Three-Step Transformation of a Traditional University Course into a MOOC: a LouvainX Experience

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ABSTRACT

This paper presents a practical approach to transform a traditional mature university course into a MOOC. The approach has been applied to *LFSAB1402 Informatics 2*, a second-year bachelor university level course about programming paradigms of 5 credits (ECTS), taught at *Université catholique de Louvain* (UCL) to about 300 students in engineering. The transformation was done in three steps spread over two years. A SPOC limited to our students was first created, covering part of the material of the traditional course. It was then opened worldwide as a MOOC. Finally, two MOOCs followed at the same time by our students and worldwide learners and covering all the material of the traditional course have been created. In addition to our 300 students, we had about 7000 (resp. 4000) external students for the first (resp. second) MOOC. About 90% of on-site students and about 4% of registered external students got a certificate at the end of the course. This gradual transformation of the traditional course has three main advantages. First, it makes it possible to reach two different publics given roughly the same efforts and human resources. Second, it opens the possibility for both publics to interact through the discussion forums. Third, it offers to our students a new learning experience supporting them in their regular work and allowing them to study the course autonomously.

Introduction

MOOCs (*Massive Open Online Courses*) are emerging all over the world, created by universities, associations or even by private companies. This new mean of education got the attention of the Université catholique de Louvain (UCL) as it joined the edX consortium in 2013 under the name *LouvainX*. Some professors took the challenge to create a MOOC from an existing course, after a selection that took place inside the institution. This paper reports on one particular experience where a traditional course on programming paradigms was transformed into a MOOC, which is now followed at the same time by our students and by other learners all around the world.

The MOOC was created from a mature traditional course that has been taught for nine years (Van Roy, 2011). The traditional course is a 5 ECTS course and its transformation into a MOOC was done over three academic semesters. In a first step, a SPOC (*Small Private Online Course*) was created and run on-site, to make it possible to test the course before opening it worldwide as a MOOC in a second step (Combéfis, Bibal & Van Roy, 2014). The third step was the creation of a new version of the MOOC, which is used for our students on- site and for all the other learners worldwide, at the same time. Similar approaches have also been followed by other authors (Fox et al., 2014; Delgado et al., 2014; Yu, 2015).

There are three main motivations for having one unique MOOC for both publics: it makes it possible to reach the two publics with the same effort and resources, it opens the possibility for the two publics to interact and it offers a new modern mean of education for our students. The reasons for having spread the migration over two years was to have a smooth transition allowing the limited human resource available to learn how to produce a MOOC and to have enough time to build it.

The remainder of the paper is organised as follows. The first section is about the three-step transformation of the traditional course into a MOOC. The second section discusses about the changes that have been made for the Fall 2014 MOOCs. Finally, the last section presents a first evaluation of those two MOOCs analysing the experience of our on-site students.

From the Traditional Course to the MOOC

The transformation of the traditional course into a MOOC was done in three steps, which are spread over three academic semesters from Fall 2013 to Spring 2014:

- During *Fall 2013*, a SPOC covering a part of the traditional course was created and used for the on-site students in a two-track structure (Combéfis, Bibal & Van Roy, 2014). Students learned part of the material of the course through the SPOC (3 ECTS) and the other part in a traditional way (2 ECTS). This first step offered the possibility for the teaching staff to learn how to build a MOOC and how to create the videos and exercises, since it was a first experience in the MOOCs world for the teaching staff. It was also an opportunity for our students to be faced to a new mode of teaching.
- During *Spring 2014*, the SPOC was turned into the "*Louv1.01x: Paradigms of Computer Programming*" MOOC, proposed on the edX platform along with three other *LouvainX* courses. During that transformation, coding exercises that were proposed on a local separate server with the SPOC were directly integrated into the edX platform thanks to the Pythia platform (Combéfis & le Clément de Saint-Marcq, 2012). It was an opportunity for the teaching staff to learn how to animate a worldwide MOOC and to teach to distant learners. Corrections were also done thanks to the feedback collected after the run of the SPOC, and integrated in this first MOOC.
- The last step of the transformation took place in Fall 2014 when the whole course (5 ECTS) was turned into two MOOCs: "*Louv1.1x Paradigms of Computer Programming – Fundamentals" and "Louv1.2x Paradigms of Computer Programming – Abstraction and Concurrency*". Both on-site students and worldwide learners are now following exactly the same course. The grader used for the coding exercises was replaced by INGInious (Derval, & Gego, 2014), which is an evolution of the Pythia platform. Moreover, the MOOC has been split in two MOOCs because a 10-week MOOC is too long which reduces the probability for a student to complete it.

Table 1: Evolution of the LFSAB1402 course before and after the introduction of the MOOCs.

	Fall 2012	Fall 2013	Fall 2014
On-site activities	Lecture: 2h/week	Lecture: 2h/week	Lecture: 1h/week
	Lab session: 2h/week	Lab session: 2h/week	Lab session: 2h/week
	Project	Project	Project
	Midterm and final exam	Midterm and final exam	Midterm and final exam
On-line activities	None	1 SPOC	2 MOOCs
		13 lessons/10 weeks	6 lessons/7 weeks + 6(+1) lessons/6 weeks
		8h37 videos	5h20 + 5h01(+1h33) videos
		Midterm and final exam	Two final exams
Resources	1 professor	1 professor	1 professor
	4 teaching assistants	4 teaching assistants	4 teaching assistants
	11 student monitors	11 student monitors	11 student monitors
		1 MOOC assistant	1/2 MOOC assistant

Table 1 summarises the whole transformation process for the LFSAB1402 course, from the last traditional version during Fall 2012 to the current MOOCs-based version first taught in Fall 2014. The table focuses on the different activities that our on-site students have to follow. The main changes are the decrease of the lecture hours and the addition of on-line material (3 ECTS for the SPOC to 5 ECTS with the two MOOCs). In the Fall 2014 version, one of the lessons of the second MOOC is optional (it represents 1h33 of videos). At a first sight, it may seem that the workload of the students increased. In fact, the 10 hours of videos correspond roughly to the 1h/week lecture that has been removed and the time spent on exercises structures the individual work they have to do in addition to the supervised activities. A second observation is that at the end of the transformation process, only a half-time MOOC assistant is necessary during one semester to handle and animate the MOOC. The additional human

resource was higher for the SPOC since material had to be created and the automatic code grader had to be implemented and tested. The number of persons dedicated to the traditional activities (lab sessions) has not changed, but the workload of the professor increased (1 day/week for the SPOC and half day/week for the MOOCs).

Changes, Evolutions and Discussion

Building a MOOC to replace an on-site traditional course by a MOOC, which is opened worldwide at the same time, is not an easy task. One first reason is the differences amongst the learners. They have different motivations, available time, education levels and requirements. We identified two categories: on-site students, and worldwide students, the latter category being further split into two groups (students and professionals):

- *On-site students* are following the MOOC as part of their university program. Their participation to the MOOC leads to a bonus or penalty for their final grade for the course. Consequently, they have to watch the videos because there are no more traditional lectures and they have to make the exercises to get the bonus. A consequence is that the MOOC has to be a university-level course.
- *Worldwide students* are following the MOOC because they are interested to learn the material of the course. Approximately two thirds have at least a bachelor's degree and about one third have at most a high school diploma. There is therefore a mix between real students and people with a professional activity. A part of those worldwide students are working on the MOOC during their free time and, consequently, do not complete the course.

Due to this difference in requirements, some traditional activities have been kept for our students. In particular, every week, the professor provides a restructuration of the new material during a one-hour lecture and students attend a two-hour lab session during which they work on the exercises of the MOOC and can ask questions about them, and they also work on additional advanced exercises.

Another concern is the evaluation of our students. Evaluating the students based on their results on the MOOC is not legal. Therefore, our students still have a proctored exam at the end of the course. In order to incentivise students participating to the MOOC, a +2 bonus/-2 penalty has been put in place. Whereas external students only have the opportunity to earn a certificate if they reach 50% for the MOOC, our students also get a bonus/penalty depending on their participation. Having a 100% mean participation for both MOOCs results in a +2 bonus, a 50% mean participation is neutral and a 0% mean participation leads to a -2 penalty. A last difficult part of the evaluation is the automatic grading of the submitted code. The system currently in place using the INGInious grader is doing a great job for the grading part, but has still to improve the feedback messages sent back to the learners in case of a wrong answer.

Evaluation of the MOOCs for UCL students

Two different evaluations of the MOOC have been launched. The first evaluation was conducted directly on the edX platform for all the learners. The second evaluation was only dedicated to our on-site students and this section presents the main results from that second evaluation. A total of 78 students participated to the survey. One of the questions is about the perceived average workload for the exercises on the MOOCs. There are two kinds of exercises: classical exercises are multiple choices or fill in the blank questions and coding exercises require the students to write a (portion of a) program. Table 2 shows the percentage of students for different mean workload duration, comparing the figures of the Fall 2013 edition with those of the Spring 2014 edition. The first observation is the same as described in (Combéfis, Bibal & Van Roy, 2014), namely that coding exercises take more

Table 1: Evolution of the LFSAB1402 course before and after the introduction of the MOOCs.

	Classical exercise		Coding exercise	
Less than 5 minutes	33.64	51.72	9.01	1.15
5 minutes	61.68	39.08	41.44	3.45
10 minutes	3.74	4.60	26.13	5.75
15 minutes	0	3.45	0.9	24.14
More than 15 minutes	0.93	1.15	22.52	65.52

time than classical exercises. But we can observe a difference for the coding exercises, for which the students perceive a larger workload.

Another set of questions from the survey asks students to give their agreement level for a set of statements. The possible answers are either yes/no or a degree of agreement on a five-level scale from totally disagree to totally agree. Hereunder are eight selected questions related to the discussion of this paper, where *"the course"* refers to LFSAB1402, the programming course that is in the students' program, and *"MOOCs"* refers to the MOOCs they have to follow for the course. Those questions and the results are shown on Figure 2. Looking at the answers for those different questions

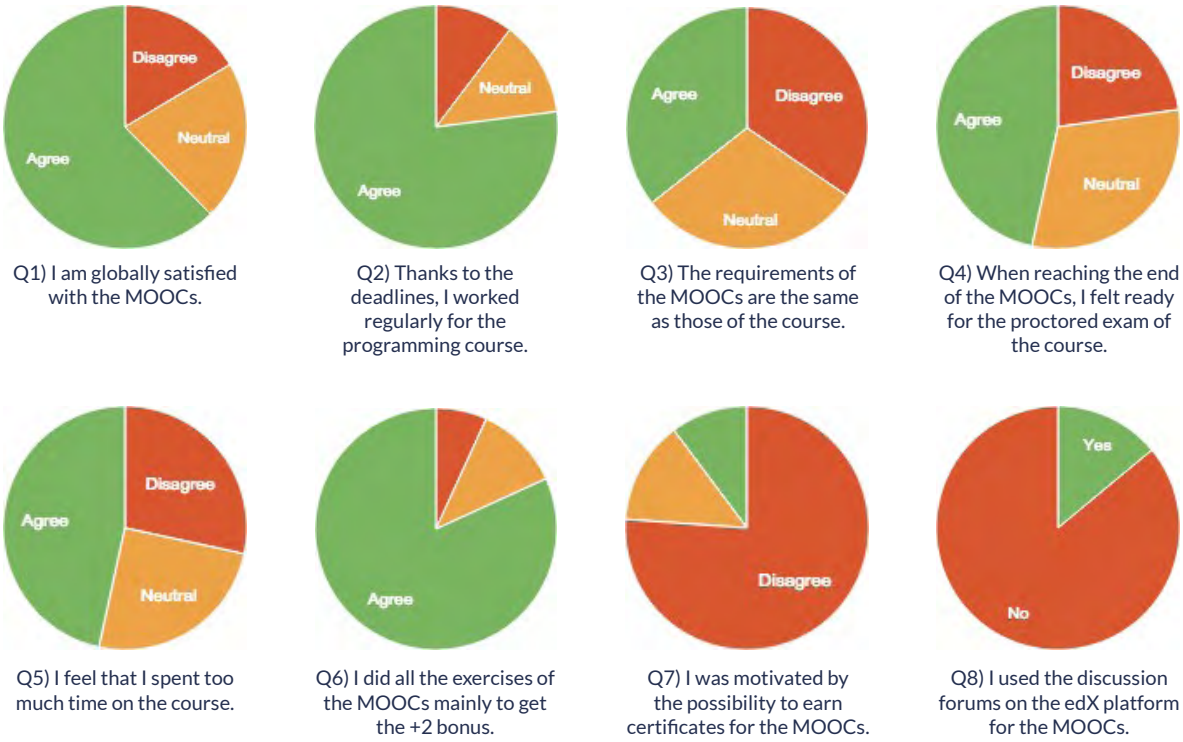

Figure 2. Results of the survey for eight selected questions.

confirms intuitions of the teaching staff and informal feedbacks received from our students. First of all, students are globally satisfied with the MOOCs. Moreover, the deadlines constrained the students to work regularly, which maybe explains that roughly half of the students felt ready for the proctored exam of the course, after having completed the MOOCs. The third question highlights the fact that students do not perceive well the difference between the requirements of the MOOCs and those for the course. This observation is reinforced by optional comments that the students were allowed to add in the survey; a certain number of them indicated that the proctored exam did not correspond to the level of the MOOC. Question 5 reveals that the workload of the MOOCs is not too high for the majority, but we have to take care because nearly a third of the students felt overloaded. Questions 6 and 7 confirm our intuition that the main motivation of our students is to get the +2 bonus, they are not interested in certificates. Finally, the interaction between the two publics is limited since only few of our students used the edX discussion forums.

Conclusion

It is not an easy task to build a MOOC from an existing and mature traditional course. It requires one full-time teaching assistant for the first edition (SPOC) and one half-time teaching assistant for each of the following editions, in addition to the time needed to set up the automatic grader. But as explained in this paper, following an approach by steps and using the MOOC for our on-site students makes the investment worthwhile. However, using the same course for two different publics (on-site and worldwide students) with different requirements involves some constraints. While the MOOC must remain a university-level course

with coding exercises needing creativity and rigour, it must also be accessible to worldwide learners who have less time to do all the exercises but are interested by the material of the course.

We discovered that there are two distinct groups in the worldwide students: those who put in the effort to obtain a certificate, and those who stay active until the end but do not target a certificate. We conclude that the exercises are too time-consuming for many of these students, as the survey reveals for our on-site students, even though they are clearly interested in the material. Perhaps there should be a way to reward these students, to encourage even more participation of this type.

The first edition of the completely remastered course as two MOOCs is now finished. The course has been significantly improved from the SPOC version, through the feedback of the learners, of our students and of the teaching staff. Future work includes a detailed analysis of those feedbacks in order to improve the MOOC to better satisfy both publics. Another improvement that we will work on is to bring a better feedback for the exercises when the learners provide a wrong answer, with a particular attention for the coding exercises. The INGInious grader will include more advanced analyses of submitted codes to provided intelligent feedbacks to support their learning.

In conclusion, our experience in transforming LFSAB1402 has been a satisfactory one. We will continue to teach the LFSAB1402 course as a MOOC from now on, with both on-site and external students. For almost the same teaching effort, the same course reaches two audiences, which is a significant increase in the number of students. As educators, this aspect of the transformation is a definite win. We will likely add further pedagogical innovations to the course in the future.

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