

HOW TO FEEL “IN LOVE” WITH MATH – A MOOC EXPERIENCE

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Abstract

In the past few years we have witnessed the fast development of distance learning tools such as Open Educational Resources (OER) and Massive Open Online Courses (MOOCs). This paper presents the “Mathematics without STRESS” MOOC Project, which is a cooperation between four schools from the Polytechnic Institute of Oporto (IPP). The concepts of MOOC and their quickly growing popularity are presented and complemented by a discussion of some MOOC definitions. The process of the project development is demonstrated by focusing on used MOOC structure, as well as the several types of course materials produced. At last, is presented a short discussion about problems and challenges met throughout the project. It is also our goal to contribute for a change in the way as teaching and learning Mathematics is seen and practiced nowadays.

Keywords: MOOC, Online Learning, Open Education, Connectivism, OER.

1 INTRODUCTION

Our educational systems are being transformed by technology and globalization. Higher Education Institutions (HEI) are adopting innovative approaches to teaching and learning while maintaining and improving the quality of education. Open Educational Resources (OER) are defined as any type of educational materials free of charge and available for anyone to use. They present educational institutions with a strategic opportunity to increase the quality of educational materials. UNESCO considers that universal access to high quality education is a key channel to peace, promoting sustainable social and economic development, as well as intercultural communication. OER are responsible for a strategic opportunity to improve the quality of education facilitating policy dialogue, knowledge sharing and building capacity. In 2001, the Massachusetts Institute of Technology (MIT), in a never before known move, announced the release of almost all of its courses on the internet with free access. As the number of institutions offering free or open courseware increased, UNESCO organized the first Global OER Forum in 2002 where the term OER was adopted [1].

Massive Open Online Courses (MOOCs) are characterized as free-of-cost, openly-accessible, online courses which can support a huge number of students. They present a new approach to training which enables attract millions of students around the world, contributing to a significant change in the way of HEI think of online training. MOOCs are incredible tools for skill development and knowledge obtainment. One of the earlier open online course entitled *Connectivism and Connective Knowledge*, also known as CCK08 [2] by George Siemens (Athabasca University), Stephen Downes (National Research Council) and Dave Cormier (University of Prince Edward Island) recorded large enrolments. Participants in the course were encouraged to develop their own online presence in order to add some value to this distributed resource network. The course authors then used a content aggregation tool in order to bring all the contents/contributions in one place. MOOC have raised a lot of attention and a great number of such online courses have been offered and MOOC platforms have also come on the market [3]. There are two different “kinds” of MOOCs described in the literature: cMOOC which are based on “connectivism and networking” and xMOOC which are based on the “cognitive-behaviorist” approach [4]. This second type of MOOC is essentially developed by world-leading campus-based universities (such as Stanford University or Massachusetts Institute of Technology) as a progress of an institutional strategy concerning on-campus teaching and digital technology [5]. Another significant factor that differentiates an xMOOC from a cMOOC is who are behind them. Instead of a group of individuals building the course as in a cMOOC, an xMOOC usually has one or more HEI behind it, and, in some cases, a for-profit company [6].

According to Downes [7] a cMOOC is designed as a network, while an xMOOC is based on a central course site, which gathers the contents to be followed by all students, thus the xMOOC, is almost like a traditional HEI course. It typically requires the development of custom content and, therefore, is

usually very expensive to build. xMOOCs are sometimes mentioned as not pedagogically driven, and the consequence is that they assume pedagogies mainly based on behaviourist psychology [8].

MOOCs are a transformation of traditional ways of teaching and learning [9]. According to Daphne Koller, co-founder of Coursera, MOOCs will transform, not disrupt, higher education and leverage technology to improve quality, she states, "We don't believe that computers should replace teachers. We think computers can enhance the work of teachers" [10].

The Polytechnic Institute of Porto (Instituto Politécnico do Porto), also known as IPP, is a Higher Education Portuguese institution providing undergraduate and graduate studies. Over 20.000 students, teachers, and researchers "inhabit" the seven schools (School of Engineering (ISEP), School of Accounting and Administration (ISCAP), School of Allied Health Sciences (ESTSP), School of Education (ESE), School of Music and Performing Arts (ESMAE), School of Management and Industrial Studies (ESEIG) and School of Management and Technology (ESTGF)) within the Porto metropolitan area. The majority of these schools, and others HEI in which Mathematics is a necessary pre requisite for their courses, have been challenged, year after year, with the problem of students having different levels of mathematics skills. In this sense, Mathematics MOOCs can be a good opportunity for students (as well as instructors), who are interested in expanding their knowledge, to learn Maths online, which will help to meet a long-term need in Portugal, generally speaking, and of Portuguese HEI in particular. In 2013, IPP developed its own MOOC platform. This project development gave us the opportunity to merge into "one", Mathematics lecturers from four of the seven schools in the IPP, exploring all the technical available resources in the platform (some new and other constraining ones), trying to adapt them into technical and pedagogical predefined goals and to the particular needs of each "customer" (students, public in general, etc). A Mathematics MOOC called "Mathematics Without STRESS" was created to serve high school students and college ones requiring remediation.

This course was chosen also by a combination of other factors and benefits:

- Earlier team experience with e-learning systems, for instance, granted by MatActiva Project [11] and Learning Management Systems (LMS) use in our own courses, helped us to structure this first MOOC;
- Attract new "future" students for IPP;
- Increase national and international visibility of the IPP;
- Importance of developing a new teaching model and learn by doing methodology;
- Develop digital learning objects, which can be used in "flipped classrooms" and enhance teaching and learning different models.

The idea of placing course materials online is not new. Since the early 2000s, HEI have provided access to course materials, lecture notes, assessment materials, and lecture recordings online. One such precursor was Massachusetts Institute of Technology OpenCourseWare (MIT OCW) project created in 2002 where course materials for approximately 2150 courses are available, among these course materials are complete sets of video lectures available for about 50 courses [12].

2 PROS AND CONS OF MOOCs

Although the concept of MOOC looks completely attractive, there are certain challenges that need to be addressed. We will look at some of the pros and cons of this approach compared to the traditional classroom training, knowing that these could be extended.

2.1 Pros

- **Flexibility:** Enable students to learn as and when they want, around their lives, rather than fitting their lives around HEI "schedules".
- **Adaptive Learning:** Students can "pause", "replay" and/or return to a topic whenever they want or need, allowing each participant to learn on its own rhythm.
- **Free:** Many of these MOOCs are free or practically free, a definite plus for the student. One of the most important factors for a lot of aspiring students is whether or not they can afford the high education fees required for enter a course. With MOOCs, all they need is a computer with an Internet connection.

- **Quality:** Would MOOCs achieve such popularity if Universities like Stanford, Harvard, MIT, etc., hadn't been the ones at the forefront of this innovative change in education? The reason why so many students sign up for these courses is because they know that they will be taught by respected and renowned professors. On the other hand, because MOOCs are short, professors are forced to examine every bit of material as well as their teaching methods.
- **Universality:** A lot of students around the world dream about getting the opportunity to enroll in a popular university. However, due to stiff competition and limited number of admissions, only a few are able to gain admission to these ones. MOOCs offer an opportunity for these students to make their dreams come true, as they get the chance to enroll for courses offered by these universities. Among these students we can certainly find several from "the other side" of the globe, being this the only way to overcome distance restrictions and complement, their "national" individual learning process. We cannot forget to refer, as "probable" MOOC "clients", the emergent economies from southern countries where the access to HE is still residual, but we have an entire (young) population avid of knowledge, and for MOOCs, as we have already stated, there is a single requirement: an internet connection to learn.
- **New business opportunities:** Some MOOC companies launched in 2012: edX, Coursera and Udacity, are offering good business opportunities on science and technology fields.
- **Previous Qualifications:** In general students don't need any special qualification to register for a MOOC. There is no limit on number and there is no selection process. Usually they just have to sign up with a few basic details and are ready to get started.

2.2 Cons

- **Make discussion a challenge.** It is very difficult to facilitate significant conversation in a classroom with 150 000 students. There are electronic alternatives: message boards, forums, chat rooms, etc., but the face-to-face communication is lost, emotions often misunderstood. This is a particular challenge for humanities courses. Heller writes, "When three great scholars teach a poem in three ways, it isn't inefficiency. It is the premise on which all humanistic inquiry is based" [13].
- **Grading papers is an impossible mission:** Grading thousands of essays or research papers is intimidating. Heller reports that edX is developing software to grade papers, software that gives students immediate feedback, allowing them to make revisions [13].
- **Make it easier for students to drop out:** Signing up is so easy, but studying to complete the course is totally different. According to statistics, only 10% of students who start a MOOC are able to complete it. In this way, MOOCs turn out to be not as massive as they seem...
- **Financial details and intellectual property:** Who owns an online course when the professor who creates it moves to another university? Who gets paid for teaching and/or creating online courses? These issues don't appear frequently in "opened debates" but they need to be widely discussed in the upcoming years.
- **Faculties will be eliminated:** Some people see MOOCs as "destroyers" of traditional higher education. Who needs professors when a school can hire an adjunct to manage a MOOC class? Fewer professors will mean fewer Ph.D.s granted, smaller graduate programs, fewer fields and subfields taught, the eventual death of entire "bodies of knowledge" [13].
- **Assessment and Certification:** Certifying MOOCs is still an "open field"... Since they are "Open" most free certificates are "Participation" ones. To have some kind of assessing credibility one must "recognise", in some way, the enrolled participant, but this usually involves costs, with synchronous or presential sessions, contradicting MOOC's spirit. .
- **Price of free teaching:** In general, teaching MOOCs requires a lot out of professors. In our particular case there were four Mathematics professors that designed, drew, created a Pool of Questions (multiple choice, true/false, matching and embedded answers), animated and recorded a complete Probability and Combinatorics Course. Designing and delivering a MOOC is time-consuming: each professor spent over 150 hours on this MOOC just to put it in an "embryonic stage", long before it even started.

3 MATHEMATICS WITHOUT STRESS MOOC

Following its goals – Promotion and development of distance education in a national and international level, fostering research and the use of digital pedagogical practices adapted to the style and the technological learning contexts promoting/implementing an educational model that allows to support/follow the student/graduate – IPP created, as we have already stated, its own MOOC platform – OpenED. Accessing the OpenED site www.opened.ipp.pt (see Fig. 1) participants can see the available courses as well as they can suggest new ones, by using an integrated message system.



Fig.1 Screen Shot of <http://www.opened.ipp.pt/> (20/01/2015).

With enhanced functionality such as video-lectures, mini-quizzes and other special features, “Mathematics without Stress” (or in its original version – in Portuguese – Matemática 100 Stress) is the first MOOC launched by IPP, for incoming HE students to prepare them for post-high-school courses using mathematics. This MOOC consists of three different Courses: Probability and Combinatorics, Introduction to Differential Calculus and Trigonometry and Complex Numbers. The Probability and Combinatorics Course (PCC) consists of nineteen different modules/lessons spanning four weeks, with a weekly average dedication of three to five hours. Topics covered include: The Random Experiment and the Sample Space, Events and Operations on Events, Probability and Properties of Probability, Exclusive Events, Conditional Probability, The Intersection (and) Rule for Independent Events, Independent Events, Law of Total Probability and Bayes Theorem, Fundamental Counting Principle, Factorial of a Natural Number, Permutations, Combinations, Pascal’s Triangle, Newton’s Binomial Formula, Probability Distribution, Binomial Distribution and Normal Distribution. Most of the topics in the Probability and Combinatorics Course have already been taught in high school.

The course also presents an entry test, not mandatory, named “Math Diagnostic Test (MDT)”, which includes a diagnostic scoring report to help students to identify strengths and weaknesses in some topic areas, and provides students with a clear and objective perception of their initial level. Our aim was to not only focus on high school students, but also to make the course attractive to anyone interested in Probability and Combinatorics or Mathematics in general. The target audience is:

- Pre-college students or individuals with basic knowledge in Probability and Combinatorics wishing to update their knowledge in these areas or that need to prepare for the National Exam of Mathematics (Code 635);
- Higher Education students who have not attended in High School, this subject, and who feel the need to acquire basic knowledge about some of the topics covered;
- High School Teachers who may use these resources with their students allowing them to develop teaching methodologies like “Flipped Classroom” [14].

All the modules have a similar structure, each has two distinct sections (Fig. 2) – Video Lectures – addressing the fundamental concepts, go together with some examples and solved problems, and the section – Proposed Exercises – a group of 5 randomly selected questions, from a question bank specifically created for this course, to be solved for consolidation of learning providing furthermore sequential moments of self-assessment.



Fig. 2 Screenshot of the structure of “Fundamental Counting Principle” module.

Concerning Video-lectures, some authors [15] are of the opinion that video styles have different effects on learning performance and students’ enrolment. We have chosen the very popular Voice Over Presentation style, whose main component is usually a PowerPoint presentation, complemented with a voice over explaining the slides. The videos duration are between 5 and 10 minutes and were created with Camtasia Studio software for a dynamical editing.

With regard to proposed exercises and quizzes, participants can take multiple attempts at each of them. This can help to make over the quiz taking process into an educational activity instead of a simple assessment. Since all the nineteen quizzes are random, the student will get a new version in each attempt, which will be useful for practice purposes. Feedback is provided for each question, allowing students to see the proposed solution, step by step, as showed in Fig. 3. The Pool of Questions, from which the quizzes are randomized, is categorized separately by learning items (modules) and each section has four subsections, namely: Easy, Medium, Difficult and National Tests/Exams.

A few Math IPP professors volunteered to review all the digital learning objects and contents. It is also very important that the development of a MOOC is led by an enthusiastic team with initiative since it is hard to create a course from scratch, without many resources available.

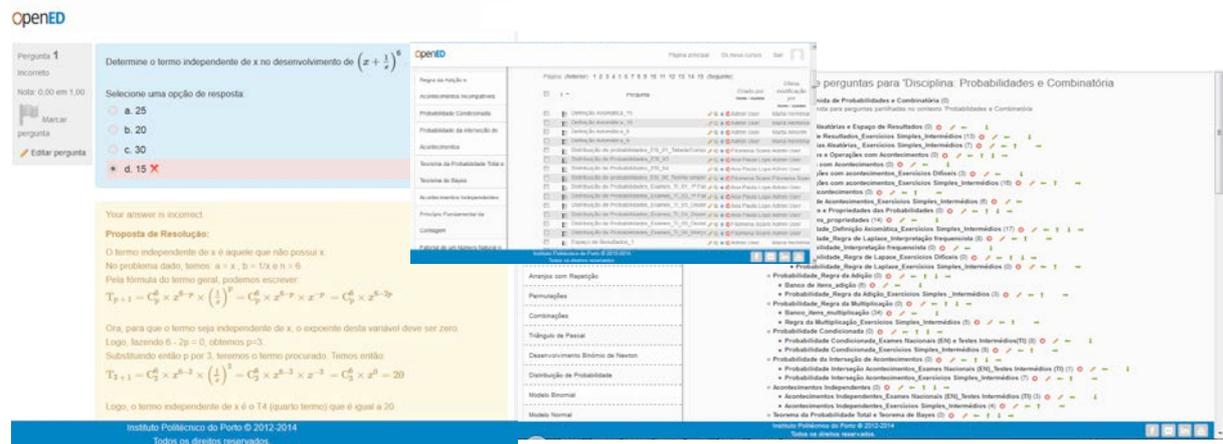


Fig. 3 Screen Shots of Feedback /Questions/ Categories <http://www.opened.ipp.pt/> (20/01/2015).

The course "ends" with a Final Knowledge 20 questions Assessment Test, covering all material from the entire course, that participants can repeat three times, at most. If the quantitative result on this test is equal or greater than 75%, the participant may obtain a Participation Certificate. All materials, including layout, design, content, pool of questions, mascot, etc., were created from scratch for this course.

In order to promote interaction and dynamism in the course, other activities, such as the Discussion Forum, are available. The discussion forum is working, for now, as a forum debate among participants. However, to encourage its use, there will be an interaction with the team that developed the course. We expect that participants take advantage of this feature by putting their questions and

feeling free to open new discussion topics. We intend to launch, as well, an open question forum – “Doubt Ed” – where participants may question instructors and other participants about all kind of doubts they have in course context. There is no limit to the number of discussion topics that can be opened in a course, so it is important that the forums have an almost direct and synchronised follow up in order to be well organised and “profitable”.

4 CONCLUSION

Whether MOOCs are a welcome blessing or an unwelcome threat to the educational system, as we know it, it is not consensual, but we feel that it is unanimous that MOOCs bring an impetuous of reform, research and innovation to the HEI. They are a quickly growing global phenomenon, changing the way how knowledge and education are being spread widely and followed in the world, a potential educational technology with a very fast development.

In this paper we have described the first MOOC experience at IPP. Based on our experience, we can say that not everything is an advantage in MOOC. They require in advance a huge preparation and a big effort from professors and the complete enrolment of an editing team. They need investment in advertising or to be put in the hands of a MOOC provider. The business model is not clear, neither are the “real” benefits.

Although MOOCs have been growing substantially worldwide, we can consider that these are still in an embryonic stage and, in particular, this course is far from being “finished”. Whenever a new content was developed and introduced, we felt that the “perfection” was far from being achieved. Recordings and reworking, editing and corrections have been a constant through this half year of work that generated this course. Being perfection something intangible, we have decided to open a first version of this course, in a somehow different format than originally planned, pursuing a kind of open pilot that allows us to constantly improve all the work done and make use of all the piloting information from this embryonic first one. All activities are registered, all opinions and feedbacks will be summarized and we will try to complement this course with more learning analytics process. Analytics provide crucial information to the instructors about student success, including areas of misunderstanding, level of effort and persistence, and other details about learning. But analytics can also provide information to the students, such as on course selection, course progress and program progress.

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