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Investigating Electromechanical Engineering Lecturers' Perceptions of MOOCs*

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Massive Open Online Courses (MOOCs) offer a wide range of training opportunities for university students. However, to date, little research has been done to assess the level of awareness and knowledge about MOOCS among Spanish engineering lecturers generally or more specifically among those teaching electromechanical engineering. To address this gap in the literature, a quantitative exploratory survey was performed. A questionnaire was sent to electromechanical engineering lecturers working in Universities across Spain and a total of 102 of these were completed and returned. Results from our corpus suggest that, despite the increased prevalence of online teaching in recent times due to the COVID-19 pandemic, there is a striking lack of knowledge about MOOCs among lecturers: 61.78 % reported having very little or only moderate knowledge of MOOCs. We also observed a very clear generational gap among lecturers in their perceptions about MOOCs. In particular, the percentage of lecturers confessing to having no opinion about MOOCs was only 6.1% for the age group 31 to 40 years old, whereas it was as high as 37.5% for those over 60. For learning and reviewing purposes, MOOCs were perceived as more appropriate for lifelong learning than as a replacement for one-time training courses traditionally offered by universities (8.0% of participants). Our findings lead us to conclude there is a pressing need for action within Spanish universities to raise awareness about MOOCs and support lecturers in the wider use of this type of course.

Keywords: higher education; ICTs; online teaching; asynchronous learning; face-to-face teaching

1. Introduction

Information and Communication Technologies (ICTs) are now a fact of everyday life. From the ubiquity of cell phones to the rise of the eBook, and the growth of social media, ICTs are now present in every area of society including educational institutions. Over the last decades, technology has offered an increasingly wide array of resources for education: from digital blackboards for use in kindergarten and primary schools to the massive online open courses now available in higher education institutions.

The MOOC revolution began in 2008 with a course run by the University of Manitoba [1], closely followed in 2012 by one of the most well-known early MOOCs, MIT's Circuits and Electronics course [2]. The movement is now in full swing [3,4] with a wealth of MOOCs being offered by universities across the world: reportedly, up to 180 million students at 950 Universities are involved in some form of MOOC, and there are 67 wholly MOOC degrees on offer [5]. Their potential is obvious from their name which aptly describes the principles on which this type of course is based [6]: (i) massiveness meaning that vast numbers of students can enroll; (ii) openness in the sense of being free of charge; and (iii) online making these courses accessible from anywhere in the world.

In terms of pedagogy, MOOCs are divided into two very different types: cMOOCs and xMOOCs [7–11]. These two categories of MOOC are distinguished by their underlying philosophies, specifically, while the former take a connectivist approach the latter are grounded in behaviorism [12]. This gives these two MOOC-types several key differences – strengths and weaknesses – which are discussed in greater depth in the work of other authors [13–15] and that we will summarize here. Considering first xMOOCs, their behaviorist approach emphasizes the importance of observable behaviors, stimuli and responses in the learning process, it also has several limitations, and a more compressive approach that considers cognitive processes, creativity, transfer, engagement, and flexibility is desirable to support students' learning

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processes more thoroughly. On the other hand, connectivist-style xMOOCs emphasize the role of networks, connections, and collaboration in learning, but these too have limitations, principally in terms of technology dependence, information overload, inadequate evaluation and their lack of emphasis on information retention, which can lead to superficial understanding. In this way, neither MOOC-type can be considered superior, rather they represent complementary approaches and, ultimately, elements of both should be incorporated to design MOOCs that constitute effective educational experiences.

Other ways of categorizing MOOCs have been suggested. For example, Clark [16] proposed a MOOC taxonomy focusing on the delivery method and identified 8 types of MOOC:

- TransferMOOCs: Existing distance learning courses are transferred to a MOOC platform.
- MadeMOOCs: Courses made specifically to be delivered on a MOOC platform which may include video lectures. They emphasize the quality of the assignments to be completed by students and encourage peer-to-peer work and co-assessment.
- SynchMOOCs: Courses have specific start and end dates, as well as dates for the execution of assessments.
- AsynchMOOCs: Courses have no fixed deadlines.
- AdaptiveMOOCs: Courses use adaptive algorithms to enable a personalized learning experience, based on dynamic assessment and course data collection.
- GroupMOOCs: Courses are designed ad hoc for specific groups.
- ConnectivistMOOC: Courses where students (individuals and groups) contribute to the running and direction of the learning experience, rather than following a strict syllabus.
- MiniMOOCs: Courses are shorter than traditional MOOCs and contain only a small amount of content.

2. Literature Review

Badi & Ali [17] stated that MOOCs change the teaching and learning process in three ways: (i) massiveness: courses can reach a large number of students and participants; (ii) transparency: courses can be made available to anyone interested, free, unobligated or previously conditional, at anytime and anywhere; (iii) diversity (heterogeneity): course members come from diverse cultures and backgrounds and have diverse inspirations.

Other authors acknowledge MOOCs as the key drivers for future learning because they offer the following range of benefits [3, 4, 18–22]:

(1) MOOCs can improve students' competencies both in terms of knowledge and skills so enhancing their lifelong learning.
(2) MOOCs offer cloud learning rooms where students can interact with other individuals in their learning community (subject specialists, other students) to exchange knowledge and opinions, and discuss any issues they may have with the course [23].
(3) MOOCs overcome the limitations of geography enabling professionals across the world to offer high-quality learning activities and courses to students wherever they are [24].
(4) MOOCs enable students and teachers from many countries to interact, sharing and transferring knowledge which has clear benefits for cross-cultural competence [25].

Finally, we would suggest that MOOCs are robust to some of the uncertainties of global events. For example, during the recent Covid19 pandemic, many educational institutions shut down so limiting many students' access to their education; students learning via MOOCs, in contrast, would not have been so affected.

However, MOOCs have received some criticism, particularly in terms of their contribution to the so called "McDonaldization" of education which tends to devalue the role of teachers and, more generally, underrates the importance of interpersonal contact in the teaching and learning experience. This theme has been explored in depth by Wilkinson [26] and Holmes and Lindsay [27].

While the majority of MOOC studies have focussed on students' attitudes towards these online courses [28–32], a small number have addressed teachers' impressions of them. Of the work in this latter group, we would like to highlight a number of articles of particular relevance to our work. The first of these is a study by Hew and Cheung [12] which identifies both the reasons behind lecturers' choice to use MOOCs (intrigue, egoistic rewards, sense of altruism) as well as the challenges they face in implementing these courses (difficulties in evaluation, absence of physical public, lack of student participation, high demands in terms of time and resources). Other work includes that of Toven-Lindsey et al. [3] which examined the extent to which MOOCs provide satisfactory collaborative learning experiences and found that, despite the efforts to include constructivist and group-oriented methodologies, outcomes generally tended to be objectivist and individualistic. Also of interest is work by Kaur et al. [33] which reported lecturers' perceptions concerning MOOC

use in higher education generally in order to identify their main drawbacks and thus propose how they might be re-designed to achieve greater social impact. In addition, we should mention two studies that are relevant because although, strictly speaking, they concern students' perceptions of MOOCs, the students in question are themselves teachers (or student teachers). Castaño-Muñoz et al. [34], for example, studied the use of MOOCs for teachers' professional development finding that although lecturers see them as beneficial, their use is still very limited and, Ortega-Sánchez and Gómez-Trigueros [35] examined MOOC use as part of the training of future social science teachers, demonstrating the positive perception that this new generation of teachers have of MOOCs.

It is clear from the literature that MOOCs can be a powerful teaching and learning tool; however, it is also true that lecturers need a good knowledge of these platforms to design and teach effective MOOCs (e.g., [36]). Despite their growing use across the world and the need for such courses in current times, there are still few works concerning Spanish lecturers' experiences with MOOCs [35, 37]. The information concerning electromechanical engineering lectures in particular is non-existent.

2.1 Research Questions

Considering the previous discussion, the aim of this research then is to investigate Spanish electromechanical engineering lecturers' current knowledge, understanding, and perceptions surrounding MOOCs. To this end we set out to answer the following research questions: (1) how aware of MOOCs are Spanish electrical engineering lecturers? (2) how do these lecturers differ in their perceptions of MOOCs depending on whether their principal teaching mode is online or onsite? (3) how do these lecturers differ in their perceptions of MOOCs depending on their age? And (4) what differences in perceptions appear when MOOCs are considered for different teaching contexts: for one-time training or lifelong learning.

3. Materials and Methods

3.1 Design

The research presented here is a qualitative exploratory study. Data were collected using an internet-based questionnaire comprising two sections. The first part was used to gather demographic data such as age and sex; professional data such as participants' status within their institution and whether they predominantly taught online or onsite; and institutional data such as the location of their institution and whether it was state or privately owned.

The second part of the questionnaire probed various aspects of lecturers' perceptions and knowledge concerning MOOCs and contained three subsections. Firstly, participants were asked whether they had used MOOCs before or if they intended to do so in future, and they were also required to rate their level of awareness of MOOCs on a scale of 0-10. Secondly, participants were questioned about how they felt MOOCs could contribute to one-time training (a degree or taught post graduate course or modules taken as part of these) or lifelong training (professional development, for example). The final sub-section concerned participants' perceptions of the specific advantages and disadvantages of MOOCs.

3.2 Sample

Our population for this research was a convenience sample: a large number of Spanish academics were emailed with a questionnaire and our corpus comprises those who correctly completed and returned it. This gave us a corpus of 102 participants. The first part of the questionnaire allowed us to characterize the corpus in terms of professional role, age, sex, geographical location, and principal teaching mode of participants (see Table A1, Appendix A).

Participants were in post at 12 different Spanish universities in various geographical areas across the country. Most participants worked at public institutions (82.4%) and the majority taught onsite (73.5%) rather than online (26.5%). Concerning age, 32.4% of participants were 31 to 40 years old; 31.4% were 41 to 50 years old; 28.4% were 51 to 60 years old; and 7.84%, were >61 years old; and the average age of the corpus was 46.2 years old. It should be noted that there is a distinct gender imbalance in the corpus with 83.3% men and 16.7% female (Table A1). The study took place from the first half of 2021 to the first half of 2022 (after the COVID-19 pandemic).

3.3 Procedure

First, we inquired about participants' general knowledge of MOOCs and elicited their perceptions concerning these courses. The first three questions were:

(i) Have you had previous experience using MOOCs?
(ii) Do you intend to teach using MOOCs in future?
(iii) Rate your familiarity with MOOCs on a scale of 0 to 10 where 0 corresponds to no familiarity and 10 to a high level of familiarity.

In the next part of the questionnaire, participants were asked whether certain statements about

Table 1. Perceptions of MOOCs' main contributions in the contexts of either one-time training or lifelong training

Category	Description	This category would fit in. . .	
		One-time training	Lifelong training
No opinion (NO)	I cannot answer this question honestly because I am not sufficiently aware of MOOCs.		
Communication	MOOCs make it possible to share and generate ideas/ experiences with a large audience.		
Negativity	MOOCs have absolutely nothing to offer to the students' training.		
Learning and reviewing (L&R)	MOOCs make it possible to learn new content and review old material.		
Innovation	MOOCs are innovative and novel training tools.		
Complement	MOOCs can be used to help students learn things that are difficult to teach in a classroom.		
Theory and practice (T&P)	MOOCs enable students to learn a wide range of theoretical and practical knowledge.		
Openness	MOOCs enable free access to learning anywhere in the world.		

Table 2. Families and categories of analysis

Category	Description	Strength	Opportunity	Weakness	Threat
Evaluation	MOOCs allow for double-blind assessment procedures.				
Massiveness, virtuality, and openness (MVO)	Promote massiveness, virtuality, and openness.				
Commodification	MOOCs generate publicity for universities, and this brings them into the market economy.				
Resistance	Lecturers require technical resources and specific training.				
Dropout	One of MOOCs' most serious problems is the high dropout rate.				
Shallow	MOOCS offer minimal content with little depth.				
Speed and accessibility (S&A)	MOOCs allow immediate and easy access to information.				
Validity	MOOCs can be offered by providers with low expertise in the topic.				
Substitution	MOOCs will replace face-to-face training.				
Trend	MOOCs are very fashionable at the moment.				
Dissemination	MOOCs can reach more people than traditional courses.				

MOOCs were more appropriate in the context of one-time training or lifelong training (participants were given the option to choose both).

Finally, participants were asked to define several MOOC characteristics (Table 2) according to whether they felt they were strengths, weaknesses, opportunities, or threats (SWOT categories). Participants were provided with the following definitions of these categories:

- Strengths: characteristics of the MOOCs that constitute an advantage over other teaching and learning methods.
- Weaknesses: characteristics of the MOOCs that constitute a disadvantage relative to other teaching and learning methods.
- Opportunities: characteristics of the MOOCs that could be further exploited to its advantage (future trend).
- Threats: characteristics of the MOOCs that could cause trouble during the teaching and learning process.

4. Results

Turning first to electromechanical engineering lecturers' general awareness of and experience with MOOCs, we asked participants first whether they

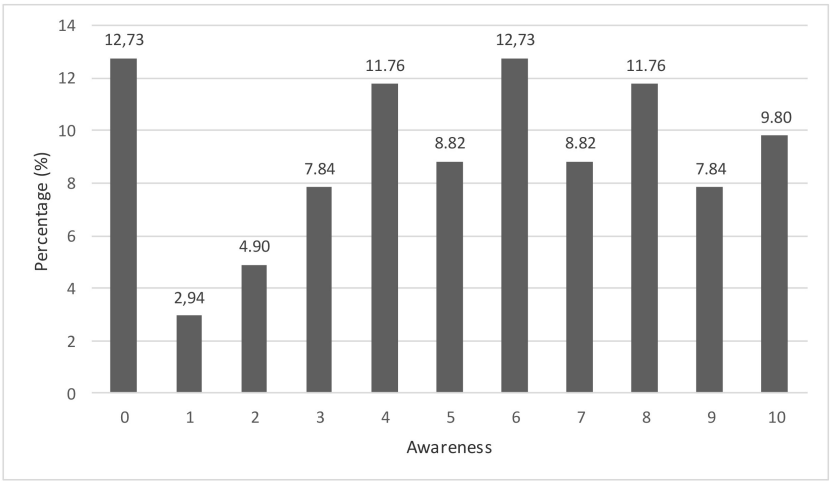

Fig. 1. Awareness of MOOCs reported by participants and rated on a scale from 0 to10 (0 – completely unaware, 10 – very aware).

had ever used MOOCs, or if they intended to do so in the near future; and we also asked them to rate their level of familiarity with the MOOC concept. Results in this area were somewhat disappointing as they show a significant lack of experience with MOOCs as a pedagogical resource among our corpus with only 4.9% reporting having used them previously. In addition, participants showed little interest in implementing MOOCs in future – only 21.6% expressed the intention to use them. The survey results did however demonstrate a considerable level of awareness of MOOCs (Fig. 1) with only 28.5% of participants reporting very little awareness (0 to 3) while 33.3% and 38.2% reported, respectively, moderate awareness (4 to 6) or high awareness (7 to 10). Interestingly, it seems there is a lot of familiarity with MOOCs despite the fact that most lecturers have not used them and do not intend to use them.

Our next area of interest concerns lecturers' perceptions of how MOOCs contribute to learning in two different contexts – one-time and lifelong training. In their answers, participants identified seven categories including: (i) communication between lecturers and students; (ii) training at an economical cost and at a distance; (iii) learning new contents and reviewing the old ones; (iv) innovation among teachers and/or students; (v) complementary pathways to official program; (vi) theoretical and practical training applicability; and (vii) nothing to offer to students. The abbreviations used for these categories are shown in Appendix B.

The perceptions of participants accustomed to onsite lecturing were found to differ from those of participants who taught online. Concerning onsite lecturers, 32% said MOOCs are valuable to improve communication in the one-time training context while 34.7% felt they were an innovative

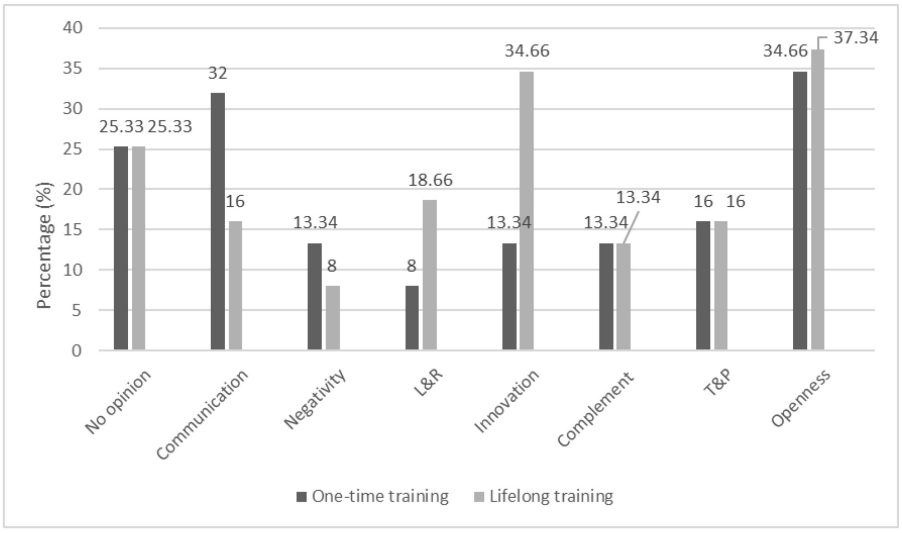

Fig. 2. Onsite lecturers' perceptions concerning MOOCs' main contributions to one-time and lifelong training.

approach to improve lifelong learning experiences (Fig. 2). This group of participants also felt MOOCs openness was important in both lifelong (37.3%) and one-time (34.7%) training. Very few participants had negative perceptions of MOOCs (13.3% for lifelong and 8% for one-time training), however, it must be said, a substantial percentage of participants felt unable to give a meaningful response to this question in either training context (25.3% in both cases). In contrast to their onsite counterparts, online lecturers were overwhelmingly positive about MOOCs. In particular, this group highlights MOOCs as a valuable tool to complement traditional teaching in one-time training (74%) and, in lifelong training, for learning new contents and reviewing old material (L&R: 44.4%) and communication (51.8%) (Fig. 3).

Disaggregating data according to age reveals a generational gap concerning opinions about MOOCs used either in one-time (Fig. 4) or in lifelong training (Fig. 5). Referring first to Fig. 4, the generation gap is apparent firstly in the large percentage of those in the >61 age bracket who stated they had "no opinion" about MOOCs (37.5%), and secondly in the high proportion of this age group who expressed negative opinions about MOOCs (75.0%). Despite this, the same age group stood out for their support of MOOCs as a good method of providing theoretical and practical knowledge (T&P: 50% in this age group compared to less than 14.9% in all other groups). The youngest age group (31 to 40 years) are notable for their overwhelming approval of MOOCs as a complement to regular teaching activities. In fact, 66.7% of

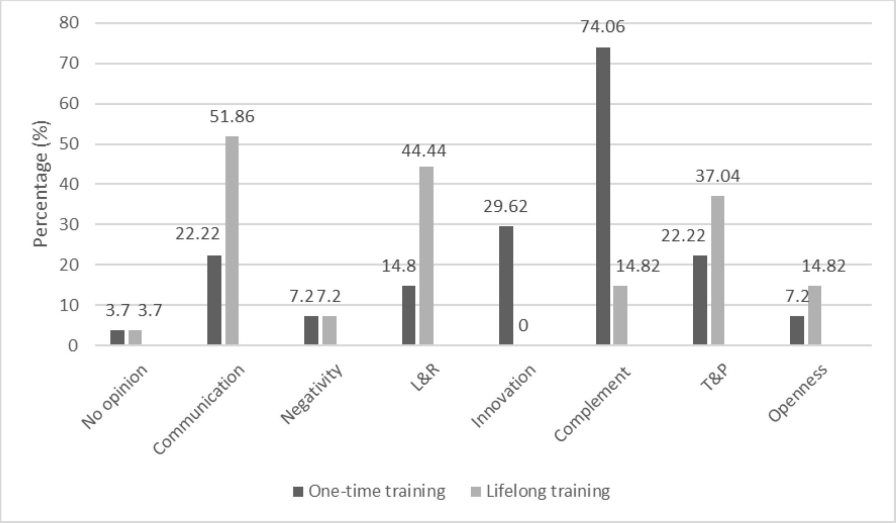

Fig. 3. Online lecturers' perceptions of MOOCs' main contributions to one-time and lifelong training.

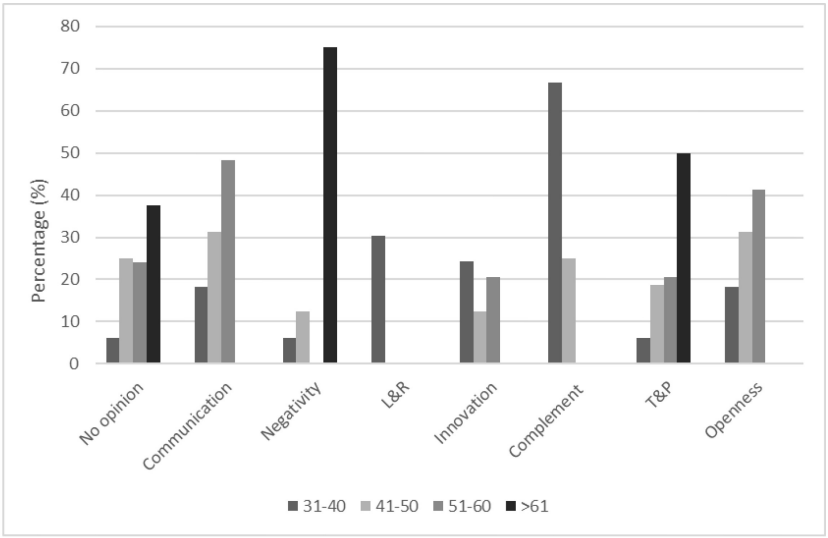

Fig. 4. Lecturer age and perceptions of MOOCs' main contributions to one-time training.

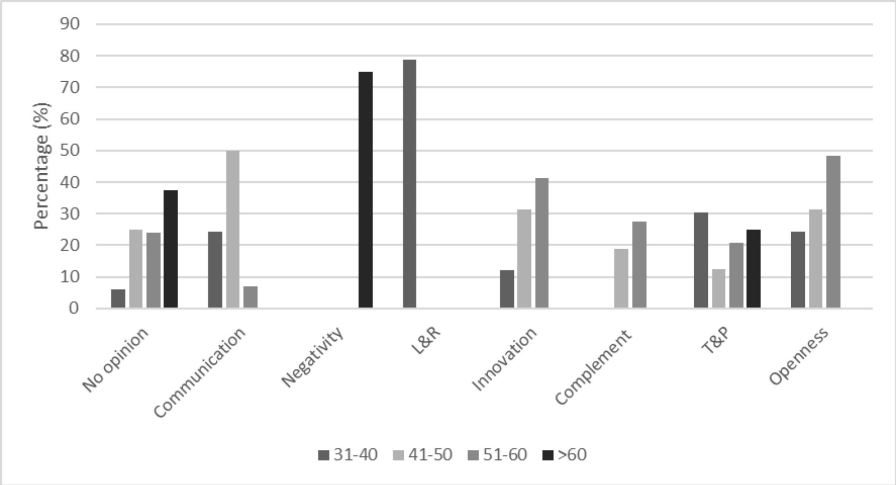

Fig. 5. Lecturer age and perceptions of MOOCs' main contributions to lifelong training.

this age group held this opinion while the percentages for other age groups were significantly lower: 25.0% for those aged between 41 to 50 years old and 0% for the two oldest groups.

Turning to Fig. 5, again we see the oldest age group (>61) is distinguished by a lack of knowledge concerning MOOCs with 37.5% expressing "no opinion". In addition, not only were they the only group expressing negativity about MOOCs in this context, but this also constituted the overwhelming majority opinion for the age group (75.0%).

Participants identified several specific advantages (strengths or opportunities) and disadvantages (weaknesses or threats) concerning MOOCs themselves and their use as a teaching and learning tool.

Turning first to lecturers' perceptions of MOOCs' weaknesses and threats (Fig. 6), here, those features uniquely considered to be weaknesses were, in order of importance, resistance (29.4%), shallowness (27.5%), and abandonment (15.7%). The only MOOC characteristic deemed to be wholly threatening was substitution (32.3%) with commodification considered to be both a significant threat (45.1%) as well as being a weakness (19.6%).

Considering positively perceived MOOC characteristics, here, there was only that was deemed to be uniquely an opportunity: dissemination. A range of other MOOC features were also perceived mostly positively, but with significant numbers of partici-

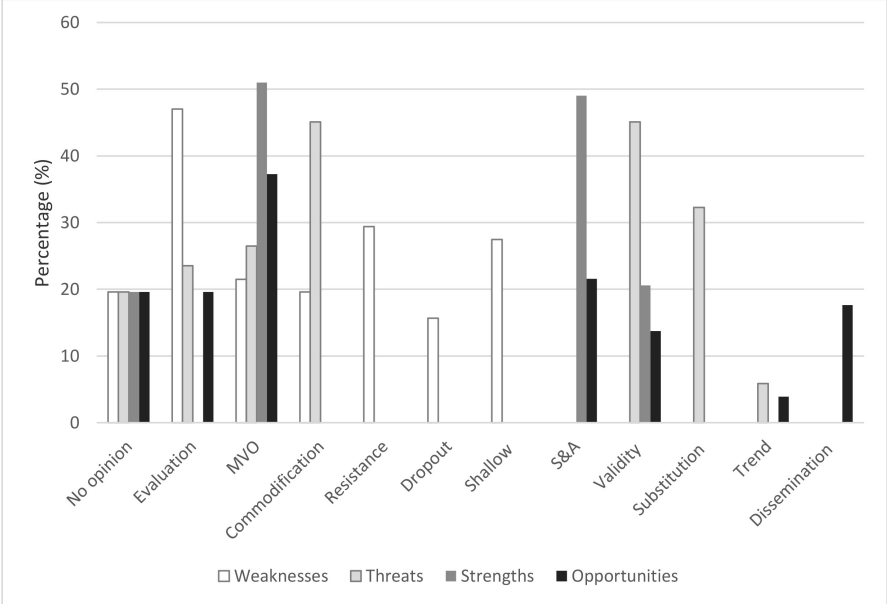

Fig. 6. MOOC features identified and whether they were perceived positively (strengths and opportunities) or negatively (weaknesses and threats) perception.

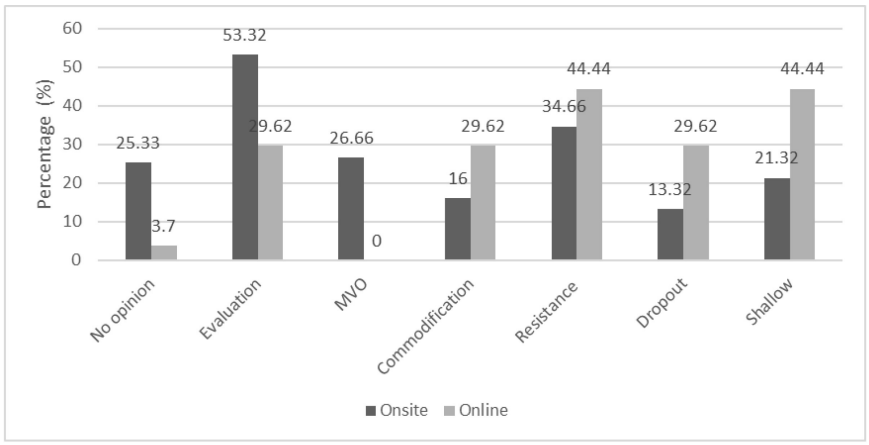

Fig. 7. Principal teaching mode and perceived weaknesses of MOOCs.

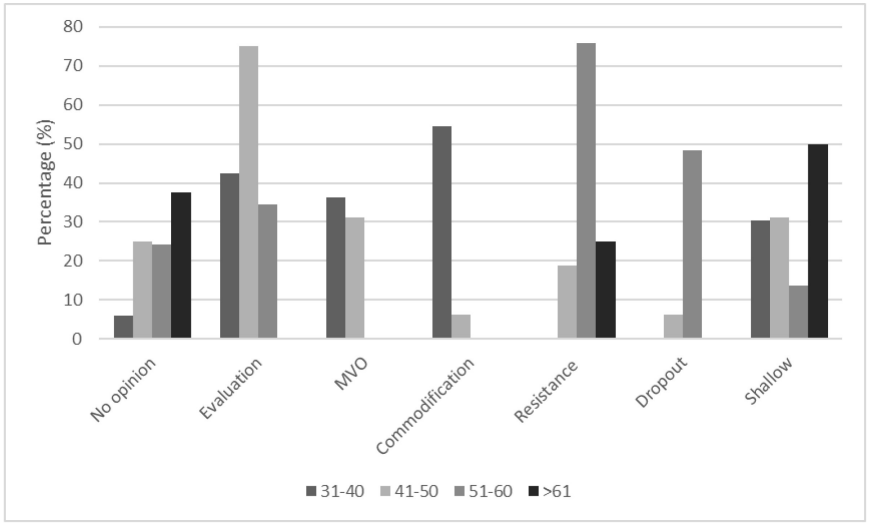

Fig. 8. Lecturer age and perceived weaknesses of MOOCs.

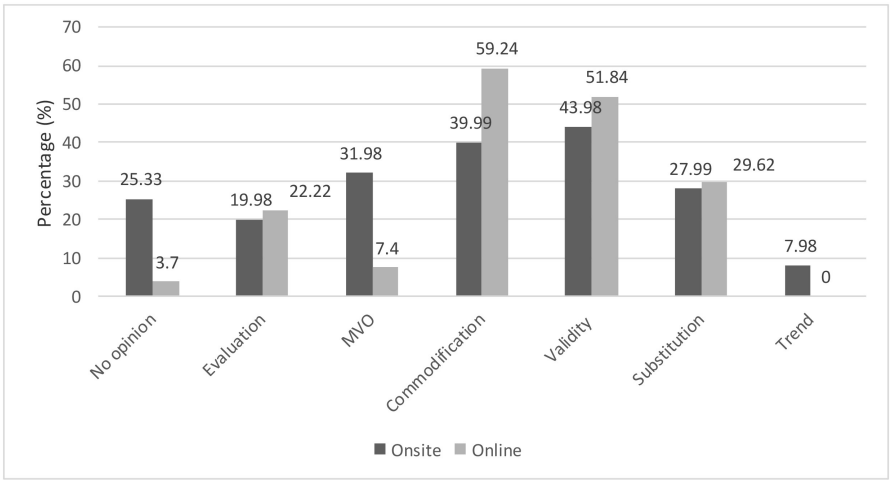

Fig. 9. Perceived threats of MOOCs varying with lecturers' principal teaching mode.

pants also considering them as negatives. For example, MVO although perceived by 51% of participants as a strength and by 37.3% as an opportunity, was also perceived as a weakness or a threat (by 21.5% and 21.5% of participants respectively). This is perhaps explained by the very general nature of this characteristic making it difficult to define.

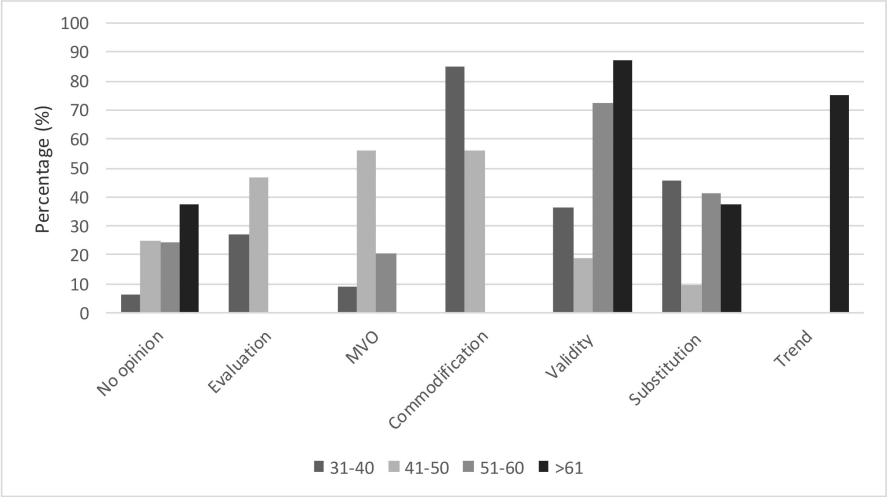

Fig. 10. Perceived threats of MOOCs as varying with lecturers' age.

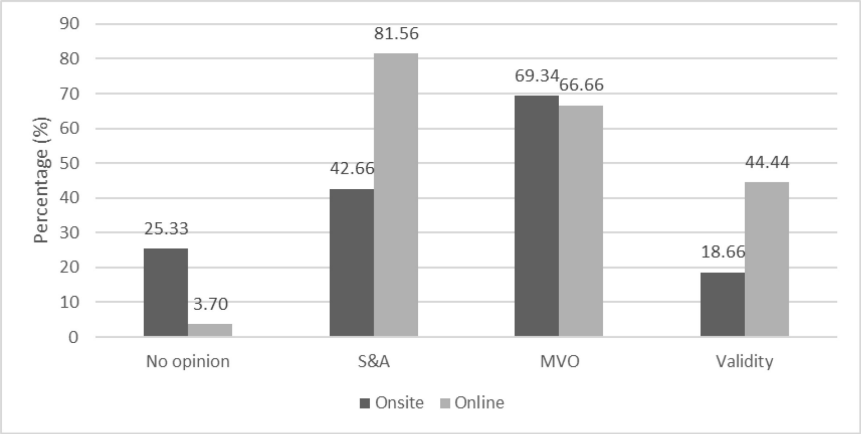

Fig. 11. Principal teaching mode and perceived strengths of MOOCs.

The SWOT data was disaggregated according to both teaching mode (online and onsite) and age group and this revealed some interesting trends.

Looking first at the perceived weaknesses of MOOCs identified by the sample (Fig. 7), a remarkable proportion of online lecturers point out that these types of courses are very shallow, that is, they are for the most part introductions to certain topics and do not go into great depth in terms of their content (44.4%). In contrast, onsite lecturers were less concerned about this issue with only 21.3% identifying it as a weakness, rather they were most worried about MOOCs evaluation systems (53.32% of onsite lecturers thought this was a weakness in comparison to only 9.62% of online lecturers. There were also some significant differences between age groups (Fig. 8), the most striking of which is how the 41 to 50 age group was far more critical than other groups with respect to the evaluation systems offered by MOOCs. Specifically, 75.0% of this age group identified evaluation as a weakness compared to 42.4% for 31 to 40 years old, 34.5% for 51 to 60 years-old, and 0% for those >61).

With respect to MOOCs' perceived threats, here more onsite lecturers cited validity (43.98%) than any other issue while online lecturers mostly referenced commodification (59.2%). It is also interesting to note the high proportion of onsite lecturers who responded to this question with "no opinion" (25.3%) (Fig. 9). Looking at age groups, while validity seemed to be perceived as the greatest threat among older lecturers (72.4% in the 40–51 year old age group and 87.5% of the >61 age group), for younger lecturers, the main threat was commodification (31–40 years old, 84.8%; 41–50 years old, 56.3% (Fig. 10).

Concerning MOOCs' perceived strengths, comparing online and onsite lectures (Fig. 11), a considerable percentage of onsite lecturers claimed not to have sufficient knowledge to make any answer (25.3%). Meanwhile, both groups identified MVO as a strength: 69.3% of onsite lecturers compared to

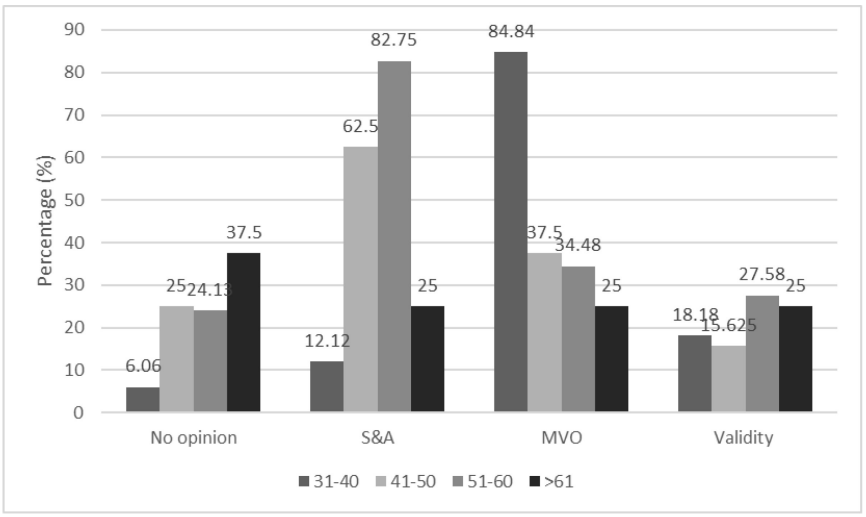

Fig. 12. Lecturer age and perceived strengths of MOOCs.

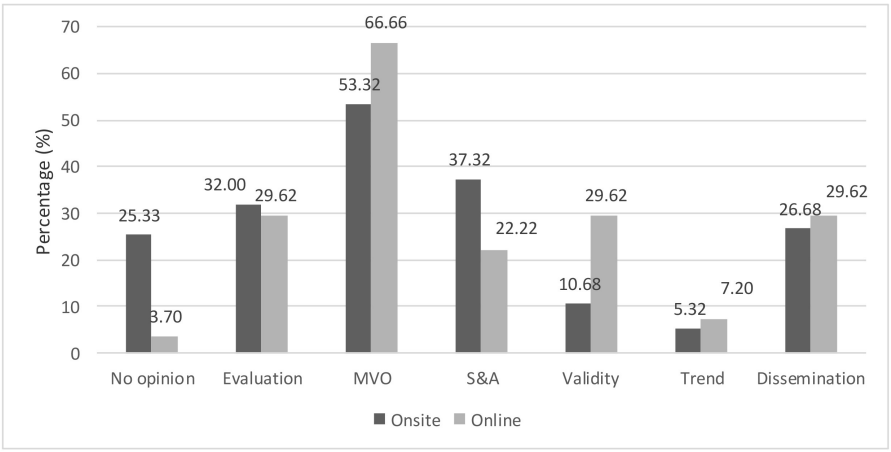

Fig. 13. Perceived opportunities of MOOCs varying with lecturers' principal teaching mode.

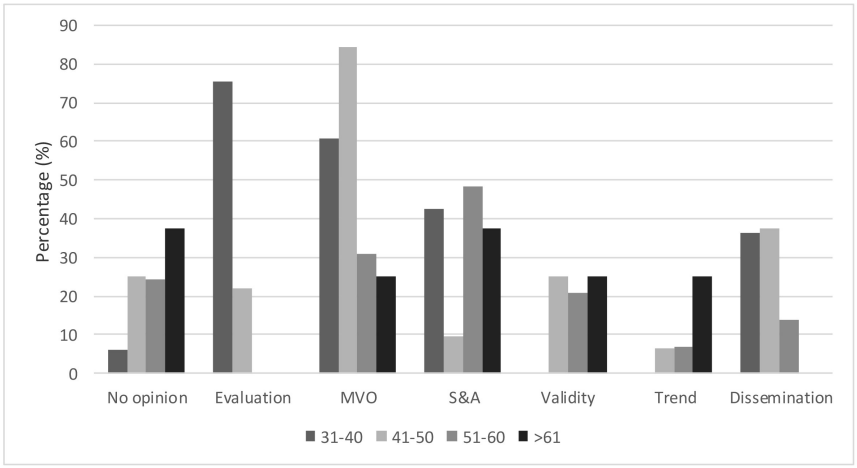

Fig. 14. Perceived opportunities of MOOCs varying with lecturers' age.

66.7% of online lecturers. Looking at age differences (Fig. 12), important results include the large number of those in the age bracket >61 who did not give any response in this regard (37.5%); that a high proportion of those participants aged 51 to 60 considered that speed and accessibility (S&A) of information to be one of the main strengths of MOOCs (82.8%); and that those aged 31 to 40

years old were most likely to highlight MVO as the main strength (84.8%).

Similar patterns can be observed in terms of MOOC's perceived opportunities. Considering first a comparison of online and onsite lecturers (Fig. 13), MVO is seen by both groups as presenting the greatest opportunity (53.3% and 66.6% respectively) and concerning age (Fig 14), more senior lecturers were most likely not to provide response to this question (51–60: 24.3%; >61: 37.5%); while younger lecturers were clear on MVO as the biggest advantage of MOOCs (31 to 40: 60.6%; 41 to 50: 84.4%).

5. Discussion

Our first research question concerned determining the degree of awareness of MOOCs among Spanish electromechanical engineering lecturers. This question is particularly important as, we feel, a lack of knowledge regarding these types of courses is perhaps one of the limitations on their more widespread use. Results were encouraging in the sense that there appeared to be significant knowledge about MOOCs within our corpus (only 25.8% of lecturers professed to little knowledge of these courses), however, it was disappointing how few participants actually had experience teaching MOOCs (just 4.9% reported using them). These results are in agreement with the findings of several other studies, for example, Almerich [37], Castaño-Muñoz et al. [34] and Kaur et al. [33].

Moreover, it is concerning that only 21.6% of participants reported having plans to teach a MOOC in the near future. There could be several reasons to explain this, first and we contend that foremost amongst these is the, the technical and organizational requirements needed to implement these courses. MOOCs are still a relatively new resource (early records of their use date to 2008 [1]) and the traditional structure of higher education does not easily accommodate their use and, lecturers seeking to create a MOOC may not necessarily have the technological skills, for instance, camera and platform design skills. Whatever the case may be, it is a concern that a significant number of lecturers appear to be unacquainted with MOOCs despite the rise in online teaching as a consequence of the COVID-19 lockdown.

Concerning our second and third research question, lecturers' principal teaching mode and age did appear to affect their perceptions in several ways. Most obviously, online and younger lecturers tended to have more positive opinions about MOOCs than their onsite and older counterparts.

In general terms, both online and onsite lecturers identified similar advantages and disadvantages; however, some differences were found, specifically in views concerning MOOCs commodification of education (40.0% of onsite lecturers thought this was the case compared to 59.2% of online lecturers); the shallow depth of content provided by MOOCs (21.3% of onsite lecturers compared to 44.4% of online lecturers); and MOOCs usefulness for learning and reviewing process (13.3%, of onsite lecturers compared to 22.2%, of online lecturers). Age differences manifested largely in the fact that older lecturers (aged >61) had the highest levels of "no opinion" and fully 75% felt that MOOCs were a negative development.

Concerning MOOCs' SWOTs, it is interesting to note that comparing online and onsite lecturers, perceptions of MOOC weaknesses were quite polarized with online lecturers seemingly most concerned about the shallow content provided by MOOCs, while onsite lecturers were more worried about their evaluation procedures. Concerns about MOOC evaluation were also very common among lecturers in the 41–50 year old age bracket. In terms of opportunities and strengths however, the differences between groups were less pronounced with MVO being rated highly by all lecturers regardless of principal teaching mode or age.

It is important to assess perceptions of MOOCs' weaknesses and threats as these naturally discourage lecturers from using them. As mentioned above, there was a widespread opinion that MOOCs have poor evaluation systems, but another issue that caused problems in the eyes of significant numbers of our participants was the worry that they might come to substitute face-to-face teaching (32.3% of all participants). Other studies have recognized these limitations for MOOC use [38–39] attributing problems to difficulties with student monitoring, learner identification and low learner-instructor interactivity. Our work also showed that a high proportion of lectures surveyed feel MOOCs represent a commodification of education which might negatively affect the quality of education (45.1% of participants saw it as an outright threat); this is a novel finding of this investigation and we would argue it is an opinion which is in line with the very widely shared view among participants that MOOCs are lacking in terms of subject content.

A particular, indeed fundamental, feature of MOOCs is their massive, virtual, open character (MVO), and although it was perceived as either a significant strength or opportunity by the majority of participants (online and onsite lecturers, and especially those in the 30 to 41 year old age bracket) a significant minority felt it to be a negative quality. That so many lecturers appear to have such a low opinion of this aspect of MOOCs suggests that our

corpus participants tend to underestimate the potential of these courses both in terms of disseminating learning but also with regards to increasing the worldwide visibility of the institutions that use them a finding reflected in a study of Dutch lecturers by Schophuizena et al. [36].

With regards to older lecturers' (aged >61) apparent tentativeness about expressing their opinions concerning MOOCs, as suggested by Ortega-Sánchez and Gómez-Trigueros [35], this probably points to a generational gap in ICT skills and knowledge tending to make this older age group feel less comfortable with technology.

Regarding our final research question, the lecturers we surveyed appear to perceive MOOCs to be useful for both one-time and lifelong learning, however, the advantages felt to be important for each differed depending most clearly on lecturers' principal teaching mode. For example, onsite lecturers felt communications was among the most beneficial MOOC feature for one-time learning while online lecturers highlighted MOOCs as a good complement for traditional teaching in the same context. Furthermore, onsite lecturers felt that MOOCs openness was a feature that would be beneficial in both teaching contexts while online lecturers felt MOOCs offered advantages for lifelong learning in terms of L&R and communications.

MOOCs have been shown to be pragmatic learning tools that promote an increase in the quality in engineering education [40], particularly in terms of lifelong learning, thus, it is disappointing that the lecturers surveyed do not appear to be fully aware of their potential benefits. The concerns expressed by participants about evaluation as a particular weakness of MOOCs suggests that those surveyed have a very behaviorist approach to teaching and learning, that is, they prioritize the acquisition of specific learning outcomes as the aim of the learning experience. Indeed, their lack of appreciation for other MOOC features such as the potential for increased interactivity and collaboration may explain their reticence about using these courses in the future.

6. Conclusions

It might be expected that electromechanical engineering lecturers would be among the first to embrace new educational technologies such as MOOCs, however, our findings show a clear need to improve perceptions about MOOCs and increase confidence in their use among this group. In this way, measures should be taken to increase lecturers' knowledge about MOOC creation, design, and implementation, as well as to promote the many opportunities this type of course can offer. In this respect, we suggest that one approach is to incentivize their use, for example, recognizing lecturers who employ MOOCs through a teaching innovation certification program that would count towards ongoing professional development and promotion; paid summer courses; teaching load release for MOOC preparation; increasing the funding available for departments offering greater numbers of online courses; and so on. In addition, to address the fact that, at least initially, many lecturers may not have the necessary skills to implement MOOCs effectively, universities should provide ICT support. Finally, universities need to adapt their current systems of assessment to better accommodate the use of MOOCs in degree and other courses.

Lecturers' teaching modality was one of the biggest factors in determining their perceptions of the weaknesses, threats, strengths, and opportunities of MOOCs. For instance, compared to onsite lecturers, their online counterparts were far more likely to see MOOCs are a useful resource to complement traditional courses in the context of one-time training.

With respect to the impact of lecturer age on perceptions about MOOCs, here the younger age groups were most accepting of this educational tool. This is likely to reflect the fact these lecturers are more comfortable with ICT; indeed, the results of this study suggest that older generations not only lack confidence with technology but also have actively negative opinions of it.

In the fast-changing, information-rich environment of our modern high-technology society it is increasingly difficult for traditional schooling to cover all the contents necessary to prepare students for the workplace, not least because topics covered now will be obsolete long before the end of students' professional lives. As a result, nowadays it is impossible to separate training from work, and lifelong learning has become a critical feature of modern careers. In this respect, our corpus did acknowledge several MOOC characteristics as being suitable for their application in lifelong learning their lack of intention to use MOOCs in the future suggests they do not consider MOOCs as an appropriate vehicle for formal learning. This attitude may be associated with lecturers' resistance to MOOCs substituting onsite teaching, the difficulties they saw in MOOCs' evaluation procedures (for example, in lifelong learning work practice is the evaluation), and the perceived shallowness of contents taught (even though MOOCs can be used to offer very specific, in-depth knowledge).

In conclusion, this research should be considered a brief overview of some of the barriers to MOOC

uptake in university engineering departments and as a guide to where further research is needed. More in-depth studies are required to facilitate the design of programs to address the problems revealed in this exploratory research project.

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References

1. C. M. Stracke, S. Downes, G. Conole, D. Burgos and F. Nascimbeni, Are MOOCs Open Educational Resources? A Literature Review on History, Definitions and Typologies of OER and MOOCs, *Open Praxis*, **11**(4), pp. 331–341, 2019.
2. L. Breslow, MOOC research: Some of what we know and avenues for the future. From books to MOOCs, pp. 57–68, 2016.
3. B. Toven-Lindsey, R. A. Rhoads and J. B. Lozano, Virtually unlimited classrooms: Pedagogical practices in massive open online courses, *The Internet and Higher Education*, **24**, pp. 1–12, 2015.
4. K. Lee, Rethinking the accessibility of online higher education: A historical review, *The Internet and Higher Education*, **33**, pp. 15–23, 2017.
5. D. Shah, *By the numbers: MOOCs in 2020*, The Report by Class Central (2020).
6. S. Aldahmani, S. A. Al-shami, H. Adil and S. Sidek, A review paper on MOOCs development stages, types, and opportunities and challenges, *Systematic Reviews in Pharmacy*, **11**(12), pp. 172–179, 2020.
7. S. J. Daniel, Making sense of MOOCs: Musings in a maze of myth, paradox and possibility, *Journal of Interactive Media in Education*, **18**, pp. 1–12, 2012.
8. S. Blum-Smith, M. M. Yurkofsky and K. Brennan, Stepping back and stepping in: Facilitating learner-centered experiences in MOOCs, *Computers & Education*, **160**, 104042, 2021.
9. V. Kovanović, S. Joksimović, O. Poquet, T. Hennis, I. Čukić, P. de Vries, et al., Exploring communities of inquiry in Massive Open Online Courses, *Computers & Education*, **119**, pp. 44–58, 2018.
10. N. Lung-Guang, Decision-making determinants of students participating in MOOCs: Merging the theory of planned behavior and self-regulated learning model, *Computers & Education*, **134**, pp. 50–62, 2019.
11. R. M Paton, A. E. Fluck and J. D. Scanlan, Engagement and retention in VET MOOCs and online courses: A systematic review of literature from 2013 to 2017, *Computers & Education*, **125**, pp. 191–201, 2018.
12. K. F. Hew and W. S. Cheung, Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges, *Educational Research Review*, **12**, pp. 45–58, 2014
13. P. Hill, Four barriers that MOOCs must overcome to build a sustainable model, https://eliterate.us/four-barriers-that-moocs-must-overcome-to-become-sustainable-model/, Accessed 16 May 2021.
14. T. Phan, S. G. McNeil and B. R. Robin, Students' patterns of engagement and course performance in a Massive Open Online Course, *Computers & Education*, **95**, pp. 36–44, 2016.
15. J. Zhang, Can MOOCs be interesting to students? An experimental investigation from regulatory focus perspective, *Computers & Education*, **95**, pp. 340–351, 2016.
16. D. Clark, (2013). MOOCs: taxonomy of 8 types of MOOC, http://donaldclarkplanb.blogspot.com/2013/04/moocs-taxonomy-of-8-types-of-mooc.html, Accessed 13 June 2021.
17. Dr. Badi and Dr. Ali, (2016). Massive Open Online Courses (MOOC) Their Impact on the Full Quality in Higher Education Institutions ''Rwaq: Saudi educational platform for MOOC'', *Journal of Library and Information Sciences*, 4. 10.15640/jlis.v4n1a6.
18. M. Barber, K. Donnelly and S. Rizvi, *An avalanche is coming: Higher education and the revolution ahead*, London: Institute for Public Policy Research, 2013.
19. L. Johnson, S. Adams, M. Cummins, V. Estrada, A. Freeman and H. Ludgate, *NMC Horizon Report: 2013 Higher Education Edition*, Texas: New Media Consortium, 2013.
20. A. Littlejohn, N. Hood, C. Milligan and P. Mustain, Learning in MOOCs: Motivations and self-regulated learning in MOOCs, *The Internet and Higher Education*, **29**, pp. 40–48, 2016.
21. A. E. Stich and T. D. Reeves, Massive open online courses and underserved students in the United States, *The Internet and Higher Education*, **32**, pp. 58–71, 2017.
22. C. Milligan and A. Littlejohn, How health professionals regulate their learning in massive open online courses, *The Internet and Higher Education*, **31**, pp. 113–121, 2016.
23. Smadar Donitsa-Schmidt and B. Topaz (2018) Massive open online courses as a knowledge base for teachers, *Journal of Education for Teaching*, **44**(5), pp. 608–620.
24. A. M. Kaplan and M. Haenlein, (2016) Higher Education and the Digital Revolution: About MOOC, SPOCs, Social Media, and the Cookie Monster, *Business Horizons*, **59**, pp. 441–450.
25. B. Plangsorn, J. Na-Songkhla and L. M. Luetkehans, Undergraduate students' opinions with regard to ubiquitous MOOC for enhancing cross–cultural competence, *World Journal on Educational Technology*, **8**(3), pp. 210–217, 2016.
26. G. Wilkinson, McSchools for McWorld? Mediating global pressures with a McDonaldizing education policy response, *Cambridge Journal of Education*, **36**(1), pp. 81–98, 2006.

27. C. Holmes and D. Lindsay, "Do you want fries with that?": The McDonaldization of University Education – Some Critical Reflections on Nursing Higher Education, *SAGE Open*, **8**(3), pp. 1–10, 2018.
28. M. Cain and S. Phillipe, An exploration of students' experiences of learning in an Online Primary Teacher Education Program, *Journal of Online Learning and Teaching*, **9**(3), pp. 304–315, 2013.
29. E. McKay and J. Lenarcic, *Macro-level learning through Massive Open Online Courses (MOOCs): Strategies and Predictions for the Future*, IGI Global: Hershey, 2015.
30. A. Watted and M. Barak, Motivating factors of MOOC completers: Comparing between university-affiliated students and general participants, *The Internet and Higher Education*, **37**, pp. 11–20, 2018.
31. S. R. Lambert, Do MOOCs contribute to student equity and social inclusion? A systematic review 2014–18, *Computers & Education*, **145**, 103693, 2020.
32. Z. Chen, Y. Liu and H. Hou, Do they really know what we need? Exploring learners' versus universities' views on open educational resources in Chinese universities, *International Journal of Educational Research*, **109**, 101817, 2021.
33. S. Kaur, W.W. Goh and P. G. Kng, Redesigning Massive Open Online Courses (MOOCs) Based on Lecturers' Perception, In S. T. Tang and S. E. Cheach (eds), *Redesigning Learning for Greater Social Impact.* Springer: Singapore, 2016
34. J. Castaño-Muñoz, M. Kalz, K. Kreijns and Y. Punie, Who is taking MOOCs for teachers' professional development on the use of ICT? A cross-sectional study from Spain. Technology, *Pedagogy and Education*, **27**(5), pp. 607–624, 2018.
35. D. Ortega-Sánchez and I. M. Gómez-Trigueros. Massive open online courses in the initial training of social science teachers: Experiences, methodological conceptions, and technological use for sustainable development, *Sustainability*, **11**(3), p. 578, 2019.
36. M Schophuizena, K. Kreijnsa, S. Stoyanova and K. Kalz, Eliciting the challenges and opportunities organizations face when delivering open online education: A group-concept mapping study, *The Internet and Higher Education*, **36**, pp. 1–12. 2018.
37. G. Almerich, J. Suárez, J. Jornet and M. Orellana, Las competencias y el uso de las tecnologías de información y comunicación (TIC) por el profesorado: estructura dimensional, *Revista Electrónica de Investigación Educativa*, **13**(1), pp. 28–42, 2011.
38. D. Gamage, I. Perera and S. Fernando, MOOCs Lack Interactivity and Collaborativeness: Evaluating MOOC Platforms, *International Journal of Engineering Pedagogy*, **10**(2), pp. 94–111, 2020.
39. U. Zakharova and K. Tanasenko, MOOCs in Higher Education: Advantages and Pitfalls for Instructors, *Educational Studies Moscow*, **3**, pp. 176–202, 2019.
40. J. L. Martín, H. A. Salvatierra and J. R. Hilera González, MOOCs for all: evaluating the accessibility of top MOOC platforms, *The International Journal of Engineering Education*, **32** (5), pp. 2274–2283, 2016.

Appendix A

Table A1. Main characteristics of the sample. Number of participants and percentage (%)

Professional Level	Professor	7.84
	Associate Professor	18.63
	Assistant Professor	16.67
	Research Associate	3.92
	Lecturer	44.12
	Instructor	6.86
	Visiting Professor	1.96
Age	31 to 40	32.35
	41 to 50	31.37
	51 to 60	28.43
	>61	7.84
Sex	Male	83.33
	Female	16.67
Location of Institution in Spain	Northern Zone (Galicia, Asturias, Cantabria, Basque Country, and Navarra)	10.78
	Southern Zone (Andalusia and Canary Islands)	18.63
	Eastern Zone (Aragon, Catalonia, Valencia, Balearic Islands and Murcia)	36.27
	Central Zone (La Rioja, Madrid, Castilla-La Mancha and Extremadura)	34.31
Ownership of institution	Public	82.35
	Private	17.65
Principal teaching mode	Onsite	73.53
	Online	26.47

Appendix B

List of acronyms and abbreviations

- L&R: Learning and reviewing
- LL: Lifelong learning

- MVO: Massiveness, virtuality, and openness
- NO: No opinion
- S&A: Speed and accessibility
- T&P: providing theoretical and practical knowledge

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