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New Challenges for the Motivation and Learning in Engineering Education Using Gamification in MOOC*

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The phenomenon of MOOC (Massive Online Open Courses) is increasingly experienced and is giving rise to new scenarios and challenges with several features that are different from previous approaches to online education. In the field of engineering education, Information and Communication Technologies are making continuous innovation in methods of teaching and learning for students. Engineering Education institutions, like the Technical University of Madrid (Spain), are expanding their online offerings and making a more effective use of technologies for learning.

This research presents a gamification cooperative MOOC model (gcMOOC) that can be applied in the design of this type of course. Using an explanatory sequential mixed methods design, which integrates the quantitative and qualitative methods, the study investigates the factors that influence motivation, collaboration and learning in gcMOOC.

This work also suggests a set of practical recommendations and tools to improve the motivation, learning level and completion rate of participants in MOOC course in Engineering Educational when the gcMOOC model is implemented. The results of this study state that the incorporation of virtual communities and gamification methodologies increase participant learning motivation in engineering MOOC courses. Additionally, these gamification tools aid students to deepen their learning and involve them in the course increasing their motivation and the completion rates in MOOCs.

Keywords: MOOC; Gamification; Social Networks; Cooperative Learning; Game Badges; Motivation; informal learning

1. Introduction

The MOOCs (Massive Open Online Courses) are courses in which the most massive and heterogeneous participants are found currently. MOOCs are free and open to everyone, which attract substantially larger audiences than traditional online education [1]. A MOOC is not only another online course; it has different and specific features: its teachings must be completed with knowledge management, informal and social learning and lifelong learning principles. Early MOOCs just replicate traditional teaching pedagogies [2], adding multimedia elements like video lectures and were designed to be tuition-free and openly accessible and did not generally incorporate formal assessment or grading [3]. Later ones went beyond, trying to engage the massive number of participants by promoting discussions and relying on their contributions to the course. MOOC platforms usually provide some built-in social tools for this purpose, although instructors or participants may suggest others to foster discussions and crowdsourcing. The enlarging development of more flexible MOOCs associated with external social virtual communities have increased the participation rates of students who enrolled in courses over recent years, completion rates of these classes are dismal compared to those of traditional online education [4].

Completion rate may not be the best measure to evaluate learning in MOOCs [5], but these low rates do raise questions regarding their effectiveness [6]. To overcome low completion rates, although MOOCs are a massive training model these courses should trend to a further customization where new technologies can be used to foster different pedagogical approaches [7]. In this context, the Technical University of Madrid is carrying out several MOOC courses that, while having a multidisciplinary perspective, are focused on home university engineering students and professors.

This new method of knowledge transmission and learning represented by MOOCs has to incorporate those necessary innovative tools and strategies to generate new types of learning, such as informal learning. Furthermore they also need to integrate these tools into such a complex and dynamic learning environment like in engineering education.

At this point, it seems necessary to identify the causes are of these low completion rates. The limited research in the past has identified some factors that

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can explain the low MOOC completion rates: a lack of incentive, insufficient prior knowledge (e.g., lack of math skills), a lack of focus on the discussion forum (e.g., off-track posts), failure to understand the content and having no one to turn to for help, ambiguous assignments and course expectations, and lack of time due to having other priorities and commitments which resulted in procrastination and eventually dropping out [8, 9]. Furthermore, since many students attend MOOCs based on personal interests, it is reasonable to assume that some might only be interested in a particular topic of the course; hence they quit after they have gone through the particular topic [9].

While some of these factors are related to the design and development of the course, in a second step, it is relevant to analyze the MOOC-learning users' attitudes and behaviors in the context of engineering learning to improve the completion rate of these courses. The need to find new training scenarios where student motivation generates a better efficiency in these interactions is considered in a third step.

The hypothesis of this work is that the incorporation of gamification methodologies and strategies in MOOCs can enhance the motivation of participants through the use of game mechanisms and can influence the participation, commitment and loyalty of students that may end in a greater number of proactive participants.

Until the present moment, there have not been many studies that examine the effects of gamification tools on MOOC learners' motivation and utility, this work aims to fill that gap.

This paper begins with a brief background of gamification, MOOCs, engineering, informal learning and their relationships. After, the methodology and the research design are presented, and the material and data are collected as well. Section 4 shows the results obtained during the research which are then discussed and compared in Section 5, together with some strategic implications in MOOC implementation to get better results such as the dropout rate, greater motivation and participation throughout the course.

2. Background and previous research

2.1 Engineering Education, informal learning and motivation

Information and Communication Technologies and e-learning strategies are implemented in engineering institutions all over the world [10]. In the field of engineering technology sophistication that have made continuous innovation, methods of teaching and learning for students that should be on track with the current changes in technology [11]. E-learning can further augment engineering education by use of e-resources, online courses, blended learning, lecture management systems, and other communication and collaboration tools [10]. Educational institutions like universities are increasingly looking to expand their online offerings and make more effective use of technologies Conole [7].

Informal learning experiences have risen to the forefront of education by proving beneficial to both teacher and student learning [12]. The MOOC represent an opportunity to work, test, investigate and consolidate informal learning [12]. In engineering contexts, informal learning could play an invaluable role helping students or employees to engage with peers and also with more experienced colleagues, exchanging ideas and discussing problems [13].

Informal learning [14] takes place in the context of everyday experience especially among adults in both Higher Education (HE) and in workplace contexts [15]. Motivation has been previously identified by Milligan et al. [16] as a key factor that helps to increase the participation and success of students.

Individual motivation is about having a reason to do something, which is derived either intrinsically or extrinsically [17]. An individual is motivated intrinsically to perform an activity for the pure satisfaction inherent in the activity, while is motivated extrinsically if the impetus to perform the activity is to receive a desired outcome. Intrinsic motivation is often measured by interest, satisfaction [18], enjoyment [17], and commitment [19]. Intrinsic motivation is generally measured using self-reports to assess an individual' interest and enjoyment about certain activities [17]. Extrinsic motivation is usually measured by examining factors like self-development, reputation [19], and perceived usefulness [20]. Satisfaction (intrinsic motivation) and perceived usefulness (extrinsic motivation) significantly influence Information Systems continuance intention [21].

2.2 Gamification and cooperative MOOC

The use of games for learning purposes has evolved since the beginning of this century. Gee [22] identified 36 learning principles that can be found in video games. Since 2010 this new emerging trend is called gamification. This trend uses the advantages that games can offer and are used in contexts that are not games [23], i.e., using elements of game design [24] in such a way that motivation toward learning activities [25] is induced.

Gamification is based on the psychological theory of self-determination [26] where two types of motivation are identified. On one hand the ''extrinsic motivation'' based on aspects such as money, score, failure or ending; and on the other

hand the ''intrinsic motivation'' associated with autonomy, achieving conviction, interest in a subject, etc. Therefore, the game should be based on intrinsic motivation [27], which is the type of motivation in which the activity is rewarding in and of itself.

There is a lack of studies analyzing the experiences and the effect of gamification methodologies as valuable and innovative learning tools in massive open online courses.

Gamification could have great potential in MOOCs learning process. Although gamification in education is ''a serious approach to accelerate the curve of the learning experience, teach complex subjects, and systems of thought'' [28], the incorporation of the social dimension to this type of learning is essential to integrate it into the MOOC learning process. This social dimension of learning takes into account that learning occurs together with others in all kinds of situations or contexts.

The MOOC's models developed until now have considered this collaboration as a key factor along with the commitment of the participants with the MOOC platforms and with the external virtual communities' generation [29]. These communities will be developed and strengthened even when the course has finished, this fact is one of the most valued elements by MOOC's participants. There are two main approaches to include game-based mechanisms in MOOCs: Using the benefits of social games [30] and employing apps for gamification [31].

An interesting recent innovation in terms of analysis is the use of ''open badges'' presented by Conole [7]. The concept is simple; learners can apply for badges demonstrating their completion of aspects of a MOOC. This may be as simple as completion of part of the course or evidence of particular aspects of learning. Badges have criteria associated with them; learners are expected to demonstrate how they have achieved these criteria and this is validated either by peers or tutors.

There are two main types of MOOCs [32–34]: courses with a conductist approach (xMOOCs) and courses with a connectivist approach (cMOOCs) [35].

The cooperative MOOC model of Fidalgo et al [35] combines both features of xMOOC (e-learning platforms) and cMOOC (learning communities based on social networks). This cooperative model is defined by 3 layers: The first is the ''technological layer'' which is linked to the LMS (Learning Management System) where the entire course content can be found and where the social network that will support the learning community is managed. The second layer named ''training strategy'' refers to the instructional design of the course. This layer is divided into a ''behavioural strategy'' focused on the acquisition of basic common knowledge and into a ''connectivist strategy'' dedicated to the generation of new learning resources by students as activities of the learning community. At this point, the resources generated from both strategies need to be organized. Finally, the ''cooperative layer'' shows the outcomes and the content generated with the cooperation of instructors and participants of the course.

Fidalgo et al [35] confirmed that the Cooperative MOOCs are a proposal for informal learning based on the connectivism. The major paradox is that the MOOC arise in a scenario for informal learning for the majority of the current MOOC but their platforms are based on formal learning. Systems used are similar to the Learning Management Systems (LMS) with their basic features [35].

3. Methodology and research design

Throughout this section a cooperative and gamified MOOC model is presented. The application of this model in a particular course and the metodologhy followed for obtaining results are also shown.

3.1 Construction of a gamification cooperative MOOC model (gcMOOC)

With reference to the cooperative MOOC model (Section 2.2) and seeking a greater motivation of students, a new layer influencing the three layers of the cooperative MOOC model is proposed. This new layer includes elements of gamification to be applied to a MOOC.

The ''technological layer'' will use the tools or features both of the course platform and of the social network that supports the learning community as elements of gamification. Some actions are required in the ''training strategy'' layer, especially in the design of activities aimed at getting students involved.

Figure 1 shows how the motivation management in the ''cooperative layer'' is applied by the faculty, using the elements of the platform and the learning community.

3.2 Model application

This model is applied to the second edition of the course ''Application of social networking to education: virtual communities'' [36] which is offered for the first time on a MOOC platform MiriadaX. This is focused on university professors, but is valid for any level of teaching. In the new edition we go a step further with the cooperative model proposed by Fidalgo et al [35], implemented in the previous course and apply the model gcMOOC using external tools.

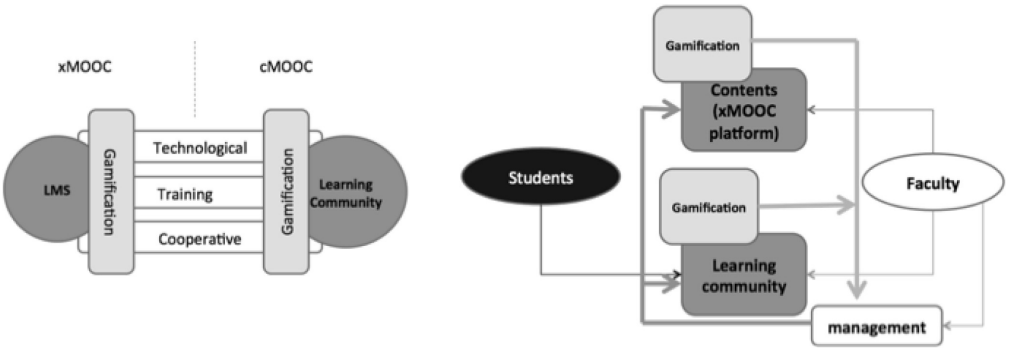

Fig. 1. Collaboration flows of the "cooperative layer" with gamification.

The course consists of four modules divided into lessons over five weeks studying a number of social networks. Teachers learn how to create virtual communities for their classrooms and manage them. This is the learning part of the initial content contributed by the teaching staff. It Consists principally in video format accompanied by additional information (links, summaries and exercises) associated with each video in text format, and relies on the cooperation of its participants to generate content. In regard to the assessment, each module has a multiple choice test that students must pass along with a final activity. This final activity should deliver a document with the scheme of a learning community using social networking that is evaluated by peers within the platform.

3.2.1 Virtual learning community

Group interactions were centralized in the "Application of social networking to education" Google + community [37] created for the previous edition of the course and who already had 2227 members.

Throughout the course using the + 1's and reviews of Google + in the proposed activities are made to students as a means for feedback and contributions, apart from the regular used to indicate students those most interesting publications and raise comments on these .

For the organization of the community 9 categories are proposed to classify publications of members, these are: presentation, announcements, discussion questions, activities and exercises, application examples, links of interest, several and I competition.

Over the course lessons exercises that students could solve and share in the community under the category "Activities and exercises" and associating specific hashtags were proposed.

3.2.2 Instagram contest

In this second edition of the course a contest on Instagram was proposed as a voluntary activity. Each proposal was raised at a possible application of Instagram in their classes. Each participant was required to write a statement that publication upload such as the community of Google + and the other had to upload an image to Instagram as an example as if they were one of his students. Students voted among them through Google +1 and the proposal with the most votes would be the winner.

3.2.3 Hangouts

During the course two live streamings via Google Hangout were offered and later stored on a YouTube channel. Students were able to listen or submit a project related to a course theme. For each hangout the teaching staff created an event on the Google + community where students had to publish a proposal (title and brief description). Each video presentation was limited to 8 participants, so that it would be other peers through the + 1s, who chose those that they considered the most interesting. The eight most voted projects were then presented in addition to receiving a badge.

3.2.4 Certificates and badges

The platform Miriada X, in which the course is taught, offers the possibility to the students to obtain a certificate of participation or overrun by the degree of completion (75% or 100%). These certificates can also be exported like badges inside the frame of the project Mozilla Open Badges.

The winner of Instagram's contest and the 16 offers presented in the two hangouts were all delivered their badges. This was due to the impossibility of the platform to offer them in an individual way where they were chosen to generate independently across the platform.

3.3 Statistical methodology

To address the research questions, the study adopted an explanatory sequential mixed methods design, which integrates the quantitative and qualitative methods during the interpretation phase [38]. The qualitative data collected through open-ended questions and semi-structured interviews were used

to "shed some light on the quantitative findings" [39]. The qualitative component in a mixed-methods study may help mitigate the negative influence of only collecting data from a self-reported survey [40].

3.3.1 Quantitative analysis

Firstly, in order to analyze the success rate and the activity generated in the course, information from the Miriada X platform had to have been downloaded. To further aid in obtaining community input and participation of students, we used the tool web statistics Allmyplus [41].

Secondly to understand the perceptions and attitudes relating to learning and student motivation for this model gcMOOC, were provided with a questionnaire regarding the course. The results were obtained from a sample of 2182 students, 54.1% of those who started the course. The tool used to obtain this information is an adaptation to SEEQ survey (Student's Evaluation of Educational Quality) [42]. On a five-point Likert scale, the participants reported their level of agreement for the 5 items (Cronbach's $\alpha = 0.88$) for perception on learning and 8 items (Cronbach's $\alpha = 0.87$) for beliefs about motivation in gcMOOC.

Exploratory factor analysis was performed on the 8 items of motivation scale using IBM SPSS version 19 to extract the underlying structure of the scale. The data was coded to indicate that the higher the summed scores, the more positive their attitudes and beliefs about learning and motivation use in gcMOOC. Constant comparison analysis [43, 44] was used as the main technique to guide the analysis of the interview data.

3.3.2 Qualitative analysis

In this study, the qualitative analysis of both the 25 open-ended questions and the interview data were integrated with the quantitative findings in the results section. The qualitative data support the findings from the quantitative results by providing detailed reasoning and stories behind the numbers [40]. The integration of findings has enriched the quantitative data by providing supporting and elaborative information, examples, explanation, and reasoning related to gamification and collaborative tools.

Participants from the quantitative phase volunteered to participate in the second phase of the study. Although the researcher had limited options in selecting participants according to [38] four recommendations for a sequential approach, structured interview questions were developed based on the initial data analysis of the quantitative data to ensure that the follow-up qualitative data provide a better understanding of the survey results.

The interviews were conducted by the course staff in hangouts, recorded for it later transcription. A mailing was sent to all the students of the course asking for the collaboration of those engineers or students of engineering who had taken part in the course, 239 responses which proceeded due to have a brief survey of which was intended to detect different profiles covered to obtain the maximum range of representative population through interviews with a total of 60 engineers. Candidate factors such as age, gender, nationality and utilization of gamification elements were taken into account. Before the interview, the 60 engineers had to complete a summary and validated version of the SEEQ focused only on the gamification elements.

4. Results

This section shows the data obtained from the second edition of the course after applying the model gcMOOC organized into two sections, first the data related to the operation of the course and the external elements of gamification and on the other the results of questionnaires and interviews with participants in their perception of the course and its elements.

4.1 cMOOC model application results

The Table 1 shows the general data of the course, 39.9% of students who started the course pass more than 75% of this, condition to obtain the certificate. On the other side shows new users and publications generated only during the course.

The results related to the assessment and the

Table 1. General data about course and community

Miriada X MOOC (Data)			
Enrolled	**Starts**	**75% ended**	**100% ended**
12849	6948	2779	977
Google + community (Data)			
All members	**New members**	**New publications**	
4873	2646	2106	

Table 2. Completion data of assessment activities

Assessment activity	Num. of participants attempted the activity	%	Num. of participants pass	%	Half note
Test—Module 1	3866	55.6%	3628	93.8%	85.7%
Test—Module 2	3258	46.9%	3141	96.4%	84.3%
Test—Module 3	3005	43.2%	2903	96.6%	86.8%
Test—Module 4	2392	34.4%	2298	95.9%	87.2%
P2P activity—Module 4	1171	16.8%	1060	90.5%	–

participation decreases as the course progresses to 16.8% that corresponds to the final activity, as shown in Table 2. Percentages are first referred to students who started the course and secondly regarding who initiated the activity. The final activity did not have a note associated, the student could only pass or not.

The activity of hashtags associated with the exercises throughout the course was evaluated also. Although Twitter was not the official community students made use of it, especially in related exercises with this network, have also been reflected these results. The results are summarized in table 3.

Resulting from Instagram contest 52 proposals obtained, with 576 votes by +1 distributed among the various proposals, the winner got 59 votes. They also emphasize 92 reviews and 20 reshares.

The data highlights three proposals rising out of the competition applicable to teaching engineering. Found a proposal aimed at students of a course of optical seek in their own day an example of reflection of light, reflections in natural or not material and will make a picture to upload it to Instagram indicating what it was. The other two proposals encouraged students to seek and photographed in his city, facades for the subject of building systems and geometric elements for a mathematics subject.

As for the results of hangout, the first edition received a large number of very active viewers throughout the broadcast, with a peak of 247 simultaneous connections and 950 total views. A total of 22 proposals giving a result of 116 votes distributed were presented. In contrast to the second broadcast only 8 proposals were presented with 56 votes and 8 were selected, the total number of visits dropped to 202.

4.2 Statistical results

Table 4 shows the percentages of respondents in reporting their perception about learning and utility about gcMOOC. In general, students show very positive attitudes with the global learning aspects of the course. The majority of the participants (90.9 –91.2% agreed or strongly agreed) felt that they learned and understood the contents of the course and they learned valuable contents. Fewer participants, but still a majority of them (85.1%), show a positive perception about which activities improve

Table 3. Data about use of hashtags in the course community and Twitter

	Google +				Twitter
Hashtag	Publications	Comments	+1's	Reshares	(Tweets)
#ARSEejemplosRRSS	400	95	796	34	8
#ARSEMalasPracticas	238	39	430	24	15
#UsosTwitterEnseñanza	58	12	137	18	338
#ARSEMOOC	160	126	777	53	340
Final activity*	56	72	224	21	–

Table 4. Descriptive Analysis

	Frequency (%)						
Perceptions on learning (1, 2, 3) and utility (4, 5) N: 2127	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Mean	SD
(1) Learn and understand the contents of the course	0.28	0.52	8.28	37.28	53.64	4.43	0.69
(2) Learn valuable contents	0.14	1.13	7.52	30.37	60.84	4.30	0.79
(3) The posed activities improve understanding	0.52	1.50	12.88	37.33	47.77	4.30	0.79
(5) The suggested activities generate useful material	0.66	1.93	14.20	34.32	48.90	4.29	0.83
(4) Web links generated through the virtual community useful for a better understanding	0.52	1.74	15.00	37.00	45.75	4.26	0.81

Table 5. Percentages of participant responses regarding their attitudes towards motivation in gcMOOC

	Frequency (%)						
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Mean	SD
(6) My interest has increased during the course	0.61	1.69	9.12	31.36	57.22	4.43	0.77
(7) I found the course stimulating	0.70	2.10	12.80	33.20	51.20	4.32	0.83
(8) The course was dynamic and active	0.90	3.00	17.00	36.60	42.50	4.17	0.88
(9) The layout of the modules could hold my attention	1.90	4.00	17.40	35.70	40.90	4.10	0.95
(10) Participate steadily and work actively in the course	2.00	8.50	26.70	36.40	26.40	3.77	0.99
(11) Students were encouraged to participate in the Virtual Community	1.40	4.30	17.80	32.30	44.20	4.14	0.95
(12) Students were encouraged to identify and share resources	1.50	3.20	18.00	36.30	41.00	4.12	0.91
(13) Students were encouraged to comment on peers' resources	1.60	3.40	20.60	36.00	38.40	4.06	0.93

understanding. These activities were considered (83.2–82.7% agreed or strongly agreed) useful for a better understanding but students considered less helpful for understanding those web links generated through the virtual community.

The descriptive analysis presented in Table 5 indicates that the values are somewhat lower in the scale of motivation that in the scale of learning. More than a half of the students completely agree that the course has been stimulating and that their interest has increased during the course. The perception is that participants are motivated by different methods of cooperation (76.5–77.34) in all cases with a value above 75%.

The preliminary factor analysis results show a well-behaved Kaiser–Meyer–Olkin value of 0.84. Bartlett's test of sphericity was significant, c^2 (28) = 10506.8, $p < 0.000$. Therefore, the factorability of the correlation matrix was supported by the data [45]. Exploratory factor analysis revealed two components with eigenvalues exceeding 1: (a) intrinsic motivation course, explaining 55.4% of the variance; (b) extrinsic motivation generated by collaboration 16.1% of the variance. The two components explained a total of 71.5% of the variance, and they are the two most important factors in evaluating motivation of gcMOOC. Students perceive a differentiation between the motivation generated by course resources and the motivation originated by the interaction and collaboration emerging from the implementation of collaborative tools. An inspection of the screenplot also supported the solution. Table 6 presents the pattern and structure matrix for the factors. The qualitative data analysis of the interviews and open-ended questions provided more textual information about the participants' perception about the learning and motivation of gamification tools in the model.

The following results of the survey that 60 engineers was formulated before the semi-structured interview, which asks for gamifying elements shown in Table 7.

Table 8 provides an example of the questions about semi-struturated interview. These questions were raised not always in the same order, adapting to the interviewee's answers.

Course design and previous experiences in MOOCs

Most interviewees agree on the dynamics of the

Table 6. Pattern and structure matrix for exploratory factor analysis

	Course Intrinsic motivation		Extrinsic motivation generated by collaboration	
	Pattern	Structure	Pattern	Structure
(6) My interest has increased during the course	0.808	0.804	–0.007	0.429
(7) I found the course stimulating	0.905	0.891	–0.027	0.462
(8) The course was dynamic and active	0.868	0.878	0.018	0.487
(9) The layout of the modules could hold my attention	0.862	0.860	–0.004	0.462
(10) Participate steadily and work actively in the course	0.542	0.550	0.016	0.308
(11) Students were encouraged to participate in the Virtual Community (Google Plus—Twitter)	0.034	0.487	0.840	0.858
(12) Students were encouraged to identify and share resources	–0.008	0.499	0.939	0.935
(13) Students were encouraged to comment on peers' resources	–0.023	0.482	0.936	0.924

Table 7. Results from previous survey interviews about gamification

Gamificatin resource	Question	Yes	No
Google +	Do you think that the elements of Google + are motivating to take part?	97%	3%
	Have you checked any publication or comments with +1?	62%	38%
	Have you proposed some debate?	20%	80%
	Do you have proved interesting contributions from other partners?	85%	15%
	Have you helped input from your peers to better understand some of the concepts proposed in the MOOC?	83%	17%
	Think you from community content can say that there are new course content?	83%	17%
Hangouts	Have you participated in any of the hangouts?	30%	70%
Instagram contest	Did you like helpful?	80%	20%
	Have you voted for a proposal?	30%	70%
	Have you participated with any proposal?	13%	87%
Certificate and badges	Did you get motivated by the fact trying to get a badge?	77%	33%
	Did you get any badge?	40%	60%
	Have you obtained the certificate?	40%	60%
	You have motivated the fact of getting the certificate for completing the course?	75%	25%

Table 8. Examples of semi-structurated interview questions

Students' perceptions on	Examples of semi-structurated interview questions
Course design and previous experiences in MOOCs	• What do you think about the dynamic of MOOC? • The course structure will appear appropriate? • Had you done other MOOC?
Utility and learning tools in the course gamification	• Do you find useful the +1 in posts and comments? • In what way do you think social networks like Google + can help you improve learning?
Motivation and collaboration tools in the course gamification	• What was your motivation for this MOOC? • Are you motivated by the fact that someone from +1 to your publications? • Did you realize the fact motivated to participate in the contest Instagram? • Explains the motivation that has led you to get the certificate or badge • Interactivity of the course has helped you in learning? why? • Do you think that these elements of gamification of the course has given you more motivation to realize it? • The gamifying elements were you generate greater interactivity or relationship with your peers during learning? Why?
Engineer vision	• Personally have you given you to this MOOC as an engineer? • Would you use any of these elements in their engineering classes? • Has the methodology used in this course including elements of gamification • could be applicable to an official subject of an engineering degree? Why?

course as one of the main attractions, combined with the use of external virtual learning community to interact with peers. For those students who had participated in other MOOC (61%) interaction they found the main difference regarding the dynamics of others, ''More dynamic and interactive'' as said one interviewee or ''The use of networks to inform social progress doubts and colleagues''. They emphasize positive comments like ''This Mooc is fun, enjoyable, motivating and easy to follow, communication is direct'' or ''The pace of the course does not decay''.

Utility and learning tools in the course gamification

The +1 gamification element has been massively used by students as indicated by the results. When asked their usefulness coincide with the idea of obtaining reputation, ''It's a way to recognize the contribution, gives you an idea of how useful or important it can be a publication''. Said one respondent versus ''I do not see utility, is a very basic option it does not give additional information associated, I prefer comments'' this response adds an interesting vision and proposes another element of gamification very closely related to +1, the comments.

Note the perception of learning exercises proposed voluntary and community as one student said ''Yes, with videos is not enough, I found it very important to use the learning community to share experiences. I liked it and found it a good exercise that proposes to use the hashtag in negative practices in social networks to find real examples in other countries'' or in the case the contest was proposed emphasizing a student ''With Instagram contest learned to use the network and put myself in the shoes of a student lie, actually played and took pictures for presentation''.

Motivation and collaboration tools in the course gamificación

The main motivation of the course, given the profile of teachers, has been implementation in their classrooms. You can see in comments like "That's motivated me to finish the course was to find applications in the professional field of social networks and course certificate", It is found that the certificates are an element that also meant motivation. One of the students stressed that "It is a certificate that can be presented in the curriculum and certifies that have made the course".

Regarding the overview of the elements of gamification find comments like "They are motivators and also aid them learn and clarify concepts", "The gamifying elements favor interactivity, allowing the experiences or for example with comments on my Instagram given me ideas" or "I started late and thanks to course elements hooked I ended well before the deadline for completion".

Students view positively the interaction of the community, stressed a software engineer "I have not interacted directly but if I went to see how other teachers interacted", "Thanks to the existence of the community I have interacted with others and helped them" commented another student.

Engineer vision

Something that characterized the entire sample of respondents was their teacher and engineer profile of which 63.3% were teaching in higher education. From the point of view of an engineer highlights comments like "I have been taught to manage MOOC courses using Google +" or "It allowed me to build relationships with communities or the use of professional social networks and other tools to apply as an engineer". As to the possibility of applying the methodology of this gcMOOC most see as possible and emphasize "Yes, applicable, and could assist keep the active participation of students and express their doubts, ideas, comments, even evaluated each other" and some nuances "It would mean a previous work of teachers when suit a traditional course" or contributions as "Through this methodology can change mind mapping and open new possibilities to further enhancing student learning". Some positions also appear reluctant "The badges and contests can be a good choice to motivate students and make them more involved, but do not see it as a methodology to base the whole subject".

5. Discussion

The incorporation of gamification frameworks in online learning environments is an increasing trend [46, 47]. Its usefulness and efficiency has been recognized in different areas of education. Several authors [48, 49] have pointed out the potential of games as valuable learning tools. However, there is a lack of research on the real effects of gamification on the learning process and whether these effects are better than those obtained with traditional processes.

The new learning models, where gamification and MOOC are integrated, are giving rise to new scenarios and challenges. There is an increasing need to enable learners to develop 21st Century digital literacy skills [50] and to equip them for a gradually more complex and changing societal context. Besides, given the proliferation of new competitors, there is a need for traditional institutions to tackle new competitive niches and business models.

The high number of engineering professors that have participated in this course highlights that the methodologies of gamification in MOOC, as the one suggested in this paper, are appropriated for engineering education. According to the results obtained in this work, the proposals of the course, i.e. the instagram contest, may apply to the formal engineering courses. Hence, the Technical University of Madrid, as a reference institution of the engineering education in Spain, is facing this type of courses. Whether or not MOOCs will reach the potential educational benefits is currently being discussed, what is clear is that we need to take them seriously [7].

Concepts such as motivation, collaboration and learning take special relevance for this study, especially the perception of students/participants about them when coursing a MOOC and its relation to the rate of success/completion of the MOOC. The gcMOOC model includes 4 proposals involving the motivation of the student and meeting the needs of relationships, autonomy and competence [51].

This new layer of gamification in gcMOOC model links the learning platform tools and the social network used by the learning community. It also serves to enhance student intrinsic motivation and to get more creative students, as is validated by the results of the surveys, semi-structured interviews and the factor analysis carried out in this work. Besides, this model offers new opportunities to reduce the high dropout rate. Regarding the completion rate, the gcMOOC model obtained a percentage of 39,9% of students completed the course, in relation to the students who started the course, far above from the average completion rate for this type of course, which is around 7% [5].

An increased motivation and commitment have been achieved with the collaborative work using a new type of resource called "collaborative resources"; these are common in the traditional

classroom or online course but not widespread in the MOOC yet. These ''collaborative resources'' may be customized for each course or group of students. The educational outcomes of the activities presented in this study as Fidalgo [35] states, become in educational evidences and in genuine resources that feedback the MOOC contents.

Wenger [52] argues that a learner needs to participate in a community in order to understand and create meaning, which is corroborated with the results of this study. The virtual community of the gcMOOC has not only stimulated social interactions using gamification elements but may have contributed to achieve the learning objectives as is indicated by Shi et al [53].

This paper verifies that the certificates and badges are an incentive to finish the course, as Haug et al [54] stated, and the more external recognition [55] they obtain, the more important element to improve the dropout rates they will become. It should not be forgotten the social recognition [56] that this elements represent that can be showed on the personal pages of students.

Students' technology affordances that are formed outside of formal educational environments (like engineering education) as well as their attitudes and beliefs may greatly influence how they learn and how they perceive learning supported by new technologies [40].

An improved understanding of students' perspectives and new roles in participatory culture may help improve the design of learning activities utilizing new technologies [40]. Consequently, the knowledge of the MOOC users' perception about motivation, utility and learning, as has been shown in this work, is essential to improve the deployment of MOOC courses. Moreover, it has a positive influence in success rates and motivation, in addition to participation, commitment and loyalty of students and therefore, in a greater number of proactive participants in MOOCs.

As limitations to this work, the authors find that the great amount of resources generated by the collaborative activities lead to information overload [57] in the virtual community. Along with the factor of low digital literacy, both two factors results in a massive duplication of contents, in a misuse of the categories or hashtags in some cases, and problems or difficulties for members in filtering, classifying and selecting the accurate information.

There is also a limitation on the learning platform to generate more type of badges, what influences the motivation at different stages of the learning process and the reinforcement of other elements of gamification.

6. Conclusions

This paper further extends the body of theory about the massive learning by providing knowledge about new tools and strategies for an improvement in the quality of the MOOC. The incorporation of virtual communities through social networks and external applications of gamification (contests and obtaining additional badges) is a new contribution to increase participant learning motivation in engineers at MOOC. The survey results indicate that most of the students are positive about gamification and social media use in education and especially in MOOCs. These results are supported by the qualitative results of the semi-structured interviews. The outcomes of this study suggest that any further analysis of new approaches and learning environments in the context of engineering education will require a better understanding of the relationship between MOOC and gamification. These gamification tools aid students to deepen their learning and involve them more in the course increasing their motivation. The gcMOOC model incorporates and enhances gamification elements in social networks in which the essential concepts of digital natives like visibility and reputation are met.

This research line will continue with the implementation of a model based on small milestones focused on skills with rewards based on badges to generate greater motivation and greater success, which may also include external tools badges. To do this, it would be needed to overcome the limitations of current MOOC platforms and integration problems with the course and user identification of external badges.

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