Impact of MOOCs and Other Forms of Online Education

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Looking back on my own education—from elementary school in South Carolina and Virginia in the United States, to secondary school in Iceland, tertiary education in France and Iceland, and finally to doctoral courses in the United Kingdom—and contemplating how teaching methods changed over those years, I come up short. The teachers themselves certainly varied in personality, degree of passion, and influence, but their role and mannerism in the classroom remained more or less the same. There are, in fact, only two specific changes that I recall, both having to do with delivery devices. First was when chalk for writing on the blackboard succumbed to magic markers. This was welcomed as a revolutionary step forward on account of dust alleviation! Second was when the blackboard gave way to transparent acetate sheets that were transferred to screens through overhead projectors.

Towards the end of my doctoral studies, however, a true revolution was about to hit, although at the time it had nothing directly to do with teaching methods. My Ph.D. research focused on the chemistry and antimicrobial activity of constituents found in lichens. The dissertation thus consisted of text, chemical structures, tables, and figures. I wrote it in 1982, and it was one of the first dissertations at the University of London to be typed on a computer. I handed in a handwritten manuscript to a secretary who subsequently typed the text on a large computer. All of the drawings of chemical structures, metabolic pathways, and isolation procedures, however, had to be painstakingly drawn manually, with the help of Letraset rub-on sheets.

There was no apprehension that we were on the verge of technological advances that would revolutionize, not only research-related work, but also influence almost every aspect of our personal lives. My reaction at the time was limited to mere relief at not having to type the text myself and that corrections were much easier to execute through the computer as opposed to the typewriter. Little did I know that a few years later I would have my own personal computer at work and another at home! And that laborious manual drawing of complicated chemical structures for publications and lectures would be a thing of the past, with the development of software programs such as Chem-Draw to do the job accurately in no time at all.

With the emergence of the Internet and fast growing developments in information technology, new options for university teaching became available—PowerPoint slides, access to electronic course books and other online material, downloadable software, web-based course management systems, etc. Communication between teachers and students took a turn with e-mail, and new opportunities for distance learning arose. The prevailing lecture format and performance of the teacher, however, did not change all that much. Granted,

the preparation of lecture material became much more fun with opportunities of explaining complicated material through clear and even entertaining audio and visual presentations. The dissemination of PowerPoint slides beforehand to students made life easier for them in the classroom. Whether these advances actually lead to enhanced learning in the long term is hard to say. I admit to having doubts.

I. OPEN EDUCATIONAL RESOURCES

As time passed, universities started to offer open access to course material and web courses that were not restricted to students registered at the parent institution. The Massachusetts Institute of Technology (MIT) opened such access in 2002 with the MIT OpenCourseWare initiative, which sparked many institutions to follow suit and the creation of a myriad of international open educational resource (OER) programs and networks. To name one example, the online teaching service Khan Academy was created in 2006 by Salman Khan.

The first massive open online course (MOOC) is generally attributed to a course in education called Connectivism and Connective Knowledge at the University of Manitoba. It was offered to 25 students in 2008 who had paid tuition and additionally to more than 2000 students who were not enrolled at the university. It was not until 2012, however, that MOOCs became a buzzword with the launching of the edX online platform by MIT and Harvard, Udacity by Sebastian Thrun, and the Coursera platform by Stanford professors Daphne Koller and Andrew Ng together with a network of 33 universities [1]. Other collaborative online platforms followed shortly, such as Udemy, FutureLearn in the United Kingdom, iversity in Germany, and platforms in many other countries worldwide [2].

Through the MOOC platforms, Internet users anywhere in the world could enroll for courses at no cost. There were no educational prerequisites or entry requirements, and the number of students was unlimited. The courses were interactive in that students got assignments and problems to solve, and received rapid feedback. They could participate in discussion fora and interact with other students. This again opened options for constructive international dialog and improved intercultural understanding. Students could furthermore register for an examination and receive a certificate after completion. Invaluable opportunities were thus opened, not only for school and university attendees, but also for disabled persons, people in developing countries, and those who, for various reasons, had not been able to attend university. A multitude of opportunities for knowledge acquisition outside formal educational systems arose, for example, in lifelong learning and vocational courses in many professions. In some ways, this new wave in teaching practices had similar roots as the novel open access initiatives toward conduct in research.

Initially, most of the courses were in technical subjects and natural sciences, where it is relatively easy to provide feedback on problem solving and examinations. Course offerings in the humanities and social sciences have gradually increased, although evaluation of assignments remains a challenge.

Since 2012 things have developed at a rapid pace. The platforms have grown substantially, with Coursera currently having 110 participating universities from around the world and edX more than 40 participating universities worldwide. Both platforms have additional participation of corporations, international organizations, and even national governments. An example of novel initiatives is the collaboration between edX and the International Monetary Fund (IMF), whereby MOOC courses are offered to IMF officials, e.g., in economics, financial policies, and debt analysis. In addition to Coursera and the World Bank offering MOOC courses on climate change, etc., they have recently teamed with the Tanzanian government to offer MOOC courses to stimulate youth employment in Africa.

To begin with, neither credits nor degrees were awarded for MOOC courses. This is another aspect that is changing. The American Council on Education's College Credit Recommendation Service (ACE Credit) has so far recommended several Coursera and Udacity courses for college credit transfer, and is working on further evaluations. Courses already accredited include algebra, bioelectricity, calculus, genetics, artificial intelligence, computer science, physics, and statistics. Whether the credits are accepted is, of course, at the discretion of each individual university. A number of universities in the United States and in Europe are already accepting transfer MOOC credits toward degree programs. Various methods are used for identifying authenticity of the students and ensuring absence of cheating. Many Coursera courses, for example, can now be taken through a "signature track" system. In other cases, secure testing centers are being developed to allow proctored examinations.

The Georgia Institute of Technology was the first university to introduce a whole MOOC-based degree. This is a masters degree in computer science, starting its run in 2014 in partnership with Udacity and AT&T. The tuition fees are $7000 as compared to $25 000 for the parallel on-campus course.

II. IMPACT FOR ON-CAMPUS TEACHING

What is the impact of these developments on traditional university teaching? How are they perceived by the universities themselves? Through personal conversations with university leaders and academics in Europe, the United States, Canada, and China, in addition to my colleagues at the University of Iceland, it is clear that

opinions differ widely. Views range from those of resolute sceptics to those of unwavering supporters.

Many in the former group maintain that teaching of this kind neither fulfills pedagogical nor quality assurance requirements for university teaching and will thus not have an impact. Furthermore, they believe that online teaching can never replace person-to-person engagement in teaching and campus social life which constitute such an important part of university education. The large dropout rates have been criticized, with the average completion rate being less than 10%. Others are concerned over the outspread of English at the cost of other languages, especially the less used languages. Many worry that governments will jump on these developments as a rescue method to reduce spending in higher education. Academics have expressed concern over the risk of staff replacement by low-cost online education. Those who have been involved with developing distance- and digital-learning practices often fail to see MOOCs as innovative and feel that their own efforts have gone unrecognized in comparison to what many regard as a MOOC hype. Smaller universities in many countries worry that they will lose out in competition with financially stronger and more famous universities.

In contrast, many adamant MOOC advocates view these developments as a step toward revolutionizing education and contributing to significant changes in teaching and learning practices in the long term. Some go as far as to predict the end of universities as we know them in the coming decades. They maintain that while technological advances have led to progressive change in numerous professions and services—such as the music and entertainment industry, publishing, banking, commerce, transportation—educational practices have remained stagnant, and merit urgent change.

A third viewpoint, to which I strongly subscribe, is demonstrated by those that welcome MOOCs and other online developments as complements to traditional on-campus teaching, and not in any way as a threat. Many of the concerns expressed by sceptics are shared, but the general view is that by integrating these novelties into traditional teaching, current educational programs can be enhanced. Furthermore, by using blended learning or flipped classroom models, students can gain basic knowledge at their own pace through MOOCs or other forms of online courses, and classroom time can subsequently be used more effectively, for example, to deepen understanding, solve problems, encourage creativity, spark innovation, and train students in critical thinking. The teaching thus becomes less didactic and more tutorial in nature, with the possibility of providing more individual attention. Opportunities further arise for training of specific skills that are in high demand and for improved collaboration between universities and business, industry, and the labor market.

Ambitious e-learning policies are being set by universities as well as by national authorities for all educational sectors. To name a few European examples, an expert committee appointed by the Norwegian government has recommended improved infrastructure for technology supported learning such as MOOCs as well as support for innovative pedagogy, research into learning analytics, and further development of digital literacy among teachers at all educational stages [3]. A lot of interest has been expressed in Spain, and the online platform, MiriadaX, aimed at Spanish- and Portuguese-speaking countries, has recently been launched globally through partnership between the university network Universia, Telefonica, and Banco Santander, and is already offering over 150 courses.

In September 2013, the European Commission initiated the Open Education Europa portal [4], with the intent of providing a European dimension on innovative learning. Among other things, a list of MOOC courses offered by European universities through various platforms is provided. Courses are available in Spanish, German, French, and Italian, in addition to English. The portal also hosts *eLearning Papers*, an online journal on open educational resources and on information and communication technology (ICT) in education.

The European Commission has further partnered with Startup Europe in launching the Open Education Challenge, where innovative startups for education can compete to receive support through the European Incubator for Innovation in Education. Nine teams out of 600 applicants have been chosen to participate in the Incubator in September 2014 [4].

III. POST MOOC DEVELOPMENT

Outcomes of ongoing research on digital learning are much awaited. Results of a study using descriptive statistics on courses offered in the first year of the edX platform, for example, from fall 2012 to summer 2013, have recently been published [5]. The data represent metrics for registration, demographics, certification rates, gender ratio, age and geographic distribution, prior educational degree, enrollment, and relative activity for over half a million students. Although a breadth of differences can be observed between the individual 17 courses analyzed, conclusions show the majority of students to be male, over the age of 26 years and to have already received a bachelor's degree. Only 29% of registrants were female, in marked contrast to the gender ratio at colleges or universities most often seen in the United States and many other countries. The percentage of registrants under the age of 15 was 1.4% and the over 50s were 6.3%.

As a means of assessing the impact and degree of learning in a specific course, certification rates and exploration rates of course material were used. It is, however, emphasized, and rightly so in my view, that these are limited in degree of accuracy into

assessing actual learning. Many registrants never intend to complete the course but benefit greatly from exploring the course material and listening to presentations. Motivation varies greatly, and, in many cases, people access a course only to acquaint themselves with a specific topic. However, it should be mentioned that during the first year of edX, more than 43 000 certificates of completion were obtained [5]. Despite being a low percentage, this is a large number!

The League of European Research Universities (LERU) recently expressed concern over the lack of consistent quality of MOOC courses and that the presentations were often poorly prepared, and even boring [6]. Having participated in a number of MOOC courses, I can corroborate this view in that the breadth in quality is huge, from monotonous monologues on behalf of the instructor to brilliant performances and outstanding course material. The LERU paper quite rightly encourages universities to apply the same quality criteria to on-campus and online courses to avoid damage in reputation. Despite the concerns, the LERU paper acknowledges that MOOCs have raised awareness of the importance of innovative teaching at research-intensive universities.

It will be extremely interesting to see how current critical aspects are addressed in the next stages of MOOC development and spin-off effects. It will also be interesting to follow research on learning analytics, online behavior, student outcome, motivation, and background of registrants, both with regard to education and socioeconomic status. Yet another fascinating aspect is to see to what extent digital courses become a part of traditional degree courses. At MIT, already over half the 4500 students take a MOOC as part of their course [7].

Small private online courses (SPOCs), sparked by MOOCs, are being initiated through edX, and involve courses offered to limited numbers of registered on-campus students. They engage blended learning techniques and allow classroom time to be utilized in a more effective manner, in the same way as blended learning with MOOC courses woven into the curriculum.

Another aspect that requires clarification is the development of a long-term business model for online teaching. It must be borne in mind that running a MOOC course is expensive, first, because of the technological infrastructure necessary to service thousands of students and also staff time to develop, execute, and, most importantly, interact with the students.

The existing platforms are either for-profit, such as Coursera or not-for-profit, like edX. It is difficult to acquire detailed information on revenue, but clearly approaches include charging institutions for participation and production tools for developing courses, certification fees, minimal charges for courses, etc. EdX and Google have teamed up to create the MOOC.org platform offering participation to educational institutions, businesses, and individual instructors interested in creating or hosting courses. Venture capital has been invested in some cases, but the return of the investments remains unclear, as is the sharing of future income.

IV. NEW ERA IN EDUCATION

Although many aspects need resolving, as referred to above, the development of MOOCs has certainly created a stir and encouraged revision of standard teaching practices. It will be fascinating to follow results of ongoing research into pedagogy, learning analytics, and comparison of outcomes between traditional on-campus teaching, MOOCs, and blended techniques, to see how further advances in teaching and learning can be achieved. It will also be interesting to follow implementation of new ideas for using digital tools in innovative teaching in the humanities and social sciences, new ideas for degree structures, semesters, and degree design. Will universities commonly be offering whole MOOC-based degrees? Will individual students be able to design their own degree by handpicking high caliber courses from different universities? Will instructors from various institutions increasingly team up to co-create courses?

Apart from striving for better teaching and learning practices *per se*, there are a multitude of changes currently taking place in our surroundings that will continue to call for more innovation and flexibility in education. These developments are technological, economic, social, demographic, and political in nature [8].

One such aspect concerns the effects of technological upbringing on the new generations, for example, individuals who are growing up using tablet computers from the time they are babies. They are developing amazing new talents and techniques for learning that will require novel methods of teaching and place heavy demands on e-literacy skills of teachers at all educational stages. We are today striving to meet needs of our current student population, who have for a number of years experienced daily use of computers, Internet, smartphones, and social media, but these needs will probably fade in comparison to those of the upcoming generations.

Another change affecting the needs of students is the rising cost of higher education with substantial increases in tuition fees in many countries. This often requires students to work longer hours than before to be able to afford their education and living expenses. For this growing number of students, digitally delivered course material provides desired flexibility as it precludes the need to be present at a set time or place.

The convention of taking a degree and subsequently being set for life is in decline. With rapid advances in technology, knowledge, and practical skills, people in most professions need to renew themselves regularly over their working careers to remain apt and competitive. Online courses offer opportunities to address these needs

for professionals in urban as well as rural areas.

MOOCs have been presented as helping to address the need for massification of education in poverty-stricken areas and, in general, to contribute to an elevated degree of education in the world. In a recent publication [9], the International Association of Universities (IAU) presented interesting viewpoints on MOOCs in developing countries, emphasizing both the opportunities, for example, with courses on prenatal and other heathcare issues in Africa, but also concerns over language and culture issues as well as lack of technological infrastructure in many places.

It is vital for universities and other educational institutions to embrace new opportunities for better performance, to the benefit of students and society. With regard to MOOCs specifically, it is important to create strategies with the aim of defining how best to motivate students and deepen their understanding and creativity. It is essential to avoid being defensive

and focusing on failures of new developments because current shortcomings will most certainly be resolved, leading to improved and innovative ways of teaching and learning. Complacency on behalf of universities and other educational institutions poses a risk of them being left behind. Already many noneducational organizations and corporations have shown a keen interest in addressing innovative education, and are prepared to step in and even take a leading role.

The openness to new ideas does not mean that mainstream practices have to be abolished. There are certainly areas where technology-mediated learning is hugely beneficial, and others where this does not apply. It is thus sensible to rethink educational strategies through strengths and weaknesses of current practices as well as those of potential innovative practices. Such an approach has just been presented in a fascinating way by a Task Force on the future of MIT education [10], where recommendations of ways forward in educational strategy are

presented in concert with discussions on relationships between space and learning.

My own view is that we have gone past the verge of a new era in education. It has already begun. In comparison to technological novelties of the 1980s, the consequences of which we had reasonable time to adjust to, we now need to respond with more urgency. The number of children who have the potential to outpace teachers and policy makers in digital competence is growing. Whether there is a threat of these individuals suffering diminished proficiency in reflective and analytical skills at the cost of increased technological aptitude remains to be answered. We need to study these issues carefully, weigh all the facts promptly, and respond strategically. A new era in education has begun, and our common goal must be continuing to strive for facilitated access to knowledge and transformed educational environments using technology in the most fruitful way possible. ∎

REFERENCES

[1] M. Gaebel, "Occasional papers: MOOCs, massive open online courses," European University Association (EUA), Jan. 2013. [Online]. Available: http://www.eua.be/Libraries/Publication/EUA_Occasional_papers_MOOCs.sflb.ashx

[2] M. Gaebel, "Occasional papers: MOOCs, massive open online courses," European University Association (EUA), Jan. 2014. [Online]. Available: http://www.eua.be/Libraries/Publication/MOOCs_Update_January_2014.sflb.ashxUpdate

[3] MOOC Commission Sub-report, "Time for MOOCs," Dec. 2013. [Online]. Available: http://www.regjeringen.no/upload/KD/Time_for_MOOCs.pdf

[4] Open Education Europa, European Commission, "The gateway to European

innovative learning," 2013. [Online]. Available: http://openeducationeuropa.eu

[5] A. Ho et al., "HarvardX and MITx: The first year of open online courses, Fall 2012–Summer 2013," HarvardX and MITx Working Paper No. 1, Jan. 21, 2014. [Online]. Available: Http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2381263

[6] S. Mapstone, S. Buitendijk, and E. Wiberg, "Online learning at Research Intensive Universities," League of European Research Universities (LERU), Advice Paper 14, Jun. 2014. [Online]. Available: http://www.leru.org/files/publications/LERU_AP16__Online_Learning_at_RIUs_final.pdf

[7] "The future of universities: The digital degree," The Economist, Jun. 28th, 2014. [Online]. Available: http://www.economist.

com/news/briefing/21605899-staid-higher-education-business-about-experience-welcome-earthquake-digital

[8] J. Micklethwait and A. Wooldridge, The Fourth Revolution: The Global Race to Reinvent the State. Baltimore, MD, USA: Penguin, 2014.

[9] International Association of Universities (IAU) Horizons, "In focus: ICTs in education—Revolution or evolution?" Jun. 27–43, 2014, vol. 20. [Online]. Available: https://www.iau-aiu.net

[10] Institute-Wide Task Force on the Future of MIT Education, "Reinventing MIT education together," Aug. 2014. [Online]. Available: https://future.mit.edu/