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SPOCs for Remedial Education: Experiences at the Universidad Carlos III de Madrid

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Abstract: *The Universidad Carlos III de Madrid has been offering several face-to-face remedial courses for freshmen to review or learn concepts and practical skills that they should know before starting their degree programme. During the last two years, our University has adopted MOOC-like technologies to support some of these courses so that a "flipping the classroom" methodology can be applied to a particular small educational context. This paper gathers a list of issues and challenges encountered when using Khan Academy technologies for small private online courses (SPOCs). These issues and challenges include the absence of a single platform that supports all the requirements, the need for integration of different learning platforms, the complexity of the authoring process, the need for an adaptation of gamification during the learning process and the adjustment of the learning analytics functionality. In addition, some lessons learned are presented, as well as specific actions taken in response, where MOOCs do not replace teachers and classrooms for these remedial courses, but improve their effectiveness.*

Key words: MOOCs, SPOCs, learning platforms, learning experiences, remedial education

Introduction

After the New York Times declared 2012 "the year of the MOOC", we found our new favorite acronym, standing for Massive Open Online Courses, in every pedagogical higher education endeavor. MOOC is one of the new words describing all the actions and technologies that educators implement in different e-Learning environments and approaches. It seems that MOOCs are here to stay, looking for academic opportunities to implement the challenging pedagogical model that they encompass, but also to enrich traditional education. Now, we MOOCify teaching and learning practices, academic courses are getting MOOCed and some new pedagogies are called MOOCification. MOOCs have gained in popularity in less than two years, encouraging new and creative learning spaces. Online education and eLearning has been around for decades at many universities. The Universidad Carlos III de Madrid implemented its first Learning Management System (LMS) ten years ago, and since then it has been steadily building a blended learning educational model, where face-to-face classes and online educational resources and activities have merged.

Remedial courses (so-called zero-level courses – "cursos 0" in Spanish) are basic courses that several universities teach on a regular basis before a degree starts, to ensure that all students are able to cope with a common baseline in disciplines such as Mathematics, Physics, Chemistry or Biology. Those courses are not strictu sensu degree courses but "extra" university short courses. They are often considered expensive in time and resources for the academic organization. The Universidad Carlos III de Madrid (UC3M) wanted to experiment with MOOC-like technologies but in a small and controlled group of students (between 100 and 300 for each course) and in a private environment (our educational intranet), so these remedial courses were the perfect context to implement so-called SPOCs, Small Private Online Courses (Goral, 2013).

These SPOCs implemented at Universidad Carlos III de Madrid aimed at solving a problem with zero-level courses at our university. These zero-level courses are usually offered during only one week at the beginning of September. Many students need more time to review the different concepts covered. The SPOCs offer students the possibility of working for more time with the topics of the course and provides additional resources. Moreover, the SPOCs enable the possibility of making the face-to-face class sessions more productive as students can watch different videos and solve several exercises in advance.

The efficacy of online learning has been discussed before the MOOC phenomenon. Glance, Forsey and Riley (2013) showed that online learning pedagogy may even be superior in the overall effect on student performance. We are going to describe here how the Universidad Carlos III de Madrid improved traditional on-campus remedial courses through MOOC-like technology, using our own adapted instance of the Khan Academy (KA) platform (Khan Academy, 2012, 2013). We will describe our experience with SPOCs in years 2012 and 2013, the different phases and the main issues: the selection of the supporting platform, the authoring of videos, the authoring of exercises, the gamification environment, and the evaluation. Decisions taken for the presented challenges are explained based on the proposed context of experiences.

Context of the KA-UC3M Experience

The first selected zero-level courses for the experiences were Physics in Summer 2012 with Mathematics, Physics, and Chemistry following in Summer 2013. Table I gives an overview of the number of videos, exercises, students enrolled, and teachers participating for each of the SPOCs and years.

The total number of videos in each course was quite similar, ranging from 22 to 30. There was a specific video for each atomic topic, so the difference depends on the different number of topics to explain for each course. Teachers had to create at least one exercise related to each video. There were some topics that required more than one exercise, especially in Chemistry, so the number of exercises was more for this course.

Traditionally, freshmen who enrolled in the remedial courses received lessons on campus. These lessons ran for one week and took place at the beginning of September. The main problems of this model were the limited amount of time to study all the concepts, and a very compressed schedule.

With the introduction of Khan Academy (KA) technology, a "flipping the classroom" methodology (Bergmann & Sams, 2012; Tucker, 2013) was planned. Students can access the different resources prepared by teachers during the month of August anytime and anywhere. Students can watch videos, solve exercises or interact with other classmates before the face-to-face lessons. These lessons take place during the first week of September, and students can take more advantage of these class sessions as they already know the concepts that they studied in August within our particular KA implementation (KA-UC3M). Therefore, students can focus and ask the teachers about more advanced topics. In addition, students can devote more time to studying the different topics as the educational resources are available on the platform during the time they are enrolled.

	Course	# Students	# Teachers	# Exercises	# Videos
Summer2012	Physics	102	6	35	27
Summer 2013	Physics	181	10	30	30
	Mathematics	278	16	30	25
	Chemistry	91	7	49	22

Table 1: Number of exercises, videos, enrolled students and teachers participating in the SPOC experience, by course and year

Implementation

In the process of the creation, deployment and evaluation of MOOC-like technologies to improve our remedial courses, different issues and challenges emerged. This section describes a list of issues, decisions taken and lessons learned through the implementation of our private Khan Academy (KA-UC3M) installation, first in 2012 and in an improved implementation in 2013.

Based on the experience in 2012, the Educational Technology and Teaching Innovation Unit was created in our university (UTEID, 2013). Its purpose is to help in the development of MOOC technology and in the creation of educational resources. The existence of this UTEID technical unit made the process easier and more scalable in 2013.

The main educational requirements considered to MOOCify zero-level courses were: the possibilities of watching videos; solving automatic exercises; provision of useful analytics of the learning process to evaluate the course; making a clear structure of contents; automatic help for students when solving exercises if they get stuck, and improving communication among students. The requirements for automatic help when solving exercises and the communication among students was stronger than in other typical MOOCs because these SPOCs run in August, the vacation month in Spain. Therefore, it was not planned that teachers would give any support during students' interaction, but instead the platform had to provide mechanisms to overcome this.

Selection of the Supporting Platform

There are quite a few different platforms for supporting MOOCs. Each platform has a specific set of features. The platform should be selected depending on the educational context requirements and the learning outcomes to be achieved.

At that moment (Spring 2012), a platform that fulfilled all the previously described main requirements was not found. We decided to use a combination of two platforms: Khan Academy and Moodle. The KA platform was used for watching videos, solving exercises, generating hints related to exercises, and providing useful analytics data about the learning process. The Moodle LMS was used mainly for communication between students.

Although watching videos and solving exercises can also be done in Moodle, the KA system provides a more powerful learning analytics module. The exercises and videos have to be related to the KA platform to enable this learning analytics support. In addition, the KA exercise framework adapted better to our purposes.

Although the KA platform provides some communication features (e.g. the possibility of inserting comments for each video), other features which are present in Moodle but not in the KA platform were required. These were the possibility of creating common forums where all the participants can contribute, and direct private messages among participants.

The content structure was provided by Moodle but also by the KA platform. In Moodle, the contents were divided by sections, subsections, and chapters. Each chapter usually had a related video and an exercise. In the KA platform the contents were presented using an index, and a knowledge map was enabled so that students could go through the different exercises and see their different connections. The combination of both platforms enables different navigational paths. Users know Moodle better and it is also the default Learning Management System for all degrees at UC3M. Therefore, students may be more familiar with the Moodle content and navigational structure, and its interface can be better for usability purposes.

There were also some features of the KA platform that were used in the SPOCs, but that were not key requirements. Among these features are the possibility of configuring an avatar, the possibility of setting and tracking goals, and the use of a recommender for subsequent exercises. On the other hand, many different features of Moodle which were not used could be enabled in the future for enhanced experiences. Some examples are the assignment, the wiki or the glossary.

The KA platform was connected with Moodle. Some aspects integrated with this solution were single sign-on and the Moodle gradebook connection with the KA user interactions. Moodle enables administrators to set the teachers and students for each course, while the KA platform needs students to select their coaches, which is a similar role to a teacher. The single sign-on should not only enable a user logged into one platform to enter the other, but also convert teachers in Moodle to coaches of all their students in the KA platform.

An important difference between Moodle and the KA platform is that Moodle is designed for private courses in which only a predefined number of enrolled students are allowed to enter and interact with the course materials (so a registered student can only access some courses), while the KA platform enables access to all videos and exercises for any students who are registered for any course. This was an issue in 2013 as there were 3 different courses with different students enrolled in each one (students might belong to one, two or all of the courses). The solution adopted was to have one Moodle instance but 3 instances of the KA platform (one for each course).

In addition, Moodle was the initial platform to enter into the course, and Moodle had external links to the KA resources.

Although an initial concern was that students might get confused with 2 different interfaces from 2 different platforms, this did not present a problem for students. In any case, some links were adapted in 2013 to simplify going from one platform to another.

Authoring Videos

The creation of videos posed two main challenges: 1) Finding the proper methodologies and good practices to maximize students' learning; and 2) Giving homogeneous videos to students so that they perceive the same general rules, such as, for example, the inclusion of university logos in the same way. To achieve this, a rule document for the creation of videos must be available to teachers.

In 2012, teachers only received a few general rules about the process of video creation (e.g. about the recommended duration). People from the UTEID technical unit reviewed all videos from 2012 and some general conclusions were obtained. Based on these conclusions, teachers received more specific rules in the 2013 edition. Some rules were related to, for instance, the combination of colors, or the applications to use for generating videos. Nevertheless, teachers had enough freedom to adapt their videos to their personal teaching style.

Another issue was how to provide resources to create the videos. Teachers were able to create videos on their own, but a place for creating videos was enabled in the library with all the necessary resources and with the support of the UTEID experts.

A final issue was how to deal with the process of receiving the videos, publishing them in the YouTube platform, and annotating them with meaningful tags. The UTEID created a tool to manage this process of uploading videos and annotating them. The tool could also receive videos selected by courses.

Authoring Exercises

One of the main problems with generating exercises was that teachers were not able to create them directly using the KA format, which is an HTML one with specific tags. Average teachers feel it is quite difficult to create the exercises directly in this format. During the first year (Phys-

ics course, Summer 2012), this issue was tackled by creating a set of word file patterns for the different types of exercises considered: fill in the blank, multiple choices and multiple response. Teachers had to fill in the corresponding patterns and send these files to 2 experts who did the final conversion to the KA framework.

In summer 2013, as the number of courses and teachers was considerable, it was not feasible to follow the previous strategy: the experts would have had to format too many exercises. A scalable solution was required. Moreover, with the previous solution, teachers were not able to see directly in the platform how the exercises ran: they only had access to the word files. An authoring tool was designed and implemented to mitigate these issues. This tool enabled teachers to create exercises through a simple Web interface. The type of exercises that the authoring tool enabled was "fill in the blank" with the possibility of establishing parametric variables. Each time that a student accessed an exercise, the parametric variables had a different random value within a range until the student answered correctly. Furthermore, the tool enabled text formatting with an HTML editor, to calculate formulae for the solution or add hints. In addition, teachers could view the exercise being done on the KA platform during their exercise design. With this solution, experts did not have to format all the exercises because the authoring tool translated them automatically into the corresponding format. Nevertheless, there were some specific exercises that the authoring tool was not able to create (e.g. restrictions among variables). Experts had to do the formatting for these exercises.

Based on the first SPOC for Physics, during Summer 2012, other lessons were learned: for example, we realized that multiple choice exercises with long texts as options presented problems with visualization, because long texts as options had to be in a narrow column on the right. For this reason, in 2013, the preferred types of exercises were fill-in-the-blank. Multiple choice exercises were only used in cases where fill-in-the-blank exercises did not make sense, with limits on the length of the possible options.

The authoring tool works without any registration and anyone with Web access can log into it to create exercises. This tool was integrated to the video authoring tool created by the UTEID. In this way, the creation of exercises is restricted to the teachers of the course, and exercises are grouped by the different courses.

An important aspect to note is that teachers create videos and exercises and upload the created resources to the servers using the authoring tools, but the educational resources are not automatically uploaded to the platforms. Instead, experts needed to do this task. To do this final step, experts needed to know the knowledge structure of the course and which exercises were related to which videos. This was given by the teachers to the experts.

Gamification

Although gamification was not one of the initial main requirements, the KA platform brought this important feature. Gamification might motivate and encourage students to learn more and better by earning points and badges during the learning process (Li, Don, Untch, & Chasten, 2013). The KA platform provides a set of five different types of badges by default (meteorites, moon, earth, black hole and challenge patches). Each type of badge is identified by a different image. These badges were adapted to the context of the Universidad Carlos III de Madrid. The initial images were replaced by five different names and images of Madrid monuments from the times of king Carlos III. The highest achievement badges (previously the challenge badges) represented one of the buildings in our own university.

The KA platform can give badges for mastering a set of different topics. A student must achieve proficiency in a topic in order to master it. As the contents of the KA platform were personalized, the conditions for achieving badges related to topics had to be redefined. Three different levels of content hierarchy were defined: section, sub-section and chapter. Students who achieved proficiency in all chapters of a sub-section received one type of badge, while students who achieved proficiency in all sub-sections of a section received another type of badge. Teachers of each course had to fill in a form with the structure in the three levels of hierarchy so the badges could be awarded in this way. The number of badges for each course was different as there were a different number of sections and sub-sections in each one.

Moreover, some of the KA badges not related to achieving proficiency in exercises had to be removed, because they did not make sense in our context. Others had to be adapted (e.g. badges for watching videos for some amount of time because the total number of minutes for watching videos was quite different from the original KA educational materials). These adaptations were made in the 2013 KA-UC3M remedial courses, based on observations from the 2012 experience.

Learning Analytics

One important functionality provided by KA is its learning analytics support. The platform generates many reports about students' interactions, students' performance, results divided by topics, etc. For example, teachers can easily see the number of students that struggle in an exercise or obtain proficiency, and students can see the time spent on different topics, divided by videos and exercises. This type of information helps students and teachers to understand the learning process, evaluate it

and try to improve it. This is particularly important when there are many students in the platform, which is the case even for a small course.

The learning analytics process has a set of phases (Clow, 2012). Collecting the data from students' interactions is done in a very detailed way in the KA platform. This data is stored in different tables within the Data Store of the Google App Engine. The KA platform processes this data to obtain useful information and provides some nice visualizations about the learning process.

Although the learning analytics support of KA is useful, we needed to extend it to include other parameters and to personalize some specific information such as the criteria for a student to progress on the platform. Some examples of proposed parameters and how to use them to evaluate the learning process are shown in (Muñoz-Merino, Ruipérez Valiente, Delgado Kloos, 2013). Some of these parameters are related to learning effectiveness, learning efficiency, students' time distribution, gamification habits and exercise solving habits. A new learning analytics module for the KA platform was developed for this purpose which is named ALAS-KA (Add on for the Learning Analytics Support in the Khan Academy platform). This module generates individual but also class information about the learning process. This information is available for teachers and experts evaluating the learning process and trying to improve it. The information is helpful for improving the face-to-face sessions but also for improving future editions of the courses. Technical details about this extension can be seen in (Ruipérez-Valiente, Muñoz-Merino, Delgado Kloos, 2013).

Conclusions and Future Work

This article presents a list of different challenges encountered while MOOCifying zero-level courses at the Universidad Carlos III de Madrid during the last 2 years. Some solutions adopted and lessons learned from the experiences are explained.

Among the challenges for the creation of educational resources (videos and exercises) are providing teachers with best practices, homogeneity of materials, enabling teachers with authoring tools which they find easy to understand, providing teachers with continuous support during the process, and centralizing all generated materials so that experts can do the final upload. These challenges require a structured methodology for the creation of educational contents. Authoring tools had to be implemented to enable this process.

As a single platform did not cover all the requirements, two platforms were combined. The combination of both platforms was a success, as they were effectively complementary. Although the use of the Moodle platform communication tools was not high during the first year, it was high during the second year, which is important as it enabled social learning.

The specific setup of the experiment implied adaptations to the gamification features of the original platform, and specific evaluation needs required specific learning analytics for which new development had to be done.

Apart from teachers, resources were required: for helping teachers to create videos and exercises, for formatting some types of exercises, to set up the platforms, or for making software adaptations to the KA platform. Based on these experiences, an educational technology unit, UTEID, was created to help in these tasks.

Some of the lessons learned can be applied to other educational contexts, but others are very specific to this educational setting. The Universidad Carlos III de Madrid plans to continue developing these experiences and improving contents, methodologies and platforms for remedial courses. Furthermore the experience gained with these courses might be extended to other learning environments within the UC3M.

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