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MOOCs and their Effect on the Institution: Experiences in Course Design, Delivery and Evaluation; Research; Faculty Development; Unbundling and Credits for MOOCs

Janine Kiers
e-mail: j.a.kiers@tudelft.nl
Product Manager MOOCs, Delft University of Technology (TU Delft). The Netherlands

Abstract: Four years after the introduction of MOOCs – which were proclaimed to be «the end of education as we know it» in 2012 – the role and effect of these free, online courses is becoming clearer. The online means of delivery to the heterogeneous audiences of MOOCs have enabled and compelled instructors and course teams to develop innovative and flexible learning materials. We can analyse the data on the study behaviour of learners to identify which course elements are effective. In addition, the integration of elements of MOOCs in campus education has resulted in promising outcomes and positive reactions from both students and teachers. On the level of the institution, we also see the effect of MOOCs: ranging from new possibilities in communication and branding, to new needs for faculty development and the support organisation. Furthermore, MOOCs play a role in the unbundling of education, e.g. the learning experience and the assessment tasks now can be uncoupled and may be delivered by different institutions and by different means: the learning experience may be in the form of a MOOC and the assessment may be a written exam at an institution.

Keywords: MOOCs; education; innovation; e-learning; institution.

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1. Innovating education through MOOCs

1.1. *Developing and offering MOOCs – from experiment to experience*

When we started developing and offering Massive Open Online Courses (MOOCs) in 2013, we began with a limited number of courses, a four-person support team and only minor integration with other online products. Today, we offer over 30 MOOCs, we have a support team that includes e-Learning

Developers, Instructional Designers, Product Managers and Business Developers, and a focus on quality and on integration with other, on-campus and online, accredited and non-credit-bearing courses (Kiers & Jorge, 2015).

This article shares the experiences and points of view developed through developing and delivering MOOCs over the past few years at the Delft University of Technology. The article does not aim to be a systematic and exhaustive review of literature.

With the experience of designing, offering and evaluating over 30 MOOCs, we are developing our views on the Quality Assurance, the value of MOOC certificates, and the use of MOOCs in formal, accredited, education.

The topics of our MOOCs represent the broad range of TU Delft programmes and expertise. The content of the courses ranges from very general, like Frame101x on Framing: How Politicians debate, to very specific like QuCryptox on Quantum Cryptography; the level ranges from high-school, like Calc001x on Pre-University Calculus, to MSc/PhD, like TOPOCMx on Topology for Condensed Matter: Tying Quantum Knots; and the focus ranges from concentrated on engineering like ET3034x on Solar Energy and TP101x on The Basics of Transport Phenomena, to more societal as NGIx on The Next Generation of Infrastructure. The number of participants in our MOOCs ranges from a few thousand to 60,000 per course, while the total number of students in a course adds up to over 100,000 when several reruns of the course have been offered. The courses are offered in English, but transcripts are available in different languages for several courses, e.g. for EX101x on Data Analysis to the MAX() the transcripts are available in Chinese, Dutch, English, Hindi and Spanish. The course on Solar Energy was not only completely translated in Arabic, but also facilitated on the Jordan-based edraak platform (www.edraak.org), with an Arabic professor, that was in close contact with our TU Delft professor.

Courses are developed and facilitated by a Course Team, that ranges in number and type of Course Team members but typically consists of one or several (assistant, associate or full) professors, a Project Manager, and teaching assistants that are mostly BSc, MSc or PhD students. Course Teams are supported by an e-Learning Developer, Instructional Designer, Product Manager and Marketing. In addition, several workshops and trainings are organised to facilitate the design, production and delivery of a high-quality course. The start of the course development is in the On Boarding day, where course team members start creating a course design and make a project planning. In following sections it is further elaborated on the course design. The forum moderators receive a Community Management training to train and advise them on how to deal with these massive number of students.

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Typically, the facilitators are active on the discussion forum on a daily basis and feedback their experience to the professor who can respond to student queries in e.g. a feedback video. This creates an engaging student experience: some students see their questions answered by the teacher. In every course, the students are encouraged to play an active role in the forum as this is part of engagement and learning. We often see students emerge that provide positive and adequate feedback and these may be upgraded to Community Teaching Assistants, which means that their feedback appears on the forum as endorsed by the course team. While Course Design and Community Management are thoughtfully developed and implemented, it remains challenging to give the learners an engaging and effective learning experience when the medium of teaching is online only, and the group of students is massive: as a rule, there is no individual contact between the teacher and the student.

The only requirement to enrol in a MOOC is to have an internet connection. This means that our MOOC audience is not the regular university student population, which is reasonably homogeneous, helped by the clear entry requirements for admission to academic programs. Learners in MOOCs are a population that is heterogeneous in numerous ways, including prior education, age, location and motivation to enrol.

The passing rates we see, and that are typical for MOOCs, range from 1% to 6% of the number of students that ever enrolled in a course. This total number of students includes the students that unenrolled before they finished the course. While these passing rates seem very low, and unacceptable for degree courses, they are considered adequate for MOOCs. As an example, the Delft Design Approach, DDA691, had one of the lower passing rates, and received the Open Education Award from the Open Education Consortium in 2015. We know that most students do not enrol in the course with the intention to receive a certificate. In addition, with the limitations in assessment due to the massive character of MOOCs, we need to recognise that the passing rate may not be an indicator of learning. This is one of the academic concepts of which we need to develop a change in perspective.

Given these challenges, how can we develop and offer MOOCs at the level of quality we envision? To this end, we need to define what constitutes course quality, identify course design guidelines, validate their implementation and evaluate the results. All of these elements are applicable to all online courses: whether they have a massive or limited audience, or culminate in an accredited certificate or not. Their implementation may, however, differ between the different types of courses.

Online Learning Experience model

To help improve and analyse the quality of online courses, we at TU Delft developed the Online Learning Experience (OLE) model, which describes eight principles for the design and development of online courses (Jorge, Dopper & Van Valkenburg, 2015). Following these design principles, the student should experience the learning as:

- Flexible (in time, space & content)
- Diverse (activities, resources & assessment)
- Inclusive (accessible, cultural & gender)
- Supportive (guidance & feedback)
- Interactive (learner – learner/teacher/content)
- Active (learning by doing)
- Contextual (real world situations & problems)
- Innovative (new tools, strategies & insights)

The OLE model is used to promote reflection within the course team before course start, and to evaluate and plan improvements after the course has ended. To visualize the OLE, a radar graph is used, which facilitates comparison between courses and explicates their objectives. An example of such a graph for a MOOC is shown in figure 1.

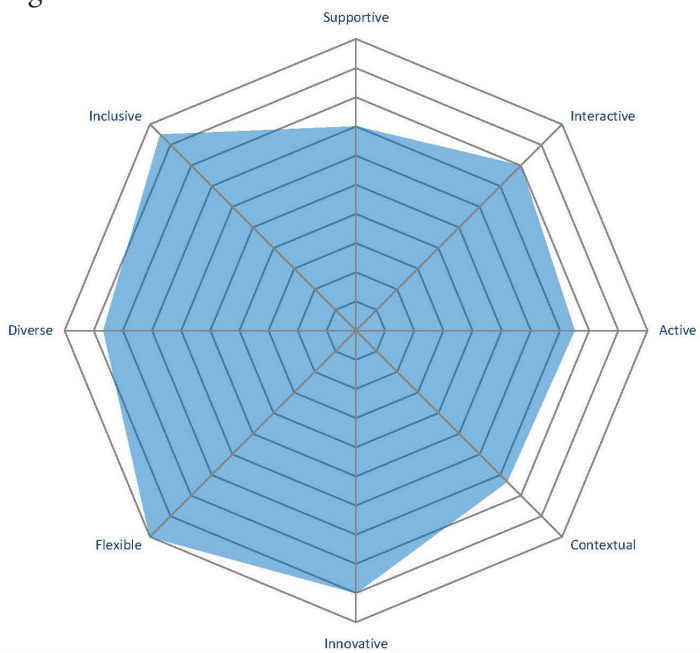

Figure 1. Example of a radar graph for a MOOC

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The open nature of MOOCs makes them flexible and accessible. At the same time, the massive number of learners will realistically limit the individual support and feedback available, because the massive character of a MOOC does typically not allow for individual learner-teacher interaction for all learners. A sense of individual interaction may be created through weekly feedback videos, where the teacher addresses typical questions or remarks from learners. In addition, the teacher addresses the individual student in the content videos. Active learning can be encouraged in MOOCs, by e.g. asking student to upload their work and have it reviewed by their peers, but although progress is being made in this area, the implementation has not been flawless. In relation to the contextual principle, we have seen interesting examples of students applying the material or technology in their own environment, and thus created databases of real world challenges and solutions. MOOCs are an excellent place to implement, and gain experience with, innovative tools.

Carpe Diem Approach to online course design

To guide course teams to consciously include the different principles of the OLE in the online courses, we have implemented the Carpe Diem approach to online course design (Salmon, 2013 and Salmon, 2014). In this approach, the course is designed such that the student experience includes five stages: 1) Access and motivation, 2) Online socialisation, 3) Information exchange, 4) Knowledge construction and 5) Development. It is a team-based approach that focusses on e-tivities, which are online activities for students. These are aligned with the learning objectives and assessment. In addition, the design is carried out «with the end in mind» and considers what the student should be able to do after finishing the course.

While the Carpe Diem approach to course design has been used for MOOCs, the implementation and evaluation of the Carpe Diem approach in course design for engineering MOOCs is ongoing. Our experience so far has involved one or more Course Design workshops for several courses, with varying course content and course teams (Meijerink, Kiers and Marquis, 2016). In our experience, it has transpired that every course team needs a tailor-made approach of the Carpe Diem workshops. One challenge to overcome was that the course team needed to be convinced of the effectiveness of the approach: why would they spend time in (re-)designing their course? Another challenge has been teaching course teams to rethink how they should design for online courses, as opposed to regular courses. The flexible application of the approach means it can be adapted based on the type of course team: whether they are more visually/design oriented, or more technological/engineering oriented; the type of course and its target audience:

what are e.g. level, learning objectives and timeframe of the course; and the status of the course when the course development starts: is the course content defined or still to be outlined.

Validating implementation of course quality assurance

The validation of the implementation of the course quality cycle involves training, support for / from the faculty, and regular checkpoints and evaluation. Training for faculty members includes an On-Boarding Day (where course teams start their course design in close collaboration with their designated e-Learning Developer, and make a project plan), an online course design workshop, camera training, and community management training for both staff and teaching assistants. In addition, various resources on online course development are made available, e.g. the range of video formats that course teams can use as inspiration (TU Delft Multimedia Academy, 2016). The course development is carried out in close collaboration with the e-Learning developers and a support team that includes expertise in the areas of Instructional Design, Multimedia, Copyright, etc. Implementation is further validated by organising formal meetings at the start of the course development, one month before course start, and an evaluation meeting.

Evaluating Teaching and Learning in MOOCs

The Educational Quality Cycle includes the Teaching and Learning evaluation strategy using methods and tools to evaluate the teaching and learning within our own MOOCs in particular. Here, the use of a set of qualitative tools is recommended, in addition to the more common quantitative tools used to evaluate the «success» of a MOOC (Marquis, Kiers & Meijerink, 2016). These qualitative tools comprise student surveys, discussion fora analysis, teaching staff journals and interviews, in order to include the different stakeholders in the MOOCs: the students, the teachers, the support staff and course designers. When these are combined with the quantitative methods like data analytics and qualitative survey data, this results in more valuable evaluations that do not only benefit the quality of the evaluated MOOC, but yield improvements for other courses as well.

1.2. *How MOOCs improve residential education*

While it mostly has been difficult to convince teachers to include online materials in their campus courses, the MOOCs have contributed greatly in the transition of innovating campus teaching by including online elements.

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Making a MOOC seems to be more attractive to faculty than making an online or a blended course, possibly based on the exposure MOOCs involve, the innovative aspects, or through institution-based rewards. Once the MOOC has been created and the more flexible learning materials, like videos and online assignments, are available, the materials are re-used in campus education. In addition, MOOCs are improving education through the need to redesign courses based on their means of delivery. The online and massive character obliges course designers to work on engaging activities and community management. The development of a MOOC, or the transformation of an existing course into a MOOC, requires a new fresh look at the course and a revision of the learning objectives and how these are aligned with the learning activities and assessment. The new medium and audience force course teams to rethink their course and this often results in more engaging and more flexible learning materials. Virtually all lecturers that develop a MOOC use some, most or all online elements in their campus teaching, thereby improving the quality of their courses.

The course EX101x, «Data Analysis to the MAX()», is one example of how a MOOC was used in campus teaching. The teacher of this course, Felienne Hermans, shares her experience in Flipping the Classroom in her blog and a video (Hermans, 2016). In addition to improving her campus course by including online elements from the MOOC, she could «be a spy» on students in the online environment and see how her students worked, assign them to ask questions in preparation for the lecture, and have the students act as teachers by asking them to upload videos, and contribute to the syllabus.

1.3. *Evaluation and Educational Research*

A characteristic of MOOCs is their massive number of participants. As every mouse click is registered, we should be able to relate the study behaviour to the study result, and see which course elements are effective. However, conclusions are limited by the heterogeneity of the learner population in prior education and motivation to enrol (Reich, 2015). In addition, the interpretation of massive data sets requires cross-course comparisons, to eliminate content-specific results. More importantly, translating the «click-behaviour» to learning is not straightforward.

On the other hand, MOOCs are able to generate data and information about how students experience the course. The large number and anonymity of students result in a high number of respondents in student surveys, particularly at the start of the course. The limitation lies in that only a fraction of the students fill out the post-course survey, mostly students that completed the

course. This means, the majority of the comments are provided by participants who have finished the course, while we could use information on the reasons why learners dropped out of the course to learn how to create more engaging course material.

Learning Transfer, does it take place in MOOCs?

In the earlier described evaluation of teaching and learning in MOOCs, we analyse events in the course and the student experience. This excludes the analysis of how students apply their newly gained competences from the MOOC in their professional lives or other fields. The Delft Research Group studies Learning Transfer, which is: how students apply what they have learned in new contexts (Davis, 2016). To study how the learning leads to the transfer of the taught concepts into practice, the programing behaviour of learners of FP101x (a MOOC in Functional Programming on edx) was analysed before and after the course. Researchers were able to link about one third of all FP101x learners to GitHub, the most popular social coding platform to date. This constituted a first exploratory analysis of learner behaviour beyond the MOOC platform. The analysis of the students' log traces on GitHub revealed that more that 8% of the engaged learners transfer, i.e. apply what they have learned in the course in a novel context, and that the learning transfer known from the classroom setting seems to be evident in the MOOC setting.

This is very interesting set-up, since it allows to study the behaviour of students before and after the course, and analyse the difference in their programming behaviour. The course is offered and the coding behaviour is available in an online environment, which allows analysis that would not be able in a regular courses.

Lots of data, but conclusions?

The sheer scale of numbers of students has led to bold proclamations of education disruption and a sector on the verge of systemic change (Siemens, Gašević & Dawson, 2015). However, from the perspective of 2015, these statements appear increasingly erroneous, as MOOCs have proven to be simply an additional learning opportunity, that the community is still trying to understand and effectively leverage, instead of a direct challenge to higher education itself. For further reference, Siemens *et al.* (2015) have created an extensive report with an overview of literature on Distance education, Blended learning, Online learning, Credentialing, MOOC research and Future learning technology infrastructures. Quoted from the introduction to this report:

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> It is our intent that these reports will serve to introduce academics, administrators, and students to the rich history of technology in education with a particular emphasis of the importance of the human factors: social interaction, well-designed learning experiences, participatory pedagogy, supportive teaching presence, and effective techniques for using technology to support learning.
>
> The world is digitizing and higher education is not immune to this transition. The trend is well underway and seems to be accelerating as top universities create departments and senior leadership positions to explore processes of innovation within the academy. It is our somewhat axiomatic assessment that in order to understand how we should design and develop learning for the future, we need to first take a look at what we already know. Any scientific enterprise that runs forward on only new technology, ignoring the landscape of existing knowledge, will be sub-optimal and likely fail. To build a strong future of digital learning in the academy, we must first take stock of what we know and what has been well researched.

1.4. *Further research*

MOOCs create an impressive source of valuable information through learners, in a wide variety of ways. In the DelftX MOOC on «Data Analysis to the MAX()», a large number of user responses were collected regarding identification of spreadsheet metadata from participants (Roy, Hermans, Aivaloglou, Winter and Van Deursen, 2016). This facilitated the understanding of how users perceive and identify metadata in spreadsheets, and the evaluation of two existing approaches of automatic metadata extraction from spreadsheets. The data generated by the MOOC participants was extra valuable because they were also the target audience for this question: they had an interest in, and some knowledge of, spreadsheets and worked with them.

Another example of how a MOOC was used to gather research data is illustrated in the course Frame101x (De Vries and De Bruijn, 2016). The topic of this MOOC is political framing, the process in which modes of message presentation shape public opinion. While verbal framing is a known research topic, not much is known about nonverbal framing: a speaker's strategic adjustment of nonverbal behavior such as tone of voice, posture and facial expression. The videos in the MOOC and the large group of learners allowed to study the effect of the way a message was delivered: students were presented with four 40-second videos of a "masculine" message (i.e., advocating gun ownership) delivered in a feminine way (i.e., sensitive tone, moderate voice, relaxed posture, and friendly facial expression) or in a masculine way (i.e., authoritative tone, loud voice, tense posture, and stern facial expression). This way the effect of the nonverbal behaviour on ow convincing the speech was could be studied.

2. What does this mean for the institution?

2.1. *Marketing of MOOCs and through MOOCs*

The combination of Marketing and MOOCs manifests itself in two ways: on one hand, the marketing of MOOCs to attract students to the MOOC, and on the other hand MOOCs are a tool for branding and communication for the university, and to draw MOOC-students' attention to other courses by the university, and to the institution as a whole. The second draws upon the first. Looking at the enrolment in a MOOC only, we see the largest effect of the activities by edX: a mention of a course in the edX newsletter or a course featured on the edX homepage results in a noticeable increase in enrolment. A press release to Dutch target groups results in a obvious increase in enrolment from the Netherlands, but does not have a obvious effect on total enrolment. The institution needs to familiarize itself with having the world as their competition, instead of the country or the continent: online learners can select courses from a worldwide range of MOOC-offering institutions.

On the level of marketing through MOOCs, we can see that the enrolment in residential degree programmes has increased, and shifted, since we started offering MOOCs: we see more applicants from countries where we haven't had applications before, and the percentage of applicants that are admitted is higher. Additionally, learners in our ProfEd courses (single, non-degree, courses, developed for professionals) indicated in questionnaires that they found the course through their participation in a DelftX MOOC. When attracting students to paid online education through MOOCs we need to take into account that the audience for MOOCs may not include the audience for paid courses.

Use of MOOC material by other universities

We have experienced that is not straightforward to convince our faculty to use open material that wasn't created by themselves. But upon offering the MOOC, we noticed that a teacher in India has used the material from one of the DelftX MOOCs, FP101x, in his classroom and published the following tweet, with a picture where his students are shown in their classroom: «Taught my first #haskell class today (based on EdX #FP101x). Students say they love @ headinthebox :)» (@pramode_ce, 2015)

Another example of use by other institutions is the offering of one of our courses through the Edraak platform, an Iran-based MOOC-platform that provides education to the Arab-speaking world (Edraak platform, 2015). In this

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case, EX3034x, a course on Solar Energy, was licensed to Edraak and a surrogate professor was selected to provide additional teaching and student support in Arabic. To ensure the Delft-quality of this offering of the course, the selection of the surrogate professor and the additional course material was developed with input from the Delft professor.

2.2. *Effect of MOOCs on the institution*

TU Delfts Vice President for Education, Anka Mulder, has argued, «The worst thing that can happen [by introducing MOOCs into the university] is that we will have improved our education». In this statement, she was referring to the uncertainty of the effect of MOOCs for the university. Apart from the described use of MOOC material in campus education, we have seen that MOOCs have resulted in more attention in the institution for improving the quality of education. While the research output is still a crucial factor when evaluating faculty members for a promotion, education has gained more attention with the development and offering of MOOCs, and may now also be considered when evaluating faculty for promotion.

The availability of MOOC material has greatly facilitated the creation and acceptance of blended teaching, while it had proved to be difficult to achieve that using other methods.

Developing a Quality Assurance procedure for MOOCs has resulted in new insights for the evaluation of campus courses.

2.3. *Unbundling of education*

The field of education is changing. Instead of receiving our education during the first 20 to 25 years of our lives from recognized institutions, we are becoming lifelong learners, who learn from a variety of sources, and MOOCs can be one of them. This more modular, more flexible, approach is an answer to the developments in society. Our current society requires a more flexible workforce, and technological developments, such as increased Internet connectivity and mobile devices, have partly changed the modes of delivery of education, from books and physical lectures, to education through a variety of media and on a variety of devices. This enables us to further personalize our education.

A complicating factor is that in this situation, it is more difficult for an employer to evaluate what an applicant has learned and which skills s/he has developed. When education is offered by a recognized institution, which offers accredited programmes, a government or another regulatory body has evaluated

and approved the programme. Furthermore, there are entry levels, which demonstrates that a graduate from such a programme, has also passed the entry qualifications.

With the unbundling process, the need arises for another way to obtain an indication of the skills an applicant possesses. A «light» version of such an alternative way for students to demonstrate what they learned is through badges (Carey, 2012). These are very flexible, and can demonstrate small fragments of learning.

2.4. *Credits for MOOCs*

In the field of recognizing courses that do not form part of an accredited programme, we see two main developments. On one hand, we see how MOOCs are being used for degree programmes, which means they need to be recognized by the institution that issues the degree. On the other hand, we see that alternative credit is being developed for MOOCs. To follow is an inventory of the different initiatives that have arisen to recognize MOOCs.

Credit for MOOCs offered by other schools: the Alternative Credit Project

The American Council of Education initiated a project to recognize MOOC credit in degree programmes at a selection of US based universities (American Council of Education, website). The Council evaluated a selection of MOOCs from different providers against a set of quality criteria, and MOOCs that met the criteria were included in the project. A number of US universities now issue college credit for these MOOCs, which do include ID-verification, but do not seem to include proctored exams. In the website, students can search courses based on topic, school offering the courses and schools accepting the credit.

A European quality label for MOOCs

In Europe, the OpenUpEd quality label was developed for MOOCs (OpenUpEd, website). Its associated institutional benchmarking is primarily meant to be applied as an improvement tool. It compares institutional performances with current best practices and leads to measures to raise the quality of its MOOCs and their operation. This process is designed to complement both an institutional course approval process, and ongoing evaluation and monitoring of courses in presentation. This quality label does not lead to credits.

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A full first year based on MOOCs: Arizona State University

The Arizona State University partnered up with edX in the Global Freshman Academy, with the aim to offer the first year of college entirely through MOOCs (Global Freshman Academy, website). Students register in the ID-verified track of the MOOC for US$ 49, take a proctored exam and, if they pass, they have a year to convert to college credit for an additional fee. The openness of MOOCs is still valid: the courses are accessible for free and without formal entry requirements like transcripts or GPA.

A BSc degree based on MOOCs

The French start-up OpenClassRooms (Openclassrooms, website) is launching the first State-recognized bachelor degree in France that relies exclusively on MOOCs. Students need to register in the paid Premium Plus track, that offers individual interaction with a mentor, and they need to have their project work evaluated by a jury.

MIT Micromasters

MIT offers as series of MOOCs that can lead to a MicroMaster's credential, issued by MITx (MIT Micromasters, website). Required for this credential are exceptional results in the online courses and in the additional, proctored, exam. Learners that have earned the MicroMasters credential can apply to be admitted to the campus program at MIT, where they can earn the full master's degree by taking additional coursework and a thesis project. The programme features «inverted admissions», which means students can take the online part of the coursework without having to apply for admission. Admitted students will be able to use their MicroMaster's credential as course credit (MIT News Office, 2015).

2.5. *The next step: recognize MOOCs in formal education*

What will it take to recognize MOOCs in formal, accredited programmes?

Six universities (Delft University of Technology; Ecole polytechnique fédérale de Lausanne; the Australian National University; the University of Queensland; the University of British Columbia; and Boston University) are working towards developing an international credit transfer system for MOOCs. This will require the consortium to develop a system of reliable testing for MOOCs and to

develop coding systems to measure the level and weight of each course, as well as to examine the entry requirements for each module.

To reach this, the next steps would be to agree on 1. finances: exchange of students and credits will be much easier without the exchange of funds; 2. coding: to enable students to include the courses in their programmes as building blocks, the level, expected prior knowledge and study load need to be clear; and 3. a system of quality and trust: when the institutions agree on the quality of the courses, they rely on trust instead of individual quality checks (Mulder, 2016).

This will lead to the greater flexibility and variety in courses, and students can cherry-pick their courses from a broad range of institutions. Student-exchange is not new: students have received credits for courses taken at other universities. But with MOOCs, we open up the potential that this number largely increases, and thus create greater flexibility for a larger number of students.

3. Concluding remarks

We can see that MOOCs drive educational innovation, and academic development on several themes and levels: in course design and evaluation, and in educational and other research, on levels ranging from the individual faculty member to beyond the institutional level. In addition to our mission to educate the world, MOOCs help to increase TU Delfts international reputation, and attract new and better students to the university. The impact of MOOCs and online courses on the organisation, apart from a new and greater focus on teaching, is that we have set an example as an innovation programme.

Developing and offering a MOOC means that faculty members need to re-think their courses, and that Course Teams need to be trained to develop and offer these courses. The supporting organisation develops and offers these new trainings focussed on online learning, and thus acquires and augments the necessary expertise. The redesign of courses, plus the use of online material in residential teaching, enhances innovation in teaching. The organisation of kick-off, progress and evaluation meetings for courses, together with creation and use of their reports, results in a structured approach to quality control, and in better reruns.

The data resulting from MOOCs, from surveys and on learner behaviour, not only give insight in what is effective course design, but can also be used to obtain a better insight in who our learners are. In addition, the courses can be used to perform research that is not focused on education, but on e.g. the topic of the MOOC. This way, we create new relationships between education and research.

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Faculty members and course developers obtain more insight and experience in online and residential education, administrators see the effect of online elements in programmes, and the institution forges new collaborations. An initiative like Credits for MOOCs will enrich the study programmes and make education more flexible for students. The «inverted admissions» of a Micromasters will open up education, and admission to degree programmes, to students that didn't have access before, and is at the same time a new product in itself.

While MOOCs haven't brought «the end of education as we know it», we do see a strong impact on education, its organisation and innovation, and they will be instrumental in implementing our ambition to develop the courses to educate students for jobs that do not yet exist.

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