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Discussion on the Possibilities and Contributions of the Moocs as a Tool to Support the Teaching of Engineering

Esdras Jorge Santos Barboza
University Paulista
São Paulo, Brazil

Luis Naito Mendes Bezerra
José Carlos Jacinto
University Paulista

Marcia Terra Da Silva
University Paulista

***Abstract*—This MOOCs have the potential to expand the limits of the knowledge in engineering courses, mainly as a source of support for the teaching-learning process, since access to different themes allows the faculty more freedom to explore and expand the content worked in the classroom and to the students, opportunities of qualification and contact with new knowledge. This article aims to show the applicability potential and how the concepts of the MOOCs are disseminated in the engineering courses, what are the interests and degree of knowledge of the teachers and students. On the other hand, the research seeks to analyze the behavior of the faculty and students as to the value they add to their academic activities from the moment they take over the tool since the MOOCs can contribute as support or supplement to the in-person subjects of the Engineering. The support for the discussions took as a base, in addition to the theoretical reference, a survey of teachers and students of Engineering courses in Regional Public and Private Institutions, located in Greater São Paulo. It results that, despite the potential of applicability and support to the teaching of Engineers, MOOCs are not adequately explored by the academic community. For data collection, the Google Docs tool was used. The study covered 224 students and 27 teachers.**

Keywords*— *MOOC, Professional Development, Engineering. Services Management, Distance Education.

I. INTRODUCTION

Information and Communication Technology (ICT) is a fundamental resource in Distance Education. The evolution of ICTs enables Distant Education to be offered in a less expensive way to more and more people. Massive Open Online Courses (MOOCs) have been called by Rifkin (1) Zero Marginal Cost because this technology enables the offering of college credits for additional students with low cost, nearly zero, after an initial investment to prepare the course; the cost is virtually the same for a few people and many people.

Moreover, this kind of course gives access to education to an important number of people since it offers qualification to people even though they live far away (2). Therefore, the experience of technology-based learning has become more and more common to students (3). In that context, in the past two years, this concept has penetrated deeply into the fabric of higher education and educational institutes take advantage of such to increase the offering of distance courses to millions of students. (1).

MOOCs have come up in the scope of distance education with open courses and a whole online format, without requirements or initial tuitions and with a potential to distribute scholarship on a large scale. So, it has the potential to enabling students from developing countries to have access to low-cost high-quality courses (4–6).

Due to such great offering of courses and the diversity of subjects, MOOCs can be a useful tool for engineering students to get access to technical knowledge up to date offered by renowned universities in other countries.

Therefore, the objective of this work is elaborate an initial research about the level of knowledge and interest of engineering students in Great São Paulo and to verify if the professors recognize and apply MOOCs as a support to their teaching.

II. THEORETICAL BACKGROUND

A turning point in the history of MOOCs took place in 2011, when Sebastian Thrun created the Artificial Intelligence in Stanford, which had 160,000 students from 190 countries (5,6). Since then, the growth of this mode of Distance Education has sped up, with the emergence of three great providers of MOOCs, such as Coursera, Udacity e EdX (7–9).

According to Sandeen (9), the initial movement of MOOCs occurred in the field of electronic engineering and computer science, with the use of disciplines of circuits and electronics from MIT and machine learning from Stanford, which drew students from all over the world who were interested in raise their level of Professional development.

Still, on the students' interest in MOOCs, we have four motivation factors: (10–12) .

- curiosity about MOOCs;
- learning about some new subject or consolidate knowledge about any previously seen;
- personal challenge;
- getting as many certificates as possible.

MOOCs came up as adaptations of the courses offered in higher education institutions around the world, and nowadays they offer several options for learning in many fields. In June 2016, Coursera platform provided 1,933 courses in several

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categories such as art, administration and management, economy, computer science and engineering. For engineering students, the area of science, engineering and physics offered 156 courses in Coursera and 52 courses in edX (5,13,14).

It is important to mention that beyond students' interests and initiatives to participate in MOOCs, there are also some initiatives from the institutions themselves to integrate MOOCs with their regular courses, which some authors have called hybrid mode. In that context, the concept of hybrid is wide, including any learning initiative, strategy or model which integrates MOOCs and their technologies in a traditional syllabus (15).

It is possible to present a context in which MOOCs and its derivations, such as SPOCs[1] (*Small Private Open Course)* share the same structure. Being considered a private version of MOOCs, a SPOC follows its model, including videos, interactive assignments, and group discussions, can be used as a supporting material to some teaching methods, mainly in the teaching-learning hybrid approach, known as *flipped classroom*. Image 1 shows the difference between traditional and flipped classroom.

The flipped classroom mode alters the logic of the traditional one, allowing students to study the contents previously, making the class a more active learning experience, where there are questions, discussions and practice activities. (16).

The hybrid mode, also referred to as *blended learning*, can be helpful to educational institutions because it enables the material initially created for MOOC to be used as a substitution or supporting material to the regular classes, making it possible to constantly update the material as well as insert new knowledge (17,18).

As an example of flipped classroom model, we could mention the work of Piccioni, Estler, & Meyer (19), which describes the success of the use of a SPOC to give support and act as a supplement to the "*Introduction to Programming"* from ETH *Zurich*. In addition to the traditional model of classes, SPOC enabled the inclusion of short-formatted classes (17-minute video segments on average), tests integrated or not to the video classes, besides programming exercises with immediate feedback.

The course devisors also included principles of gamification, with medals to students who have obtained 100% of correct answers in the questionnaire, in order to increase students' motivation. The most important results have been:

- students enjoyed the course and responded enthusiastically to the experience with SPOC;
- presence in the classes remained stable in relation to the previous year;
- the average number of retries to solve the online tests was five times greater than the average number of video class views;
- On any of the tests, an average of 48% of freshman students obtained 100% of correct answers, earning the medal.

Source 1 - flipped classroom

TRADITIONAL CLASSROOM
Teachers presentation with a little time for exercises.

FLIPPED CLASSROOM
Group activities outside the classroom. Students previously study the content, with a subsequent attention from the teacher.

The authors (2016)

III. METHODOLOGY

As for the technical procedure, the analysis was structured in a survey format, which proved to be more convenient for the objective of this work. A survey uses a meaningful sample of an issue to be studied in order to, by quantitative analysis, draws conclusions corresponding to the collected data, aiming at contributing to the improvement of knowledge in a particular area of the interest or theme, collecting information about individuals or about the environments of these individuals. (Benfatti & Stano, 2010; GIL, 2002; Miguel, 2007; Yin, 2015).

An initial data collection was made on the opinion of engineering students from 3 private institutions and 1 public one, in order to identify whether MOOCs have been used along with engineering subjects, as academic support or complement in the course.

The opinions of engineering professors from public and private institutions were also collected to identify whether they have used MOOCs along with engineering subjects, as academic support or complement in their course.

The questionnaire aimed at assessing of the course and students' difficulties as well as professors' ability to make use of these programs as a complement to their classes. This initial data collection provides a better understanding of such scenario, once MOOCs public is not very frequently studied.the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

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A. Data Collection

For data collection we used Google Docs tool to create a form consisting of 17 questions, 15 closed and 02 open, targeted at students and 10 questions to teachers, 9 closed and one open. The student form was available on the link: http://goo.gl/forms/rnYY9L10BR and students answered the questions from March 23, 2015 to May 03, 2015 on the first round of the survey and from June 02, 2016 to June 30, 2016 on the second. The teacher form was available on the link http://goo.gl/forms/QoPQwLDWL08WRYcN2 and was answered from June 1 2016 to June 30 2016.

Before applying the questionnaire, a test with printed material was made in two technology course in the field of information and communication to students, to check and improve the understanding of the questions and to engineering teachers. The responses of this test were added to the total number of respondents. Research by electronic form included 4 higher education institutions, a total of 5 Engineering courses. In all, 224 students and 27 teachers answered.

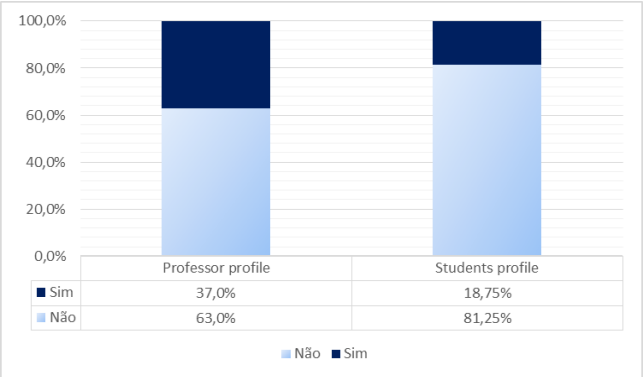
IV. RESULTS DISCUSSION

The answers indicate that the open *on line* courses are not well known by students. According to graph 1, 18,75% of engineering students said that they had already had some experience with this type of course. The low interest is surprising once the students researched are digital native and researchers expect a higher level of interest for this mode of course.

It also surprises the low number of teachers that have some knowledge of MOOCs (37%). The teacher who accessed such type of course learned about them from the internet or a colleague. Therefore, disseminating this mode of teaching can increase access to the content available on MOOCs, what helps to better the engineering classes and also opens a channel of professional development after graduation.

The student's answers that describe difficulties and demotivation with MOOCs were classified, and we treated only the ones from scholars who have already taken this type of course. In that case, there is no divergence of opinion between technologists and engineers and will be presented together on the next topics.

Graph 1 – Knowledge of MOOCs - Teachers x Students



Source: The authors (2016)

The answers were analyzed and generated four tables which follow below:

From the data presented in table 1, it is verified that the main reason they take a MOOC course is the possibility of professional updating, which represents 45,2% of the answers. On the other hand, though, a substantial number of students who have already taken this mode of Distance course did so in order to consolidate the knowledge learned in class, which represents 26,2 % of the students.

Table 1- Reason to take a MOOC course

Why did you take a MOOC course?	Number	Equivalence
Professional updating	19	45,2%
Knowledge consolidation	11	26,2%
Understand methodology	6	14,3%
Increase network	3	7,1%
Online class	1	2,4%
All of the above	1	2,4%
Other	1	2,4%
Total	42	100,0%

Source: The authors (2016)

However, on Table 2, students showed that they could not take the course due to lack of time, which represents 66,7%.

Their lack of time is an issue for most of the students due to the discipline the course demands (20). Therefore, besides being crucial to have knowledge and familiarity with the technology, discipline is essential for success and effectiveness in the learning (21).

The issue of language barriers, since most of the courses are in English, seems to be solved by the insertion of subtitles in Portuguese, so students can benefit more efficiently from the content, being able to gain knowledge for professional update and consolidation of the topics studied in class.

Table 2 – Difficulties to take a MOOC

Difficulties	**Number**	**Equivalence**
Lack of time	28	66,7%
Language	7	16,7%
Difficulties to understand the structure of the course	4	9,5%
Others	2	4,8%
None	1	2,4%
Total	42	100,0%

Source- The authors (2016)

Table 3 illustrates the correlation among the variables in the questionnaire and shows what factors impact on students' interest and motivate them to take a new course, and, at the same time, indicate points to be improved.

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- The first result is the substantial correlation between students' interest in taking another MOOC and the fact that the courses need to have more interactivity between students and tutor - 50,0% of the answers. Therefore, it is necessary that interactivity is improved, because it makes the learning process a better and more efficient process (2,22,23).

Interactivity is considered a key factor to success in distance learning (2,23–25).

This concept has been considered one of the foremost pedagogical points in the classroom, mainly for large groups and technology courses. When the learning process is interactive, not only are students more excited to learn but also, they tend to be more alert, participate more and be more willing to exchange information and knowledge with their peers (2,26,27).

There are two different types of MOOCs: connectivist MOOCs (or cMOOCs) and another one known as behaviorist or constructivist or simply xMOOC which is currently the most widely used model, with content (mainly vídeos) and tests based on the previously available textbooks, Sandeen (2013).

The constant use of video is the most frequently method in the xMOOCs model adopted by the main MOOCs platforms such as Coursera, edX and Udacity. In oder to measure the effectiveness of such didactic resource we can mention the *PES (Precise Effectiveness Strategy)* system. The system uses metrics to calculate the effectiveness of students when using, for example, video lectures and automatic correction exercises. The PES establishes that the completion of a video, for example, indicates a correct interaction with activity. Therefore, a resource is completed when a student solves an exercise correctly, but not when the student tries to do it unsuccessfully (Muñoz-Merino, Ruipérez-Valiente, Alario-Hoyos, Perez-Sanagustin, & Kloos, 2014).

The claim for interactive courses identified by the questionnaires points to using xMOOCs along with the regular classes, which can provide a better interactivity, as a good strategy.

As Table 3 shows, it appears that 85.7% have interest in new courses, which indicates the potential of MOOCs courses as a support tool for the teaching of engineering.

Other interesting results should be highlighted. Respondents point out that greater interaction between classmates, 19.0%, the update of the issues addressed, 14.3%, and the insertion of subtitles for all courses 9.5%, are important factors for improvement in this mode, signaling students' difficulties.

Through this study we can identify the interest of students in taking new courses and also recommending it to their colleagues. However, many of them did not complete their last MOOC mainly due to the barriers listed in Table 3. Even so, it is interesting to note that for students to complement a subject seen in class, completing a MOOC course is not so important. After all, one of the advantages of open courses to support classroom lessons is that it is possible to access and watch only the topics that they have most difficulty in.

Table 3 - Interest and points to improve

		Would you be interested in taking another MOOC?			
		No	Yes	Total	%
In your opinion. What should be improved for this mode of course?	More interactivity between student and tutor	3	18	21	50,0%
	More interactivity among peers	1	7	8	19,0%
	Updating of the topics available	1	5	6	14,3%
	Subtitles in Portuguese for all the courses		4	4	9,5%
	Daily reminders		1	1	2,4%
	Content reduction	1		1	2,4%
	Other			1	2,4%
	Total	6	36	42	
	%	14,3%	85,7%		

Source: The authors (2016)

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It is important to mention the aspects related to recommending the course to others, for students state that they would recommend this mode to their peers. The practical use of the course content in the professional field of the student was also highlighted as positive by respondents. Furthermore, according to students, MOOcs offer support to the content seen in class.

Table 4 shows that 92.9% of students would recommend the course to others, since it met their expectations, and in 90.5% of the cases the students were able to manage the course content and the practice, showing that the subjects covered are directly correlated to their practice/study area.

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Table 4 - Recommendation and use in the Professional area

		Would students recommend this mode of course to others?			
		No	Yes	Total	%
Is the course content practical to use in the professional field?	No	2	2	4	9,5%
	Yes	1	37	38	90,5%
	Total	3	39	42	
	%	7,1%	92,9%		

Source: The authors (2016)

Teachers showed greater knowledge of MOOCs, since 37% of respondents reported knowing this type of course, as can be seen above in graph 1.

In Table 5, it can be noted that the main experiences teachers had with MOOCs were knowing the platform, and 30% of these started the course without completing it. Furthermore, the following results were shown: 20% opened a course to see how it works; only to know the platform, 10% or to start a course without finishing it, 10%.

Table 5- Teachers' experiences with MOOCs

Main experience with MOOCs	Number	Equivalence
Knowing the platform, starting a course but did not finish it	3	30,0%
Finishing the course	3	30,0%
Opening a course Just to see how it works	2	20,0%
Knowing the platform	1	10,0%
Starting but not finishing	1	10,0%
Total	10	100,0%

Source: The authors (2016)

It reveals that 70% of the surveyed teachers know MOOCs, but have a superficial view of the content and effective implementation of the courses as a support to the development and improvement of students' knowledge.

It was found that only 30% of teachers took the course to the end. The main reason why the teachers adopted a MOOC as a support for the graduation course was for complementing the students' experiences and knowledge.

The main benefits were the use of MOOCs as a supporting material to the classes and a better theoretical bases. This scenario highlights the potential of MOOCs regarding the provision of grants and complementation of the issues dealt with in the classroom courses.

However, the main difficulties teachers indicated in the use of MOOCs was a supporting material to the courses were: 1) The course structure, that is, in some cases the topic is the same of the one seen in class, but with a different approach, which can affect students' understanding; 2) Course duration; 3) Students' lack of time; 4) Language; 5) No prior knowledge of the courses.

FINAL REMARKS

The This research allows to know better a public with potential for online open courses, a distance teaching mode that has grown in recent years. On the other hand, reaffirms the main points of the analysis of data, as suggestions were pointed for new studies, research and activities that can contribute to academic knowledge and development of new studies, research and activities that can contribute to academic knowledge and development of new courses and / or existing courses in this mode of MOOCs.

It is important to highlight that most students do not know MOOCs – Massive Open Online Course yet and that there are relevant points to be improved.

Therefore, it can be noted that the students who have had contact with MOOCs courses were motivated primarily by professional updating and improving knowledge of classroom subjects. Thus, it is observed that this method can serve as a foundation to it in the improvement process for Engineering..

On the other hand, it can be noted that students who have interest in this mode, however, states that there are many points to be improved, such as, topics, subtitiles insertion, more student/student and student/teacher interactivity

It was found that despite the possibility of knowledge consolidation MOOCs offer, , 81,25% of students do not know anything about this mode of teaching. The dissemination of this courses and the encouragement from the teachers would allow its use as a supporting material to Enginneers, enabling contact with approaches and peers from all over the world.

Nonetheless, teachers' knowledge about MOOCs is too superficial.

In a nutshell, this work accomplished its goal when it comes to an initial research on the level of college students' familiarity with and interest in MOOCs in Great São Paulo. However, there is a restriction here since the study has been made with educational institutions in Sao Paulo. Therefore, a more comprehensive study with students from other parts of the country would allow a more complete diagnosis.

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