley, now including other institutions.

Udacity, the first MOOC for credit opened in January this year from San Jose State University. Now, in conjunction with AT&T and University of Georgia, it offers a $7000 Masters programme. *Udacity*'s CS101 course, with 300 000 students, is the largest course to date.

MOOCs now exist in UK, Switzerland (*EPFL*), and Australia, in Spanish, and a MOOC for secondary students. It is easy to find several hundred MOOCs available worldwide.

Anyone can create a MOOC, and a MOOC does not need to be connected to an institution. Platforms like *Udemy* offer the facility for anyone to design and offer a course. *Udemy* takes a cut of the instructors fee (about 30%). The *Khan Academy* and other sites are MOOC-like.

Design

There is no standardisation of MOOC design, but there are two general types: connectivist and broadcast. The former create interactive classes (e.g. *Udacity*), the latter (e.g. *Coursera*) simply broadcast material and any feedback or testing is automated. Connectivist MOOCs ("cMOOCs") aggregate online materials of different kinds and remix them and reform them into the content of the course. Broadcast (or traditional) MOOCs ("xMOOCs") pre-prepare materials such as recorded lectures and are more like a lecture course delivered online.

Both types present material, facilitate some type of interactive engagement, and assessment, if any, is either automated or peer-assessed. Machine grading of written assessments is being developed.

[1] Most of the material on this first page and a half is a summary of the Wikipedia page.

Instructional Cost

Kolowich's (2013) survey of 103 MOOC lecturers reported average pre-course development at 100-hours (though some was much shorter), and in-course instructional time at 8 hours/week. They were evenly split on whether MOOCs would eventually reduce the cost of a degree, and a majority did not think that successful MOOC students deserved degree credit—although a majority also agreed that MOOCs were worth the hype.

Participation

MOOCs are promoted as available to all, worldwide, but in fact most participation currently is by well-off, male, English-speakers. For example, most *Coursera* students already have degrees. Over 85% of university MOOC students are male.

Lewin (2013) claims that most MOOCs have drop-out rates exceeding 90%.

General Issues

MOOCs have been hyped since their inception, and opinion varies on whether that hype will plateau, or whether MOOCs will radically challenge and change higher education. Diana Laurillard (University of London's Knowledge Laboratory) believes that MOOCs have been hyped mainly by people who do not understand the technical and pedagogical requirements but are just looking at the big numbers—and hence the inevitable disappointment will mean that the investment to make the idea really work will not be forthcoming. In any event, she says, MOOCs do not have the potential to be as transformative as many people believe.

On the optimistic side, she also believes that MOOCs are at a very early stage of development, comparable to the early days of the Open University, and they are liable to develop quite fast and change significantly in the future. It is difficult, therefore, to predict what their ultimate impact will be.

Keith Devlin (Stanford University) has developed a MOOC on Mathematical Thinking that is already in its second iteration, see <http://mooctalk.org>. He confirms most of Diana's points, but notes that MOOCs offer a completely different experience: learning for its own sake, free of evaluative assessment and formal credit. This transforms, and frees, both the lecturer and the student. His MOOCs are the antithesis of procedural learning available in many MOOCs.

Avowed positive uses of MOOCs, include:

- Revenue streams—either using course fees, or advertising.
- Branding—either of institutions or individual lecturers.
- Supplementary learning opportunities for existing courses.
- Outreach and access to education in developing areas.
- Providing free open learning to those not wishing to take courses.

Drawbacks that have been pointed out include:

- Exploitation of students who get poor pedagogy.
- Low completion rates.
- Time and resource commitment greater than anticipated.
- Negative impact on enrolment in formal education (no evidence of this has been seen).

The general issues are the following.

1. Full utilisation of the potential of mass technology.
   It would seem logical that the fast and ground-breaking changes in technology, and

human use of technology to communicate with each other, will lead to significant changes in the way teaching and learning can take place. It is likely that some of these new modes will be improvements for particular types of learning for particular groups of students.
That said, just what uses of technology will be a breakthrough for whom and why are unlikely to be straightforward questions to answer. The speed of technological and communication change means that a significant evaluation task lies ahead.

2. Full utilisation of our knowledge of effective pedagogy.
Our understanding of pedagogy is also significantly greater than ten years ago and is also developing, if not quite so quickly. The combination of new technologies, new perspectives on communication, and new educational insights will result in effective education to challenge present-day practices. The design of such learning environments presents a significant research task.

3. Transformation or more of the same ?
The indications are that MOOCs (or their future developments) will transform the way many people think about education, particularly post-compulsory education. It is difficult to predict what these transformations will be, however a shift in control (from institution and lecturer to the learner), and a shift in the concept of the value of a course (from gaining credit to learning for its own sake), are two areas where there are already indications of change.

4. Practical issues
Issues such as how and whether to assess for credit, and resource preparation time, are features that are likely to have multiple resolutions that will emerge through practice.

Implications for Mathematics

What has been said above applies in particular for mathematics. Devlin's MOOC shows that MOOCs can deliver more than procedural techniques, however there are plenty of examples of simple technique instruction.

It has been suggested that MOOCs are a potential way of giving instruction to less able or less well-prepared students. The current state of MOOCs is unlikely to deliver good results for these students. On the contrary it is the experienced learners who are using MOOCs and are likely to be best able to make use of the new modes.

Summary & Recommendations

MOOCs are in the early stages of development. Their promotion to date has largely been predicated on potential revenue or promotional benefits to institutions, and based on the hype of IT visionaries. As the reality of proper preparation, ancillary activities, certification and reliable assessment have emerged, the development of effective learning opportunities that are worth the cost has become considerably more complex than originally anticipated.

Nevertheless, the use of new and future technology, software, social interaction modes, and media dissemination techniques will offer new ways to learn mathematics, many of which will be more effective (in one or more of coverage, content, participation, cost, cognition, reach) than any current mode of teaching or learning. We need to embrace these, invest funds, resources and research energy in them sensibly, and evaluate them comprehensively, including comparing them with current methods. The development of MOOCs will be fast.

In brief: the (as yet unrealised, but potential) benefit of MOOCs is the enhancement of learning in new ways, not the generation of new funding streams.

1. Broadcast MOOCs
Making available videos of lectures and other passive mathematical learning materials

does not constitute an effective learning experience for students. Such materials are well-suited to those who have passing interest, or specific interests, such as students wishing to revise a particular topic or build on other learning experiences, or non-students with a curiosity about a topic or mathematical application. The web is full of such materials, which are easy to find and access.

2. Connectivist MOOCs
   Utilising modern technology, software and personal connectivity in order to produce an environment in which students can interact with other students, lecturers, and a variety of materials is likely, in the future, to offer new effective mathematics learning opportunities for a wider audience of students. There is little evidence that this is occurring now, although development may be very fast. It is likely that significant investment will be required, and, in general, the cost (in human and resource terms) will not be very different from conventional methods (which will also benefit from savings due to technological enhancements).

3. With respect to the activities of IMU and ICMI, there are likely to be (or will be in the near future) specific situations where MOOC-type delivery of learning opportunities will provide solutions or enhancements to development activities. Examples could be:

   a. a MOOC based inside a CANP Workshop, and being a platform for on-going interaction between regional mathematicians, mathematics educators, and teachers;

   b. a MOOC associated with a visiting lecturer programme to extend its length and participation beyond the time of the lecturer's trip and the single destination that he/she was able to visit;

   c. a MOOC associated with the materials of the Klein Project that brings together teachers in different countries as well as link them to experts in the field of each Vignette;

   d. a MOOC linking the mathematics departments of two universities.

   Each of these examples would be expensive (for example, the cost of equipment, lecturer time, organisational resources), but would make possible an extended quality of experience not otherwise possible.

References

Kolowich, Steven (March 26, 2013). "The Professors Who Make the MOOCs", *Chronicle of Higher Education.*
< http://chronicle.com/article/The-Professors-Behind-the-MOOC/137905/#id=overview>, retrieved June 10, 2013.

Lewin, Tamar (February 20, 2013). "Universities Abroad Join Partnerships on the Web", *New York Times.* <http://www.nytimes.com/2013/02/21/education/universities-abroad-join-mooc-course-projects.html?_r=1& >, retrieved June 10, 2013.

Waldrop, M. Mitchell; Nature magazine (March 13, 013). "Massive Open Online Courses, aka MOOCs, Transform Higher Education and Science", *Scientific American*.
<http://www.scientificamerican.com/article.cfm?id=massive-open-online-courses-transform-higher-education-and-science>, retrieved June 10, 2013.