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Résumé de l'article

MOOCs (Massive Open Online Courses) have changed the way in which OER (Open Educational Resources) are bundled by teachers and consumed by learners. MOOCs represent an evolution towards the production and offering of structured quality OER. Many institutions that were initially reluctant to providing OER have, however, joined the MOOC wave. Nevertheless, MOOCs detractors strongly criticize their high dropout rates. The dropout rate is a commonly accepted metric of success for traditional education, but it may not be as suitable when dealing with OER, in general, and with MOOCs, in particular, since learners' motivations to take a course are very diverse, and certain self-regulated learning strategies are required to tackle the lack of personalized tutoring and keep pace in the course. This paper presents an empirical study on the motivation and learning strategies of MOOC learners. Six thousand three hundred and thirty-five learners from 160 countries answered a self-report 7-point Likert-type questionnaire based on the Motivated Strategies for Learning Questionnaire (MSLQ) as part of a MOOC titled Introduction to Programming with Java. Results indicate that learners were highly motivated and confident to do well in the course. Learning strategies, however, can be improved, especially regarding time management.

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Abstract

MOOCs (Massive Open Online Courses) have changed the way in which OER (Open Educational Resources) are bundled by teachers and consumed by learners. MOOCs represent an evolution towards the production and offering of structured quality OER. Many institutions that were initially reluctant to providing OER have, however, joined the MOOC wave. Nevertheless, MOOCs detractors strongly criticize their high dropout rates. The dropout rate is a commonly accepted metric of success for traditional education, but it may not be as suitable when dealing with OER, in general, and with MOOCs, in particular, since learners' motivations to take a course are very diverse, and certain self-regulated learning strategies are required to tackle the lack of personalized tutoring and keep pace in the course. This paper presents an empirical study on the motivation and learning strategies of MOOC learners. Six thousand three hundred and thirty-five learners from 160 countries answered a self-report 7-point Likert-type questionnaire based on the Motivated Strategies for Learning Questionnaire (MSLQ) as part of a MOOC titled *Introduction to Programming with Java*. Results indicate that learners were highly motivated and confident to do well in the course. Learning strategies, however, can be improved, especially regarding time management.

Keywords: MOOCs, OER, motivation, learning strategies, MSLQ

INTRODUCTION

Open Educational Resources (OER) have been available for decades (Atkins, Brown, & Hammond, 2007), boosted by the MIT OpenCourseWare (OCW) initiative (Abelson, 2008). Many universities have gradually adhered to OCW, publishing contents from regular courses to be consumed by any learner worldwide, and even using third-party OER to complement and improve teaching on campus. Creating and sharing OER represents an altruistic vision of education, but also has positive effects on

the visibility of institutions, even providing recruitment advantages in some cases (Carson, Kanchanaraksa, Gooding, Mulder, & Schuwer, 2012).

OER have traditionally been offered as both textual and audiovisual materials in online repositories, but without any kind of interaction with the teacher who created them, or with other potentially interested learners. MOOCs (Massive Open Online Courses) have managed to evolve the concept of OER, gathering together teachers and learners around courses built on sequences of materials that are typically published using open licenses (Yuan & Powell, 2013). These communities of teachers and learners created around MOOCs represent a great opportunity for opening debates, curating and enriching course materials, and getting answers from peers without (or with minimum) instructors' intervention (Alario-Hoyos et al., 2013).

MOOCs are succeeding in making universities that were reluctant to join the OER movement rethink their strategy. Providing MOOCs can be seen as an opportunity for promoting the university brand to learners who would have been difficult to reach otherwise, and, at the same time, as a way of improving the quality of residential education by applying MOOC-like technologies and innovations on campus through the so-called SPOCs (Small Private Online Courses) (Fox, 2013). Nonetheless, MOOC detractors criticize their lack of educational value, as most of these courses replicate the traditional lecture-based teaching practices, and the high dropout rates, which in many cases are over 90-95% of enrollees (Clow, 2013).

The dropout rate is a metric commonly used to measure success in formal education, where learners typically pay a fee to enroll a course and expect to obtain an accreditation certifying that they passed the course. MOOCs, however, remove the entry fee, allowing a much more heterogeneous population of learners with very diverse motivations for enrolling. Their free nature, refreshing knowledge, the opportunity to learn from a top-class university, or simply curiosity, are some of the reasons argued by learners to enroll a MOOC (Davis, Dickens, Leon Urrutia, Sánchez-Vera, & White, 2014). Finishing and passing the course does not seem a priority anymore for most MOOC enrollees, although that should not stop them from making the most of the MOOC until they believe it is worth their while. The heterogeneous population of learners in MOOCs requires a deep analysis to get information about learners' motivations, with the aim to help to design more attractive courses and promote engagement, which may lead to better retention.

Beyond the role motivation plays in dropout rates, it is noteworthy that learners need some learning strategies, and other advanced self-regulated learning skills, to be able to succeed in MOOCs (Halawa, Greene, & Mitchell, 2014; Littlejohn & Milligan, 2016), as there are neither timed face-to-face lectures, nor personalized tutoring with teachers. Learners who report completion of a bachelor's degree or higher are typically more likely to complete MOOCs (Ho et al., 2014); this can be explained by the development of self-regulated learning skills during undergraduate studies and beyond. The heterogeneous background and skills of learners also requires a deep analysis to get information about learners' self-regulated learning strategies, with the aim to complement MOOCs with activities that allow for a more personalized monitoring of learners, helping them to better organize their time and providing hints for scaffolding self-regulated learning (Gutiérrez-Rojas, Alario-Hoyos, Pérez-Sanagustín, Leony, & Delgado Kloos, 2014).

The objective of this paper is to provide insights into the motivation and learning strategies that characterize MOOC learners. These insights come from an empirical study conducted in a MOOC

titled *Introduction to Programming with Java*, deployed in the edX platform. This MOOC is selected because it had a big impact, attracted a wide range of learners' nationalities and backgrounds, and was delivered in both synchronous and self-paced modes. The empirical study is supported by the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, García, & McKeachie, 1991; Pintrich, Smith, García, & McKeachie, 1993), which is a widely used self-report Likert-type questionnaire for analyzing motivation and learning strategies in educational settings (Colorado & Eberle, 2010; Morales Chan, Hernández Rizzardini, Barchino Plata, & Amelio Medina, 2015).

The remainder of this paper continues analyzing the related work. Then, the MOOC employed in the study is briefly presented, summarizing the demographics of the learners that participated in the study, and the data collection and analysis methods. Results from learners' answers are detailed and discussed afterwards. Finally, the paper finishes drawing the conclusions of the empirical study and indicating some of the future lines of work.

Related Work

Since the advent of MOOCs, it became clear that these courses exhibit a set of characteristics, mainly its openness and the possibility to reach potentially thousands of learners, which set them apart from more traditional courses. Although some media initially presented MOOCs as the panacea for the problems of Higher Education (Pappano, 2012), soon researchers and academia tempered this early excitement, understanding, at the same time, that traditional learning indicators, such as completion rates, had to be complemented with other metrics to measure the success and impact of MOOCs (Riel & Lawless, 2017).

According to systematic literature reviews (Liyanagunawardena, Adams, & Williams, 2013; Veletsianos & Shepherdson, 2016), many empirical studies related to MOOCs have tackled the task of characterizing these courses by studying participation patterns, participants' demographics and intentions, types of design, and use of learning analytics. The work by Gasevic, Kovanovic, Joksimovic, and Siemens (2014) analyzed 266 project proposals submitted to the MOOC Research Initiative (MRI) funded by the Gates Foundation, identifying motivation and self-regulated learning (Zimmerman, 2002) as two of the five main research themes for future research in MOOCs. Actually, different studies (DeBoer et al., 2013; Gasevic, Kovanovic, Joksimovic, and Siemens, 2014; Riel & Lawless, 2017; Terras & Ramsey, 2015; De Barba, Kennedy, & Ainley, 2016) agree on the necessity of more analysis of learners' motivation, self-regulated learning strategies, attitudes, and behavior, in order to gain insight and enable a more efficient learning and teaching MOOC experience. This section goes through the literature on motivation and self-regulated learning strategies in MOOCs and the instruments to measure them, from which we derive the main research questions of this work.

Motivation in MOOCs

Motivation plays a significant role in learners' self-regulated learning (Pintrich, 1999; Schunk & Zimmerman, 1998). Prior works on self-regulated learning make a distinction between intrinsic and extrinsic motivation. While extrinsic motivation is related with external values and demands (Deci, Vallerand, Pelletier, & Ryan, 1991), intrinsic motivation refers to doing an activity for the enjoyment and inherent satisfaction of performing a task (Ryan & Deci, 2000), this latter having more weight in

the learning achievements and attitudes of traditional learners (Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007).

Both intrinsic motivation, in the form of perceived enjoyment, and extrinsic motivation, as perceived usefulness or task value, have been found to play a role on learners' attitudes towards online courses (Lee, Cheung, & Chen, 2005). In MOOCs, where the population of learners is heterogeneous and people register with different intentions, motivation plays a key role on how learners will address the course (Kizilcec & Halawa, 2015; Hood, Littlejohn, & Milligan, 2015). However, in MOOCs, unlike in other types of online courses, learners' intrinsic motivation for the subject addressed is of higher importance, as the certification obtained after completion (extrinsic motivation) has typically a low recognition (Wang & Baker, 2015). Gamification and collaborative learning are some of the main strategies that are being explored in the literature to increase learners' intrinsic motivation in MOOCs (Gené, Núñez, & Blanco, 2014; Vaibhav & Gupta, 2014; Collazos, González, & García, 2014).

Self-Regulated Learning Strategies in MOOCs

Self-regulated learning is the ability of the learner to control and regulate his own learning through the usage of cognitive and metacognitive strategies (Zimmerman 2002). According to various researchers, self-regulation is something that is not fixed, but influenced as people learn, so it can be trained through learning strategies (Schunk, 2005). Based on this notion, Pintrich, Smith, García, & McKeachie (1993) identified three categories of strategies that students should employ to regulate their own learning: (1) cognitive strategies, which refer to activities that learners utilize in the acquisition, storage, and retrieval of information; (2) metacognitive strategies, which refer to activities utilized by learners for monitoring and reflecting on their learning process to accomplish a goal; and (3) resource management strategies, which refer to activities students use to manage their time, study environments, and the resources provided.

It is already established that effective learning depends on the nature and sequencing of self-regulated activities by the learner (Bannert & Reimann, 2012); and although self-regulation skills and learning strategies are needed for any educational context, they are more important in a technology-enhanced learning environment (Lin, Hmelo, Kinzer, & Secules, 1999). In MOOCs, where there is no guidance or support from an instructor, and the course is not structured around classes, learners' ability to self-regulate their own learning process is especially relevant (Hood et al., 2015; Cohen & Magen-Nagar, 2016).

Researchers studying self-regulation in MOOCs have pointed out that self-regulated learning strategies, such as metacognitive strategies and time management, are among the most critical ones for learners. Time management is a specific, self-regulated learning skill that includes scheduling, planning, and managing the personal study time. Studies reveal that poor time management is one of the main reasons for withdrawing from MOOC, along with the lack of attractiveness and suitability of the course for each learner (Nawrot & Doucet 2014; Kizilcec & Halawa, 2015; Zheng, Rosson, Shih, & Carroll, 2015). Furthermore, in a recent article by Kizilcec, Pérez-Sanagustín, and Maldonado (2016) in which the authors interviewed 17 learners who successfully completed a MOOC, time management strategies, such as reserving time in the week for studying, were identified as some of the most effective self-regulation learning strategies.

Measuring Motivation and Self-regulated Learning Strategies

One of the most well-known instruments to assess both learners' motivation and self-regulated learning strategies is the Motivated Strategies for Learning Questionnaire (MSLQ), which was proposed by Pintrich et al. (1993). The MSLQ is a self-report instrument designed to measure learners' motivation and self-regulated learning in classroom contexts. Although this instrument has been mainly applied in traditional learning settings, some studies have used it to understand the motivation and learning strategies of MOOC learners. For example, Magen-Nagar & Cohen (2016) conducted an experiment in Israel with 164 high school students taking two different MOOCs. Their study concludes that learners with higher motivation use better learning strategies, and this leads to a higher sense of achievement. Morales Chan et al. (2015), used the MSQL to study the motivational and cognitive learning strategies of learners from a MOOC on Cloud-based Tools for Learning developed by Galileo University in Guatemala. However, their sample only included 230 students with most of them from the same country (Guatemala).

Recently, some researchers proposed adaptations of the MSLQ to be applied in MOOCs. One example is the instrument designed by Hood, Littlejohn, & Milligan (2015). This instrument was a slightly modified version of an instrument by Fontana, Milligan, Littlejohn, and Margaryan (2015) for assessing self-regulated learning in adult learners in the workplace, which integrated items from the MSLQ together with other learning strategies. They ran the instrument with 788 learners from 79 countries enrolled in an introductory data science course. The study concludes that the learner's context and role have a positive impact in their attitude towards a MOOC and that those learners with prior knowledge in the field obtained better scores. Based on the instrument by Hood et al. (2015), and Barnard, Paton, and Lan (2008), Kizilcec, Pérez-Sanagustín, and Maldonado (2017) proposed another questionnaire to measure self-regulated learning skills in MOOC learners. The questionnaire was used with 4831 learners in six different MOOCs. Results showed that goal setting and strategic planning are better predictors for attainment of personal course goals. Finally, a recent study by Jansen, Van Leeuwen, Janssen, Kester, and Kalz (2016) proposed another questionnaire for measuring self-regulated learning in MOOCs. In this case, they took as a reference a combination of questionnaires defined in the literature of self-regulated learning and adapted them to the MOOC content. In this work, they extended the MSLQ to include more questions related with the preparatory and appraisal phases of the self-regulated learning process, according to other theoretical models in the literature (Puustinen & Pulkkinen, 2001); however, this latter questionnaire suppressed some of the questions related with the model by Pintrich, Smith, García, & McKeachie (1991) and Pintrich et al. (1993), which is the model that will be taken as a basis for this work.

Research Questions

The current literature demands a deeper investigation on the characterization of MOOC learners regarding motivation and self-regulated learning strategies. Thus, we pose the following two research questions:

- RQ1: What are the motivations that characterize MOOC learners?
- RQ2: What are the self-regulated learning strategies that characterize MOOC learners?

Concerning RQ1, most works in the literature have studied learners' intentions when enrolling MOOCs (Kizilcec & Halawa, 2015; Hood et al., 2015), detecting that learners' intentions had a strong relationship with their motivation. However, there are very few large-scale studies of the motivation

that characterizes MOOC learners, and of the studies that can be found in the literature, there is a focus on learners from specific regions or homogeneous sociocultural characteristics (Magen-Nagar & Cohen, 2016; Morales Chan et al., 2015; Kizilcec, Pérez-Sanagustín, and Maldonado, 2017).

Concerning RQ2, the information on current studies about self-regulated learning strategies, which are more effective for learners to succeed in MOOCs, is scarce. On the one hand, existing studies focus on different aspects of self-regulation, providing only a small picture of what self-regulated learning strategies MOOC learners use (Nawrot & Doucet 2014; Kizilcec, Pérez-Sanagustín, and Maldonado, 2016). On the other hand, most existing studies collect information only from MOOCs that attract a quite homogeneous set of learners from a sociocultural perspective (Magen-Nagar & Cohen, 2016; Morales Chan et al., 2015; Kizilcec et al., 2017).

All in all, there is need for more empirical studies on learners' motivation and self-regulated learning strategies in MOOCs with the aim to extend the data spectrum and contribute to the design and development of more engaging and effective courses.

Materials and Methods

Background of the Course

The empirical research presented here is supported by data obtained from a MOOC titled *Introduction to Programming with Java*, which was deployed in the edX platform. This MOOC included video-based lectures and numerous interactive activities (Alario-Hoyos et al., 2016); all the materials generated for this course were offered as OER under a Creative Common license (CC-BY-NC-SA). This MOOC ran twice during two consecutive editions (runs) of the MOOC in the years 2015 and 2016. The first run followed a synchronous approach, and materials were released weekly; the second run followed a self-paced approach, and all the materials were available from the beginning. Table 1 presents an overview of the general information of the MOOC. This general information was available for learners before enrolling the MOOC. In total, 228,979 learners enrolled in the two runs of the MOOC.

Table 1

General Information on MOOC Titled Introduction to Programming with Java

Title	IT.1.1x Introduction to Programming with Java - Part 1: Starting to Program in Java (1st run) IT.1.1x Introduction to Programming with Java - Part 1: Starting to Code with Java (2nd run)
Platform	edX
Dates	April, 28, 2015 – June 30, 2015 (1st run – synchronous) November 17, 2015 – June 30, 2016 (2nd run – self-paced)
Length	5 weeks
Estimated workload	5-7 hours per week (1st run) 7-10 hours per week (2nd run, adjusted based on learners' feedback)
Area	Computer science
Institution	Universidad Carlos III de Madrid (UC3M), Spain
Level	Introductory
Language	English

Video Transcripts	English, Spanish, Portuguese, Mandarin
Prerequisites	None
Number of teachers	8
Assessment type	Quizzes and peer review (1st edition) Quizzes (2nd edition)

Data Collection Methods

Data for the analysis of learners' motivations and learning strategies was collected using a self-report, voluntary, and anonymous questionnaire filled in by learners of this MOOC during the two consecutive runs in 2015 and 2016. Learners could complete the questionnaire at any time, as long as the course in which they were enrolled was active.

The questionnaire was a 7-point Likert scale questionnaire from 1 (lowest) to 7 (highest), based on MSLQ (Pintrich et al., 1991; Pintrich et al., 1993) with two parts: a first part with a set of assertions to be assessed in relation with learners' motivation to participate in the MOOC, and their preferences on materials and assignments; and a second part with a set of assertions to be assessed in relation with learners' self-regulation learning strategies. The questionnaire was designed containing a subset of categories from MSLQ, with a total of 30 assertions to be assessed (see Table 3). There were several categories could not be directly applied to MOOCs, in general, and of this MOOC in particular, and so these categories were not included in the questionnaire. Reasons for not including categories from MSLQ were: the category refers to physical situations that typically take place in a classroom, and the assertions cannot be easily adapted to online learning (e.g., category named *Help Seeking*); the category assumes that taking this course is mandatory, while enrolling in a MOOC is a voluntary choice (e.g., category named *Effort Regulation*); the category assumes that the learner takes a final exam, while this MOOC follows a continuous evaluation system (e.g., category named *Test Anxiety*); the category relies on memorization as the base of learning, while this MOOC relies on practicing and interaction (e.g., category named *Rehearsal*). Once the categories were selected, some of their assertions required minor adjustments to make sense in the particular educational setting of a MOOC context. The complete list of assertions is presented in the next section. Overall, 18 questions out of the 31 on motivation, and 12 questions out of the 50 on learning strategies were included in the questionnaire.

Table 2

Categories of MSLQ Included in the Questionnaire

Motivation	Value Component: Intrinsic Goal Orientation (IGO) (4 assertions)
	Value Component: Task Value (TV) (6 assertions)
	Expectancy Component: Self-Efficacy for Learning and Performance (SELP) (8 assertions)
Learning Strategies	Cognitive and metacognitive strategies: Critical Thinking (CT) (5 assertions)
	Resource management strategies: Time and Study Environment (TSE) (7 assertions)

Sample Size and Demographics

Of the 228,979 learners who enrolled in this MOOC, 6335 (2.8%) volunteered to complete the questionnaire about motivation and learning strategies. Table 3 shows the (self-reported) demographics for the participants in the study. It is interesting to note that 160 countries are represented in the sample and that there is certain heterogeneity in the age, level of education, and previous background in the field of the learners that participated in the study.

Table 3

Sample Size and Self-Reported Demographics of Participants in the Study

Total number of enrollees	228,979: 93,556 (1st run), 135,423 (2nd run)
Sample size	**6335 (2.8% of enrollees)**
Gender	• Male: 4915 (77.6%) • Female: 1399 (22.1%) • Other: 21 (0.3%)
Age	• < 18: 423 (6.68%) • 18 - 24: 2142 (33.81%) • 25 - 29: 1229 (19.40%) • 30 - 34: 835 (13.18%) • 35 - 39: 557 (8.79%) • 40 - 44: 364 (5.75%) • 45 - 49: 270 (4.26%) • > 50: 515 (8.13%)
Highest level of education achieved	• Doctorate: 131 (2.07%) • Master's or Professional Degree: 1376 (21.72%) • Bachelor's Degree: 2353 (37.14%) • Associate's Degree: 390 (6.16%) • Secondary/High School: 1676 (26.46%) • Junior secondary / junior high / middle school: 255 (4.03%) • Elementary / primary school: 36 (0.57%) • None: 13 (0.21%) • Other: 105 (1.66%)
Number of countries represented	160 countries • Asia: 1856 learners (29.3%), 43 countries. ✓ Top three: India (1199), Philippines (92), Pakistan (81) • Europe: 1593 learners (25.15%), 44 countries. ✓ Top three: Spain (302), United Kingdom (140), Ukraine (121) • North America: 1517 learners (23.95%), 3 countries. ✓ Top three: USA (1075), Mexico (303), Canada (139) • South America: 696 learners (10.99%), 12 countries. ✓ Top three: Brazil (244), Colombia (142), Venezuela (80) • Africa: 428 learners (6.76%), 37 countries. ✓ Top three: Nigeria (109), Egypt (69), South Africa (51) • Central America and the Caribbean: 170 learners (2.68%), 17 countries. ✓ Top three: Dominican Republic (38), Costa Rica (26), Guatemala (25) • Oceania: 75 learners (1.28%), 4 countries. ✓ Top three: Australia (59), New Zealand (12), Fiji (3)
Working in a job or business	• Yes: 3376 (53.29%) • No: 2956 (46.71%)
Teaching experience	• Yes: 1487 (23.47%) [in computer science 654 (10.32%)] • No: 4848 (76.53%)

Previous computing or statistical experience	• Yes: 4408 (69.58%) • No: 1927 (30.42%)

Data Analysis Methods

The data collected from the questionnaire have a quantitative nature taking discrete integer values with 1 as the minimum value and 7 as the maximum value. Descriptive statistics are used to analyze these data in order to better understand motivation and learning strategies through this sample of MOOC learners. More specifically, the central tendency of these data is evaluated through the mean value (M), and the variability through the standard deviation (Std.).

Results

The results are divided into two blocks: motivation and learning strategies. In total, 6335 learners volunteered to complete the questionnaire, which had two phases. In the first phase learners had to assess assertions related to motivation. In the second phase learners had to assess assertions related to learning strategies.

Motivation

Learners assessed 18 MSLQ assertions about their motivation to participate in the MOOC and their preferences on materials and assignments (Table 4). These assertions are grouped in three categories: IGO (Intrinsic Goal Orientation), TV (Task Value), and SELP (Self-Efficacy for Learning and Performance). Each assertion received exactly 6335 answers.

The four assertions on IGO obtained high rates from learners, who pointed out their preference for challenging materials (M = 5.65, Std. = 1.33) that trigger curiosity (M = 5.84, Std. = 1.25). Interestingly, learners also reported their wish to delve into the contents (M = 6.04, Std. = 1.16), and to complete all the course assignments even if that did not mean getting good grades (M = 5.92, Std. = 1.24).

The six assertions on TV obtained very high rates from learners, showing that this particular course arouse great interest among them. Both the subject of this MOOC (programming with Java) and the area of knowledge (computer science) represent a great source of motivation for learners (M = 6.08, Std. = 1.13, and M = 6.07, Std. = 1.13, respectively). The potential usefulness of the materials to be studied is also well assessed (M = 6.18, Std. = 1.09), considering learners of importance the proper learning (M = 5.94, Std. = 1.27) and understanding (M = 6.09, Std. = 1.17) of these materials, as well as their potential application in the future (M = 5.94; Std. = 1.23).

The eight assertions on SELP also obtained high rates from learners, which generally rely on their ability to learn, not only basic concepts (M = 6.22, Std. = 1.11), but also the most complex (M = 5.45, Std. = 1.40) and difficult materials (M = 5.28, Std. = 1.45) of the MOOC. Learners' self-esteem leads them to believe that they will do well in the course (M = 5.77, Std. = 1.23), master the skills that will be taught (M = 5.77, Std. = 1.28), do an excellent job in exams and assignments (M = 5.58, Std. = 1.31), and get an excellent grade at the end of the MOOC (M = 5.47, Std. = 1.37).

Table 3

Learners' Self-Reported Answers to Assertions on Motivation

Type	Assertion	1	2	3	4	5	6	7	Mean	Std.
IGO	In a course like this, I prefer course material that really challenges me so I can learn new things.	92 (1.5%)	98 (1.5%)	212 (3.3%)	705 (11.1%)	1369 (21.6%)	1785 (28.2%)	2074 (32.7%)	***5.65***	***1.33***
	In a course like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	52 (0.8%)	82 (1.3%)	165 (2.6%)	576 (9.1%)	1208 (19.1%)	1844 (29.1%)	2408 (38%)	***5.84***	***1.25***
	The most satisfying thing for me in this course will be trying to understand the content as thoroughly as possible.	48 (0.8%)	49 (0.8%)	117 (1.8%)	410 (6.5%)	969 (15.3%)	1902 (30%)	2840 (44.8%)	***6.04***	***1.16***
	When I have the opportunity in this kind of courses, I try to do all the exercises and course assignments that I can learn from even if they don't guarantee a good grade.	60 (0.9%)	88 (1.4%)	126 (2%)	516 (8.1%)	1037 (16.4%)	1936 (30.6%)	2572 (40.6%)	***5.92***	***1.24***
TV	I think I will be able to use what I will learn in this course in other courses.	67 (1.1%)	61 (1%)	148 (2.3%)	472 (7.5%)	1030 (16.3%)	1922 (30.3%)	2635 (41.6%)	***5.94***	***1.23***
	It is important for me to learn the material in this course.	69 (1.1%)	76 (1.2%)	164 (2.6%)	526 (8.3%)	980 (15.5%)	1739 (27.5%)	2781 (43.9%)	***5.94***	***1.27***
	I am very interested in the content area of this course.	53 (0.8%)	20 (0.3%)	100 (1.6%)	420 (6.6%)	958 (15.1%)	1895 (29.9%)	2889 (45.6%)	***6.07***	***1.13***
	I think the course material in this course will be useful for me to learn.	49 (0.8%)	39 (0.6%)	74 (1.2%)	320 (5.1%)	784 (12.4%)	1899 (30%)	3170 (50%)	***6.18***	***1.09***
	I like the subject matter of this course.	49 (0.8%)	40 (0.6%)	73 (1.2%)	445 (7%)	881 (13.9%)	1953 (30.8%)	2894 (45.7%)	***6.08***	***1.13***
	Understanding the subject matter of this course is very important to me.	57 (0.9%)	53 (0.8%)	107 (1.7%)	405 (6.4%)	842 (13.3%)	1815 (28.7%)	3056 (48.2%)	***6.09***	***1.17***
SELP	I believe I will receive an excellent grade in this course.	94 (1.5%)	123 (1.9%)	300 (4.7%)	916 (14.5%)	1382 (21.8%)	1820 (28.7%)	1700 (26.8%)	***5.47***	***1.37***
	I am certain I can understand the most difficult material presented in this course.	112 (1.8%)	206 (3.3%)	421 (6.6%)	947 (14.9%)	1496 (23.6%)	1680 (26.5%)	1473 (23.3%)	***5.28***	***1.45***
	I am confident I can learn the basic concepts taught in this course.	53 (0.8%)	36 (0.6%)	87 (1.4%)	343 (5.4%)	673 (10.6%)	1694 (26.7%)	3449 (54.4%)	***6.22***	***1.11***
	I am confident I can understand the most complex materials that will be presented by the instructor in this course.	91 (1.4%)	167 (2.6%)	346 (5.5%)	785 (12.4%)	1410 (22.3%)	1853 (29.3%)	1683 (26.6%)	***5.45***	***1.40***
	I am confident I can do an excellent job on the assignments and tests in this course.	63 (1%)	115 (1.8%)	233 (3.7%)	808 (12.8%)	1390 (21.9%)	1932 (30.5%)	1794 (28.3%)	***5.58***	***1.31***
	I expect to do well in this class.	60 (0.9%)	79 (1.2%)	175 (2.8%)	624 (9.9%)	1113 (17.6%)	1957 (30.9%)	2327 (36.7%)	***5.81***	***1.26***
	I am certain I can master the skills that will be taught in this course.	65 (1%)	87 (1.4%)	190 (3%)	634 (10%)	1189 (18.8%)	1940 (30.6%)	2230 (35.2%)	***5.77***	***1.28***
	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this course.	60 (0.9%)	66 (1%)	157 (2.5%)	644 (10.2%)	1223 (19.3%)	2077 (32.8%)	2108 (33.3%)	***5.77***	***1.23***

Learning Strategies

Learners assessed 12 MSLQ assertions about their usual learning strategies (Table 5), which gives hints about their strengths and weaknesses when facing MOOCs regarding organizational aspects. These assertions are grouped in two categories: CT (Critical Thinking), and TSE (Time and Study Environment). This second set of assertions was optional for those learners who completed the first

set of assertions; each assertion of this second set received a maximum of 5956 answers and a minimum of 5875 answers.

The five assertions on CT obtained moderately high rates from learners, showing that they are able to question themselves about the concepts explained in the course (M = 5.08, Std. = 1.50), look for supporting evidences (M = 5.20, Std. = 1.39), and alternative explanations (M = 5.11; Std. = 1.37). Learners also try to develop their own vision of what is explained in the course (M = 5.35, Std. = 1.37), and connect the learned concepts with previous knowledge (M = 5.31, Std. = 1.38).

The two TSE assertions related to study environment received moderately high rates from learners, while the five TSE assertions related to time management show that there is margin of improvement. Regarding the study environment, it normally allows focusing in the course work (M = 5.70, Std. = 1.37), although it is not always a dedicated study space (M = 4.72, Std. 1.83). Regarding time management, learners consider they make a reasonable use of their study time (M = 4.93, Std. = 1.46), although present some difficulties to stick to the schedule (M = 4.31; Std. = 1.79), have occasional distractions (M = 4.19, Std. = 1.72), and sometimes cannot find enough time to prepare for examinations (M = 3.58, Std. = 1.78). Still, they are motivated to try to keep pace in the MOOC (M = 5.70, Std. = 1.37).

Table 4

Learners' Self-Reported Answers to Assertions on Learning Strategies

Type	Assertion	1	2	3	4	5	6	7	***Mean***	***Std.***	N/A
CT	I often find myself questioning things I hear or read in course that I am taking to decide if I find them convincing	145 (2.5%)	256 (4.3%)	450 (7.6%)	1024 (17.3%)	1415 (23.9%)	1534 (25.9%)	1091 (18.4%)	***5.08***	***1.50***	420
	When a theory, interpretation, or conclusion is presented in a course, I try to decide if there is good supporting evidence.	81 (1.4%)	189 (3.2%)	405 (6.8%)	978 (16.5%)	1556 (26.3%)	1584 (26.8%)	1127 (19%)	***5.20***	***1.39***	415
	When I study, I treat the course material as a starting point and try to develop my own ideas about it.	64 (1.1%)	144 (2.4%)	387 (6.5%)	853 (14.4%)	1443 (24.4%)	1648 (27.8%)	1383 (23.4%)	***5.35***	***1.37***	413
	I try to play around with ideas of my own related to what I am learning.	80 (1.4%)	142 (2.4%)	361 (6.1%)	936 (15.9%)	1475 (25%)	1568 (26.6%)	1336 (22.7%)	***5.31***	***1.38***	437
	Whenever I read or hear an assertion or conclusion in a course, I think about possible alternatives.	69 (1.2%)	186 (3.2%)	464 (7.9%)	1066 (18.1%)	1635 (27.7%)	1481 (25.1%)	991 (16.8%)	***5.11***	***1.37***	443
TSE	I usually study in a place where I can concentrate on my course work.	79 (1.3%)	115 (1.9%)	236 (4%)	597 (10%)	1224 (20.6%)	1501 (25.2%)	2204 (37%)	***5.70***	***1.37***	379
	I make good use of my study time.	96 (1.6%)	282 (4.8%)	586 (9.9%)	1178 (19.9%)	1546 (26.1%)	1312 (22.2%)	920 (15.5%)	***4.93***	***1.46***	415
	I find it hard to stick to a study schedule	406 (6.9%)	765 (12.9%)	809 (13.7%)	1055 (17.8%)	1129 (19.1%)	964 (16.3%)	783 (13.2%)	***4.31***	***1.79***	424
	I have a regular place set aside for studying.	362 (6.2%)	528 (9%)	683 (11.6%)	865 (14.7%)	1039 (17.7%)	1184 (20.2%)	1214 (20.7%)	***4.72***	***1.83***	460

	I will make sure that I keep up with the weekly videos and assignments for this course.	75 (1.3%)	164 (2.8%)	390 (6.6%)	928 (15.7%)	1384 (23.4%)	1625 (27.5%)	1347 (22.8%)	***5.31***	***1.40***	422
	I often find that I don't spend very much time on online course that I've taken because of other activities.	422 (7.2%)	768 (13%)	815 (13.8%)	1228 (20.8%)	1165 (19.8%)	939 (15.9%)	557 (9.5%)	***4.19***	***1.72***	441
	I rarely find time to review my notes before an exam.	813 (13.8%)	1157 (19.6%)	990 (16.8%)	1054 (17.9%)	883 (15%)	627 (10.6%)	378 (6.4%)	***3.58***	***1.78***	433

Discussion

This study provides a quantitative account to advance on the understanding of motivation and self-regulated learning strategies in MOOCs. Results are based on a large sample of 6335 MOOC learners with heterogeneous backgrounds and origins (160 countries). This analysis thus provides a broader scope with respect to the works by Morales Chan et al. (2015), and Kizilcec et al. (2017), in which an MSLQ-based questionnaire was applied to 230 learners enrolled in a MOOC on cloud-based tools for learning (in the first work), and to 4831 learners across six MOOCs in Spanish-speaking language (in the second work).

Implications

Results presented here allow us to answer the two research questions (RQ1 and RQ2) and have implications in understanding learners' motivation and learning strategies in MOOCs, and other similar learning environments. Concerning RQ1 ("What are the motivations that characterize MOOC learners?"), results on IGO show the changing trend in learners' preferences, going from being more interested in passing courses and getting certificates in residential education, to acquiring new knowledge through online learning (Rovai, Ponton, Wighting, & Baker, 2007); this finding may partially explain the low completion rates in MOOCs. A lesson that can be learned is the need for designing MOOCs that are rich in exercises and assignments (even if these do not count for the final grade), so that learners can practice and better understand the contents of the course. In addition, results on TV partially explain the high figures of enrolled learners in the MOOC used in this study. It is noteworthy that MOOCs in the computer science field are among the most demanded ones (Ho et al., 2015), mainly because the obtained skills present a high demand in the current labor market (LinkedIn, 2016). A lesson that can be learned is the importance of offering courses in subjects and areas that awaken interest from learners, so that they at least come to the course with a high motivation level. Finally, results on SELP show a high level of confidence of learners, which can be partially explained by the lack of prerequisites for enrolment of this MOOC and by the fact 69.58% of learners already had some previous computing or statistical experience (see Table 2). A lesson that can be learned is the need for taking advantage of learners' initial high self-esteem level, and design MOOCs that, if tagged as introductory, really lack prerequisites. This can help to meet learners' expectations regarding the difficulty level of lectures, assignments, and exams.

Concerning RQ2 ("What are the self-regulated learning strategies that characterize MOOC learners?"), results on CT show a moderately high maturity of MOOC enrollees, who may be used to analyze, accept, and refute information from different sources in the Web, and to reach their own understanding and conclusions on the topics they want to learn. A lesson that can be learned is the need for equipping MOOC learners with the proper tools so that learners can build their own

knowledge upon them. Fostering debate among the community of learners in the social tools around the MOOC seems to be also a good approach to confront different arguments and viewpoints. In addition, results on TSE show that not all the learners have properly developed the time management skills that are needed to keep pace in MOOCs. A lesson that can be learned is the need for providing balanced weekly contents so that learners can follow a routine, as well as clarifying from the very beginning the estimated weekly workload and the individual workload of each assignment

In order to advance on generalizing the answers to these two research questions, the results obtained in this work can be compared with those from similar studies. Comparing these results with those from the work by Morales Chan et al. (2015), whose supporting MOOC combines the computer science and education fields, it is possible to confirm that aggregated average scores are similar with respect to assertions on IGO. However, the study presented here has obtained slightly lower aggregated average scores in the cases of assertions related to TV and SELP, and slightly higher aggregated average scores in the cases of assertions related to CT and TSE. It is noteworthy that in the study by Morales Chan et al. (2015) the questionnaire was sent to learners in the second week of the MOOC and was available for only a week; therefore, all the learners already had an initial overview of the course materials and assignments, and their difficulty level before answering the questionnaire. In the study presented here, however, the questionnaire was included in an introductory week, although learners could complete the questionnaire at any time, as long as the course was still available. Learners following the course sequentially (which represent a significant number of learners) filled in the questionnaire before inspecting course materials and assignments. For completeness, it is important to point out that learners positively evaluated the materials of the MOOC in a survey conducted at the end of the course (Alario-Hoyos et al., 2016).

Limitations

This study has three main limitations that condition the generalization of the results and conclusions. The first limitation refers to external validity. This study is based on a MOOC on computer science, delivered in English, and where most of the learners are males, already have a Higher Education diploma, and some experience in computing or statistics. Still, this course combines learners enrolled in synchronous and self-paced modes, and from a wide range of countries (160). The latter advances on previous studies focused on a particular region, such as those by Morales Chan et al. (2015) or Kizilcec et al. (2017), which were focused on learners mainly from Spanish-speaking countries. This heterogeneity in learners' origins is of relevance, as social-cultural differences have an impact on learners' engagement in online courses (Guo & Reinecke, 2014). The fact that the MOOC studied here is in the area of computer science can be indeed a factor that leads to an increase in the overall motivation of the learners, as this area has a great demand (Ho et al., 2015) due to the skills acquired promote employability (extrinsic motivation).

The second limitation refers to data reliability. The data obtained from this study could not be extracted directly from users' action in the MOOC. Instead we used a self-report questionnaire, which was completed by the learners themselves. Even though a large sample of learners filled in this questionnaire (6335), only 2.8% of those enrolled in the MOOC actually completed the questionnaire. Typically, the most motivated learners (intrinsic motivation) are the ones who take voluntary activities; this is reflected in the questionnaire with the answers to assertion "When I have the opportunity in this kind of courses, I try to do all the exercises and course assignments that I can learn from even if they don't guarantee a good grade" ($M = 5.92$, Std. = 1.24).

The third limitation refers to construct validity. The questionnaire used in this study contains a subset of MSLQ, which is a well-known and validated instrument (Pintrich et al., 1991; Pintrich, et al., 1993). MSLQ, although generally accepted, has been also criticized as it was designed in western homogeneous settings (Hamid & Singaram, 2016). The questionnaire used in this study is focused on five categories (three regarding motivation, and two regarding learning strategies) that are relevant in the MOOC context. The selection of the subset of MSLQ is a trade-off between using a complete instrument with many items that do not fit in the educational context and creating an entirely new instrument ad hoc. In addition, asking volunteer learners to complete the entire MSLQ questionnaire demands a high workload, so there is also a trade-off regarding completeness and the number of responses that can be obtained in the study (Kizilcec et al., 2017).

Conclusions and Future Work

MOOCs typically consist of OER bundled following sequences of video-based lectures and assignments distributed in a weekly format. In MOOCs, learners' interaction occurs with OER, which are deployed in a MOOC platform, and with other learners, through the course forum and other social tools. The global impact of MOOCs brings together learners with many different profiles and motivations. In addition, the format of these courses, without supervised tutoring, demands new self-learning skills on learners. In order to shed some light on the motivations and learning strategies of MOOC learners, this paper conducted an empirical analysis with 6335 learners from a MOOC titled *Introduction to Programming with Java*. The empirical study is supported by the MSLQ Likert-type questionnaire. Self-reported answers from learners about their motivation show high values on Intrinsic Goal Orientation and Self-Efficacy for Learning and Performance, and very high values on Task Value. Self-reported answers from learners about their learning strategies show moderately high values on Critical Thinking Skills and Time and Study Environment, although time management is an aspect that learners need to improve. MOOCs shall therefore be designed to facilitate time management to learners. Early precise estimations of the weekly workload and of the individual workload of each assignment, detailed specifications of mandatory and optional tasks, and analyses of average times devoted by learners based on their previous backgrounds, can help to better manage time among MOOC learners.

Future lines of work must address the three main limitations of this study. First, regarding external validity, similar analyses with large populations of MOOC learners shall be conducted in other areas, particularly in natural sciences and social sciences. Moreover, learners' motivation may be very different when taking MOOCs aimed at promoting professional development as compared to MOOCs aimed at satisfying curiosities or improving general culture. Likewise, similar analyses on learners' motivation and learning strategies can be conducted in advanced courses, as the MOOC used in this study was an introductory course. Advanced courses typically have prerequisites, which entail a first filtering for enrollees. In some cases, advanced courses are part of sequences of related MOOCs, and so, enrollees may have previous experiences with similar MOOCs, which may affect both their perception of their motivation and learning strategy. The way the course is designed can also lead to interesting results; for example, Cohen and Magen-Nagar (2016) suggest that project-based learning subjects have a significant positive impact on motivational orientations and learning strategies. Second, regarding data reliability, future work shall analyze the relationship between learners' answers to the questionnaire and their actual performance in the course, including variables such as

grades in the different assignments, and whether the learners completed the MOOC or not. This analysis was not carried out in this study because the questionnaire filled in by learners was anonymous and the answers could not be matched with learners' performance throughout the course. And third, regarding construct validity, deeper analysis can be done combining other instruments from the literature, such as those by Barnard et al. (2008) or Jansen et al. (2016), to gain further insights on learners' motivation and self-regulated learning strategies.

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