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Greening the global classroom: experiences using MOOCs to advance sustainability education

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Abstract

The proliferation of massive open online courses (MOOCs) has been a phenomenon in higher education but only recently the subject of academic literature. MOOCs combine the traditional ideas of cohort and guided learning with open access and a truly global classroom. With over twenty thousand learners attracted to such courses, we argue that they can be a powerful tool in advancing sustainability education in terms of global reach. Like traditional education, the quality of the education delivered by MOOCs is influenced by their design and this is also integral to their success in promoting deeper learning of sustainability topics.

However, designing a quality course and ensuring genuine learning experiences in this open and massive context is not without challenges. We describe our practical experience with curriculum design, production and delivery of a MOOC with a wide sustainability focus of "Greening the Economy: Lessons from Scandinavia". The background of students taking the MOOC, motivations and reasons for seeking this type of sustainability education and perceived benefits from this MOOC and other MOOCs with topics related to sustainability are discussed. Combining pedagogical approaches in the form of teacher-led lectures and quizzes for basic understanding with more constructivist forum discussions and peer assessment created the opportunity for the MOOC to not only disseminate knowledge about sustainability issues, but also encourage discussion, peer interaction, and deeper engagement with these issues. An interesting aspect of this reciprocal learning was the collected insights from learners in the form of case studies and survey responses. The promise, as well as potential issues, of MOOCs in contributing to the goals of sustainability education and lifelong learning are discussed and reflected upon.

1. Introduction

The proliferation of massive open online courses (MOOCs) has been a very recent phenomenon in higher education. There have been a variety of MOOCs offered, generally categorised as either cMOOCs, based on connectivism and learners building their own course content and xMOOCs which combine the traditional ideas of cohort and guided learning with open access and a truly global classroom (Rodriguez, 2013; Yuan & Powell, 2013). MOOCs have gained much interest for their potential to make higher education more open and accessible, help drive down costs, and to disrupt the field of higher education but it is still too early to draw conclusions (Chen, Barnett, & Stephens, 2013; Yuan & Powell, 2013). So far universities have been motivated to invest and develop MOOCs mainly to extend the reach of an institutions education, but also its brand, as well as to experiment with different pedagogy in online education (Yuan & Powell, 2013). We argue that MOOCs also have the potential to be a powerful tool in advancing sustainability education in terms of global reach.

As with other universities, one reason for Lund University and the International Institute for Industrial Environmental Economics (IIIEE) to develop a MOOC was for brand promotion of both Lund University and the IIIEE but it was also seen as a way to continue to experiment and innovate with the IIIEE's online education and pedagogy. Lastly, the MOOC was seen as a good way to tie together education, research, and the IIIEE's contribution to and participation in societal development, in particular the transformation to a more sustainable society. In this paper we describe experience of designing and delivering the IIIEE's MOOC "Greening the Economy: lessons from Scandinavia" (GtE MOOC). We present and discuss the impact of certain design choices for online learning in relation to the aims for developing the course. We also reflect on the potential of MOOCs to contribute to sustainability education.

2. Greening the Economy MOOC development

2.1 Context

In January 2014 a principal decision was taken at Lund University for a three-year project in which all faculties should be allowed to develop and implement a MOOC (Collberg, 2014). The stated intentions included to 1. promote and highlight Lund University, 2. to contribute to the development of the regular training and instructors' digital expertise and the infrastructure that supports e-learning, 3. to promote cross-border cooperation between faculties with regard to training, and 4. to provide new large groups of course participants worldwide access to the University's excellence in research and education. Moreover, a wish by the university board was that the faculties could show examples of how MOOCs could promote innovation of the traditional curriculum of the faculties at the university.

At the IIIEE, there was already a strong history of online education. The first year (30 ECTS credits) of the IIIEE's flagship Masters program in Environmental Management and Policy (EMP) has been delivered online since 2006. This online module has had a remarkable retention rate of up to 80 %. In 2005-2010 the IIIEE hosted the Energy for Sustainable Development online course (www.e4sd.org) in partnership with the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the Global Network on Energy for Sustainable Development (GNESD). From 2008 to 2010 the course was funded by the Swedish International Development Cooperation Agency (SIDA). The course included 80 hours of learning activities spread over 8 weeks. It was completed by more than 400 energy and development professionals from more than 100 countries. For over a decade until 2012, the IIIEE also hosted the Young Masters Program (YMP, www.goymp.org), a global web-based education and learning network which has involved over 20,000 16-18 year old students from over 110 countries. The IIIEE also developed content for iTunes University, what could be argued to be a forerunner of the MOOCs.

In the course of these online education activities, the IIIEE developed its pedagogical e-learning approaches with emphasis upon engaging students in practical case-studies and active discussions. For example, after learning theory and analysing case studies from the curriculum, Masters students are asked to identify and analyse similar cases in their own countries and communities. Often this work is peer-assessed in groups and discussed in forums or skype. As sustainability issues can differ greatly depending on the local context (Stephens, et al., 2008), it is important that students engage in their own context and be able to recognise similarities and differences. IIIEE educational programmes are also marked by their interdisciplinary approach. This prior experience influenced much of the course design decisions for the MOOC.

2.2 Course design

The overall topic of the course is the "Green Economy", which can be considered a more specific orientation of the broader concept of sustainable development. In the late 1990s, a 'Green Economy' was framed around technology innovation, resource efficiency, natural capital, ecological risks, and human development (Pearce et al. 1989). Lately, a green economy has been framed as one which is low-carbon, resource efficient and socially inclusive (UNEP 2011). While the term has many different interpretations, the topic had a good potential to link IIIEE's education and research agendas. The topic lends itself to illustrate both problems and solutions that are part of the transition to a more sustainable society, at the same time that it is subject to regional and market-specific preconditions. The topic green economy was supplemented with"- Lessons from Scandinavia", thereby using the Scandinavian context to illustrate and discuss one setting while allowing learners to reflect on their own geographical and political-economic settings. While the course was designed to highlight some of the policies in which the Scandinavian region excels, it was also designed to critically discuss continuing challenges and barriers for more complex insight and reflection. The regional focus also helped to scope what is otherwise a very large topic.

The course was intended to appeal to a wide group of learners. Therefore it was designed to be a short five week course expecting 5-8 hours of work each week. The course was also structured with different modules highlighting the problems, initiatives and decisions taken towards greening the economy in four arenas: individuals, businesses, cities and nations. In each module there is a quiz as an assessment task and in modules 2-5 students identify and analyse their own example of a product, business and city that is an example of the concepts of greening. These cases are then assessed by peers using a marking scheme

provided.

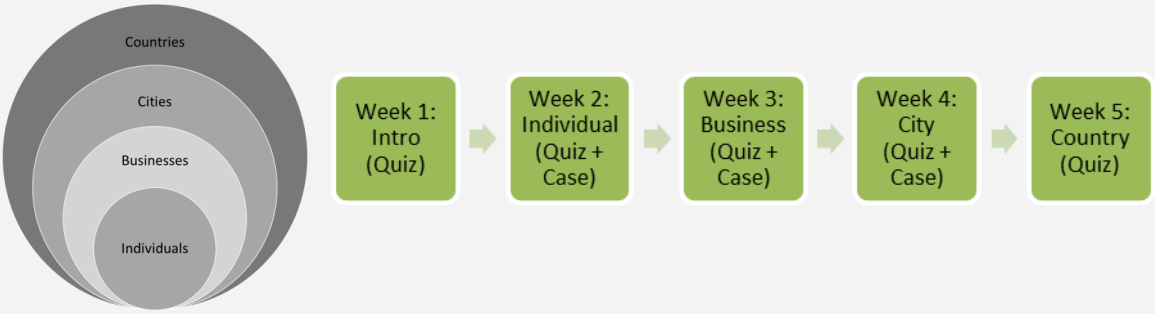

Figure 1. Green Economy Course Outline

Unlike traditional lectures, the lecture videos in the MOOC short, typically 6-10 minutes, and there were 6-8 lecture style videos each week with additional interviews and a segment called "Meet the Parkers" which followed a Swedish family and how the topic of the week related to their lives. Videos also contained short polls seeking to elicit responses from the learners and they were supported by the compendium reading (a free e-book for the course covering the lecture topics and highlighting links to additional relevant material for the keen learners). Building upon prior experience with online education within its Masters programme, the IIIEE the MOOC course was designed to encourage maximum interaction and participation within the Coursera platform. The IIIEE MOOC included course activities to support this aim, including forums and peer assessment. To further emphasise the importance of interaction, these were mandatory learner activities and part of the grading in addition to the weekly quizzes.

Table 1. Course activities (=mandatory)*

Activity	**Function**
Readings (Compendium)*	Complementing video lectures with written material and additional externa
Quizzes*	Testing knowledge from video lectures and compendium
Forum discussions*	Stimulating learner discussions on the key concepts, deeper learning and application
Course assignment*	Requesting learners' own reflections and choice of greener initiatives for d learning and application
Peer assessing*	Evaluation of other learner assignment work, reflection upon own approac
Hangout	Allowing for instructors involvement/in-depth explanations, discussions ar responses to learner discussions
In-video polls	Soliciting data from the learners
Community engagement	Promoting a feeling of a learner group
Readings (additional literature)	Offering more specific information on the key concepts; introducing learne academic readings

From the mandatory activities listed in Table 1, most involved communications between learners to learners (both one way and two-ways) as a means of further synthesising and deepening learning for participants in the course. Moreover, the course assignment was designed so that higher quality cases could be identified (via the peer grading process), to be further analysed by Masters students in the on-site education at the IIIEE. In this way, there was also a tie between the outputs of the MOOC and inputs for the on-site degree programme.

The choices and development of the activities was also influenced in part by the design of the Coursera platform. It was a decision by Lund University that the MOOCs would be hosted on the Coursera platform and in one way this helped guide the design of course elements. Another difference from past courses and also a difference between the GtE course compared to the majority of Coursera courses was the number of teaching staff involved at the IIIEE. Typically MOOC courses have one or two professors teaching (Zhan et al., 2015) but since the GtE topic was chosen as an overarching concept, this allowed for contribution from many aspects of education and research at the IIIEE and thus the participation of over 15 teaching staff. In order to maintain coherence these teachers developed their short lectures within a pre-planned course architecture taking elements from different modules in the existing on-site Masters programme and individual research and ensuring that there were linkages but not overlaps in teaching key concepts. Developing the course in this way had the advantage of allowing a large number of teaching staff to engage and experiment in this medium as well as keeping the workload low for the majority of the teachers by limiting them to one or two short lectures to develop.

2.3 Learner Engagement

A total of more than 20,000 people signed up for the GtE course, and they represented 177 countries (34% from emerging economies). Nearly 40% of the learners were students themselves. The geographical location of learners by continent is shown in Figure 1.

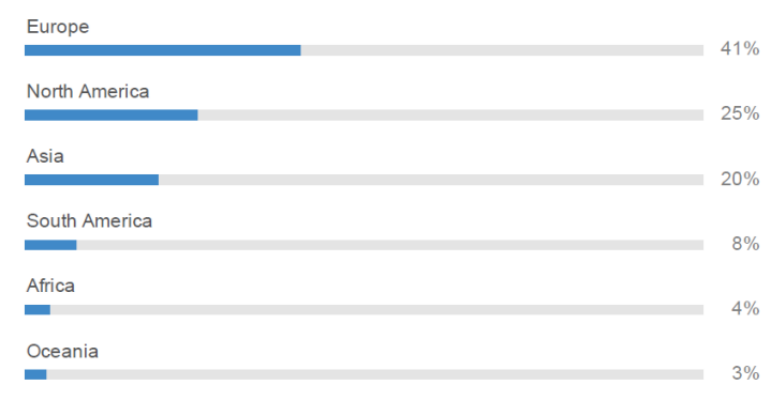

Figure 2. Geographic (using IP data from registered participants) of learners in the GtE MOOC, January 2015

Over 10,000 participants visited the course, over 7,000 watched a lecture, 3,650 submitted an exercise, over 3,000 browsed the forums, 1,423 completed the course assignment and 1,240 passed the course in its entirety. From the perspective of the educational value in terms of visited and downloaded course materials, the MOOC statistics showed that the lecture videos and interviews were watched 167,000 times, and that quizzes and assignments were submitted over 22,000 times.

Learners viewed the course assignment requiring relating concepts and analysis of cases within the learner's own context favourably, with the majority rating it "very good" or "excellent". In the first session of the MOOC, over 4,000 greener initiatives were collected, described and submitted and a majority of these were deemed of good quality.

Participation and interaction amongst learners was also apparent with the over 10,000 forum posts. Moreover, there were very few negative postings, indicating that the forums, course material, and learner community were stimulating constructive discussions. The positive community built was also evidenced by learners staying in touch after completion of the course through Facebook, Linkedin and even on-site visits to the IIIEE. The most popular discussion topics also indicate that the sustainability topics were more than academic to the participants with the most popular thread being *What are you doing yourself to "greening your life"?* with 442 posts and over 2,400 views.

Finally, the feedback from 787 participants collected via a survey at the end of the course was also positive. These showed that 95% of the participants judged the quality of the course materials as "good or excellent", 90% of the participants judged the video lectures as "valuable or extremely valuable", 77% of

the participants claimed that their understanding of the topics covered had improved ”quite a lot or very much”. Also of note were the majority who felt the level and workload were “just right” for them.

3. Reflection and Discussion

It was interesting to note that after the GtE MOOC was completed, learner activity was still noticeable. The compendium continues to be downloaded and distributed, the videos are still watched and the community of participants is still active through social media. This has prompted the exploration of an “on demand” option of the course whereby students can access the materials anytime, but Coursera takes over more of the management of day-to-day running of the course and the academic institutions have less involvement. Weller (2013) notes the blurring of lines between MOOCs and open educational resources (OER) and this development would be close to merging the two. The development of online communities of learners, if they eventually go on to self-organise their learning could also be the beginning of merging the xMOOcs and cMOOCs as well. However, then there could be resulting issues about quality and further development if the IIIEE has less control over the MOOC.

The evolution of the Coursera platform also counters somewhat the argument that such platforms dampening innovation if in fact Coursera responds and explores further innovation along with its course institutions and instructors. While it is unlikely to ever be as innovative as custom made solutions, the Coursera platform does enable smaller institutions like the IIIEE to more easily enter the MOOC realm in the first place. What could arguably be an inhibiting factor with the platforms is the recent development of not giving statement of accomplishments to all learners who complete the course, only those who paid a comparatively (to formal university) small fee to have their results verified. Such a development is in response to the criticisms about quality but it may also deter would be learners and with sustainability education this would be a negative development.

One common criticism of MOOCs is regarding the lack of academic rigour. To experts in the sustainability field, the rigour of the GtE could be perceived as low but we argue that the importance of this also relates back to the aims of providing such a course. The GtE course level of learning was set with the aim to reach a wide and general audience and majority of learners found the level of rigour suited them. Other courses in sustainability may have a different aim and different approach to their course as a result. In a survey of MOOC courses on sustainability, Zhan et al., (2015) identified and analysed 51 MOOC courses related to sustainability, finding a variety of pedagogies and course designs.

In feedback in a forum, one learner reflected upon the rigour of the course compared to another course in sustainability studied simultaneously:

> *“This one has required less work than the other, but I do not believe that I have learned equivalently less here. I will leave it open, at what level of difficulty and hours required, is most appropriate. I guess I pretty much liked this level. I have felt more "at home" and "supported" in this course, which is also of importance, when studying on the internet. This is due to little things as the way staff welcomes and responds etc. I also think that Lund has been better at making quiz responses more logical than tricky, it is very easy to make students fail on details and technicalities, rather than to emphasize on making sure that the greater picture of learning is obtained (especially important when studying by internet). So all in all, not a very hard course to take, especially with the option of being able to re-do quizzes, - BUT nevertheless I have learned quite a lot, and in a very pleasant way, I have been looking forward to your "company" every week.”*

The comment reiterates what research has shown (see e.g. Swan, 2001, 2002, 2003): the need for creating a community and the importance of interaction for learning online. Such interaction and community is also argued as key towards improving retention rates for MOOCs (Khalil & Ebner, 2014) but they are also important for deeper learning to take place (Marton & Säljö, 1976; Ramsden, 1988). However, the retention rate of the GtE MOOC was not any higher than general MOOCs, if counting from the 20,000 students first enroled. One possible explanation for this is the correlation between higher retention with automated grading only and lower retention rates with required peer assessment tasks (Jordan, 2015). Thus requiring students to engage and discuss with each other may be a deterrent towards many successfully completing the course. However, this is only a problem if the goal of the GtE MOOC is to retain as many students as possible. How meaningful the learning is for those who attend the course without completing it is impossible to gauge but it is arguably more important for the learners to have

engaged with the course than to have completed it (LeBar, 2014) and it can also be argued that using the enrolment numbers is not the best way of calculating retention as many students can register months in advance with a couple clicks of the mouse whereas traditional education has much more investment. Another perspective on retention is that the number of students who did actually complete the GtE course, and thus have engaged, discussed and analysed sustainability issues for at least five weeks, is higher than the summed total number of graduates from all other courses taught by IIIEE in the last 20 years.

The learner comment is also interesting in its comparison of the approach with another sustainability course which the learner deems more academically rigorous but not necessary more useful for their learning. With a topic as broad as sustainability it is positive that there are different approaches available for learners. Research at Duke University (Belanger & Thornton, 2013) found that the majority of learners in the MOOC surveyed took the course for enjoyment and/or as part of lifelong learning and a general interest in the topic. Some students used the MOOC to help guide their degree choices or because they could not afford formal education (Belanger & Thornton, 2013). With learners seeking learning via MOOCs for reasons other than formal degrees or recognition, it is important to have MOOCs pitched for a general audience with the goal to meaningfully engage in the topic. It is also important to recognise that even those learners who do not complete all elements of the course may have learned and benefited from it However, measuring the achievement of deeper understanding or whether learners go on to use what they have learned in professional practice is still difficult (Auyeung, 2015)

The positive feedback from learners in the GtE course indicated that it was clearly pitched well to a general but already educated audience. This is true of most MOOCs where the majority of learners already have degrees and it is unclear how MOOCs could be made to further meet the needs of those struggling to access formal education, or if they even can or should (Lentell, 2014). Even as access to the MOOC material is increasingly less the issue with MOOCs available free with mobile apps (Schaal & Lude, 2015), more learner support and skill building will most likely not be adequately addressed by the massive format (Lentell, 2014). Issues like plagiarism that could be the result of lack of skills clearly detract from meaningful learning but are also hard to monitor in the massive setting (Davis et al., 2014). The requirements of platforms like Coursera also means that learners using only mobile devices without a webcam and/or typing recognition needed for verification will have difficulty obtaining a verified certificate even if they successfully complete all aspects of the course. It is clear there will be limits to what MOOCs can do as well and trade-offs between competing interests in developing the potential of MOOCs. Thus it is important to discuss now what MOOCs can contribute to education for sustainability in order to advance development towards that end.

In looking at the survey of the education backgrounds of the GtE students (Figure 3 below), it is clear that the GtE course appealed to lifelong learners with the majority having already completed a university course. While the ideal of sustainability education is that it is embedded in all aspects of higher education, until this is a reality, it is useful that interested learners who may not have had any exposure to sustainability issues in their degree to be able to learn about it now. In fact, an often mentioned barrier to embedded sustainability education is that university instructors themselves lack adequate knowledge to integrate sustainability into their own teaching (Borg, Gericke, Hoglund, & Bergman, 2012; Cebrián, Grace, & Humphris, 2015). Sustainability MOOCs in this way could offer a way for teachers to cultivate this knowledge. The variety of sustainability MOOCs also means that learners can explore which aspects of the topic and pedagogical approaches work best for their learning. That said, despite over 50 courses related to sustainability, there is still a danger of relatively few institutions on a few platforms monopolizing how sustainability education is taught through this medium (this has been a criticism of MOOCs in general, e.g. see Weller, 2013).

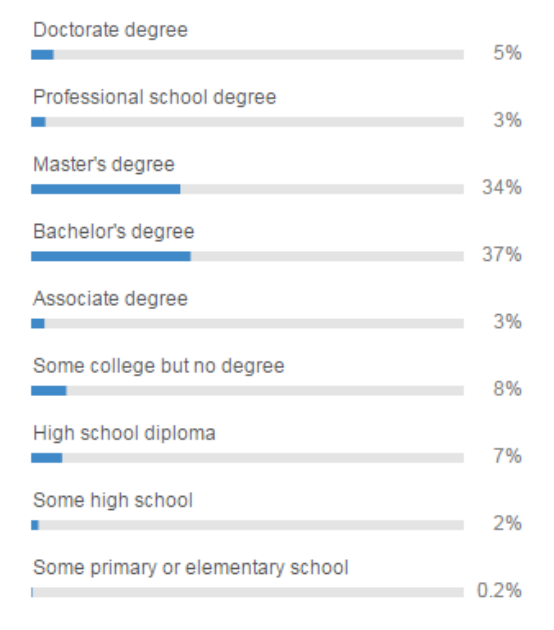

Figure 3 Educational background of learners in GtE course (based on responses from 2507 learners)

In our experience we also received feedback and interest in MOOCs from learners who felt that their businesses or organisations would also benefit from using the MOOC for wider training in sustainability. While a motivation for taking MOOCs is an existing interest in the topic, in this way interested learners might have tools to further share sustainability knowledge with others who may not initially have this interest. Besides the potential for collaboration with business and NGOs, MOOCs can also be a nexus between research, education, and public action. Indeed, we have seen potential for research projects to drive further development and updating of the MOOC material as research funding organisations increasingly emphasise the need to promote societal impact of research. Beyond being a means of communicating the latest research results, the GtE MOOC also demonstrated that there is potential for learners to contribute to the research as well. For example, in-video polls related to individual sustainable consumption were answered by over 2,000 people and the assignment yielded over 4000 case studies. Further refinement of these elements could make learners a valuable input to future research projects.

The tie between research and education as well as the involvement of a wider group of actors may be key to addressing the issue of funding of MOOCs, currently deemed to be an unsustainable business model (Auyeung, 2015; Daniel, 2012). Of course funding outside the education systems will also bring with it another set of issues about the quality and influence on the education then provided. The development and sharing of MOOCs could encourage further collaboration between different actors and the university, perhaps promoting what has been described as emerging third mission for high education, i.e. for co-creation for sustainability (Trencher, Yarime, McCormick, Doll, & Kraines, 2014).

It is still early in the MOOC development to predict how they will be developed and used best but it is clear there is potential for MOOCs to play a role in sustainability education. In the meantime MOOCs can be seen as testing grounds with which instructors are given the opportunity to experiment.

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