Mauro Calise
Carlos Delgado Kloos
Justin Reich
Jose A. Ruiperez-Valiente
Martin Wirsing (Eds.)

LNCS 11475

Digital Education

At the MOOC Crossroads Where the Interests of Academia and Business Converge

6th European MOOCs Stakeholders Summit, EMOOCs 2019
Naples, Italy, May 20–22, 2019
Proceedings

Springer

Lecture Notes in Computer Science 11475

More information about this series at http://www.springer.com/series/7409

Mauro Calise · Carlos Delgado Kloos ·
Justin Reich · Jose A. Ruiperez-Valiente ·
Martin Wirsing (Eds.)

Digital Education

At the MOOC Crossroads Where the Interests of Academia and Business Converge

6th European MOOCs Stakeholders Summit, EMOOCs 2019
Naples, Italy, May 20–22, 2019
Proceedings

Springer

Editors
Mauro Calise
University of Naples Federico II
Napoli, Italy

Carlos Delgado Kloos
University Carlos III de Madrid
Madrid, Spain

Justin Reich
Massachusetts Institute of Technology
Cambridge, MA, USA

Jose A. Ruiperez-Valiente
Massachusetts Institute of Technology
Cambridge, MA, USA

Martin Wirsing
Ludwig Maximilian University of Munich
Munich, Germany

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-030-19874-9 ISBN 978-3-030-19875-6 (eBook)
https://doi.org/10.1007/978-3-030-19875-6

LNCS Sublibrary: SL3 – Information Systems and Applications, incl. Internet/Web, and HCI

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The landscape of higher education (HE) is changing. As the information economy progresses, demand for a more highly, and differently, qualified workforce and citizens increases, and HE Institutions face the challenge of training, reskilling, and upskilling people throughout their lives, rather than providing a one-time in-depth education. The corporate and NGO sectors are themselves exploring the benefits of a more qualified online approach to training, and are entering the education market in collaboration with HE Institutions, but also autonomously or via new certifying agencies. Technology is the other significant player. It allows for new, data-based ways of measuring learning outcomes, new forms of curriculum compilation, and alternative forms of recruitment strategy via people analytics.

MOOCs are the crossroads where the three converge. We ask ourselves whether university degrees are still the major currency in the job market, or whether a broader portfolio of qualifications and micro-credentials may be emerging as an alternative. What implications does this have for educational practice? What policy decisions are required? As online access eliminates geographical barriers to learning, the growing MOOC market is increasingly dominated by the big American platforms. What strategic policy—if any—do European HE Institutions wish to adopt in terms of branding, language, and culture?

The EMOOCs 2019 conference, the 6th in the series of European MOOCs Stakeholders Meetings, was held in Naples, Italy, and hosted by the Federica Weblearning Centre at the University of Naples Federico II, during May 20–22, 2019.

It was planned as a dynamic and interactive meeting between MOOC stakeholders—decision makers from universities, corporations and non-profit organisations—to discuss policy, share knowledge, and carry forward the debate around MOOCs, as with previous editions of the EMOOCs conference. It follows on from the initial closed conference at EPFL in Lausanne (Switzerland) in 2013. A second open conference was also held in Lausanne in 2014. In 2015, the Université Catholique de Louvain hosted the event in Mons (Belgium) and in 2016 it was the turn of Universitat Graz in Graz (Austria). The standing of the debate around open and multimedia learning was confirmed at EMOOCs 2017, when a large and enthusiastic audience attended the event at the Campus of Universidad Carlos III de Madrid. This year, as always, previous hosts of EMOOCs conferences are heavily involved in the organization of the academic program.

Altogether approximately 120 contributions were submitted as a result of the different calls for papers for this 6th EMOOCs meeting. Of these, 42 were considered for inclusion in this volume and, as a result of the review process, 15 submissions were accepted for presentation at the conference and publication as full papers, eight in the Research Track and seven in the Experience Track. This made for an acceptance rate of 41%. Six additional papers were accepted at a later date and are presented here as short, work-in-progress papers (four for the Research Track and two for the Experience Track).

Many people have contributed to the success of this event. Special thanks go to the authors for their contributions, the Program Committee members for their reviews of the submissions, and especially to the Track Chairs in the Research and Experience Tracks for their fundamental role in creating the Track topics and panel sessions and in the overall organization of the conference.

May 2019 Mauro Calise

Organization

General Chair

Mauro Calise	Federica Weblearning Centre, University of Naples Federico II, Italy

Research Track Chairs

Carlos Delgado Kloos	Universidad Carlos III of Madrid, Spain
Martin Wirsing	Ludwig Maximilian University of Munich, Germany

Experience Track Chairs

Justin Reich	Massachusetts Institute of Technology, USA
José A. Ruipérez-Valiente	Massachusetts Institute of Technology, USA

Program Committee Members

Carlos Alario-Hoyos	Universidad Carlos III of Madrid, Spain
Giora Alexandron	Weizmann Institute of Science, Israel
Oriol Borrás Gené	Universidad Rey Juan Carlos, Spain
Christopher Brooks	University of Michigan, USA
Eric Bruillard	Paris Descartes University, France
Manuel Castro	UNED, Spain
Ruth Cobos	Universidad Autónoma de Madrid, Spain
Eamon Costello	Dublin City University, Ireland
Inge de Waard	The Open University, UK
Stavros Demetriadis	Aristotle University of Thessaloniki, Greece
Yves Deville	UCLouvain, Belgium
Pierre Dillenbourg	École Polytechnique Fédérale de Lausanne, Switzerland
M. Carmen Fernández-Panadero	Universidad Carlos III de Madrid, Spain
Armando Fox	UC Berkeley, USA
Dragan Gasevic	Monash University, Australia
Jeff Haywood	University of Edinburgh, UK
Rocael Hernández Rizzardini	Universidad Galileo, Guatemala
Davinia Hernandez-Leo	Universitat Pompeu Fabra, Spain
Garron Hillaire	Massachusetts Institute of Technology, USA
Isabel Hilliger	Pontificia Universidad Católica de Chile, Chile
Elizabeth Huttner-Loan	Massachusetts Institute of Technology, USA

M. Blanca Ibáñez-Espiga	Universidad Carlos III de Madrid, Spain
Yuma Inzolia	MiriadaX, Spain
Matt Jenner	Futurelearn, UK
Srecko Joksimovic	University of South Australia, Australia
Marco Kalz	Heidelberg University of Education, Germany
Ruth Kerr	University of Naples Federico II, Italy
Janine Kiers	TU Delft, The Netherlands
René Kizilcec	Cornell University, USA
Vitomir Kovanovic	University of South Australia, Australia
Josh Littenberg-Tobias	Massachusetts Institute of Technology, USA
Anja Lorenz	Lübeck University of Applied Sciences, Germany
Katherine Maillet	Télécom École de Management, France
Colin Milligan	Glasgow Caledonian University, UK
Pedro M. Moreno-Marcos	Universidad Carlos III de Madrid, Spain
Pedro J. Muñoz-Merino	Universidad Carlos III de Madrid, Spain
Alejandro Ortega Arranz	University of Valladolid, Spain
Abelardo Pardo	University of South, Australia
Mar Pérez-Sanagustín	Paul Sabatier University, France
Eva Ponce	Massachusetts Institute of Technology, USA
Ting-Chuen Pong	Hong Kong University of Science and Technology, SAR China
Gustavo Ramírez-Gónzalez	Universidad del Cauca, Colombia
Valentina Reda	University of Naples Federico II, Italy
Felix Seyfarth	Universität St. Gallen, Switzerland
Marcus Specht	TU Delft, The Netherlands
Orlando Trejo	Universidad Simón Bolivar, Venezuela
Tim van der Zee	Eindhoven University of Technology, The Netherlands
Armin Weinberger	Saarland University, Germany
Elle Yuan Wang	EdPlus Action Lab, USA

Contents

Research Track

Chrome Plug-in to Support SRL in MOOCs

María Elena Alonso-Mencía, Carlos Alario-Hoyos(✉),
and Carlos Delgado Kloos

Department of Telematics Engineering,
Universidad Carlos III de Madrid, Madrid, Spain
{maralons, calario, cdk}@it.uc3m.es

Abstract. Massive Open Online Courses (MOOCs) have gained popularity over the last years, offering a learning environment with new opportunities and challenges. These courses attract a heterogeneous set of participants who, due to the impossibility of personal tutorship in MOOCs, are required to create their own learning path and manage one's own learning to achieve their goals. In other words, they should be able to self-regulate their learning. Self-regulated learning (SRL) has been widely explored in settings such as face-to-face or blended learning environments. Nevertheless, research on SRL in MOOCs is still scarce, especially on supporting interventions. In this sense, this document presents MOOCnager, a Chrome plug-in to help learners improve their SRL skills. Specifically, this work focuses on 3 areas: goal setting, time management and selfevaluation. Each area is included in one of the 3 phases composing Zimmerman's SRL Cyclical Model. In this way, the plug-in aims to support enrolees' self-regulation throughout their complete learning process. Finally, MOOCnager was uploaded to the Chrome Web Store, in order to get a preliminary evaluation with real participants from 6 edX Java MOOCs designed by the Universidad Carlos III de Madrid (UC3M). Results were not conclusive as the use of the plug-in by the participants was very low. However, learners seem to prefer a seamless tool, integrated in the MOOC platform, which is able to assist them without any learner-tool interaction.

Keywords: Self-regulated learning · Massive Open Online Course · Plug-in · MOOCnager · Tool

1 Introduction

A MOOC (Massive Open Online Course) can be defined as "an online course with the option of free and open registration, a publicly shared curriculum, and open-ended outcomes" [1]. These courses offer new opportunities to learn in a timeless and demographically unrestricted way. Their impact on higher education has been envisioned [2], reaching figures of more than 101 million enrolees up to 2018 [3].

Despite this remarkable success, one of the main problems of these courses is the funnel of participation [4] with a typical completion rate ranging between 5 and 10% [5]. MOOC instructors deal with a heterogeneous environment with many enrolees that differ in motivation, background and previous knowledge. Moreover, the high number of participants does not allow for personalised attention from the instructors.

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 3–12, 2019.
https://doi.org/10.1007/978-3-030-19875-6_1

Consequently, one important difficulty is that this new educational model requires learners to be autonomous due to the lack of personal mentorship. Participants are free to choose their own learning path, with little or no help to complete it successfully [6]. Thus, they need to self-regulate their learning to achieve their goals.

Nevertheless, directing one's own learning process is complex, and many enrolees do not have the adequate self-regulated learning (SRL) skills. In addition, current MOOC platforms do not have enough mechanisms to support self-regulation [7]. Therefore, it seems essential to find complementary instruments which can assist MOOC learners and improve their SRL skills.

Despite the need to support learners' SRL skills, researchers have mainly developed exploratory works to understand the characteristics of MOOC participants. Only a few research works implemented interventions to support SRL in MOOCs [8]. However, tools presented in the literature tend to focus on specific SRL sub-processes rather than accompanying the participant during all the learning process. In fact, authors in [9] highlight the importance for learners of receiving support during all the phases of SRL. Thus, there is a demand for more instruments to assist MOOC participants throughout their entire learning process.

In this line, we present an external tool aimed to help MOOC learners to develop and improve their SRL skills. This tool is intended to support learners in the establishment of their own learning path. Thus, this tool aims to help those participants who, wishing to do so, might not be able to complete the MOOC because they are not able to manage their learning adequately. This idea is concretised in the development of a Google Chrome extension or plug-in focused on three specific SRL strategies: (1) goal setting, (2) time management, and (3) self-evaluation.

2 Prior Work

2.1 Self-regulated Learning

In the field of educational psychology, self-regulated learning (SRL) is a major area of research, as it encompasses many influences of learning. One well-known definition of SRL [10] is Zimmerman's [11]. He described SRL as learner's generation of thoughts, feelings and behaviours to achieve his goals. One of his contributions is the Cyclical Phases Model, which considers self-regulation as a 3-phase cyclic process:

1. **Forethought.** In general, students plan their learning, including the personal objectives they want to achieve. Moreover, they reflect on their motivation to learn (e.g., to get a good grade, professional development, personal interest, etc.).
2. **Performance.** Among several skills, learners organise the necessary tasks and schedule some time to learn. Additionally, they monitor themselves to see how they are progressing. Thus, they can make changes if they are not satisfied.
3. **Self-reflection.** Students evaluate their learning performance and the reasons for it. After this reflection, learners decide what changes they need to make to adapt their strategies and improve these strategies in the next cycle.

2.2 Self-regulated Learning in MOOCs

Initially, self-regulated learning (SRL) was studied in traditional educational settings, where the student and teacher were in the same physical location and could establish personal contact. Later on, research on SRL has continued in online learning environments, such as MOOCs.

However, the differences between MOOCs and traditional educational settings create new challenges, mainly due to the heterogeneity and massiveness of the participants. Additionally, learners are expected to self-regulate their learning, although prior works have shown that many MOOC participants lack the needed skills. Therefore, there is a need for research works which carry out interventions to support self-regulation in MOOC participants.

Some authors have developed MOOC platforms to encourage learners to be active in their learning. For example, eLDa platform allows learners to choose the delivery mode between the *instructor-led* mode (with a pre-recommended order of lessons) and the *self-directed* mode (in which the learner freely decides which learning path to take) [12]. Moreover, elements to improve participants' motivation and self-regulation are incorporated, such as lesson prerequisites, private messaging, forums, and progress maps [13]. In a pilot study conducted in 2015 [14], the participants of a programming MOOC in eLDa platform were offered a survey regarding their preferences in MOOCs. The results were that the participants mostly preferred short MOOCs, with short lecture videos, as they intended to spend less than an hour per day in the course. Finally, regarding the type of online course delivery, the answer distribution was: 15.5% preferred collaborative learning, 15.5% preferred instructor-led learning; 46% preferred interactive learning, and 23% preferred self-directed learning. Therefore, learners seem to prefer an adaptative approach, followed by the self-directed mode.

Other tools found in the literature to support SRL in MOOCs are focused on specific instructional elements, such as videos. This is the case of Video-Mapper, which is presented as a "video annotation tool" [15]. Learners can add annotations to specific time points in MOOC videos, as well as reading the annotations of the other enrolees. Thus, this tool aims to foster collaboration, discussion and interaction with the content of the MOOC videos. An evaluation of the tool with real MOOC participants showed its effectiveness and usability. Moreover, learners' engagement is increased through the visualisations, as they can have an appealing overview of the lectures. Another constructive feature is the option to link questions to a specific time point in a video. However, it is difficult for a learner to keep track of his activities or his peers'. Video-Mapper helps learners to organise their learning path with the map structure of the lectures. Some SRL strategies this tool is intended to support are goal-setting and strategic planning. Enrolees can analyse what they have already done, and what they want to do according to their personal objectives. Moreover, the annotations are shared by all the participants, which helps to create a sense of community and fosters motivation and help-seeking.

Other authors focus on one SRL phase, such as NoteMyProgress [16]. This tool was developed to support the SRL strategies of the performance phase of enrolees in Coursera MOOCs. Specifically, the implemented and evaluated tool focuses on task strategies (note-taking) and time management. NoteMyProgress is composed of two elements: a plug-in for Chrome and a web application. The plug-in allows the learner to take notes while taking the course. The web application is a dashboard in which the user gets different personalised visualisations so that he can observe how he has interacted with the MOOC. For example, the user can get figures showing the number of videos watched and the time spent on them, or the percentage of time spent on the course versus the time spent procrastinating. After an evaluation with real users, positive results regarding the usability of the tool were obtained [16].

However, authors in [15] state that more effectiveness might be achieved by helping learners across all the phases of SRL. Therefore, we opted for designing a tool to support one SRL strategy per self-regulation phase, as modelled by Zimmerman's SRL model [11].

3 Analysis

Before designing a tool to support SRL in MOOCs, we reviewed the literature to decide on which 3 SRL strategies this tool should focus. Regarding the forethought phase, goal setting is considered helpful in the literature [17, 18] but, in general, is a weak area for learners [17, 19]. Regarding the performance phase, time management appeared to be influential to succeed in MOOCs [20], although learners seem to have difficulties to effectively adapt their study time according to their goals [21]. Regarding the self-reflection phase, the self-evaluation strategy seems to have promising outcomes. For example, Learning Tracker is a tool which improved the performance of learners by fostering self-evaluation through social comparisons [22]. Additionally, emotions are an influential factor in learners' interactions, whose regulation helps to predict the academic outcomes [23].

After this decision, the authors derived a set of requirements to support goal setting, time management and self-evaluation in MOOC environments. The summary of requirements is presented below:

- Provide *sign up* and *authentication* for the users so that their information is not shared among other users. Data privacy is considered an essential requirement.
- Provide the option of indicating *the MOOC(s)* in which the user is *enrolled*. The tool should have a list of supported MOOCs, from which the user can select those courses in which he is registered.
- Support the *creation of goals* for the MOOC(s) in which the user is enrolled to foster goal setting. Additionally, the user should be able to *view*, *mark as completed*, and *delete* the goals he has set.
- Support the *notification of expired goals* according to their due date. When a goal expires, an alert should be triggered to raise the awareness of the learner.
- Provide a *timeline display* with the user goals according to the due date to foster time management. Specifically, the supported display should be a calendar with a colour code indicating the status of the goals which expire in each specific date.
- Support the learner's own *evaluation of performance* and *emotions* to foster selfevaluation. This self-evaluation should be simple to ease learners' reflection. Providing several predefined options to choose from is advisable.

- Provide some *advices* to the learners in order to improve their SRL skills as well as inspirational *quotes* to increase their motivation.
- Provide an *intuitive and appealing interface*. Designing a simple and user-friendly interface is considered important to achieve high usability and learners' engagement with the tool.

4 Design

4.1 Design Decisions

After determining the SRL strategies to support, the specific type of tool was chosen with the constraint of focusing on edX platform, as this was the institutional MOOC platform. In fact, other intervention types apart from tools were not suitable for our work. On the one hand, path recommendations or interventions that are embedded in the MOOC platform cannot be implemented in edX platform. On the other hand, study groups are not considered the best option in MOOC environments due to location constraints (e.g., Guo and Reinecke identified 196 origin countries among enrolees of 4 different MOOCs [24]).

Therefore, the initial designing step was selecting between a computer or mobilebased tool. Currently, the edX mobile application allows participants to watch videos and complete exercises. However, this application does not yet allow completing evaluations. Thus, enrolees who intend to complete the MOOC should access the course through a computer, at least, to take the exams. Additionally, a browser should be used when accessing the course. According to Statcounter[1], Google Chrome browser has a worldwide market share of more than 50% during 2017 and 2018. Consequently, the idea of a computer-based tool is concretised in the development of a Google Chrome extension (also called plug-in) to be designed according to the requirements summarised in the previous section. This tool, named MOOCnager, aims to support MOOC participants in their development of their SRL skills.

Finally, the last design decision was choosing a suitable database to store and access the information generated by the enrolees' usage of the plug-in. A local database was discarded so that the information of a user was not constrained to the device he is accessing the plug-in with. In other words, the intended behaviour is that the information of a user is accessible, after logging in, regardless of the device. Additionally, a non-relational database (NoSQL) was preferred because possible future changes in the stored information do not imply major database modifications.

[1] http://gs.statcounter.com/browser-market-share.

5 Implementation

HTML (HyperText Markup Language) and JavaScript has been used to complete the implementation of the plug-in, in addition to Firebase Realtime Database to store and retrieve the required information. The following subsections summarise the possible interactions between a registered user and the plug-in.

5.1 Enrolled MOOCs

The user can specify in which MOOC or MOOCs he is enrolled. This information is used so that the user is only able to set goals to his enrolled MOOCs. For the preliminary evaluation, MOOCnager is configured to include a provisional list of courses (specifically, 6 Java programming courses offered by UC3Mx), although it can easily be modified to add or remove courses.

5.2 Goal Setting

One of the supported SRL strategies, included in the forethought phase, is goal setting. Learners should set their personal objectives before their learning, to direct it towards achieving these goals. With MOOCnager, users can set goals for the supported MOOCs in which they are enrolled. To help participants with their goal setting strategy, some predefined goal types are included: finishing a specific unit, watching a number of videos, doing a number of assignments, or completing a number of evaluations. Each goal has an expiration date and belongs to one of two groups according to it: current goals (their due date has not arrived yet) and past goals (they have already expired). Figure 1a shows an example list of current goals. Users can remove a current goal or indicate that it has been completed. When a current goal expires, a notification appears so that the user indicates if it was achieved or not. Additionally, the list of past goals displays them with green font (if they were achieved) or red font (if they were not achieved).

5.3 Time Management

Time management, included in the performance phase, appears to be challenging to MOOC participants, according to prior literature. MOOCnager aims to support this strategy with a personalised calendar (see Fig. 1b). Each day is displayed according a colour code: grey, if no goals expire on that day; green, if all the goals that expire on that day have been achieved; red, if no goals that expire on that day have been achieved; and orange, if some of the goals that expire on that day have been achieved and some have not. Additionally, the goals that expire on a day are shown when hovering the mouse over that day. In this way, learners have a quick and general vision of their week and the goals they want to achieve. Thus, they might focus more on them and manage their time to accomplish their personal objectives.

5.4 Self-evaluation

The supported strategy of the self-reflection phase is self-evaluation. MOOCnager encourages users to reflect on their emotional state and performance by completing a form (see Fig. 1c). This form includes a first block to evaluate emotions and a second block to evaluate one's own performance. To facilitate self-evaluation, the emotion and performance blocks have 6 predefined options each, among which the user can choose the one that best fits his evaluation.

5.5 Advices

Different advices, quotes or questions are included in MOOCnager to assist learners with their learning skills and motivation. There are different categories: goal setting, study place, concentration, time management, motivation, and other. For instance, a goal setting advice is "*try to set SMART goals: S-Specific, M-Measurable, A-Attainable, R-Realistic, T-Time-Bounded*".

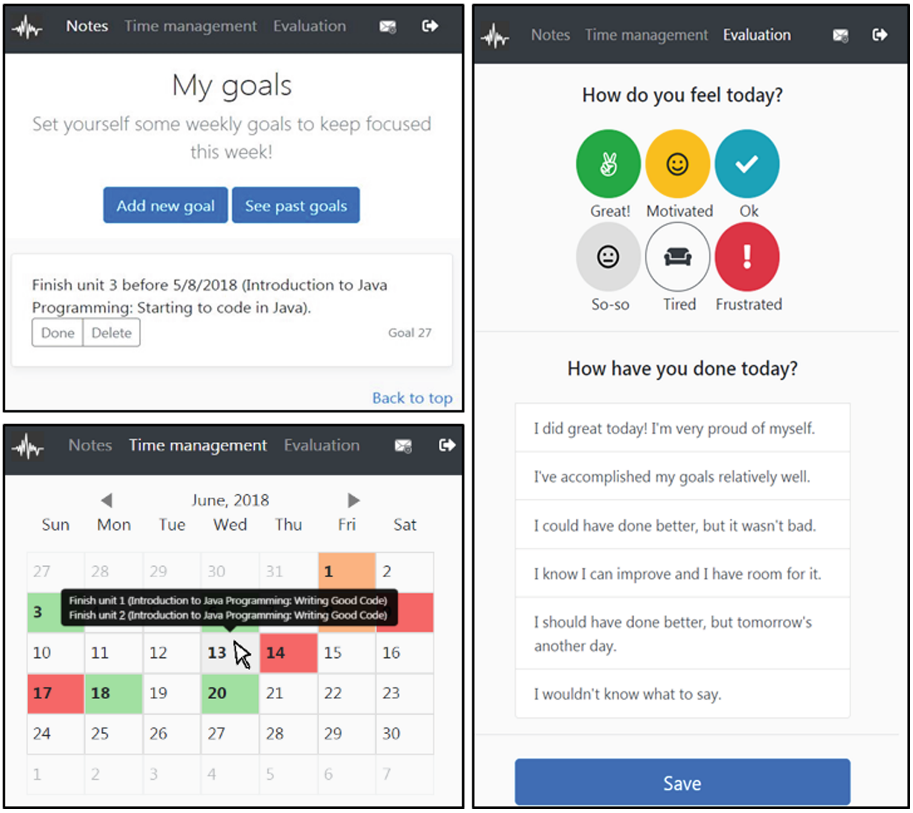

Fig. 1. MOOCnager captions. From top to bottom, and left to right: (1a) Goal setting; (1b) time management; (1c) self-evaluation.

6 Evaluation

A preliminary evaluation has been conducted, conditioned by the brief available period of time to complete it. Learners of 6 Java MOOCs offered by UC3Mx were sent the link of Chrome Web Store corresponding to MOOCnager. However, the use of the plug-in was very low (only 38 users set a target, and 21 submitted a self-assessment). For this reason, a short survey was sent to the users to delve into the reasons for their low use, although only 5 users completed the survey. Regarding the main reasons for the low interaction with the plug-in, the participants could select a predefined answer or add a personalised answer. Results include *not having enough time* (2 respondents), *not an attractive interface* (1 respondent), *prefer running a side project* (1 respondent), and *being inactive in the course* (1 respondent).

Moreover, we also hypothesise that other factor influencing the low interaction with the plug-in might be that the MOOCs were very advanced when the plug-in was published. Therefore, only a small percentage of the enrolees were active. In fact, one survey respondent pointed this as his main reason for the low interaction. It is important to be aware that of those registered in the MOOC, only a small percentage of them access the course and are active during most of the course length [5].

In addition, the survey contained one free-response field whose answers showed that another important usability problem is that the tool is external to the MOOC platform. A user commented in the survey that he would have preferred a tool which is not external, as he claimed, "to forget that I even have a plug-in that tracks my progress". Thus, a tool which is integrated in edX might have been more popular. However, this integration would require working with Open edX platform and not edX.

7 Conclusions and Future Work

MOOCnager aimed to help MOOC learners in their SRL, providing support during the 3 SRL phases [9]. The low use of the tool and the survey taken by some participants showed that learners have difficulties to manage their study time. In fact, this has been an important issue reason for participants to leave MOOCs [5]. Moreover, enrolees seem to prefer tools which are integrated in the MOOC platform and do not require any interaction from the user. Thus, we encourage collaboration between MOOC platforms and researchers to design tools that can give advices and support learners' SRL based on their performance, without needing additional information.

According to our results, we propose revising the idea of the plug-in so that the tool is embedded in a MOOC platform, such as Open edX. However, although Open edX offers more flexibility for developers and instructors, MOOCs tend to be published in edX to obtain more enrolees. In the future, we will make the plug-in available to MOOC learners from the beginning, getting a more precise evaluation of the tool. We might reach the contradiction that those who most need support in their SRL are the least likely to use the MOOCnager spontaneously. Predictive analytics could be used in such a way that learners are shown that using the plug-in increases their chances of success in the MOOC, as a way of convincing them to use MOOCnager.

Moreover, results of research work in MOOCs might be constrained to the context (e.g., MOOC topic, length, delivery mode) due to the heterogeneity of the environment. Consequently, it might be interesting to study the plug-in usage among enrolees of other courses and analyse their similarities and differences.

In addition to MOOCnager, we implemented another system which uses the plug-in information (e.g., achieved and unachieved goals, self-evaluations) to create and send reports with personalised advice in order to help participants improve their SRL skills. As a future work, we propose the evaluation of this system with real users, as a complement of the plug-in. In this way, the intervention can be adapted to each learner and his performance, which seems to be valued among MOOC participants [25].

Acknowledgments. The authors acknowledge the eMadrid Network, funded by the Madrid Regional Government (Comunidad de Madrid) with grant No. P2018/TCS-4307. This work also received partial support from the Spanish Ministry of Economy and Competitiveness/Ministry of Science, Innovation, and Universities, Projects RESET (TIN2014-53199-C3-1-R) and Smartlet (TIN2017-85179-C3- 1-R), and from the European Commission through Erasmus+ projects COMPETEN-SEA (574212-EPP-1-2016-1-NL-EPPKA2-CBHE-JP), LALA (586120-EPP-1-2017-1-ES-EPPKA2- CBHE-JP), and InnovaT (598758-EPP-1-2018-1-AT-EPPKA2-CBHE-JP).

References

1. McAuley, A., Stewart, B., Siemens, G., Cormier, D.: The MOOC Model for Digital Practice. University of Prince Edwards Island, Canada (2010)
2. Gašević, D., Kovanovic, V., Joksimovic, S., Siemens, G.: Where is research on massive open online courses headed? A data analysis of the MOOC research initiative. Int. Rev. Res. Open Distrib. Learn. **15**(5), 134–176 (2014)
3. Shah D.: By the numbers: MOOC in 2017. https://www.class-central.com/report/mooc-stats-2018/. Accessed 24 Dec 2018
4. Clow, D.: MOOCs and the funnel of participation. In: Proceedings of the 3rd International Conference on Learning Analytics and Knowledge, pp. 185–189. ACM, Leuven (2013)
5. Khalil, H., Ebner, M.: MOOCs completion rates and possible methods to improve retention-a literature review. In: Proceedings of the 22nd World Conference on Educational Multimedia, Hypermedia and Telecommunications, pp. 1236–1244. AACE, Tampere (2014)
6. Min, L., Jingyan, L.: Assessing the effectiveness of self-regulated rearning in MOOCs using macro-level behavioural sequence data. In: Proceedings of the 5th European MOOCs Stake-Holders Summit - Work in Progress Papers, pp. 1–9. CEUR, Madrid (2017)
7. Pérez-Sanagustín, R., Maldonado-Mahauad, J.J.: How to design tools for supporting self-regulated learning in MOOCs? Lessons learned from a literature review from 2008 to 2016. In: Proceedings of the 42nd Latin American Computing Conference, pp. 1–12. IEEE, Valparaíso (2016)
8. Alonso-Mencía, M.E., Alario-Hoyos, C., Maldonado-Mahauad, J., Estévez-Ayres, I., Pérez-Sanagustín, M., Delgado, C.: Self-regulated learning in MOOCs: lessons learned from a literature review. Edu. Rev. (2019, forthcoming)
9. Jansen, R.S., Van Leeuwen, A., Janssen, J., Kester, L., Kalz, M.: Validation of the self-regulated online learning questionnaire. J. Comp. High. Educ. **29**(1), 6–27 (2017)
10. Panadero, E.: A review of self-regulated learning: six models and four directions for research. Front. Psychol. **8**, 1–28 (2017)

11. Zimmerman, B.J.: Attaining self-regulation: a social cognitive perspective. In: Boekaerts, M., Pintrich, P., Zeidner, M. (eds.) Handbook of Self-regulation, pp. 13–39. Academic Press (2000)
12. Onah, D.F., Sinclair, J.E.: Measuring self-regulated learning in a novel e-learning platform: eLDa. In: Proceedings of the 15th Koli Calling Conference on Computing Education Research, pp. 167–168. ACM, Koli (2015)
13. Onah, D.F.O., Sinclair, J.E.: A multi-dimensional investigation of self-regulated learning in a blended classroom context: a case study on eLDa MOOC. In: Auer, M., Guralnick, D., Uhomoibhi, J. (eds.) ICL 2016. AISC, vol. 545, pp. 63–85. Springer, Cham (2017)
14. Onah, D.F., Sinclair, J.E.: Design science MOOC: a framework of good practice pedagogy in a novel e-learning platform eLDa. In: Proceedings of 28th Annual World Conference on Educational Media and Technology, pp. 1–7. AACE, Vancouver (2016)
15. Yousef, A.M., Chatti, M.A., Danoyan, N., Thüs, H., Schroeder, U.: Video-mapper: a video annotation tool to support collaborative learning in MOOCs. In: Proceedings of the 3rd European MOOCs Stakeholders Summit EMOOCs, Mons, pp. 131–140 (2015)
16. Pérez-Álvarez, R., Maldonado-Mahauad, J.J., Sapunar-Opazo, D., Pérez-Sanagustín, M.: NoteMyProgress: a tool to support learners' self-regulated learning strategies in MOOC environments. In: Lavoué, É., Drachsler, H., Verbert, K., Verbert, J., Pérez-Sanagustín, M. (eds.) EC-TEL 2017. LNCS, vol. 10474, pp. 460–466. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-66610-5_43
17. Jo, Y., Tomar, G., Ferschke, O., Rosé, C.P., Gašević, D.: Expediting support for social learning with behavior modeling. In: Proceedings of the 9th International Conference on Educational Data Mining, Raleigh, pp. 400–405 (2016)
18. Kizilcec, R.F., Pérez-Sanagustín, M., Maldonado, J.J.: Self-regulated learning strategies predict learner behavior and goal attainment in massive open online courses. Comput. Educ. **104**, 18–33 (2017)
19. Chen, P.J., Chen, Y.H.: Facilitating MOOCs learning through weekly meet-up: a case study in Taiwan. In: Proceedings of the 1st ACM Conference on Learning@ Scale Conference, pp. 183–184. ACM, Atlanta (2014)
20. de Waard, I., Kukulska-Hulme, A., Sharples, M.: Self-directed learning in trial FutureLearn courses. In: Proceedings of the 3rd European Stakeholder Summit EMOOCs, Mons, pp. 234–243 (2015)
21. Milligan, C., Littlejohn, A.: How health professionals regulate their learning in massive open online courses. Internet High. Edu. **31**, 113–121 (2016)
22. Davis, D., Chen, G., Jivet, I., Hauff, C., Houben, G.J.: Encouraging metacognition and self-regulation in MOOCs through increased learner feedback. In: Proceedings of the Learning Analytics and Knowledge Workshop on Learning Analytics for Learners, pp. 17–22. CEUR, Edinburgh (2016)
23. Ruiz, S., Charleer, S., Urretavizcaya, M., Klerkx, J., Fernández-Castro, I., Duval, E.: Supporting learning by considering emotions: tracking and visualization a case study. In: Proceedings of the 6th International Conference on Learning Analytics and Knowledge, pp. 254–263. ACM, Edinburgh (2016)
24. Guo, P.J., Reinecke, K.: Demographic differences in how students navigate through MOOCs. In: Proceedings of the 1st ACM conference on Learning@ scale Conference, pp. 21–30. ACM, Atlanta (2014)
25. Leris, D., Sein-Echaluce, M.L., Hernández, M., Bueno, C.: Validation of indicators for implementing an adaptive platform for MOOCs. Comput. Hum. Behav. **72**, 783–795 (2017)

Curiouser and Curiouser: The Wonderland of Emotion in LMOOCs

Elaine Beirne(✉), Mairéad Nic Giolla Mhichíl, and Conchúr Mac Lochlainn

Dublin City University, Dublin, Ireland
elaine.beirne4@mail.dcu.ie

Abstract. Emotions and learning are inextricably linked and as such, computer-based learning environments should be cognisant of learning-enhancing emotions. More research, however, is needed to identify the factors that lead to specific emotions in digital and online learning environments, along with research to explore our understanding of the effects that different emotions can have on learning and on performance. This paper reports on a study-in-progress in the National Institute for Digital Learning in Dublin City University in Ireland, which is investigating the relationship between emotion and learning in Language MOOCs (LMOOCs). This study reports on preliminary findings of the first run of the Irish 101: Introduction to Irish Language and Culture, LMOOC, hosted on the FutureLearn platform. Using an experience sampling method, participants self-reported on their emotional experience after completing a range of activities during the three-week course. Initial findings show that Curiosity was the emotion participants felt most strongly, followed by Excitement, Hope and Pride. Affective states shifted over the duration of the course, most notably from week 1 to week 2, and following various MOOC activities. This paper concludes by providing an initial insight into the importance of considering learner affect in an LMOOC and in MOOCs more generally.

Keywords: Emotion · Learning design · Language learning MOOC

1 Introduction

In the last few decades, educational researchers have begun to recognise the significance of emotions in the learning process. Corresponding research has explored the effects of emotion on learning and achievement showing that emotions, both positive (e.g. enjoyment, pride) and negative (e.g. anxiety, boredom), have a significant impact on learners' motivation, well-being, self-regulation and academic achievement [1–3]. Due to this impact that emotions have on learning, studies have also attempted to leverage the connection between emotion and learning to improve learning [4]. One avenue of research that is particularly important in this regard investigates the antecedents of learner emotions. A better understanding of the factors that lead to certain emotions is essential for generating ideas on how to foster more learning enhancing emotional experiences [5]. This line of research is particularly beneficial for online learning contexts where the dynamics of emotional experiences are less visible but

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 13–20, 2019.
https://doi.org/10.1007/978-3-030-19875-6_2

nevertheless have an impact on learning. The relationship between emotion and learning has been investigated in a variety of digital and online learning contexts (for a review see [6]). However, due to the domain specificity of emotions [7], there are numerous additional learning contexts that have yet to be explored.

This study focuses on emotion as it relates to language learning in the context of an LMOOC. MOOCs continue to grow in popularity worldwide, with over 101 million learners enrolled in over 11,000 MOOCs throughout the world in 2018 [8]. LMOOCs, more specifically, are only beginning to engage with this educational model, however. Only 26 LMOOCs were identified among the major MOOC platforms in 2014 [9]. A more recent review of the field shows that this number is growing [10]. LMOOCs are unique in that language learning is both skill-based and knowledge-based and acquiring language skills requires interaction with other speakers [9, 11]. As a result, course designers face the challenge of adapting existing MOOC templates, which are predominantly knowledge-based, to facilitate the acquisition of language-specific skills. While a few papers have considered emotions in a MOOC context [12–14], LMOOCs present a unique and unexplored context in which to observe the relationship between emotion and learning. The LMOOC investigated in this study was designed for ab initio or complete beginners of the Irish Language from around the globe. The Irish language is both the national and first official language of the Republic of Ireland, the English language, however, remains the dominant and majority communication language within the State [15]. Irish holds an elevated position in the constitution and is taught in all schools in the Republic of Ireland.

2 Theoretical Framework

The control-value theory of achievement emotions [16] is the underpinning theoretical framework of this study. Achievement emotions are defined as “emotions tied directly to achievement activities or outcomes” [16, p. 317]. Following research that assumes appraisals are determinants of human emotion, the control-value theory posits that two cognitive appraisals are of particular relevance to achievement emotions: (i) subjective control and (ii) subjective value. Subjective control refers to an individual’s evaluation of agency over the achievement activity and its outcomes, whilst subjective value refers to an individual’s evaluation of the importance of an activity and its outcomes [16]. Different combinations of control and value appraisals are considered to instigate different types of emotions.

3 The Current Study

The aim of this work in progress paper is to investigate the range of emotions that learners experience during Irish 101: Introduction to Irish Language and Culture LMOOC to determine whether the appraisal pattern of these emotions aligns with the assumptions of the control-value theory of emotions. This is the first study to investigate a range of learner emotions and their antecedents in an LMOOC. This paper addresses the following three research questions:

1. What emotions do learners experience in an LMOOC?
2. How do these emotions change over the duration of the course?
3. What are learners control and value appraisals for each task type?

4 Method

4.1 Learning Environment

Irish 101 is an introductory Irish language and culture MOOC offered by DCU as part of the Fáilte ar Líne (Welcome Online) initiative. This project is co-funded by the Irish Government, specifically the Department of Culture, Heritage and the Gaeltacht, under the Twenty-Year strategy for the Irish Language, with support from the National Lottery. Irish 101 is hosted by the social learning platform, FutureLearn. The course is three weeks long and consists of approximately 4 h of learning per week. The course covers topics ranging from basic greetings to counting and giving directions in Irish. The course is designed to be completed in sequential order. However, all content was released to students at the same time, so students were free to complete the material at their own pace and in whatever order they desired.

4.2 Participants

Of the 10,646 students from 135 countries enrolled in the first iteration of the course, 2,931 students reported their emotions following at least one task during the course. These 2,931 students constituted the sample of this study.

4.3 Data Collection

Data was collected using an event focused, experience sampling method, which is consistent in design with emotion based studies [17, 18]. Students were prompted to self-report on their experience following various MOOC activities such as videos, quizzes, discussion forums and articles over the three weeks. These four task-types are common to all FutureLearn MOOCs. This approach facilitated 'in the moment' emotion reports, reducing the retrospective bias inherent in self-report data [18]. There were 18 data collection points in total (6 per week). All responses were anonymous and participation was optional. Ethical approval for the study was obtained from DCU's Research Ethics Committee in March 2018 (DCUREC/2018/044).

Emotions

The emotions learners experienced during the tasks were measured using a short version of the Epistemic Emotion Scale (EES) [19], with an adapted list of emotions for an Irish language learning context. The adapted list was derived from a preliminary study which sought to identify emotions specific to Irish language learning. Only emotions reported by over 10% of the respondents in the preliminary study (n = 460) were considered for use on the scale. In addition, only emotions recognised as epistemic or achievement emotions were included. The final scale investigated eleven emotions: Anger, Anxiety, Boredom, Confusion, Curiosity, Enjoyment, Frustration, Hope, Hopelessness, Pride and Surprise. For each emotion, participants are asked to report how strongly they felt the emotion using a 5-point Likert scale (1 = not at all to 5 = very strong).

Control and Value Appraisals

Appraisal measures were obtained using single-item scales adopted from [20]. To measure appraisals of control, participants were asked to respond to the statement, "I felt in control of my performance during the task". To measure value appraisals, participants were asked to respond to the statement "I valued the task". For both items, responses were measured on a 7- point Likert scale where a rating of 1 indicates that the participant strongly disagrees with the statement and a rating of 7 indicates that the participant strongly agrees with the statement. Other studies that have adopted an experience sampling approach have used similar single-item measures to assess appraisals of subjective task control and value appraisals [5, 21].

5 Findings

5.1 What Emotions Do Students Experience in an LMOOC Setting?

Preliminary findings show that Curiosity was the emotion felt most strongly during the course, with over 55% of participants reporting 'Strong' or 'Very Strong' instances of curiosity. This is followed by Excitement (32%), Hope (28%) and Pride (26%). To date, emotion research in language learning contexts has focused predominantly on Anxiety. Interestingly, throughout this LMOOC less than 6% of respondents identified with Anxiety strongly. Furthermore, many of the emotions learners identified strongly with during the course have not been investigated in previous research on emotion in digital and online learning environments [6].

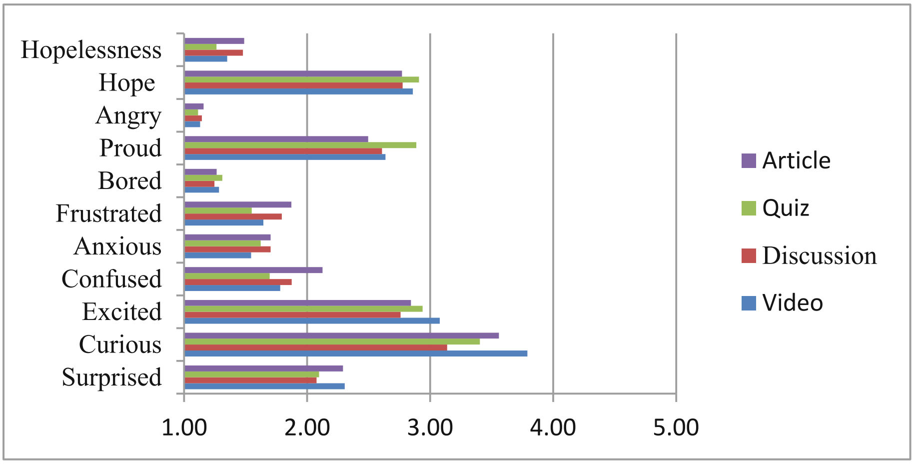

Fig. 1. Mean rating of emotion by task-type

Figure 1 presents a breakdown of the mean reports of each emotion during each task type. Notably, emotions varied in response to certain activities. For instance, negative emotions (*Anxiety*, *Frustration, Confusion* and *Hopelessness*) were felt more strongly during Discussion and Article tasks rather than during Video and Quiz tasks. This indicates that learners experience different emotions during different activities in an LMOOC.

5.2 How Do These Emotions Change over the Duration of the Course?

Figure 2 presents participants' mean emotion reports over the course. Note that Curiosity, Hope, Excitement and Pride remained dominant positive emotions throughout the course. Interestingly, negative emotions such as Confusion, Anxiety and Frustration increased slightly in week 2. This corresponded with a slight drop in the reports of positive emotions in the same week.

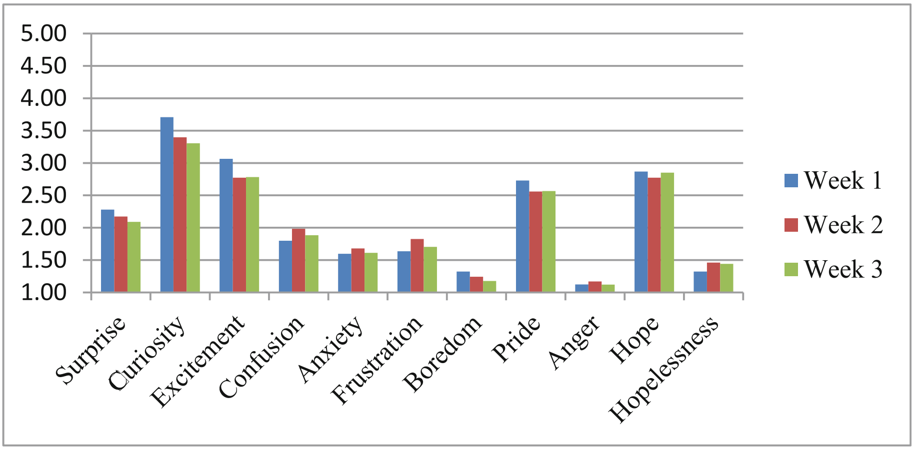

Fig. 2. Mean rating of emotion over course

5.3 What Are Learners Control and Value Appraisals for Each Task Type?

Figure 3 presents participants mean control and value appraisals for video, quiz, article and discussion steps on the course. In general, respondents valued the tasks and felt in control of their performance during the tasks. Quizzes stand out as an activity that evokes comparatively higher control and value appraisals among respondents. According to the Control-Value Theory of Emotions, participants with higher control and value appraisals experience more positive emotions overall.

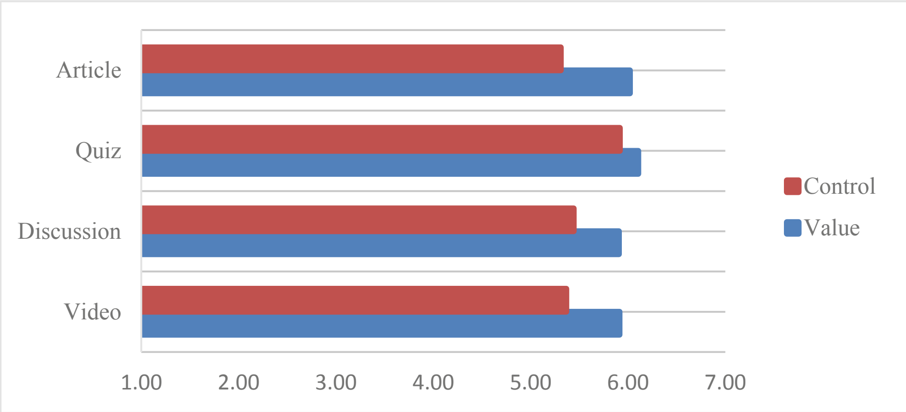

Fig. 3. Mean control and value appraisals for each task-type

6 Discussion

It is evident that learning in MOOCs is not a cold intellectual activity; it is punctuated with emotion. Learners reported a wide range of both positive and negative emotion during the course. This paper is significant in that it presents the first study of emotion in an LMOOC context. To date, the research on emotion during language learning outside of a traditional classroom setting has focused solely on anxiety [22, 23]. Interestingly, in this LMOOC, learners experienced relatively low levels of anxiety. This draws comparison to Hurd's study [22] where she found that while the distance context was anxiety-provoking for some language learners, others (27%) found that the distance context made them less anxious. Learners attributed this to having more control; being able to work at their own pace; less exposure; less competition; and chances to practice in private [22]. It is possible that the informal nature of learning a language in a MOOC context reduces the anxiety learners experience, however, this will need to be explored further. Due to this prevalence of anxiety-focused studies in the literature, particularly interesting was the finding that *Curiosity*, *Excitement* and *Hope* were the emotions learners felt most strongly during the MOOC. The strong presence of positive emotion is comparable to the results obtained by Dillon and colleagues [11] who conducted a similar study during a statistics MOOC.

We also found that emotions fluctuate during the course and depending on learning content. This has practical implications for LMOOC and MOOC designers, more generally. It provides a better understanding of how learners feel about different types of learning content. Identifying the prominent emotions associated with various types of content in a MOOC, as well as the factors that lead to their occurrence, has clear implications for learning design and pedagogical scaffolding strategies. One of the main challenges faced by LMOOC designers is creating opportunities for language production (speaking and writing). In this LMOOC, discussion tasks facilitated such interactions. Notably, it was during the discussion tasks that learners experienced relatively stronger negative emotions such as *Confusion*, *Frustration* and *Hopelessness*.

The same trend is also evident during article tasks, which usually introduced learners to new grammatical concepts and vocabulary and were thus rich with new information for learners to process. These preliminary results highlight possible areas of contention for LMOOC learners. Further research into the specific antecedents of these emotions will help generate ideas for design interventions aimed at supporting learners through the process. In this regard, emotionally-aware MOOC designs have the potential to improve learning success on these platforms.

7 Next Steps

This paper reports the preliminary findings of a broader study. Moving forward, we intend to conduct a more detailed correlational analysis to clarify the relationship between the emotions and control and value appraisals. An upcoming iteration will include a qualitative element in the hopes of obtaining more in-depth data pertaining to the antecedents of learner emotions, in addition to understanding more clearly the relationship between emotions and task-type. This will serve to enhance the credibility of quantitative responses. Furthermore, learner demographics will be collected so that any trends in the data that might be attributable to these variables can be identified. Finally, individual responses will be tracked over the duration of the course to investigate with-in person trends.

References

1. Pekrun, R., Goetz, T., Titz, W., Perry, R.P.: Academic emotions in students' self-regulated learning and achievement: a program of qualitative and quantitative research. Educ. Psychol. **37**(2), 91–105 (2002)
2. Linnenbrink-Garcia, L., Pekrun, R.: Students' emotions and academic engagement: introduction to the special issue. Contemp. Educ. Psychol. **36**(1), 1–3 (2011)
3. Efklides, A., Volet, S.: Feelings and emotions in the learning process. Learn. Instr. **15**, 377–515 (2005)
4. D'Mello, S., Blanchard, N., Baker, R., Ocumpaugh, J., Brawner, K.: I feel your pain: a selective review of affect-sensitive instructional strategies. In: Sottilare, R., Graesser, A., Hu, X., Goldberg, B. (eds.) Design Recommendations for Intelligent Tutoring Systems - Volume 2: Instructional Management. U.S. Army Research Laboratory, Orlando (2014)
5. Goetz, T., Frenzel, A.C., Stoeger, H., Hall, N.C.: Antecedents of everyday positive emotions: an experience sampling analysis. Motiv. Emot. **34**(1), 49–62 (2010)
6. D'Mello, S.: A selective meta-analysis on the relative incidence of discrete affective states during learning with technology. J. Educ. Psychol. **105**(4), 1082–1099 (2013)
7. Goetz, T., Frenzel, A.C., Pekrun, R., Hall, N.C.: The domain specificity of academic emotional experiences. J. Exp. Educ. **75**(1), 5–29 (2006)
8. Class Central. https://www.class-central.com/report/moocs-stats-and-trends-2017/
9. Bárcena, E., Martín-Monje, E.: Language MOOCs: an emerging field. In: Bárcena, E., Martín-Monje, E. (eds.) Language MOOCs: Providing Learning, Transcending Boundaries. Degruyter Open (2014)

10. Beirne, E., Nic Giolla Mhichíl, M., Cleircín, G.Ó.: LMOOCs, classifying design: survey findings from LMOOC providers. In: Borthwick, K., Bradley, L., Thouësny, S. (eds.) CALL in a Climate of Change: Adapting to Turbulent Global Conditions – Short Papers from EUROCALL 2017, pp. 30–34. Research-publishing.net (2017)
11. Dillon, J., Bosch, N., Chetlur, M.: Student emotion, co-occurrence, and dropout in a MOOC context. In: Proceedings of the 9th International Conference on Educational Data Mining. International Educational Data Mining Society (IEDMS), Raleigh (2016)
12. Leony, D., Muñoz-Merino, P.J., Ruipérez-Valiente, J.A., Pardo, A., Kloos, C.D.: Detection and evaluation of emotions in massive open online courses. J. Univ. Comput. Sci. **21**(5), 638–655 (2015)
13. Wen, M., Diyi, Y., Rosé, C.P.: Sentiment analysis in MOOC discussion forums: what does it tell us? In: Proceedings of the 7th International Conference on Educational Data Mining. International Educational Data Mining Society, London (2014)
14. Sokolik, M.: What constitutes an effective language MOOC? In: Bárcena, E., MartínMonje, E. (eds.) Language MOOCs: Providing Learning, Transcending Boundaries. Degruyter Open (2014)
15. CSO, https://www.cso.ie/en/media/csoie/releasespublications/documents/population/2017/7._The_Irish_language.pdf
16. Pekrun, R.: The control-value theory of achievement emotions: assumptions, corollaries, and implications for educational research and practice. Educ. Psychol. Rev. **18**(4), 315–341 (2006)
17. Larson, R., Csikszentmihalyi, M.: The experience sampling method. In: Flow and the Foundations of Positive Psychology, pp. 21–34. Springer, Dordrecht (2014). https://doi.org/10.1007/978-94-017-9088-8_2
18. Napa Scollon, C., Prieto, C.K., Diener, E.: Experience sampling: promises and pitfalls, strength and weaknesses. In: Diener, E. (ed.) Assessing Well-Being, vol. 39, pp. 157–180. Springer, Dordrecht (2009). https://doi.org/10.1007/978-90-481-2354-4_8
19. Pekrun, R., Vogl, E., Muis, K.R., Sinatra, G.M.: Measuring emotions during epistemic activities: the Epistemically-Related Emotion Scales. Cogn. Emot. **31**(6), 1268–1276 (2017)
20. Jarrell, A., Harley, J.M., Lajoie, S.P.: The link between achievement emotions, appraisals, and task performance: pedagogical considerations for emotions in CBLEs. J. Comput. Educ. **3**(3), 289–307 (2016)
21. Tong, E.M.W., et al.: Emotion and appraisal: a study using ecological momentary assessment. Cogn. Emot. **21**(7), 1361–1381 (2007)
22. Hurd, S.: Anxiety and non-anxiety in a distance language learning environment: the distance factor as a modifying influence. System **35**(4), 487–508 (2007)
23. de los Arcos, B., Coleman, J.A., Hampel, R.: Learners' anxiety in audiographic conferences: a discursive psychology approach to emotion talk. ReCALL **21**(1), 3–17 (2009)

Applied Mobile-Assisted Seamless Learning Techniques in MOOCs

Max Bothe(✉) and Christoph Meinel

Hasso Plattner Institute, Prof.-Dr.-Helmert-Str. 2-3, 14482 Potsdam, Germany
{max.bothe,christoph.meinel}@hpi.de

Abstract. As Massive Open Online Courses (MOOCs) are nowadays used in an increasingly ubiquitous manner, the learning process gets disrupted every time learners change context. Mobile-Assisted Seamless Learning (MSL) techniques have been identified to reduce unwanted overhead for learners and streamline their learning process. However, technical implementations vary across the industry. This paper examines existing MSL research and applied techniques in the context of MOOCs. Therefore, we discussed related MSL research topics. Afterward, eleven characteristic MSL features were selected and compared their implementations across five major MOOC platforms. While web applications provide a bigger feature set, mobile clients offer advanced offline capabilities. Based on the findings, a concept outlines how MSL features can enhance the learning experience on MOOC platforms while considering the technical feasibility.

Keywords: Seamless learning · MOOCs · Mobile learning

1 Introduction

Massive Open Online Courses (MOOCs) offer free online education at scale for everyone who has access to the Internet. In the past limited to stationary computers, nowadays an increasing number of people access the Internet via mobile phones, tablets and other mobiles devices on a daily basis in a subconsciously way. Along with that, users have the possibility to move away from stationary learning towards learning-on-the-go [18]. However, mobile learning is not suitable for every learner as learning behaviors differ [13]. Learners are able to choose from a variety of devices, methods and situations. They pick their most preferred context to achieve the best learning outcome. As learning activities do not always occur in the same setting, Sharples states the importance of "supporting a continuity of learning success across context and devices" [16]. Seamless learning techniques reduce the overhead that is created every time learners experience context changes during their learning process. While de Waard et al. emphasize that "seamless learning for MOOCs will enhance many contemporary learners" [21], seamless learning possibilities are often not explicitly promoted to the learner. Moreover, they are integrated by the MOOC providers to enhance

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 21–30, 2019.
https://doi.org/10.1007/978-3-030-19875-6_3

the general user experience. By taking a closer look, the impact of convenience functionality on the learning outcome and efficiency becomes evident. Therefore, this work examines the following research question: How are seamless learning techniques applied in major MOOC platforms across all client applications?

In this paper, we examine and discuss multiple features of MOOC platforms that support seamless learning. Hereby, we highlight resulting advantages for the learners and challenges for platform providers when adopting these features. Additionally, we compare the availability of these features for major MOOC platforms to create a comprehensive overview of the current level of support for seamless learning. Furthermore, we present a concept on how to streamline and enhance the seamless learning experience for MOOC platforms. While pedagogical advantages are shown, we will also focus on technology-enhanced learning methods and technical feasibility in order to be useful for the learners.

2 Pedagogical Rationale

Wong distinguished between two forms of seamless learning [23]. On one side, the author identified the process of combining learning activities inside and outside the classroom in higher education. On the other side, Wong recognized the trend of increased mobile and ubiquitous learning opportunities triggered by more and more one-to-one learning situations (one device per learner) [4]. As these personal devices are used in a variety of different situations, it became noticeable that the learning process is required to adapt to context switches. This second form is also known as Mobile-Assisted Seamless Learning (MSL) and is in the focus of this work. Wong and Looi formalized the ten levels of MSL by researching the ways context switches can occur [24]. They defined the following ten levels, which are widely accepted in the community:

- MSL1: Encompassing formal and informal learning
- MSL2: Encompassing personalized and social learning
- MSL3: Across time
- MSL4: Across locations
- MSL5: Ubiquitous knowledge access to learning resources
- MSL6: Encompassing physical and digital worlds
- MSL7: Combined use of multiple device types
- MSL8: Seamless switching between multiple learning tasks
- MSL9: Knowledge synthesis (prior, new knowledge, multi-disciplinary)
- MSL10: Encompassing multiple pedagogical or learning activity models

As a result of one-to-one learning, learners were also encouraged to be more independent in their learning process. This connects MSL to Self-Regulated Learning [25] as learners have the opportunity to learn not only what they prefer but also at which pace, in which order or in which context. Furthermore, increased learning independence promotes Self-Directed Learning [7] where learners start new learning journeys due to intrinsic motivation.

3 The Status Quo of MSL in MOOCs

An extensive summary of research possibilities for MSL in MOOCs was given by de Waard et al. [21]. They referred to the ten levels of MSL by Wong and Looi as categorization for research strands. Influenced by their work, this section discusses specific research studies of applied MSL concepts through technology-enhanced learning techniques in the context of MOOCs. Hereby, the focus is drawn to studies with potential in automatization while at the same time providing an overview of current research.

3.1 Formal and Informal Learning (MSL1)

MOOCs can be applied in various areas to provide free education. Chen and Bryer connect formal learning to in-classroom situations, while informal learning is driven by the learner's personal interest [3]. Most MOOC providers strive to promote lifelong learning and by this means for informal learning. However, in the context of enterprise learning, MOOCs are partly applied in a classroom-like context for the purpose of employee onboarding and further training [11].

3.2 Personalized and Social Learning (MSL2)

While formalizing the ten levels of MSL, Wong and Looi place the "learner at the center of production of knowledge" [24]. Thus, MOOC platforms aim to support multiple learning paths through the provided material. By promoting Self-Regulated Learning techniques, Rohloff et al. presented a concept for personalized learning objectives which allows learners to focus on specific learning items instead of participating in the MOOC from start to end [13]. Other social features intent to substitute face-to-face-learning [6] which is lost in the MOOC context. The most prominent example of this is a learner forum where learners exchange ideas specific to the learning material. In a series of studies, Staubitz et al. investigated in supporting social interactions and collaborations on MOOC platforms [17]. The authors provided small groups of learners with additional collaboration tools like video conferences, a separate forum and document sharing to be used within such learning groups. They discovered that collaboration and group work needs to be actively promoted and triggered in MOOCs.

3.3 Across Time and Locations (MSL3 and MSL4)

By definition, MOOC platforms are online services and can be used by everybody with access to the Internet. Due to the wide broadband coverage [19], the universal access to MOOC platforms is guaranteed. This impact is amplified by the omnipresence of personal mobile devices and one-to-one learning possibilities [4]. In the original design, MOOCs are time-boxed with a fixed start and end date to concentrate on learning activities and learner motivation. Nevertheless, MOOC providers keep past courses accessible to allow Self-Directed Learning.

These courses might still feature the complete set of learning material. However, they will not retrieve the same level of user activity (by instructors and learners). Hence, some MOOC platforms restrict access to the learner forum. Some MOOC platforms offer recap tools which reuse self-tests from previous learning material to enhance the learning outcome through repetition [2]. Such tools can as well be utilized to provide guidance into the course's topic after learners have been absent from a course for a given period of time and transitioned through multiple context switches.

3.4 Ubiquitous Access to Learning Resources (MSL5)

Building on the general accessibility of MOOC platforms across time and locations, all learning resources can be accessed if the required bandwidth is provided. Learning material and user data are stored online to provide universal access. However, these conditions change in rural areas and developing countries. Here, learners might experience low bandwidth or bad mobile data coverage. Whereas in developing countries, mobile devices are primarily used to access the Internet [19]. Because originally designed as web applications for desktop computers, the interface of MOOC platforms needs to adapt to the smaller screen of mobile devices. Responsive web layouts provide an adequate solution for supporting various screen sizes [12]. However, this approach does not resolve the demand for data efficient network operations and complete offline availability in unstable networks. While offline support can be added to learning web applications [9], native mobile clients provide a more advanced solution. Nevertheless, interactions like enrollments to courses or forum activities are not supported in both approaches. As a result, de Waard et al. support the claim that a "combination of web-based and mobile learning platforms adds to the future vision of integrated ubiquitous and seamless online learning environments" [21].

The most challenging part in providing universal access to all learning resources remains to be in creating solutions for mobile devices with complete offline support that are equivalent to the web applications. As Brady et al. determined, learners less proficient in the taught course language are also more likely to download the provided videos, whereas approaching course assignments created similar effects [1].

3.5 Combining Physical and Digital Worlds (MSL6)

Integrating the physical world into a digital product like MOOCs is a challenging part. Nevertheless, some efforts were made to bridge these two worlds. Hagedorn et al. explored how MOOCs could be utilized for preparation or follow-up activities for on-site employee training in a medical context [5]. A similar procedure was applied for university courses at the Hasso Plattner Institute, where MOOCs were utilized as preceded or collateral learning material. Furthermore, the spatial locality of the learners can be used to promote local learning groups or meetups beside online activities. However, such activities should always be complementary as not all learners will have fellow students in their surroundings.

3.6 Usage of Multiple Devices (MSL7)

As MOOC platforms store learning progress, settings and activities online to guarantee ubiquitous access, multiple clients with varying levels of functionality can access and process such data. Primarily, browsers are used to access the web application, but mobile clients receive more and more attention. To promote the usage of multiple devices, it must be of high priority for the MOOC provider to enable a mechanism that eases the data exchange between devices. In conjunction with MSL3, learners should have straightforward access to previously consumed and following learning materials. This calls for instant synchronization of the required learners' data to continue the learning process on a different device as learners might immediately continue learning in the same context. Apple provides with *Handoff* a similar proprietary mechanism to continue activities on other devices instantly. Rohloff et al. explored a different take on the multi-device usage [14]. The authors utilized mobile devices as companions to the web application by presenting complementary views - like slides or the learner forum - while the web application was playing the video content. Similar results can be achieved by connecting a second screen to the primary learning device.

3.7 Seamless Switching Between Learning Tasks (MSL8)

Learners have to perform various tasks when participating in a MOOC. Most learning material in a MOOC alternates between video content, tests and further reading material. For social interactions (MSL2) learners consult the learner forum. By annotating forum entry with video timestamps, new questions can be created and existing ones can be viewed when the video playback was paused. Thereby, self-organization among learners is promoted.

3.8 Knowledge Synthesis (MSL9)

An important part for reflecting on the content is the process of creating knowledge documents [17] to form connections and identify knowledge gaps [24]. These documents can then either be shared with a small learning group or can be made publicly available to all fellow learners. In support of lifelong learning, new learning topics should be easily discoverable. As de Waard et al. phrased it: "Learning and knowledge are in a constant state flux" [22]. In order to promote further Self-Directed Learning, MOOC platforms may evolve to learning hubs by encouraging learners to discover new learning topics through an advanced search which includes semantic information and learner-created material.

3.9 Encompassing Multiple Pedagogical or Learning Activity Models (MSL10)

Similar to the implementation of formal and informal learning, employing multiple pedagogical models highly depends on the design of a course. Here, multiple factors like experimental learning techniques [8], motivated instructors [20] and sharing of non-curriculum-based content to kickstart learner motivation [21] have been explored.

4 MSL Features Implemented by MOOC Platforms

This section provides a framework analysis of MSL features implemented by major MOOC platforms [15]. Therefore, the implementation level and feature discovery are evaluated for each MSL feature. As MSL 1, 6 and 10 were previously identified as course design specific, only a subset of MSL levels was used to select distinctive features that enhance the learning experience through technology. Features that are not included in this overview were not applied by any MOOC platform at the time of this study. Due to the advanced state of these MOOC platforms, fundamental capabilities, like archived courses, native mobile clients, responsive web layouts applications, were assumed and thus also not included.

4.1 Comparison of MOOC Platforms

We examined the following MOOC platforms for the framework analysis: edX, FutureLearn, Udemy, Udacity[1] and the HPI MOOC platform. Thereby, the web applications and native mobile clients were explored separately on January 9, 2019. As only small differences between native mobile clients for each MOOC platform exist, the latest mobile client experiences were tested with an iPad (iOS 12.1.1). The web applications were examined through the Chrome browser (version 71.0.3578.98) for macOS. Each MSL feature was either categorized as *fully provided* (●), *partially provided* (◐) or *not provided* (○). Features which were only applicable for the mobile clients got marked as *not supported* (-) for web applications. Table 1 displays all evaluated features grouped by MSL level.

4.2 Discussion

As Table 1 shows, MSL features are implemented on major MOOC platforms in various degree. By default, web applications offer a bigger feature set compared to mobile clients while FutureLearn is the only examined MOOC platform that does not offer any native mobile clients. The majority of MOOC platforms lack in providing collaboration spaces, as well as supporting learner-created material. Web applications of MOOC platforms should start to offer downloads for primary and complementary learning materials as these are often available in the respective mobile counterparts. In general, mobile clients need to support equal functionality as web applications which can be adapted to the smaller screen sizes and the mobile context. This especially includes providing access to the learner forum, offering downloads of additional learning materials like slides or transcripts, and allowing discussions while watching videos. Additionally, mobile clients rarely promote enhanced learning continuity features, like the next learning item, on a central learner dashboard. In order to become valuable clients, a concept for enhancing MSL should promote mobile clients to make extensive use of multi-screen functionality and advanced offline support. The shown pedagogical implications have to be examined in detail in future research along with the learner behavior as this would exceed the scope of this work.

[1] Udacity discontinued their mobile application as of January 9, 2019.

Table 1. Comparison of MOOC platforms in terms of MSL support

	Web					Mobile Client				
	edx	FutureLearn	Udemy	Udacity	HPI MOOC platform	edx	FutureLearn	Udemy	Udacity	HPI MOOC platform
MSL2										
Learner Forum	●	◐	○	◐	●	●	-	○	○	◐
Collaboration Spaces	○	○	○	○	●	○	-	○	○	○
Learner Created Material	◐	○	○	○	◐	○	-	○	○	○
MSL3										
Recap Mode	○	○	○	○	●	○	-	○	○	◐
MSL5										
Video Download	○	●	○	○	●	◐	-	●	●	●
Additional Material Download	◐	○	○	○	●	◐	-	○	○	◐
Offline Assessments	-	-	-	-	-	○	-	○	◐	○
MSL7										
Last Visited Item	◐	◐	●	●	◐	○	-	●	◐	○
Multi Screen Support	-	-	-	-	-	○	-	◐	◐	◐
MSL8										
Discussions in Video Context	○	●	●	○	◐	○	-	○	○	○
MSL9										
Advanced/Global search	◐	◐	●	◐	◐	◐	-	◐	◐	○

5 Concept for Enhanced MSL for MOOCs

In this section, we outline a concept to enhance the support of MSL for MOOCs. Based on previous findings in related research and through a framework analysis on MOOC platforms, the concept covers multi-screen capabilities, advanced offline functionality and supports learner-created material. The focus was set on technology-enhanced learning methods and technical feasibility rather than on specific course designs or application areas. Above all, feature completeness across all clients should be considered mandatory for successful MSL.

5.1 Multi-Screen Capabilities

Currently, mobile clients display learning material adapted to their smaller screen sizes. To increase the learning experience, they should embrace multi-screen support by providing complementary tools for the learner while the video content is presented on an external screen [14]. The same applies if the primary learner device features a sufficiently large screen. Here the data can be shown side-by-side. These complementary tools can provide further static content like matching slides or transcripts, as well as interactive components like discussions, self-tests or annotation tools in order to create learner-created material.

5.2 Advanced Offline Functionality

One shortcoming of mobile devices is an unguaranteed network connection. They are required to handle unexpected network changes as the learner traverses through different context states. Mobile clients pre-download course content to ensure the best possible learning experience by not depending on a connection to the Internet. Learners could manually select the content to be downloaded. However, this requires sufficient storage capacities, as well as for learners to plan ahead. Automated approaches can provide a superior approach by analyzing the learner's behavior and the available learning material. Upcoming material can be downloaded automatically in the background when a stable Internet connection is provided. While the download of static content is trivial, interactive elements require a more selective approach to obtain the desired learning effects. Graded assessments, for example, are often limited in attempts or time. To prevent fraud, an Internet connection could be partially mandatory. Otherwise, learners could launch multiple instances of the same assessments. These measures may not be required if the assessments are ungraded and only used for self-test purposes.

5.3 Support of Learner-Created Material

The learning outcome increases if learners engage in note-taking activities in combination with passive content consumptions [10]. Therefore, it may be beneficial for the learner to reflect on taught content by creating personal notes. Such learner-created material can be shared with the entire course community, a smaller subset of fellow students or it may be kept private to the learner. A downside of learner-created material is the increase in storage capacities [17]. At the same time, personal mobile devices offer some storage space that can be utilized to provide private learner-created material. In this way, learner-created material can be realized in a limited, but affordable manner.

6 Conclusion

This paper examined applied MSL techniques in MOOCs and highlighted future research opportunities. For that, existing research was discussed and categorized in the ten levels of MSL defined by Wong and Looi. Besides pedagogical implications, technical challenges and requirements of these approaches were shown. MSL 1, 6 and 10 have been identified as specific to the course design or application area, while the remaining levels can be enhanced through technology or fulfilled through the nature of MOOCs. In a framework analysis, we selected eleven characteristic MSL features in six MSL levels and compared these across the web applications and mobile clients of five major MOOC platforms. The support for MSL varied slightly between platforms while the web applications provided a bigger feature set compared to the mobile clients. At the same time, mobile clients offered an improved user experience through content download for offline usage. Pedagogical implications and learner behavior of the explored MSL features should be examined in detail in future research to provided comprehensive findings.

In order to enhance the support for MSL in MOOCs, a concept was introduced that outlines multi-screen capabilities, advanced offline functionality and support of learner-created material. Here, the focus was set on technology-enhanced learning methods and technical feasibility rather than on specific course designs or application areas. This work creates a foundation for future research in the fields of seamless learning and mobile learning to achieve more adaptive learning environments in the context of MOOCs.

References

1. Brady, K., Narasimham, G., Fisher, D.: Who downloads online content and why? In: Proceedings of the Fifth Annual ACM Conference on Learning at Scale, p. 41. ACM (2018)
2. Bruner, R.F.: Repetition is the First Principle of All Learning (2001)
3. Chen, B., Bryer, T.: Investigating instructional strategies for using social media in formal and informal learning. Int. Rev. Res. Open Distrib. Learn. **13**(1), 87–104 (2012)
4. Dunleavy, M., Dexter, S., Heinecke, W.F.: What added value does a 1: 1 student to laptop ratio bring to technology-supported teaching and learning? J. Comput. Assist. Learn. **23**(5), 440–452 (2007)
5. Hagedorn, C., Utunen, H., Renz, J., Meinel, C.: Exploring possibilities to partially transform simulation exercises into interactive games on openwho. org digitizing live role-playing game exercises online for epidemics and health emergency work. In: 2018 IEEE 6th International Conference on Serious Games and Applications for Health (SeGAH), pp. 1–6. IEEE (2018)
6. Johnson, S.D., Aragon, S.R., Shaik, N.: Comparative analysis of learner satisfaction and learning outcomes in online and face-to-face learning environments. J. Interact. Learn. Res. **11**(1), 29–49 (2000)
7. Knowles, M.S.: Self-directed Learning (1975)
8. Looi, C.K., Seow, P., Zhang, B., So, H.J., Chen, W., Wong, L.H.: Leveraging mobile technology for sustainable seamless learning: a research agenda. Br. J. Educ. Technol. **41**(2), 154–169 (2010)
9. Marco, F.A., Penichet, V.M., Gallud, J.A.: What happens when students go offline in mobile devices? In: Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services Adjunct, pp. 1199–1206. ACM (2015)
10. Ornstein, A.C.: Homework, studying, and note taking: essential skills for students. NASSP Bull. **78**(558), 58–70 (1994)

11. Renz, J., Schwerer, F., Meinel, C.: openSAP: evaluating xMOOC usage and challenges for scalable and open enterprise education. In: Proceedings of the 8th International Conference on E-Learning in the Workplace (2016)
12. Renz, J., Staubitz, T., Meinel, C.: MOOC to go. In: International Association for Development of the Information Society (2014)
13. Rohloff, T., Bothe, M., Renz, J., Meinel, C.: Towards a better understanding of mobile learning in MOOCs. In: 2018 Learning With MOOCS (LWMOOCS), pp. 1–4. IEEE (2018)
14. Rohloff, T., Renz, J., Bothe, M., Meinel, C.: Supporting multi-device e-learning patterns with second screen mobile applications. In: Proceedings of the 16th World Conference on Mobile and Contextual Learning, mLearn 2017, pp. 25:1–25:8. ACM, New York (2017). http://doi.acm.org/10.1145/3136907.3136931
15. Shah, D.: Massive list of MOOC providers around the world. Where to find MOOCs (2017)
16. Sharples, M.: Mobile learning: research, practice and challenges. Distance Educ. Chin. **3**(5), 5–11 (2013)
17. Staubitz, T., Pfeiffer, T., Renz, J., Willems, C., Meinel, C.: Collaborative learning in a MOOC environment. In: Proceedings of the 8th Annual International Conference of Education, Research and Innovation, pp. 8237–8246 (2015)
18. Thüs, H., et al.: Mobile learning in context. Int. J. Technol. Enhanc. Learn. **4**(5–6), 332–344 (2012)
19. Union, I.T.: ICT Facts and Figures 2017 (2017). http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf
20. Uosaki, N., Ogata, H., Li, M., Hou, B., Mouri, K.: Guidelines on implementing successful seamless learning environments. Int. J. Interact. Mob. Technol. **7**(2), 44–53 (2013)
21. de Waard, I., Keskin, N.O., Koutropoulos, A.: Exploring future seamless learning research strands for massive open online courses. In: Handbook of Research on Emerging Priorities and Trends in Distance Education: Communication, Pedagogy, and Technology, pp. 201–216. IGI Global (2014)
22. de Waard, I., et al.: Exploring the MOOC format as a pedagogical approach for mlearning. In: Proceedings of 10th World Conference on Mobile and Contextual Learning, pp. 138–145 (2011)
23. Wong, L.-H.: A brief history of mobile seamless learning. In: Wong, L.-H., Milrad, M., Specht, M. (eds.) Seamless Learning in the Age of Mobile Connectivity, pp. 3–40. Springer, Singapore (2015). https://doi.org/10.1007/978-981-287-113-8_1
24. Wong, L.H., Looi, C.K.: What seams do we remove in mobile-assisted seamless learning? A critical review of the literature. Comput. Educ. **57**(4), 2364–2381 (2011)
25. Zimmerman, B.J.: Self-regulated learning and academic achievement: an overview. Educ. Psychol. **25**(1), 3–17 (1990)

Socializing on MOOCs: Comparing University and Self-enrolled Students

François Bouchet[1(✉)] and Rémi Bachelet[2]

[1] Sorbonne Université, CNRS, Laboratoire d'Informatique de Paris 6, LIP6, 75005 Paris, France
francois.bouchet@lip6.fr
[2] Centrale Lille, PRES Université Lille Nord de France, 59650 Villeneuve d'Ascq, France
remi.bachelet@centralelille.fr

Abstract. MOOCs are becoming more and more integrated in the higher education landscape of learning, with many institutions now pushing their students towards MOOC as part of their curriculum. But what does it mean for other MOOC learners? Are these students socializing the same way when they have an easier possibility to interact with classmates offline? Is the fact that they do not personally choose to enroll in a MOOC also having an effect? In this paper, we compare university-enrolled students to other MOOC participants and in particular other self-enrolled students, to examine how and why they socialize on and around the MOOC. Using data from two French MOOCs in project management, we show that university-enrolled students are less attracted by forums and seem to interact less than others when the workload increases, which could lead to misleading conclusions when analyzing data. We therefore encourage MOOC researchers to be particularly mindful of this new trend when performing social network analyses.

Keywords: MOOC · Social interaction · Interaction motivation · Students · Enrollment

1 Introduction

MOOCs have started as an alternative to traditional education and have met a notable success in lifelong learning. However, universities and higher education institutions - which were the original target for MOOC education - are now catching up and implementing MOOCs in their curriculum, with professors either suggesting or requiring that their students register and complete a MOOC as part of their class.

This growing use of MOOCs in universities raises a question: does this new public behave in a specific way when compared to self-enrolled students? Self-determination theory [1] highlights how the nature of the motivation (extrinsic vs. intrinsic) plays a critical role in learning outcomes. Thus, whether a MOOC student is self-enrolled or compelled to enroll might play a critical role in their learning behavior. Only one study so far has compared MOOC vs. for-credit courses but it did not consider the fact MOOCs could be included in for-credit courses [2]. Of course, one would expect a

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 31–36, 2019.
https://doi.org/10.1007/978-3-030-19875-6_4

much lower dropout rate (*i.e.* no “funnel of participation” [3]) when registration is compulsory, but what about other behaviors?

Another key aspect is that university-enrolled students have an easy offline access to other people following the MOOC, and therefore may not need as much to go towards forums or dedicated pages on social networks. It is well-known that socialization is key to learning [4], with isolation being often mentioned as one of the major factors for dropping out [5]. Thus, one can wonder how this might affect the reliability of some observations in the data collected. Indeed, detecting the loss of social relationships has been shown to be an important way to detect early drop-out in MOOCs [6], and several tools have been developed to help with this issue [7, 8]. One could also wonder the impact this population might have for social network analyses, a common method [9], particularly when dealing with MOOC data [10].

In this study, we compare online social behaviors like the use of discussion forums, social networks, and other means of interacting with peer learners. More precisely, we chose to investigate the following research questions:

(RQ1) Are students enrolled by their university socializing differently from other MOOC participants in general?
(RQ2) Are students enrolled by their university socializing differently from other MOOC university students in particular?

Our hypotheses are that students enrolled by university must be doing most of the socialization outside of the platform, with their classmates, and therefore should be less interested in socializing with other MOOC participants. They should therefore differ from both MOOC participants, and other (self-enrolled) students in particular.

2 Methods

2.1 Datasets and Subsamples

We consider two datasets corresponding to two different sessions of the same French MOOC on project management called GdP. It corresponds to the 6th (2015) and 8th (2016) edition of this popular biannual MOOC, and referred further on as GdP6 and GdP8. This MOOC allows participants to obtain a *basic certificate*, corresponding to a moderate workload (15–25 h), as well as an *advanced certificate*, corresponding to a heavier workload (35–45 h). For each of the following analyses, we therefore split the datasets in two, depending on the certificate the participants were working on. Moreover, several universities suggest or compel their students to follow this MOOC as part of a larger training course in project management, which allows us to investigate our initial question by considering two separate samples: (1) “university-enrolled students” (**UES**), for the MOOC participants enrolled by their university, (2) “other MOOC participants” (**OMP**), for the rest of the participants (enrolled on their own). Students in the latter categories were coming from 3 to 8 different curriculum associated to 6 different universities. Additionally, in GdP8, participants were also asked about their socio-professional status, which allows to split the second sample into two subsamples: (2.1) “self-enrolled MOOC students” (**SES**), for participants who declared to be students but for whom we knew they had not been enrolled by their university, (2.2) "non-students" (**NS**), for participants who declared they were not students (*i.e.* unemployed, retired or already employed persons). Participants who did not reply to this question are not considered here. Figure 1 presents a summary of the different aforementioned subsamples for both datasets with their respective sizes.

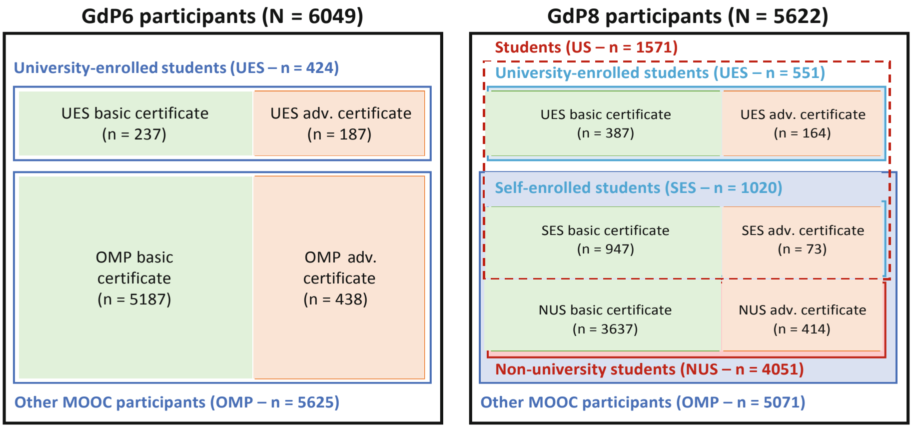

Fig. 1. Summary of the samples used from both datasets (GdP6 and GdP8).

To answer RQ1, we compared samples UES and OMP from GdP6. To answer RQ2, we compared samples UES and SES from GdP8. Finally, to nuance our answer to RQ2, we also performed a comparison between samples SES and NS, to identify whether it was students overall who were different from other participants. For each research question, we compared separately participants who chose (or were asked by their university) to obtain the basic certificate from participants who chose/were asked to obtain the advanced track, and therefore performed 6 sets of comparisons.

2.2 Variables Considered, Data Coding and Cleaning

To investigate the need for socialization and the one that really occurred, we relied on 7 different variables extracted from a larger research questionnaire that participants filled at the beginning of week 3 of the MOOC. Although optional, this questionnaire is filled by most of the MOOC students still active at that point (85–95%). The variables correspond to the answers on a Likert scale to the following statements:

1. **ForUseful:** "I consider the forums to be useful to me" (from 1 - completely disagree to 5 - completely agree)
2. **SocNetUseful:** "To learn, I consider that social networks (Facebook, Google+, Twitter…) are useful to me" (from 1 - completely disagree to 5 - completely agree)
3. **ForUsed:** "I have participated to the forums" (from 1 - never, to 3 - regularly)
4. **SocNetUsed:** "I have exchanged on social networks to ask/answer questions, share experiences…" (from 1 - never, to 3 - regularly)

5. **TalkUnclear:** "I talk with other students regarding points of the course that seem unclear" (from 1 - completely disagree to 7 - completely agree)
6. **TalkCheck:** "I interact with other students to see if we have understood the same thing" (from 1 - completely disagree to 7 - completely agree)
7. **TalkHowTo:** "I interact with other students to know how to work in online courses" (from 1 - completely disagree to 7 - completely agree)

The first 4 variables allow to examine students' interest in the socialization tool on the MOOC, whereas the 3 following ones allow us to see what motivates students to interact with others. Variables 5 to 7 are only available for GdP8 and use a different 7-point scale as they are part of a larger questionnaire. For items 3 and 4, it did not seem relevant to consider more than 3 values considering the activity on forums.

This questionnaire includes several attention checks/trap questions (*e.g.* "please leave the answer to this question blank"): participants who failed at any of these were excluded from the dataset. Moreover, a few participants did not answer to all questions so the sample size for each analysis slightly varies.

3 Results

For each comparison, we ran a Mann-Whitney U test to compare whether the distribution of the answers for each variable were statistically different. To avoid the risk of type I error with multiple comparisons (*e.g.* 4 tests for RQ1 with GdP6 basic certificate), we corrected the results of each set of tests using Holm-Šídák method.

Table 1 provides a synthesis of the results. We do not report in details all the results, but for instance, for the first row of Table 1, when comparing (1) university-enrolled students (UES) to (2) other MOOC participants (OMP) in GdP6 for the basic certificate, a Mann-Whitney test indicated that for ForUseful (1) (med = 3, mean = 2.81) was inferior to (2) (med = 4, mean = 3.34), $U = 62209.0$, $p < 0.001$; for ForUsed (1) (med = 1, mean = 1.09) was inferior to (2) (med = 1, mean = 1.17), $U = 76731.5$, $p = 0.021$, however this result was not statistically significant after correction for multiple tests; other tests were not statistically significant when comparing these two samples.

Table 1. Results summary of Mann-Whitney U tests

GdP	Certificate	Samples compared	For Useful	For Used	SocNet Useful	SocNet Used	Talk Unclear	Talk Check	Talk HowTo
6	Bas.	UES/OMP	<***	<*	=	=	N/A	N/A	N/A
6	Adv.	UES/OMP	<***	<***	<***	<***	N/A	N/A	N/A
8	Bas.	UES/SES	<***	<*	=	=	=	=	=
8	Adv.	UES/SES	<*	=	<*	=	=	=	=
8	Bas.	SES/NS	=	=	>***	>***	> ***	>***	>***
8	Adv.	SES/NS	=	=	>*	>*	=	>*	>*

* p < 0.05 before adjustment for multiple tests, *** p < 0.05 after adjustment = means no stat. sig. difference between the two samples, < (resp. >) means the first sample had a stat. sig. lower (resp. higher) median/mean than the second sample

4 Discussion

To answer to RQ1, students enrolled by their university in the basic track found forums to be less useful to them than the other MOOC participants do, but they declared participating as often as other MOOC participants do, and this difference was not observed for social networks. However, when considering the advanced track, requiring a heavier workload, students enrolled by their university found less value in both forums and social networks, and declared using them less than other MOOC participants. This result is in line with our initial hypothesis, but the basic *vs.* advanced track comparison brings an additional insight: *the heavier the workload, the more university-enrolled students must rely on their real-life connections*. Conversely, with a moderate workload, despite their perception that forums are less useful, university-enrolled students seem to interact with others on the MOOC in a similar manner as other MOOC participants do (using both the forums and social networks).

When examining the results relative to RQ2, in the basic track, we observe the same difference between university-enrolled students and other students as we did between them and other MOOC participants (*i.e.* report that forums are less useful to them). This result confirms the difference comes from the university-enrollment factor and not from being students. However, when comparing the two populations of students on the advanced track, the differences between them disappear.

When comparing self-enrolled students with non-students in terms of forum and social networks use and usefulness, the main difference is that in the basic track, students tend to use more and find social network more useful (which could be a generational difference, as students tend to be younger than others and younger people are heavier users of social networks). This difference however is no longer significant when considering the advanced track: the heavier the workload, the more self-enrolled students socialize like other self-enrolled MOOC participants.

Finally, if we consider the last 3 variables to examine what MOOC participants socialize for, there are no difference between self-enrolled students and other students. However *self-enrolled students socialize more with others than non-students*, for the 3 reasons considered here (clarifying misunderstandings, checking agreement on learning and making sure they use the platform well), particularly in the basic track.

5 Conclusion

Overall, we found that students enrolled by their university have the same motivation as other self-enrolled students to communicate with others. However, they consistently value less the social tools provided to them such as forums. Also, when the workload increases and requires more interaction with other to succeed (peer grading, group projects), whereas self-enrolled students tend to become more like the self-enrolled non-students in terms of use and perceived usefulness of the socialization tools, self-enrolled students become more different, as they rely more on their external socialization networks (classmates) for those tasks.

Knowing the importance of socialization for successful learning, it is critical for MOOCs pedagogical teams to be mindful of students enrolled by their university.

Indeed, ignoring their status when analyzing interactions between MOOC participants may lead to incorrectly assume they are dropping out (socializing less than others when they should do it more). As MOOCs become more and more integrated with the overall learning landscape, this is a pitfall more and more analyses might fall into if participants are not explicitly being asked about it. Finally, it might be worth to specifically encourage university-enrolled students to interact with each other through the forums: indeed, as students in general seem more prone to check their understanding with others (a good behavior, from a self-regulation point of view), losing the activity from this population forums might be detrimental to the rest of the participants.

One of the limits of this work is the reliance on a single MOOC: replication studies on other MOOCs would be necessary to validate those results. Future work will also involve checking students' performance and actual forum usage from log data.

References

1. Ryan, R.M., Deci, E.L.: Toward a social psychology of assimilation: self-determination theory in cognitive. In: Self-Regulation and Autonomy: Social and Developmental Dimensions of Human Conduct, p. 191. Cambridge University Press (2013)
2. Almeda, M.V., Zuech, J., Utz, C., Higgins, G., Reynolds, R., Baker, R.S.: Comparing the factors that predict completion and grades among for-credit and Open/MOOC students in online learning. Online Learn. **22**, 1–18 (2018)
3. Clow, D.: MOOCs and the funnel of participation. In: Proceedings of the Third International Conference on Learning Analytics and Knowledge, pp. 185–189. ACM, New York (2013)
4. Wilcox, P., Winn, S., Fyvie-Gauld, M.: "It Was Nothing to Do with the University, It Was Just the People": The role of social support in the first-year experience of higher education. Stud. High. Educ. **30**, 707–722 (2005)
5. Croft, N., Dalton, A., Grant, M.: Overcoming isolation in distance learning: building a learning community through time and space. J. Educ. Built Environ. **5**, 27–64 (2010)
6. Yang, D., Wen, M., Rosé, C.P.: Peer influence on attrition in massive open online courses. In: Proceedings of the 7th International Conference on Education Data Mining, London, UK, pp. 405–406 (2014)
7. Labarthe, H., Bouchet, F., Bachelet, R., Yacef, K.: Does a peer recommender foster students' engagement in MOOCs? In: Barnes, T., Chi, M., and Feng, M. (eds.) Proceedings of the 9th International Conference on Educational Data Mining, Raleigh, NC, USA, pp. 418–423 (2016)
8. Potts, B.A., Khosravi, H., Reidsema, C., Bakharia, A., Belonogoff, M., Fleming, M.: Reciprocal peer recommendation for learning purposes. In: Proceedings of the 8th International Conference on Learning Analytics and Knowledge, pp. 226–235. ACM, New York (2018)
9. Biancani, S., McFarland, D.: Social networks research in higher education. Educ. Stud. 85–126 (2013). https://doi.org/10.17323/1814-9545-2013-4-85-126/BibUnstructured>
10. Poquet, O., Dawson, S.: Untangling MOOC learner networks. In: Proceedings of the 6th International Conference on Learning Analytics & Knowledge, pp. 208–212. ACM, New York (2016)

On the Use of MOOCs in Companies: A Panorama of Current Practices

Jean Condé and Matthieu Cisel(✉)

Laboratoire EDA, Université Paris-Descartes,
45 rue des Saint-Pères, 75006 Paris, France
mathieucisel@parisdescartes.fr

Abstract. MOOCs represent an opportunity for companies to either save money, by asking their employees to follow a free course instead of using paying services, or to freely increase the proportion of workers who benefit from training opportunities. Some companies go beyond providing mere encouragements to follow these online courses. They can set common time slots for employees to collaborate on the course, allow them to follow the MOOC during working hours, discharge them of some tasks, or even reward, to some extent, those who manage to complete the course. In this article, we study these practices through a survey that was answered by 1847 users of Unow, a French platform that used to design MOOCs that targeted companies. It is uncommon for employees to be allowed to follow the course during working hours. MOOCs are typically integrated in an informal way, since they do not fit in the traditional frameworks structuring professional training in companies. It comes at a risk for employees, who may have to negotiate in an interpersonal way in what conditions the course is followed, without the protection of negotiated company agreements.

Keywords: MOOC · Professional training · Companies

1 Introduction

1.1 MOOCs in Companies

Over the past five years, MOOCs have gone through at least two major paradigm shifts. Firstly, free certificates or statements of accomplishment have disappeared in most important platforms, like Coursera or edX (Shah 2015). Secondly, focus on professional training has increased substantially (ibid). As it was shown repeatedly through surveys, adult learners often follow MOOCs on their own initiative, on their free time without referring about it to their colleagues. Nevertheless, learners sometimes follow the course in a collective manner, notably to address the issues that arise when one follows the MOOC on their own, lack of motivation being one of them (Cisel 2018).

These interactions sometimes occur in work settings (Castaño-Muñoz et al. 2017; Hamori 2017), whether the initiative is taken by the workforce, or by the management. Involvement of the highest levels of management sometimes reflects the fact that for companies, MOOCs represent an opportunity to either save money, by asking their employees to follow a free MOOC instead of using paying services, or to freely

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 37–46, 2019.
https://doi.org/10.1007/978-3-030-19875-6_5

increase the proportion of workers who benefit from training opportunities. As Condé (2018) described through field observations in various structures, some companies go beyond mere encouragements to follow these online courses. These courses may be integrated in an informal way (Condé 2018), since they do not fit in the traditional frameworks structuring professional training in companies. It comes at a risk for employees, who may have to negotiate in an interpersonal way in what conditions the course is followed, without the protection of negotiated company agreements.

This consideration led us to investigate several questions on how the MOOC was used in companies, and more specifically: Who usually takes the initiative to register to a MOOC in a company, employees, or employers? What kind of support does the employer provide to its workforce in order to foster engagement in the course? How strong are the interactions between MOOC users from the same workplace? How often do they occur, and in what circumstances?

We addressed these questions through a survey that was answered by 1847 users of the Unow platform, one of the most important French MOOC platforms (Cisel 2016) at the time of this study. It is specialized in the design and broadcast of MOOCs addressing the needs of professional training in companies.

There has been a significant number of research articles, typically based on qualitative approaches (Milligan and Litllejohn 2014), on interactions that occur outside the boundaries of the course platform: on the workplace, among students, etc. They had revealed, however marginally, that MOOCs were used in a company setting (Cisel 2018). However, to our knowledge, there is little research, let alone quantitative research, on how these courses are used in a company setting. Research carried out in companies typically focus on how MOOCs' certificates are perceived by employers (Radford 2014).

This work is part of a larger study, based on mixed methods, that laid emphasis on the issue of inequities in the ways MOOCs are used. Consistently with this thematic, we used Sen's (2000) concept of capabilities as a framework to analyze our data. As we will see, this theoretical framework has gained momentum over the past decade in many researches on adult education. In the following paragraphs, we present some of the most important elements of the theory.

1.2 From the Capability Approach to Empowering Organizations

We used Zimmermann's (2014) concept of empowering organizations to analyze our data. It derives from Sen's concept of capabilities. In the following paragraphs, we will go further into details about this framework. As Lambert et Vero (2007) stated, the capability approach is a theory of social justice that takes its origins in economical researches and political philosophy, notably in Rawl's (1971) book, "A theory of justice'. It was adapted to various fields in the past decades: labor law (Caillaud 2007; Caillaud et Zimmermann 2014), sociology (Zimmerman 2016; Farvaque et Bonvin 2005, Lambert et Vero 2007, Conter et Orianne 2011), and education sciences (Fernagu Oudet 2012, 2016; Boboc et Metzger 2015; 2017). The latter authors used it as a conceptual framework to analyze the tensions arising from the ongoing transformations of professional training, and notably the fact that employees are increasingly accountable for their training, and, more globally, for their employability.

The concept aims at providing a better understanding of people's empowerment, by going beyond the mere resources and rights one can benefit from (Robeyns 2003). It can be used at various levels: political, organizational, individual or pedagogic. It was notably used to deconstruct the idea that the causes of the ongoing inequities of access to professional training are to be found in individuals, and their appetite for learning (Lambert et Vero 2007), rather than in the social and organizational context.

Sen uses the capability approach as a framework to analyze inequities. It relies on two key concepts: functioning and capabilities. "Functionings represent parts of the state of a person–in particular the various things that he or she manages to do or be in leading a life. The capability of a person reflects the alternative combinations of functionings the person can achieve, and from which he or she can choose one collection" (Sen 2000). While some theoretical models consider liberty as a mean to an end, he considers it as a space, that should be studied *per se*. It "distinguishes it from more established approaches to ethical evaluation, such as utilitarianism or resourcism, which focus exclusively on subjective well-being or the availability of means to the good life, respectively" (Sen 2000).

According to Sen, it is not enough for an individual to have access to resources; one should also have the possibility to convert them into accomplishments that can be valorized. Resources ought to be converted into capabilities, or real opportunities, through conversion factors (Fernagu Oudet 2012). For Sen, resources correspond to everything an individual has to increase his well-being, whether they originate from the public, the private, or the associative sectors (Bonvin et Farvaque 2007). They are described by Sen as external to an individual. Internal dispositions, notably psychological ones (cognitive, conative, metacognitive) are categorized as personal conversion factors (Pierik and Robeyns 2007; Le Morellec 2014). Robeyns (2000) and Bonvin and Farvaque (2007) distinguish three types of factors. Individual factors correspond to characteristics and skills, social factors to sociopolitical and cultural context, and environmental factors to the geographical and organizational context an individual evolves in.

The work of Lambert and Vero (2007) corresponds to one of the first empirical researches that applied the capability approach in the field of professional training. It uses a large-scale survey-based investigation to grasp inequities in the professional training; this study inspired our research to a great extent. It provided insights into the opportunities for training (like the training sessions that were proposed, and accepted or declined by the employee), and the surrounding constraints (notably whether the session is mandatory or optional). One of the results of such investigations is that some organizations lay a strong emphasis on the professional development of their employees. These organizations are defined by Vero and Sigot (2017) and Zimmermann (2014), as empowering organizations, a concept that will be instrumental in analyzing our data.

2 Methods

We based our research on a survey that was sent to more 1847 learners, mostly through the French Unow MOOC platform. The items of the survey focused on the modalities of the following of the class, which correspond to conversion factors. How employees were informed regarding the MOOC, how much they were incited or compelled to follow the course, to what extent the certificate was paid by the company, monitoring of the time spent on the course, to what extent learners were discharged from work related tasks while they were following the MOOC, the nature and origin of help (for learners who declared they had received some help).

The survey was sent in fifteen different MOOCs that had been organized in the platform; these courses were not running and were closed. We collected 1847 answers through the survey. The link to the survey was sent in their mailbox to all users who had agreed to receive mails from Unow. The flagship course of the platform, the project management MOOC from Central Lille (Bachelet and Chaker 2017), accounted for 35% of the answers. Each remaining course accounted for less than 15% of the answers each. They covered topics such as Digital Human Resources, Digital Marketing, Social Networks, Disrupting Innovations, or Design Thinking. All these courses offered a paying certificate. The few learners who had registered to more than one course in Unow were asked to report they experience only in the course they had engaged in the most.

From the sociodemographic point of view, our results were consistent with what was published in the scientific literature. Both average and median age of our sample was 42 ($\pm$7) years old; 78% of respondents are on the job market, 9% are students; 55% have a Master degree or a PhD. Also consistent with studies on interactions between learners (Cisel 2018), we saw that most registrations originated from the learner itself. The following survey was addressed only to learners who were employed by a private company; they represent 1316 out of 1847 respondents. Among them, 29% work for large companies (over 5000 employees), 34% for companies of intermediate size (between 250 and 5000 employees), 26% for small-size and middle-sized companies (between 20 and 259 employees), and 12% for very small companies (below 20 employees).

Some questions were directed only to learners who had chosen a specific item. For instance, items on modalities of support by companies were only available for learners who worked in a company that had put in place a form of support. In the following section, we will specify the category of learner a question was addressed to, and provide descriptive statistics associated of the answers we obtained through out survey. It is important to note that these descriptive statistics do not include standard deviation, since there is little meaning, in our argumentation, to compare descriptive statistics among courses.

3 Results

About 82% of learners had registered in the course at their own initiative, 3% by friends, family, 5% by a colleague, and 9% had been incited to register by their hierarchy. It is in this kind of situation that formalization is the more likely to happen. It is not uncommon for employees to notify their employer when they follow a course that is related to their professional development, with 28% of all employees being this configuration; nevertheless, they usually talk about it with colleagues that do not correspond to their managers (34% or occurrences) (Table 1). This may be linked to the fact that most of the time, the following of the MOOC is initiated by employees themselves, and less commonly by the employer. For 51% of learners where the employer incited to follow the course, the company incited to do so to all its employees, and in 40% to only a subset of its employees. In some rare occurrences (9%), the MOOC was recommended to the respondent only.

The next question is how the employer supported their employees, whether it is by authorizing to engage in the course during working hours, by providing financial support, or by discharging them of work-related tasks. In almost half of the cases (47%), they were allowed to follow the course fully (24%) or partially (23%) during working hours (Fig. 1). Nevertheless, this authorization was formally delivered in a written manner in only 12% of the cases. Other respondents were tacitly authorized to follow the course on their working hours, or were not accountable for the way they managed their time. While it is common to follow a MOOC during working hours when it is linked to professional development, it is very uncommon (2% of employees) to be discharged of some professional tasks to foster collaboration. When employees were incited to follow the MOOC by their employer, it was very uncommon to receive financial support from their company. The question regarding the discharge of professional tasks was asked only to the learners who had notified their hierarchy that they were following a MOOC. The vast majority (98%) declared that they followed the online course in addition to their usual tasks.

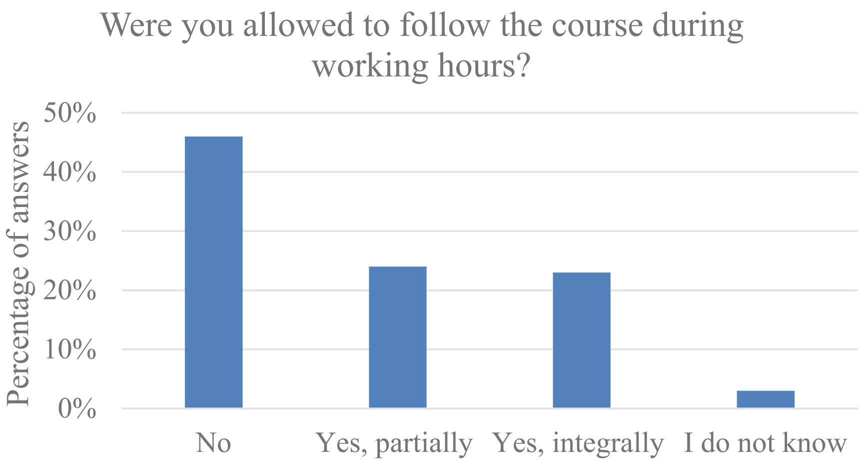

Fig. 1. Distribution of the answers to a question addressed to l*earners who notified their management that they were following a MOOC (N = 753)*

Table 1. Phrasing of the questions used in the survey, and descriptive statistics of the answers. In italics, we specify to which category of learners a question was addressed to.

Did you get financial support for following the MOOC?	
Employees (N = 1275)	
Yes, totally: 7.1%	I do not know: 3.2%
Yes, partially: 1.3%	No: 88.3%
Have you been discharged of some professional tasks to follow the MOOC?	
Learners who notified their management that they were following a MOOC (N = 753)	
Yes: 2%	No: 98%
Were you allowed to follow the course during working hours?	
Learners who notified their management that they were following a MOOC (N = 753)	
No: 46%	Yes, integrally: 23%
Yes, partially: 24%	I do not know: 3%
Was there a formal written authorization to follow the course during working hours?	
Learners who had asked whether they could follow the course partly or totally during working hours (N = 575)	
Yes, formally: 12%	Yes, tacitly: 28%
I am not accountable for how I spend my time: 42%	The MOOC is not about my work: 19%
Was it mandatory to follow the MOOC?	
Employees who were incited to follow the class by their hierarchy (N = 125)	
Yes: 12%	No: 88%
Who did you tell about the fact you followed the MOOC?	
All employees (N = 1275)	
Direct manager: 14%	One or several colleagues: 36%
Direction or administration: 14%	
Whom did your hierarchy propose to follow the course?	
Employees who were incited to follow the class by their hierarchy (N = 116)	
To me only: 9%	To a specific group of employees: 40%
To all employees: 51%	
Have you followed the MOOC synchronously with other colleagues?	
All employees (N = 1275)	
Alone: 82%	With colleagues: 14%
With friends of family: 5%	
When would interact with your colleagues regarding the MOOC?	
Employees that interacted with colleagues they followed the course with (N = 169)	
No exchange: 12%	Informal moments: 77%
Meetings with dedicated time slots: 10%	
How often would you meet to discuss about the course?	
Employees that interacted with colleagues they followed the course with (N = 136)	
We would not meet: 53%	Once during the MOOC: 7%
Twice or thrice during the MOOC: 9%	Once a week or more: 31%

For MOOCs that were broadcasted by the *Unow* platform, it was more common for learners to interact with colleagues than with friends or family, which is consistent with the fact that the courses we studied were related to professional development, especially the flagship course on project management, that accounts for most answers in the survey. We focused on how the course was used when it was followed synchronously by other colleagues, which concerned only 173 respondents. They were asked how often and in what circumstances they would interact with their colleagues. Interactions occur mostly during informal moments (77%), and rarely during meetings with dedicated timeslots (10%). Such interactions, when they occur, sometimes only once (6% of respondents), but more often between once or twice a week during the whole MOOC (31% of situations).

4 Discussion

Even when they manage to convince their colleagues to follow an online course they registered to, most adult learners who engage in MOOCs for professional motives do not benefit from a formal support from the employer. However, sometimes the top management of a company takes some measures to foster the use of these courses with regards to professional development. They can set common time slots for employees to collaborate on the course, allow them to follow the MOOC during working hours, discharge them of some tasks, or even reward, to some extent, those who manage to complete the course. The descriptive statistics we have presented in this article cannot account for the diversity of situations that occur in the workplace. The interpretations we will provide, notably through the notion of empowering organization (Zimmerman 2014), also derive from both qualitative observations that were carried out in three companies (Condé 2018), and from further analyses of our dataset based on clustering techniques.

Based on Sen’s (2000) “Capabilities” theoretical framework, that inspired the notion of empowering organization, we will present two types of approaches in these companies, the “informal agreement” approach, and the “empowering organization approach” (Zimmerman 2014). They represent two of various situations that were described more thoroughly in a recently published doctoral dissertation (Condé 2018). We chose them because they correspond to the extremities of a gradient, where at one side there is little formalization, and at the other side, a support that takes many shapes and forms.

The first approach was labelled the *Informal Agreement*: there is an informal incitation to follow the course, mostly interpersonal, via the middle management of a structure. In this situation, neither Human Resources nor social partners (for instance, unions) take part in the design of the conditions of the course project. The conditions of engagement in the course (dedicated time, discharges, funding) are negotiated in an interpersonal way, usually with the direct manager. This negociation is not regulated collectively nor formally by the administration. In this configuration, MOOCs are proposed mostly because of the absence of alternatives that could satisfy the same need, and outside of any clear professional development strategy. This approach exists in all types of companies, regardless of their size. This Informal agreement approach corresponds to situations that are unlikely to foster the development of capabilities, in all their dimensions, and have a high chance to increase the inequities in the abilities of people to develop professionally.

The empowering organization (Zimmerman 2014) corresponds to the situation where there is a long-term professional development strategy and MOOCs can become part of a larger scheme, and complement existing strategies. As much as possible, MOOCs are integrated with the professional development plan. When possible, management asks to have the possibility to follow how learners performed in a MOOC, and whether their employees completed the course and obtained the certificate of completion. Nevertheless, this is only possible for platforms like Unow, where such additional services can be sold to a company, and belong to the Freemium offer that can help the MOOC have a sustainable economic model, despite of the fact that the registration is free. Social partners can be associated to the choices of the conditions in which a MOOC is followed, despite of the fact that the online course does not belong to a formal framework of professional training.

There are several issues that companies that want to include MOOCs in their professional development strategy face. First, they need to follow the dates of release of each course, on several platforms. It comes at a cost, and some start-ups, like Mymooc in France, focus on providing to the companies they partner with a precise scheduling of the oncoming training sessions that may be of interest for them. Course designers do not adapt the schedule of the MOOCs to the needs and constraints of organization, which becomes an incentive for companies corresponding to empowering organizations to privatize some versions of the course, and therefore to provide both course designers and hosting platforms with an economic model. Should the company favor informal solutions, by encouraging their workforce to engage in the course without a proper framework to follow, it comes at a risk even if it can allow companies to save money.

5 Conclusion

MOOCs offer a large amount of flexibility, not only because, as the newest avatar of distance education, they lift geographical constraints, but also because, as free courses, they enable companies to circumvolute all the administrative and legal issues involved by the organization of a formal training session. In other words, by remaining outside of the formalized training systems, they represent “outlaws” in the professional training ecosystem; it comes with advantages, but also with disadvantages. While this flexibility can solve a certain amount of issues, such as access to training to traditionally less favored members of the workforce, it can also come at a cost for employees. Since these courses lay outside of collectively negotiated conditions, there is less weigh of the collective. The risk is that people have to negotiate with their employer the conditions of training in an individual manner, with an unfavorable power balance. For instance, they might be strongly incited to follow the course, without being formally authorized to follow the MOOCs during their working hours. This is more generally one of the issues are bound to happen when the world of Open Education intersects with the world of professional training. A better understanding on how Open Education can benefit and sometimes affect the workforce would be needed to fully apprehend the consequences of its development. We are likely to witness unexpected negative consequences if the lack of a legal framework becomes a burden to employees.

References

Bachelet, R., Chaker, R.: Toward a typology of MOOC activity patterns. In: Delgado Kloos, C., Jermann, P., Pérez-Sanagustín, M., Seaton, D., White, S. (eds.) EMOOCs 2017. LNCS, vol. 10254, pp. 134–139. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-59044-8_15

Boboc, A., Metzger, J.L.: La formation en entreprise au défi de la coopération: apports et limites des dispositifs numériques. Biennale de l'éducation, de la formation et des pratiques professionnelles (2015), Coopérer, Paris, France (2015). https://hal.archives-ouvertes.fr/hal-01185089

Bonvin, J.M., Farvaque, N.: L'accès à l'emploi au prisme des capabilités, enjeux théoriques et méthodologiques. Formation emploi. Revue française de sciences sociales (98), 9–22 (2007)

Caillaud, P.: La construction d'un droit de la formation professionnelle des adultes (1959–2004). In: Brucy, G., Caillaud, P., Quenson, E., Tanguy, L. (dir). Former pour réformer, pp. 171–210. La Découverte, Paris (2007)

Caillaud, P., Zimmerman, B.: Sécurisation des parcours et liberté professionnelle: de la « flexicurité » aux capacités. Formation emploi (2011)

Castaño-Muñoz, J., Kalz, M., Kreins, K., Punie, Y.: Influence of employer support for professional development on MOOCs enrolment and completion: results from a cross-course survey. In: Proceedings of the European Stakeholder Summit on Experiences and Best Practices in and Around MOOCs (EMOOCS 2016), Graz, Autriche, pp. 251–263 (2016). http://emoocs2016.eu/wp-content/uploads/2016/02/proceedings-emoocs2016.pdf

Cisel, M.: Utilisation des MOOC, éléments de typologie. (Unpublished doctoral dissertation), ENS Paris-Saclay, Cachan, France (2016)

Cisel, M.: Interactions in MOOCs: the hidden part of the Iceberg. Int. Rev. Res. Open Distrib. Learn. **19**(5), 197–213 (2018). https://doi.org/10.19173/irrodl.v19i5.3459

Condé, J.: Logiques d'utilisation des MOOC en entreprise au prisme des capabilités (Unpublished doctoral dissertation), ENS Paris-Saclay, Cachan, France (2018)

Condé, J., Huguenin, S.: Etat des lieux des MOOC au prisme de la conférence EMOOCS 2017. Adjectif.net (2017)

Conter, B., Orianne, J.F.: La flexicurité et la formation des demandeurs d'emploi: les politiques wallonnes à l'aune de l'approche par les capacités. Formation emploi **113**, 49–62 (2011). https://www.cairn.info/revue-formation-emploi-2011-1-page-49.htm

Fenwick, T.: Questioning the learning organization concept. In: Scott, S.M., Spencer, B., Thomais, A. (dir) Learning for Life: Canadian Readings in Adult Education, pp. 140–152. Thompson Education Publishing, Toronto (1997)

Fernagu Oudet, S.: Concevoir des environnements de travail capacitants: l'exemple d'un réseau réciproque d'échanges des savoirs. Formation emploi **119**, 7–27 (2012)

Fernagu Oudet, S.: L'approche par les capabilités au prisme de la formation: vers la conception d'environnements capacitants. Dans Fernagu Oudet, S.F., Batal, C. (dir) *(R)* évolution du management des ressources humaines (2016)

Hamori, M.: The drivers of employer support for professional skill development in MOOCs. In: Dans Kloos, C.D., Jermann, P., Perez-Sanagustin, M., Seaton, D.T., White, S. (dir). EMOOCs 2017: Digital Education: Out to the World and Back to the Campus, Madrid, Espagne, pp. 203–209 (2017). https://doi.org/10.1007/978-3-319-59044-8_24

Lambert, M., Vero, J.: Formation continue: quelles capacités d'action des salariés: L'approche par les capacités comme grille de lecture. Formation emploi **98,** 55–75 (2007). https://www.cairn.info/revue-formation-emploi-2007-2-p-55.htm

Le Morellec, F.: L'approche par les capabilités un nouveau cadre pour l'analyse de l'accessibilité universelle: application à la mobilité des personnes vieillissantes (thèse de doctorat non publiée). CNAM, Paris, France (2014). https://tel.archives-ouvertes.fr/tel-01153195/document

Milligan, C., Littlejohn, A.: Supporting professional learning in a massive open online course. Int. Rev. Res. Open Distance Learn. **15**(5), 197–213 (2014). https://doi.org/10.19173/irrodl.v15i5.1855

Radford, A.W., Robles, J., Cataylo, S., Horn, L., Thornton, J., Whitfield, K.E.: The employer potential of MOOCs: a mixed-methods study of human resource professionals' thinking on MOOCs. Int. Rev. Res. Open Distrib. Learn. **15**(5), 1–25 (2014). https://files.eric.ed.gov/fulltext/EJ1045984.pdf

Rawls, J.: A Theory of Justice. Harvard University Press, Harvard (1971)

Robeyns, I.: An unworkable idea or a promising alternative? Sen's capability approach re-examined. Econometrics (2000). https://core.ac.uk/download/pdf/6979068.pdf

Robeyns, I.: Sen's capability approach and gender inequality: selecting relevant capabilities. Fem. Econ. **9**(2–3), 61–92 (2003). https://www.tandfonline.com/doi/abs/10.1080/1354570022000078024

Sen, A.: Repenser l'inégalité. Seuil, Paris (2000)

Shah, D.: Less Experimentation, More Iteration: A Review of MOOC Stats and Trends in 2015 (2015). https://www.class-central.com/report/moocs-stats-and-trends-2015/

Subramanian, D., Zimmermann, B.: Voice in French corporate training: a critical issue in developing employee capability economic and industrial democracy. J. Econ. Soc. **43**(3), 520–545 (2017). http://journals.sagepub.com/doi/abs/10.1177/0143831X17704311

Vero, J., Sigot, J.C.: Comment les entreprises s'organisent pour mettre les salariés en capacité de se former. Formation emploi **1**(137), 73–95 (2017). https://www.cairn.info/revue-formation-emploi-2017-1-p-73.htm

Zimmermann, B.: Ce que travailler veut dire. Une sociologie des capacités et des parcours professionnels (2ème éd.). Économica, Paris (2014)

Zimmermann, B.: Développement des compétences et capacité d'agir. Fernagu-Oudet, D.S., Batal, C.: (dir) (R) évolution du management des ressources humaines: des compétences aux capabilités. Septentrion Presses Universitaires, Villeneuve D'Ascq, France (2016)

Exploring the Effect of Response Time on Students' Performance: A Pilot Study

Cristina Davino[1(✉)] and Emmanuel Zilberberg[2]

[1] Department of Economics and Statistics, University of Naples Federico II, Naples, Italy
cristina.davino@unina.it

[2] ESCP Europe/CREF, University of Paris Nanterre, Paris, France
ezilberberg@escpeurope.eu

Abstract. Teaching mediated by computers allows tracing some forms of students' participation as all their actions/reactions are recorded including time spent on any pedagogical resource offered. For a quiz, response time provides an additional variable enriching the simple correctness of answers. The present study intends to describe and model different patterns of time-related participation, performances (answer correctness) and the relation between the two parameters which measures the time productivity using quantile regression.

Keywords: Response time · Learning and teaching analytics · Quantile regression · Audience Response

1 Introduction

The Internet revolution allows the use and experimentation of innovative forms of teaching that makes extensive use of computers whether synchronously or not to cooperate and collaborate. While the MOOCs are mostly remote and asynchronous, Audience Response Systems are used during synchronous face to face lessons, also for technological constraints (dedicated radio/infrared terminals). Dematerialized/online artifacts are inevitably replacing the dedicated terminals and allow to extend the collection of data online instead of being face to face. Those artifacts should no longer be called classroom response systems since they can be used outside the class. Among the numerous names used, Audience Response System is the most adequate since audience is a word the meaning of which has gradually evolved away from the unity of place (radio, TV) and even the unity of time (book) to refer to "the people giving attention to something" (Oxford Dictionary[1]) thus wherever they are. Hence online massive usage of Audience Response Systems in MOOCs seems a natural evolution of what such artifacts were designed for.

The paper presents results of a pilot study where data are collected through an Audience Response System to explore if and how response time can affect students' performance.

[1] https://en.oxforddictionaries.com/definition/audience.

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 47–52, 2019.
https://doi.org/10.1007/978-3-030-19875-6_6

According to Schnipke and Scrams (2002), “the term response time refers to the time an examinee spends on an item in a test”. For Wise and Kong (2005), “response time is the difference in seconds between when an item is presented and when it is answered by the examinee”. Schnipke and Scrams (1997) identify two successive temporal behaviors as the time available for an examination decreases. They first observe an in-depth search of the correct response designated by solution behavior; this behavior can be replaced by rapid responses, not leaving sufficient time to deal with the question, which are then qualified as “rapid guessing”. Some researchers are interested to relate the temporal effort and the answers accuracy. A higher temporal effort doesn’t necessarily lead to a higher rate of correct answers. Thus, Lasry et al. (2013) observe: “a reversed speed-accuracy relationship because correct answers are given faster than incorrect ones”. Miller et al. (2014) come to a similar conclusion although the “response time difference is only statistically significant for easy questions”. The present paper is embedded in this conceptual framework and aims at relating the efforts provided by students in terms of response time and the results obtained. This goal is achieved proposing a static and dynamic analysis.

The paper is structured as follows: results of the static and dynamic analysis performed are simultaneously presented and discussed in Sect. 2 through the case study. Finally, some conclusions and further developments.

2 Data Description and Main Results

The experiment was carried out in a 15-h Management Accounting course with three classes of students belonging to a ESCP Europe program called MEB, Master in European Business in 2017. The case study is based on 116 students coming from twenty countries and almost symmetrically distributed according to age between 18 and 33 years. The data were collected with ActivInspire which includes rich functionalities of synchronous interactions provided by the vendor Promethean. The experiment relies on 12 sequences representing 31 questions asked during 5 face-to-face sessions. The questions asked are multiple choice or multiple answers questions. They are mostly conceptual but can rely on numeric data too. Considering the questions altogether, the participation rate is quite heterogeneous and symmetrically distributed.

The following analysis is mainly based on two variables: the percentage of right answers (with respect to the overall group of 31 questions) and the percentage of time used to answer (with respect to the total time allocated by the teacher).

Analyzing Patterns of Time-Related Performances: A Static Description
A first perspective to analyze patterns of time-related performances is to focus on the group of students with both the percentage of right answers and the percentage of allocated time used to answer to all the questions below the overall averages (Fig. 1) (the upper ordinate value is the average percentage of correct answers when the upper axis value is the average percentage of time used considering the allocated time). They represent students in quadrant III (Fig. 2) where students are plotted according to their percentage of right answers versus percentage of time used to answer all questions.

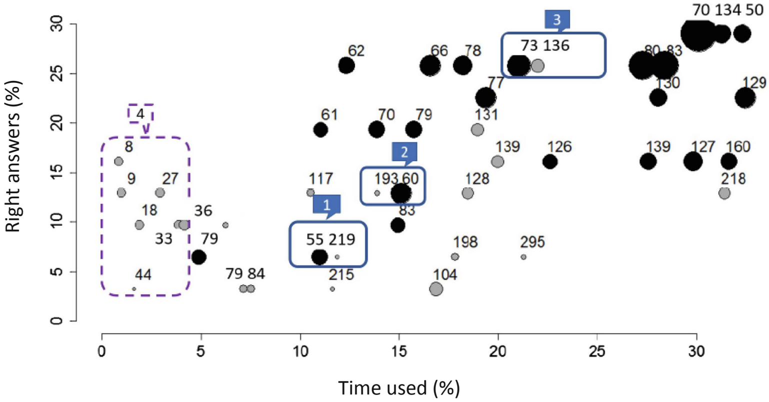

Fig. 1. Students with a percentage of right answers and time used below the average

This heterogeneous quadrant represents the highest percentage of our population (40%) and aggregates students who answered significantly fewer questions than the other quadrants (30.6%) with a conversion ratio (correct answers/answers provided) of 51.5%. In this chart, the dimension of bubbles represents the percentage of questions answered, thus a measure of students' participation. The black bubbles represent the students who have answered a higher percentage of questions than the quadrant's average which is equal to 30.6%. Conversely, the grey bubbles show the students who have answered a lower percentage of the quadrants average. The label of each point is the average response time per answer.

When one plots an horizontal straight line aligning bubbles, one observes students who have participated equally when considering the percentage of right answers provided. However, it doesn't mean their pattern of participation is identical as shown in the 3 areas (1, 2 and 3) highlighted in the chart. In the area 1, the left black bubble shows a student who has answered more questions than the student represented in the right grey bubble. Since they have used a similar total amount of time, the latter has used far more time per answer than the former (219/ 55 ~ 4 times more). Since they have a similar percentage of correct answers, the student on the left has a much lower rate of correct answers in relation to the answers he provided than the student on the right (see also the areas 2 and 3). These students in this context of facultative participation seem to have difficulties to self-regulate but their difficulties are not alike. Cosnefroy (2011) defines self-regulation as follows: "Every learner is thus faced with a double problem: getting to work and staying there. …The emphasis on the specificities of action leads to a crucial distinction between goal setting and goal attainment, motivation and volition. The former prepares decisions, while the latter protects the implementation of these decisions: motivation promotes an intention to learn, volition protects it[2]". The small bubbles show the behavior of students who have difficulty to find a motivation, to find reasons to start learning. Their motivation is sporadic,

[2] Translation by the authors.

fluctuating. The neighboring large bubbles show students who answer many questions very and possibly too rapidly given their low ratio of correct answers. They have difficulties to sustain, to protect their motivation. While the average time per answer of the two groups might seem relatively close (111,1 s for those who answered fewer questions versus 92 s who answered more questions) there is an important response time dispersion (standard deviation of 81,1 s for an average of 111,1 s) due to students who answered few questions very rapidly. Those students, whose low response times impact significantly the average time (area 4), are not only confronted with motivational difficulties but also with volitional challenges. The literature considers that below a certain threshold time depending on the question surface (text and/or figure), a response should be considered as "rapid guessing".

Modeling Patterns of Time-Related Performances: A Dynamic Analysis The previous analysis, purely descriptive and static, can be enriched by determining trends which show how the different identified profiles of students could benefit of an incremental usage of allocated time when considering their answers accuracy. A simple regression line (Ordinary Least Square, OLS) applied to the data shows that there is a positive relation between the percentage of correct answers and the percentage of allocated time used. That means that a higher usage of allocated time allows to obtain a higher rate of correct answers. However, an OLS regression only allows to consider an average student. Quantile regression (QR) (Koenker 2005; Davino et al. 2013) enables to explore if this (positive) relationship observed with the OLS changes when one considers categories of students who are quite far from the average performer. QR coefficients allow to analyze the contribution of each regressor on the entire conditional distribution of the dependent variable. The parameter estimates in QR linear models have the same interpretation as those of any other linear model.

A classical OLS and a QR regressions for a set of selected quantiles, the three quartiles (θ = [0.25, 0.5, 0.75]), are performed to explore the dependence relationship. The graphical representation of the regression lines can aid in interpretation of the results. Figure 2 shows OLS (solid) and QR (dashed) lines imposed on the scatterplot of the percentage of right answers and the percentage of time used to answer to all the questions. Greater variability of the response variable (Right responses) for higher percentages of time used is evident from the scatterplot and from the fan shape of the QR lines. The effect of the regressor (time used) remains stable around the average or median but differs in size below and above the median. The 3 quantile regression slopes are positive but the upper one (line 3) which aligns the performances of the best students has a higher slope than the lines 2/OLS and 1, which means that the best students would benefit much more from an incremental usage of the allocated time than an average student (OLS) who would also benefit significantly more from increasing her response time than a low-performing student (line 1). All coefficients are significant with p-values lower than 0.001 except for the intercept at 0.25. Moving from lower to higher quantiles, the effect of the time used on the right answers increases showing that the highest performers could take more advantage of an incremental use of allocated time than the lowest ones.

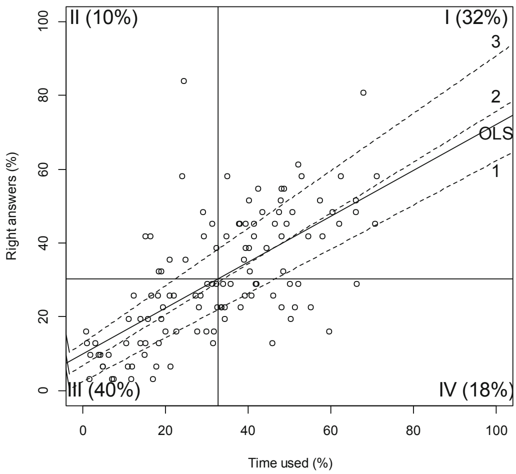

Fig. 2. Scatterplot with OLS and QR lines for the three quartiles

3 Conclusions and Further Developments

The analysis proposed in the paper exploits the capacity of Audience Response Systems to extract participation data, usually invisible, such as response times and transform them into teaching and learning analytics. Data collected through MOOCS represent an evolution of the concept of Audience Response System where the main novelty is represented by the magnitude of the collected data: there are no limitation to the number of students that can access the course and thus to the collected data.

The proposal doesn't aim at presenting inferences but a possible methodology for processing the data collected and for providing a description of the relationship between the use of the time allocated to students to answer each sequence of questions and the accuracy of the answers obtained (temporal productivity).

The analysis allows to investigate in more details a sub-category of students characterized by below-average time utilization and below-average accurate response rates. These are students who are confronted with self-regulation difficulties and that have been separated into two subcategories thanks to the study of average response times: motivational difficulties and volitional difficulties. Response time allows to observe differences between students obtaining similar grades.

Such an heterogeneity of students according to their learning strategies is further explored enriching the static analysis with a trend-based analysis of students' performance patterns which has shown a positive relationship between the incremental use of time allocated and the students' performance. In this regard, the paper proposes to go beyond the use of classical statistical models based on the exploration of "average effects" through the exploitation of potentialities of Quantile Regression. QR offers information on the overall conditional distribution of the students' performance, allowing us to discern effects that would otherwise be judged equivalent using only a static and average-based analysis.

This study presents some limitations. Response time is an indicator of maximum time on task since actual working time may be less due to procrastination and/or multitasking which "result in severe performance costs in terms of increased response latencies and/or error rates" (Fischer and Plessow 2015, p. 2). So, response time is as a proxy of temporal efforts. Nevertheless, it effectively measures the time taken by students to send their answer once they have been presented a question. Distraction from task, daydreaming or multitasking, whether managed or not is part of learning strategies (self-regulation), We don't think, even if it could be done, that this diverted time should be subtracted from response time to calculate the effective time on task.

We can explore further possible factors of heterogeneity: internal pedagogical variables such as the nature of questions (numerical or conceptual multiple-choices), but also sociodemographic variables such as gender, age, nationality, and former studies.

For Aguilar (2018, p. 39) "Learning analytics … is important because it has the potential to move away from the fallacy of designing toward the average". Audience Response Systems not only give a voice to all students who want to participate; they show that for certain students, temporal needs differ. Choosing an average time won't be adequate for the whole class and some students however need other resources than time to overcome their learning difficulties.

References

Aguilar, S.J.: Learning analytics: at the nexus of big data, digital innovation, and social justice in education. TechTrends **62**(1), 37–45 (2018)

Cosnefroy, L.: L'apprentissage autorégulé: perspectives en formation d'adultes. Savoirs **23**(2), 9–50 (2011)

Davino, C., Furno, M., Vistocco, D.: Quantile Regression: Theory and Applications. Wiley, New York (2013)

Fischer, R., Plessow, F.: Efficient multitasking: parallel versus serial processing of multiple tasks. Front. Psychol. **6**, 1366 (2015)

Koenker, R.: Quantile Regression. Econometric Society, Monographs No. 38. Cambridge, New York (2005)

Lasry, N., Watkins, J., Mazur, E., Ibrahim, A.: Response times to conceptual questions. Am. J. Phys. **81**(9), 703–706 (2013)

Miller, K., Lasry, N., Lukoff, B., Schell, J., Mazur, E.: Conceptual question response times in Peer Instruction classrooms. Phys. Rev. Spec. Top. Phys. Educ. Res. **10**(2), 020113-1–020113-6 (2014)

Schnipke, D.L., Scrams, D.J.: Modeling item response times with a two-state mixture model: a new method of measuring speededness. J. Educ. Meas. **34**, 213–232 (1997)

Schnipke, D.L., Scrams, D.J.: Exploring issues of examinee behavior: insights gained from response-time analyses. In: Mills, C.N., Potenza, M.T., Fremer, J.J., Ward, W.C. (eds.) Computer-Based Testing: Building the Foundation for Future Assessments, pp. 237–266. Laurence Erlbaum Associate Publishers, Mahwah (2002)

Wise, S.L., Kong, X.: Response time effort: a new measure of examinee motivation in computer-based tests. Appl. Meas. Educ. **18**(2), 163–183 (2005)

Blended Learning with MOOCs

From Investment Effort to Success: A Systematic Literature Review on Empirical Evidence

Maka Eradze[1,2](✉), Manuel León Urrutia[3], Valentina Reda[1], and Ruth Kerr[1]

[1] University of Naples Federico II, Naples, Italy
[2] Tallinn University, Tallinn, Estonia
maka@tlu.ee
[3] University of Southampton, Southampton, UK

Abstract. This paper reports on a systematic literature review by analysing 48 empirical studies on the use of Blended Learning with MOOCs. The results report on the pedagogically motivated, infrastructural and design-intensive efforts of the institutions. Moreover, they empirically confirm previously made claims that within hybrid initiatives, Flipped Classroom model is the most used one. They also indicate that blended learning in the context of MOOCs yields positive results. At the same time, most of the reviewed empirical research uses so called "*MOOCs as Driver*" model, where a traditional course in the curriculum is organized around a MOOC.

Keywords: MOOCs · Hybrid learning · Blended learning

1 Introduction and Related Work

Blended learning is an approach that harnesses the virtues of both face-to-face and online learning to deliver high quality teaching and learning experiences [1]. This is especially true for MOOCs on-campus, since the effort and resources invested in the development of MOOCs can yield positive results [2]. Attempts have been made to provide models for the use of MOOCs in the classroom, but there is a lack of empirical evidence on their effectiveness. Evidence-based frameworks can prove useful to help institutions make appropriate decisions.

There are a number of literature reviews on the general subject of MOOCs [3, 4] or specific aspects of pedagogical design, such as gamification in MOOCs [5, 6] but to the best of our knowledge, there are no systematic literature reviews that specifically focus on blended learning with MOOCs. Starting from existing frameworks and models, this paper provides a systematic literature review by mapping existing hybrid MOOC initiatives and empirical evidence based on 48 papers. The main contribution of this paper is a validated and updated framework [7].

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 53–58, 2019.
https://doi.org/10.1007/978-3-030-19875-6_7

2 MOOCs and Hybrid Initiatives

Higher Education institutions have a wide range of motivations for embracing MOOCs. These can range from addressing visibility and positioning needs to pedagogical and design concerns of the modern university teaching and learning [1]. However, there are also deterrents such as their lack of financial sustainability [8] and the research-evidenced reservations about MOOC pedagogies [9, 10]. To address infrastructural, pedagogical, and sustainability issues for the production of MOOCs, a discussion around *Hybrid Learning* Initiatives has opened within the institutions.

Blended learning can be described as "the thoughtful integration of classroom face-to-face learning experiences with online learning experiences" [1], taking the best from online and face to face teaching and learning. Hybridization or blending of MOOCs in the curriculum can range from a teacher designing and implementing their own MOOC to using external MOOCs [8]. Some authors indicate that one particular model – Flipped Classroom, is the most popular one within blended initiatives [7, 11]. This model is deemed as highly effective [12], although there is evidence that these kind of initiatives involve significant effort and careful design [13].

To the best of our knowledge there are few studies that offer taxonomies or models [14, 15] systematically and even fewer suggest a framework. To analyze MOOC-based blended learning, we use the H-MOOC framework provided by Pérez-Sanagustín et al. [7]. This framework uses models provided by two authors [14, 15] and maps them on two axes: (1) the institutional support needed (x-axis), and (2) the alignment of the hybrid initiative with the curricular content (y-axis). In this paper we use the same models (and identify new ones) to illustrate the existing situation via a systematic literature review:

Descriptive model 1: Zhang [15]: (1) Learner services for MOOC participants (2) MOOCs as Open Resources; (3) Flipped classrooms (4) Challenge courses for MOOCs and (5) Credit transfer from MOOCs.
Descriptive model 2: Kloos et al. [15] provided us with 6 hybrid models for integrating MOOCs with blended learning: (1) Local digital prelude (2) Flipping the classroom (3) Canned digital teaching with f2f tutoring (4) Canned digital teaching in f2f courses (5) Remote tutoring in f2f courses (6) Canned digital teaching with remote tutoring.

Flipped classroom was merged, so we ended up with 10 descriptive models. As a result of the framework evaluation, the author of the H-MOOC framework re-describes the existing institutional terrain in 4 models: (1) MOOC as a service (2) MOOC as a replacement (3) MOOC as a driver; and (4) MOOC as an added value. After using the 10 descriptive models for analysis, we used the 4 institutional models provided by [7] to map the current situation on the H-MOOC framework.

3 Methodology, Research Questions and Data Analysis

The study addresses the following research questions:

RQ1. Why MOOC-based Blended Learning?

RQ2. What type of blended learning models studies report? (are there any new models?)
RQ3. How was the approach evaluated? (methodological considerations of the studies)
RQ4. What is the research purpose and results reported?

To analyse the research works, the study follows 'PRISMA statement' [16] for systematic literature reviews. We ran a preliminary query in the following 4 scientific databases: IEXLORE, ACM, ISI web of knowledge, Scopus. The final query was built with the help of a bibliometric tool. The query was shaped by following keywords: *("Blended learning" OR blended OR hybrid OR "hybrid learning" OR flipped OR "flipped classroom") AND (mooc* OR "massive online open course*") AND ("higher education" OR "university" OR HEI)*. Running the query returned 470 papers. The search was filtered for 2013–2018, and was run between 24.10.18 and 29.10.18. The resulting 452 articles were subjected to a manual selection process, resulting in 48 papers. Inclusion criteria were: high quality empirical studies, mentioning all the keywords and within the scope. An initial abstract-based selection rejected 282 papers and there were 89 duplicates. At second stage selection, 33 articles were rejected after reading.

4 Findings and Discussion

Content analysis method was applied to analyse the selected papers [17]. A coding template was created through a content analysis that also established an initial inter-coder reliability, by analyzing a sample of 12 papers and negotiating the categories between the team of coders (4) [18]. In a second iteration of the process, with papers evenly-distributed between the research team, the categories found by open coding were renegotiated, and recoded by merging some of the codes. Codes are not self-exclusive and in most cases several codes could be applied to one article.

The systematic analysis of the selected papers resulted in the following findings[1], mapped against the research questions:

Reasons and Models: Main reasons were *added pedagogical value* (32%) (for instance [19, 20], followed by *educational transformation* (25%) and *student experience and support enhancement* (23%), 6% of papers report using blended learning as an *extension to MOOC offer*. Remaining issues are *Drop out rates, teacher support issues, visibility and positioning and other issues*. The main blended learning model is *flipped classroom* (43%) ([19, 20] or more concretely - Flipped Classroom with SPOCs (5%), followed by *Canned digital teaching in F2F courses* (25%) [21, 22]). No significant use of new models has been identified in this study but there are several models found: *synchronous digital teaching in F2F courses (2%)*, *remedial hybrid model with low levels of integration, wrapped MOOC model, existing MOOC repurposed as Open*

[1] Due to the publication page limit the full dataset with the list of articles is published on this link http://bit.ly/2FXPx4Z.

Educational resource and *student-centered online scaffolding, peer-led blended learning with MEC (massively empowered classroom)* (all single cases).

Methodology and Research Design: *Survey* and *case study* are most frequently used (20 papers), 14 papers used experiment for measurement and analysis. Contrary to expectation, learning analytics is one of the least used methods (only 13 papers). As regards research design, quantitative design is most frequently used (43%) against qualitative (40%) and mixed methods (17%).

Research Purpose and Results: The main purpose of the studies was to *test pedagogical theory* (33% of cases e.g. [21, 22]), followed by *student perceptions* (24%), *comparison of new and traditional form of learning* (17%, e.g. [20, 23]) and understanding success factors of learning (8%). Results indicate *improved* outcomes (75%) when using any type of blended approach with MOOCs against *mixed* and *neutral* results (15% and 8%). Although it is common knowledge that studies with negative learning outcomes/results are rarely reported, this finding is still significant.

The main outcome of the analysis of MOOC-based hybrid initiatives is the following mapping using H-MOOC framework (Fig. 1).

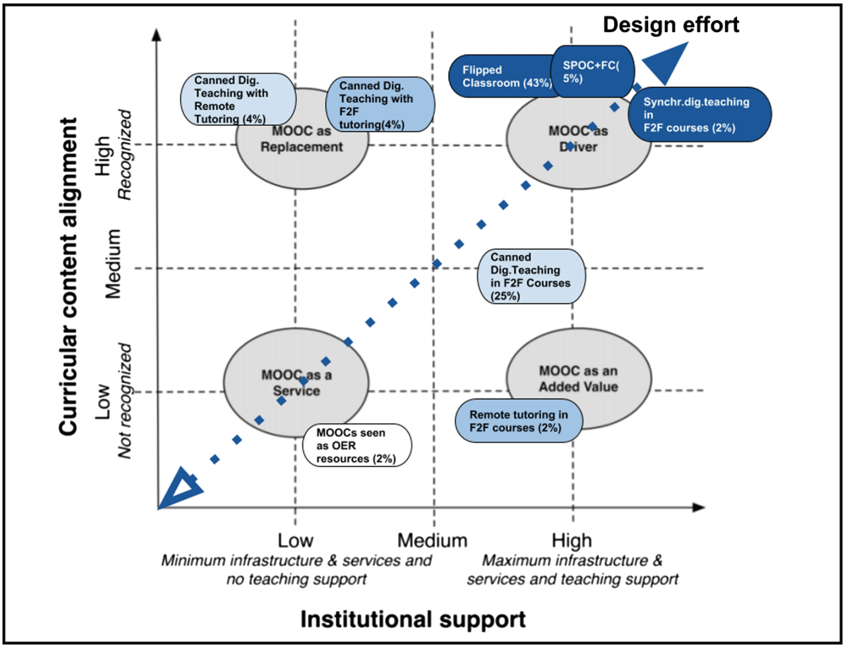

Fig. 1. Results mapped on H-MOOC framework: the blue line defines the pedagogical design effort in delivering *blended learning with MOOCs* – the darker the blue, the higher the design effort (Color figure online)

The mapping of the validated results on the existing framework indicates maximum curricular alignment, institutional support and the design effort included in the development of hybrid initiatives. The literature review revealed 1. Design-intensive approach – *Flipped Classroom* is the most widely used 2. The initiatives are pedagogically motivated and research aimed at the analysis of the pedagogical value. Moreover, the study results indicate the effectiveness of using MOOC-based hybrid initiatives. Thus, we conclude that most of the initiatives are design-intensive endeavors involving the highest infrastructural and teaching support with *MOOCs acting as a driver* for institutions resulting in successful educational offer.

Acknowledgments. This research has been supported by the funds provided within the frame FERSR 2014/2020, No. 792205 and Horizon 2020 research and innovation programme under grant agreement No. 669074.

References

1. Garrison, D.R., Kanuka, H.: Blended learning: uncovering its transformative potential in higher education. Internet High. Educ. **7**(2), 95–105 (2004)
2. Fair, N., Russell, S., Harris, L., Leon Urrutia, M.: Enhancing the student experience: integrating MOOCs into campus based modules. Editorial Octaedro (2019, in press)
3. Liyanagunawardena, T.R., Williams, S.A.: Massive open online courses on health and medicine: Review. J. Med. Internet Res. **16**, e191 (2014)
4. Gašević, D., Kovanović, V., Joksimović, S., Siemens, G.: Where is research on massive open online courses headed? A data analysis of the MOOC research initiative. Int. Rev. Res. Open Distance Learn. **15**, 134–176 (2014)
5. Khalil, M., Wong, J., De Koning, B., Ebner, M., Paas, F.: Gamification in MOOCs: a review of the state of the art. In: IEEE Global Engineering Education Conference, EDUCON (2018)
6. Ortega-Arranz, A., Muñoz-Cristóbal, J.A., Martínez-Monés, A., Bote-Lorenzo, M.L., Asensio-Pérez, J.I.: How gamification is being implemented in MOOCs? A systematic literature review. In: Lavoué, É., Drachsler, H., Verbert, K., Broisin, J., Pérez-Sanagustín, M. (eds.) EC-TEL 2017. LNCS, vol. 10474, pp. 441–447. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-66610-5_40
7. Pérez-Sanagustín, M., Hilliger, I., Alario-Hoyos, C., Kloos, C.D., Rayyan, S.: H-MOOC framework: reusing MOOCs for hybrid education. J. Comput. High. Educ. **29**, 47–64 (2017)
8. Albó, L., Hernández-Leo, D.: Blended learning with MOOCs: towards supporting the learning design process. In: The Online, Open and Flexible Higher Education Conference 2016 (2016)
9. Margaryan, A., Bianco, M., Littlejohn, A.: Instructional quality of Massive Open Online Courses (MOOCs). Comput. Educ. **80**, 77–83 (2015)
10. Armellini, A.: Are Massive Open Online Courses (MOOCs) pedagogically innovative? J. Interact. Online Learn. **14**(1), 17–28 (2016)
11. Albó, L., Hernández-Leo, D., Oliver, M.: Blended MOOCs: University teachers' perspective. In: CEUR Workshop Proceedings, pp. 11–15. Universitat Pompeu Fabra, Barcelona, Spain (2015)
12. Klemke, R., Eradze, M., Antonaci, A.: The flipped MOOC: using gamification and learning analytics in MOOC design—a conceptual approach. Educ. Sci. **8**(1), 25 (2018)

13. Rodríguez, M.F., Hernández Correa, J., Pérez-Sanagustín, M., Pertuze, J.A., Alario-Hoyos, C.: A MOOC-based flipped class: lessons learned from the orchestration perspective. In: Delgado Kloos, C., Jermann, P., Pérez-Sanagustín, M., Seaton, D.T., White, S. (eds.) EMOOCs 2017. LNCS, vol. 10254, pp. 102–112. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-59044-8_12
14. Delgado Kloos, C., Muñoz-Merino, P.J., Alario-Hoyos, C., Estévez Ayres, I., Fernández-Panadero, C.: Mixing and blending MOOC Technologies with face-to-face pedagogies. In: IEEE Global Engineering Education Conference, EDUCON (2015)
15. Zhang, Y.: Benefiting from MOOC. In: Herrington, J., Couros, A., Irvine, V. (eds.) Proceedings of EdMedia + Innovate Learning 2013, pp. 1372–1377. Association for the Advancement of Computing in Education (AACE), Victoria, Canada (2013)
16. Liberati, A., et al.: The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. J. Clin. Epidemiol. **62**, e1–e34 (2009)
17. Elo, S., Kyngäs, H.: The qualitative content analysis process. J. Adv. Nurs. **62**, 107–115 (2008)
18. MacQueen, K.M., McLellan, E., Kay, K., Milstein, B.: Codebook development for team-based qualitative analysis. Field Methods **10**(2), 31–36 (1998)
19. Konstan, J.A., Walker, J.D., Brooks, D.C., Brown, K., Ekstrand, M.D.: Teaching recommender systems at large scale: evaluation and lessons learned from a hybrid MOOC. ACM Trans. Comput. Interact. **22**(2), 10 (2015)
20. Zhang, M., Zhu, J., Zou, Y., Yan, H., Hao, D., Liu, C.: Educational Evaluation in the PKU SPOC Course "Data Structures and Algorithms." In: Proceedings of the Second (2015) ACM Conference on Learning @ Scale - L@S 2015 (2015)
21. Wan, H., et al.: Hybrid teaching mode for laboratory-based remote education of computer structure course. In: Proceedings - Frontiers in Education Conference, FIE (2016)
22. Andone, D., Mihaescu, V.: Integrating open education concepts in blended learning with MOOCs. In: 2018 IEEE 18th International Conference on Advanced Learning Technologies (ICALT), pp. 24–26. Politehnica University Timisoara, Timisoara, Romania (2018)
23. Rothkrantz, L.: Dropout rates of regular courses and MOOCS. In: Communications in Computer and Information Science. pp. 25–46. Delft University of Technology, Mekelweg 4, Delft, Netherlands (2017)

Goal Setting and Striving in MOOCs: A Peek Inside the Black Box of Learner Behaviour

Maartje Henderikx[1(✉)] and Marco Kalz[2]

[1] Open University, Welten Institute, Heerlen, Netherlands
maartje.henderikx@ou.nl
[2] Heidelberg University of Education, Heidelberg, Germany
kalz@ph-heidelberg.de

Abstract. Reaching goals can be challenging, especially if they are not in the near future like with learning in MOOCs. The aim of this explorative study was to get insight in this goal achievement process, which can help to understand learner behaviour. Two research questions were examined namely: (1) what goals do learners set, and do they succeed in reaching these goals? and (2) how does the course of action of several learners look taking Gollwitzer's Rubikon model of action phases as a guideline? We found that even though learners did not achieve the goals they set, they were still generally satisfied with the knowledge they gained. In addition, learners went more or less intuitively through the theorised action phases, yet typically did not take the time to deliberately plan (before the start) and evaluate (after finishing) their learning process. This insight can serve as starting point for developing supporting tools for learners and personalised dashboards, which can offer the tools at appropriate times in a learner's course of action.

Keywords: MOOCs · Online learning · Goal setting · Goal striving · Goal achievement

1 Introduction

Reaching goals can be challenging, especially if a goal is not in the near future [1] like with learning in MOOCs. Since the appearance of the MOOC, many studies focused on learner retention and behaviour as a way to unravel the success or failure of MOOCs [2]. In these studies completion of the course and acquisition of a certificate predominates as the expected main goal of learners. Gradually scholars agreed that due to the exceptional learning circumstances learners can have alternative learning goals in MOOCs and that there are a variety of goals learners can intend to achieve [3–5].

Yet, despite the vast and increasing amount of research about MOOC-learning covering many different topics [6], there are still important issues which need to be addressed in order to further our understanding of MOOC-learning. One of these issues concerns the course of action learners undertake after they decide they want to gain certain knowledge or skills. This starts with a learner's wish for (certain) knowledge and ends with the evaluation of the outcome [1]. Gollwitzer [1] proposes the Rubikon model of action phases to get insight into the processes involved in achieving goals.

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 59–69, 2019.
https://doi.org/10.1007/978-3-030-19875-6_8

This 4-phase model addresses questions like how individuals choose their goals (goal setting), how they plan and enact on the execution of these goals (goal striving) and how they evaluate their efforts.

Insight in the complete goal setting and goal striving process will help to understand learner behaviour in MOOCs and subsequently to develop useful interventions to support learners in this process. This paper presents an overview of a first explorative study explaining learner behaviour in MOOCs taking the Rubikon model of action phases as a theoretical guideline. The research questions that will be answered are: (1) what goals do learners set, and do they succeed in reaching these goals? And (2) How does the course of action of learners look?

2 The Rubicon Model of Action Phases

According to Gollwitzer [1, 7] a course of action (i.e. the process of forming an intention to evaluating actual behaviour) is a "temporal and horizontal path" (p. 6), that can be divided into 4 phases: (1) the predecisional phase, (2) the preactional phase, (3) the actional phase and finally the (4) postactional phase (see Fig. 1). Each phase is marked by a transition point; the end of the pre-decisional phase is marked by setting a goal, the end of the preactional phase is marked by planning on how to reach this goal and the initiation of actions and the end of the actional phase is marked by evaluating the achieved outcomes (see Fig. 1).

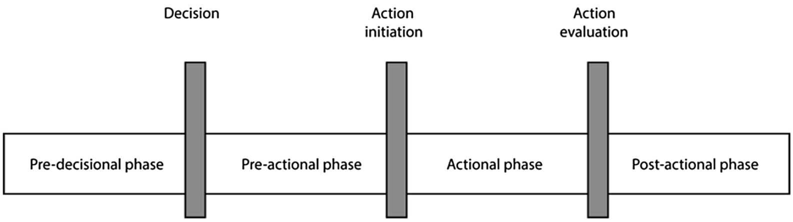

Fig. 1. The Rubikon model of action phases [1]

In the pre-decisional phase, which is about deliberating and weighing the different options an individual might have [1, 7], a specific goal is set or in other words a goal intention is formed. Translated to learning in MOOCs this means that a potential MOOC-learner might contemplate whether a MOOC fits his/her needs and wishes for gaining certain knowledge and subsequently decide to enroll. Furthermore, based on the available information about the content of the MOOC, learners will make a (first) decision about what they intend do in the MOOC. This may vary from the intention to browse to finish one or more modules to completing the course and getting the certificate. Due to the open accessible nature of MOOCs, learners can formulate their own individual intentions.

The preactional phase is about planning concrete strategies for achieving the set goal. Ideally a MOOC-learner should address issues like when, where and how learning will take place to strengthen the attainment of the specified goal intention and what action to take if something interferes with this initial planning [1, 7]. This is particularly important if multiple steps are needed to achieve the desired goal, or if a set goal cannot be reached in the near future [1]. The formulation of when, where, how plans is generally referred to as forming implementation intentions [8]. Implementation intentions have the purpose to shield a learner from getting distracted from unwanted and/or anticipated disturbances. The rationale is that by formulating if…then questions, anticipating issues that could hinder goal attainment, the chance of reaching the goal will increase. For example, if X happens, then I will perform goal-directed response Z [1, 7]. Also, the strength of the goal intention (how determined is someone to reach the intended goal) and the perceived behavioural control (someone's perception of the degree of control (s)he has over performing a behaviour) will have an effect on goal attainment [8, 9].

The actional phase revolves around enacting the strategies which were planned in the preactional phase in pursuit of goal achievement [1, 7]. During this phase, various disturbances may be encountered that can delay or even prevent individuals from reaching their goals. In MOOCs these disturbances, or barriers as they are generally referred to, can be either MOOC-related like or non-MOOC related [10, 11]. Typical MOOC- related barriers often mentioned by learners are lack of interaction, lack of instructor presence and bad course content [10]. Examples of Non-MOOC related barriers are insufficient academic knowledge, lack of time and technical issues like bad internet or lack of digital skills [10]. Depending on the strength of the goal commitment and whether the individual was sufficiently shielded from these barriers, the intended outcome will be achieved to a greater or lesser extent.

In the final phase, the postactional phase, an evaluation takes place of whether the goal striving has succeeded [1, 7]. This success depends on two criteria. The first criterion is whether the individual goal intentions, which were formed in the predecisional phase are achieved. Did the MOOC-learner achieve the goal that (s)he intended to achieve? According to Henderikx, Kreijns and Kalz [3] this can result into three different (goal) intention –behaviour (achievement) patterns: (1) the learner achieved the intended goal (inclined actor), (2) the learner did more than intended (disinclined actor), (3) the learner did not achieve the intended goal (inclined abstainer). The second criterion which must be addressed when evaluating the achieved outcome is whether the achievement matches the expectation. In other words, is the result of the goal striving in sync with the expected value. After finishing learning in the MOOC, a learner will assess whether the learning gains met expectations and satisfied all the learning needs. A proper postactional evaluation will benefit future deliberation and planning needs.

According to Gollwitzer [1, 7], there are some issues regarding the goal setting and goal striving process, as visualised in the Rubikon model of action phases, that need to be taken into consideration. Firstly, not every initiation of action is preceded by careful deliberation, and goal setting (forming a goal intention). Secondly, formation of a goal intention is not always followed by concrete planning i.e. forming implementation intentions. Thirdly, overlap between action phases is possible. In some cases, a course of action can be an iterative process. Fourthly, the decision points in the model, which mark the end of the phases do not represent points of no return, yet points of putting deliberation to rest and commitment to pursue a set goal.

3 Method

3.1 Participants

Participants took part in a MOOC about 'Governing climate change; Polycentricity in action'. The MOOC was designed by respective teams at the Open University of the Netherlands in cooperation with external parties. None of the authors was involved in the design of the course. The MOOC ran from September 2018 until the end of October 2018, covering 10 units in 8 weeks and the estimated study load was 4–5 h per week. A total of 49 learners enrolled in this MOOC of which 22 learners completed the pre-course survey (16 females, 6 males, M_{age} = 38,4 years, age range: 22–62 years, St_{dev} = 16,8). The post-course questionnaire was completed by 13 learners (11 females, 2 males, M_{age} = 36,4 years, age range: 22–62 years, St_{dev} = 11,8). In addition, 5 learners, 4 females and 1 male (M_{age} = 28,8 years, age range: 24–33 years. St_{dev} = 3,4) were recruited using convenience sampling, to provide additional in-depth information in the form of interviews.

3.2 Materials

To measure individual goal setting and goal striving a self-constructed set of items was used which was aligned with the design of the respective MOOC following Henderikx, Kreijns and Kalz [3]. Items covered increasing goal intentions from browsing, participation in one or more units, up to participating in all learning activities and requesting a certificate. These items were included in both pre- and post-course surveys of the MOOC. In the post-course survey learners were asked to indicate their actual goal achievement on the same set of items used in the pre-course survey taking into account the methodological issues of scale correspondence [12]. In addition, the pre-course survey included several general questions on gender, age, educational background, employment status and online learning experience and the post-course survey included additional questions about the perceived value of the learning and course satisfaction.

To gain deeper insight in the goal setting and goal striving process of the learners, a self–constructed set of open questions was formulated based on the Rubikon model of four action phases [1, 7, 8] for the purpose of face-to-face or email interviews. Example questions are: 'Were you looking for a MOOC specifically about this subject?' and 'Were you able to learn in the MOOC according to your plan?'. Questions regarding (perceived) control were derived from Fishbein and Ajzen [9]. An example question is: 'Were you confident that you would reach your learning goals?'.

3.3 Procedure

In the first week of the MOOC, all the registered learners received an invitation via the open source online survey tool Limesurvey (visit http://www.limesurvey.org), to participate in the pre-course questionnaire. At the end of the last week, again, all registered learners received an invitation via Limesurvey, to participate in the post-course questionnaire. Participation was on a voluntary basis and filling out the questionnaire took approximately 5 min.

Two weeks after the runtime of the MOOC all registered learners received an invitation via email to provide more in-depth information about their goal setting and goal striving process in the MOOC in the form of an interview, either face-2-face, via email or via a videoconferencing application. It was emphasised that it was not necessary to have finished the course or completed any of the surveys.

4 Results

4.1 Goal Setting

In the first phase, the predecisional phase the goal is set. Figure 2 shows that most learners in the MOOC indicated that they set the goal to complete the MOOC (23%) and request the certificate (45%).

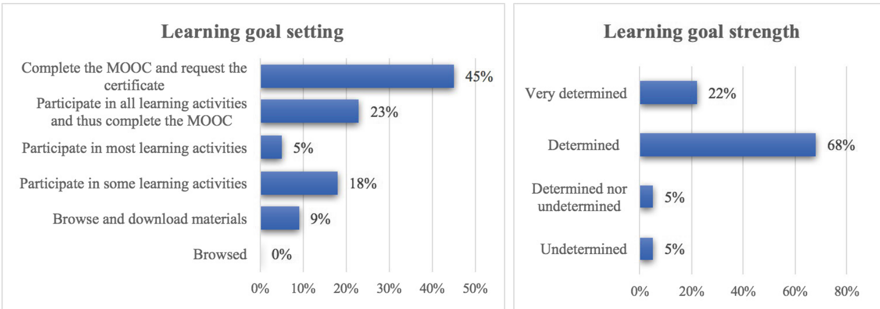

Fig. 2. Goal setting (N = 22) and goal strength (N = 22, 5-point Likert scale)

They also indicated that they were generally determined (68%) or very determined (22%) to reach this goal (see Fig. 2). Additionally, besides the content-oriented goals which were set, learners indicated alternative goals which were important for them. Seeking connection with other learners on the topic of climate change (39%) and finding collaboration possibilities with other organisations on climate change issues (36%) were mentioned most (see Fig. 3).

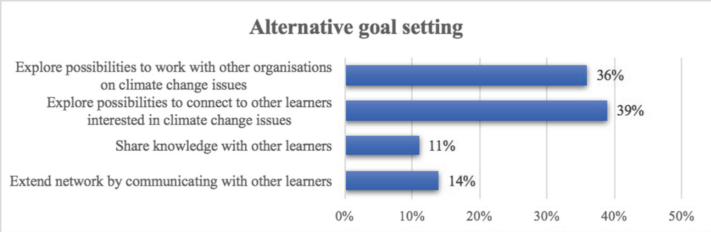

Fig. 3. Alternative goal setting (N = 22)

4.2 Goal Achievement

In the postactional phase an evaluation takes place of whether the goal striving actions were successful. At first, it was evaluated if the content-oriented goal, which was set in the predecisional phase, was achieved. Figure 4 shows that 23% of the learners completed the MOOC and that the majority of the learners merely participated in some (46%) or most learning activities (15%).

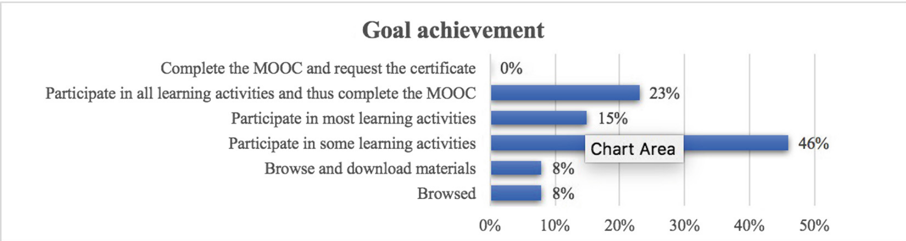

Fig. 4. Goal achievement (N = 13)

Yet, achievement reaches further than the mere quantitative measurement of the content-oriented goals. Therefore, it was additionally evaluated if the achieved outcome matched the expectation, which can be characterised as a form of subjective evaluation of achievement. The majority of the learners indicated that they achieved their personal goals to some extend (46%) or a great extend (15%), that their expectations were met to a great extend (46%) or completely (7%) and that they were satisfied (54%) or very satisfied (7%) with the course (see Fig. 5).

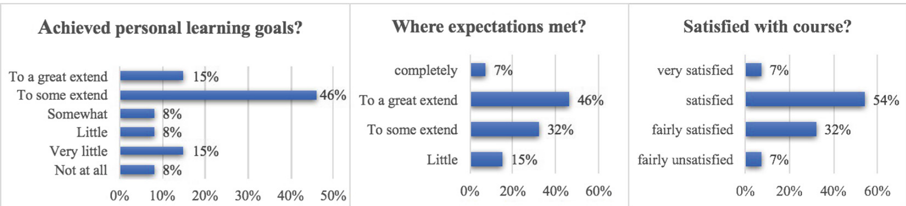

Fig. 5. Subjective evaluation of achievement, expectations and satisfaction (N = 13, 7-point Likert scale)

In-depth interviews were conducted to give additional insight into the courses of action these learners followed, how they progressed through the goal setting and goal striving process and how their subjective value judgements are substantiated.

4.3 Qualitative Results

The post-interviews were analysed using deductive thematic analysis [13] and were coded for themes derived from the theoretical framework of the Rubikon model of action phases [1].

The interviewees rated their English proficiency as good to very good and all of them had a master degree. In addition, each of them had previous experience with learning in MOOCs. All but one set the goal to complete the MOOC and all of them indicated that they were determined to very determined to reach their set goals. In addition to their set learning goals they also specified that they wanted to share knowledge with other interviewees, explore possibilities to connect to other people who are interested in climate change issues and explore possibilities to work with other organisations on climate change issues.

4.4 Predecisional Phase

In this phase, different options are deliberated and weighted and a specific goal is set [1, 7]. All five of the interviewees indicated that they were not specifically looking for a MOOC, but merely for information and learning possibilities regarding the topic of climate governance and polycentricity: "I stumbled across it when I was looking for information on polycentric governance" (P2) and "…In fact, I was not actively searching for a MOOC" (P5).

In addition, neither of them knew whether there were more MOOCs available on this specific topic. As soon as they came across this specific MOOC, they did not search any further for alternative learning options. Before making the decision to enroll, all of them evaluated the specified weekly workload of the MOOC, yet only one interviewee stated that the workload actually influenced his decision to sign up, as he wanted to make sure that he would able to follow the MOOC next to his normal daily workload. The other four interviewees did think about their available time for learning in the MOOC, but did not let this influence their decision: "I knew that I would not be able to complete it, because I was on field research that time, but I still enrolled to look at it" (P2) and "When I enrolled in the course I was not yet sure whether I would have time to participate in the MOOC" (P3).

All interviewees but one signed up for the MOOC immediately after they found the MOOC and read the available information. One interviewee first sent an email to the MOOC organisers to ask for any formal requirements and signed up after receiving an answer.

4.5 Preactional Phase

This phase is about planning concrete strategies for achieving the goal set in the predecisional phase [1, 7]. Three of the interviewees specifically spend time thinking about planning their learning and indicated that they would generally learn at home after work and during weekends. However, most of the interviewees did not think about issues that could hinder their learning and thus did not make alternative (shielding) plans in advance. Only one interviewee indicated that he specifically thought about issues in his personal environment that could hinder him successfully reach his set goal intention: “I figured that if I would not be able to study on a certain day, or would not have sufficient time, instead of working smarter or harder, I would just have to work longer” (P5).

Three of the interviewees were confident that they would reach their learning goals and two of them were not sure about it. One of the interviewees stated that a previous experience with a MOOC made her uncertain: “I had done another MOOC in the spring, one that even cost money, but I could not motivate myself to finish. So, I was unsure if I would be able to hold on [in this MOOC]” (P4).

The opinions of the interviewees are divided regarding their own responsibility for reaching their goal intentions. Some of them are very determined that it is totally up to the learner, some are not sure and one of them feels that it also depends on the course design and the feedback of the instructors.

4.6 Actional Phase

This phase is about enacting the strategies which were planned in the preactional phase in pursuit of goal achievement [1, 7]. Two interviewees indicated that they learned according to their plan. Another two interviewees were not able to study as planned due to circumstances and one interviewee stated that she kind of learned as planned: “as I did not have a real plan, but I did have time… to look into it once in a while” (P2).

While acting in this phase in pursuit of their set goals, two of the interviewees deliberately changed their set goal intention because their interest changed and they did not like the method of learning (online as opposed to face-to-face) which made them lose motivation and ultimately quit the MOOC after several weeks. Yet, one of the interviewees specifically indicated that: “the quality (content) and quantity (workload) were not the reasons why I dropped out” (P3).

4.7 Postactional Phase

In this final phase, the achievement of the individual goal intentions is evaluated [1, 7]. None of the interviewees consciously took the time to evaluate their achievement. Yet, when specifically asked about it, four interviewees stated that they did not reach their initially set goals, yet at the same time all five of the interviewees were mostly satisfied with the knowledge they gained: “Even if I didn’t reach the goal completely, there was a lot of learning involved” (P1). One of the interviewees added that although she gained the knowledge she aimed for, she was not happy with the amount of time she had to spend on it: “but [I] do not feel satisfied with the knowledge I gained versus the time I invested” (P4).

Further evaluation whether the achieved outcome was in line with the expected value was also very positive. One source of some dissatisfaction was the lack of interaction in the course” “the instructors had little participation. At some point, it seemed like the course was “abandoned” (P1) and “too little discussion took place in the discussion forum. … I had hoped to learn much more from others’ experiences and thoughts on the course” (P5). Overall, all interviewees indicated that the MOOC met their expectations. Most important aspects for this value judgement were content, theoretical deepening, usefulness for practice and flexibility of the MOOC.

5 Discussion

The aim of this explorative study was to get a deeper understanding of learner behaviour in MOOCs. We examined two research questions namely (1) what goals do learners set, and do they succeed in reaching these goals? and (2) How does the course of action of learners look? Regarding the first research question we found that the majority of the participants (90%) wanted to finish the MOOC, with or without requesting a certificate. They also indicated that they were determined or very determined to do so. In addition, besides the content orientated goal they set, most of them had some alternative goals which were mainly to connect with other participants in the course and to explore possibilities to work with other organisations. The goal achievement results showed that only 23% of the participants did reach their initially set goals, yet 61% indicated that they achieved their personal learning goals and over 50% indicated that their expectations were met and that they were satisfied with the course. This was confirmed by the interviewees who all but one did not achieve their set goals, yet who were overall satisfied with the knowledge they gained. The apparent discrepancy might be explained by the broad learning opportunities MOOCs provide. The individual learning can go beyond course content related learning and also include alternative goals participants set for themselves at the start of the course or somewhere along the way. Another explanation can be the dynamicity of the intention-behaviour process [11]. Learners may change their intention (set goal) while learning in the MOOC due to various circumstances [11]. As this happens after they start learning in the MOOC, changes of goal setting are very difficult to determine, but should still be taken into consideration when evaluating learner success in MOOCs.

In answer to the second research question, we found that the interviewed learners more or less intuitively went through the action phases as theorized by Gollwitzer [1, 7], touching upon the transition points (setting the goal, planning how to reach the goal and initiate action and evaluating the achievement) to a greater or lesser extent. All of the interviewees set their goals before the start of the MOOC, yet neither of them weighted or deliberated different options or let the indicated workload and their individual available time influence their decision. Once they came across the MOOC, they basically immediately signed up. Some of the interviewees did spend time thinking about the planning of their learning, however they did not anticipate issues that could hinder their learning. While learning in the MOOC some of the interviewees changed their initial set goal or quit the MOOC and after finishing the MOOC neither of them consciously took the time to evaluate the process. This is somewhat surprising, especially as one interviewee stated that a negative experience with a previous MOOC made her feel unsure about reaching her learning goal this time.

These transition points might be the key to supporting a successful learning experience. A well-thought-out planning, also anticipating issues which could hinder the learning process can contribute to achieving the set goals [8]. Evaluation of the learning process after finishing learning in the MOOC in the sense of reflecting on the process and determining why negative as well as positive outcomes happened will benefit future deliberation and planning needs [1, 7] and take away unnecessary uncertainties.

This study has several limitations. One important issue is that the current sample is very small. Another limitation is that the topic of the MOOC is very specific, thus the findings are context-specific. Also, due to convenience sampling, the interviewees were moderately representative for the participant population. Needless to say, that more research is necessary to establish learner behaviour patterns in courses of action in various MOOCs, which can then serve as starting point for developing learner supporting tools and personalised dashboards, which can offer the tools at the appropriate moments in a learner's course of action.

Acknowledgement. This work is financed via a grant by the Dutch National Initiative for Education Research (NRO)/The Netherlands Organisation for Scientific Research (NWO) and the Dutch Ministry of Education, Culture and Science under the grant nr. 405-15-705 (SOONER/ http://sooner.nu). We thank James Patterson and Dave Huitema for providing us with the opportunity of data collection in the MOOC.

References

1. Gollwitzer, P. M.: Action phases and mind-sets. In: Handbook of Motivation and Cognition: Foundations of Social Behavior, vol. 2, pp. 53–92 (1990)
2. Veletsianos, G., Shepherdson, P.: A systematic analysis and synthesis of the empirical MOOC literature published in 2013–2015. Int. Rev. Res. Open Distrib. Learn. **17**(2), 67–90 (2016)
3. Henderikx, M., Kreijns, K., Kalz, M.: Refining success and dropout in MOOCs based on the intention-behavior gap. Distance Educ. **38**, 353–368 (2017)
4. Koller, D., Ng, A., Do, C., Chen, Z.: Retention and intention in massive open online courses: in depth. Educ. Rev. **48**(3), 62–63 (2013)
5. Reich, J.: MOOC completion and retention in the context of student intent. Educause Review Online, 8 December 2014. http://er.educause.edu/articles/2014/12/mooc-completion-and-retention-in-the-context-of-student-intent
6. Zawacki-Richter, O., Bozkurt, A., Alturki, U., Aldraiweesh, A.: What research says about MOOCs–an explorative content analysis. Int. Rev. Res. Open Distrib. Learn. **19**(1), 242–249 (2018)
7. Gollwitzer, P.M.: The goal concept: A helpful tool for theory development and testing in motivation science. Motiv. Sci. **4**(3), 185–205 (2018)
8. Gollwitzer, P.M.: Implementation intentions: strong effects of simple plans. Am. Psychol. **54**(7), 493–503 (1999)
9. Fishbein, M., Ajzen, I.: Predicting and Changing Behavior: The Reasoned Action Approach. Taylor & Francis, Milton Park (2011)

10. Henderikx, M., Kreijns, K., Kalz, M.: A classification of barriers that influence intention achievement in MOOCs. In: Pammer-Schindler, V., Pérez-Sanagustín, M., Drachsler, H., Elferink, R., Scheffel, M. (eds.) EC-TEL 2018. LNCS, vol. 11082, pp. 3–15. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-98572-5_1
11. Henderikx, M., Kreijns, K., Kalz, M.: Intention – behaviour dynamics in MOOC learning. What happens to good intentions along the way? In: Castro, M., Tovar, E. (eds.) Proceedings of the Fifth Learning with MOOCs Conference, pp 110–112. IEEE, Madrid (2018b). https://doi.org/10.1109/lwmoocs.2018.8534595
12. Sutton, S.: Predicting and explaining intentions and behavior: how well are we doing? J. Appl. Soc. Psychol. **28**, 1317–1338 (1998)
13. Braun, V., Clarke, V.: Using thematic analysis in psychology. Qual. Res. Psychol. **3**(2), 77–101 (2006)

Markov Decision Process for MOOC Users Behavioral Inference

Firas Jarboui[1,2(✉)], Célya Gruson-Daniel[3,5], Alain Durmus[2], Vincent Rocchisani[1], Sophie-Helene Goulet Ebongue[3], Anneliese Depoux[3,4], Wilfried Kirschenmann[1], and Vianney Perchet[2]

[1] ANEO, Boulogne Billancourt, France
firasjarboui@gmail.com
[2] CMLA, École normale supérieur Paris Saclay, Université Paris Saclay, Paris, France
[3] Centre Virchow-Villermé for Public Health Paris-Berlin, Université Sorbonne Paris-Cité, Paris, France
[4] GRIPIC - EA 1498, Sorbonne Université, Paris, France
[5] DRISS (Digital Research in Science & Society), Paris, France

Abstract. Studies on massive open online courses (MOOCs) users discuss the existence of typical profiles and their impact on the learning process of the students. However defining the typical behaviors as well as classifying the users accordingly is a difficult task. In this paper we suggest two methods to model MOOC users behaviour given their log data. We mold their behavior into a Markov Decision Process framework. We associate the user's intentions with the MDP reward and argue that this allows us to classify them.

Keywords: User behaviour studies · Learning analytics · Markov Decision Process · Inverse Reinforcement Learning

1 Introduction

Finding an efficient way to identify behavioural patterns of MOOC users community is a recurring issue in e-learning. However, as detailed in the review of Romero and Ventura [1] on educational data science research, the way this problem was studied was either testing correlations given conjectures or trying to identify communities of look-a-likes.

The main approaches study aggregates of data generated by users in order to identify their respective behaviors with respect to some typology of the students. For instance, Ramesh et al. [2] distinguish learner behavior according to their engagement into *active*, *passive* and *disengaged* learners. They predict their behavior based on a probabilistic soft logic model taking into account users features relating to their engagement on the Mooc. Corin et al. [3] describes the behaviour of users through flow diagrams of the state transitions through comparing different sets of behaviours with graphical models. Cheng and Gautam [4]

Supported by ANR-15-IDFN-0003-04.

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 70–80, 2019.
https://doi.org/10.1007/978-3-030-19875-6_9

predicted users drop-out through temporal granularities in features suspected to influence the drop-out of the users. Finally, Christopher et al. [5] cover the prediction of the users achievement through their levels of activity in the course. Unfortunately, given a different typology of users profile, we can not easily transpose these approaches because the features used to characterize the learner are selected with respect to the definition of the classes. For example, performance related typology can be matched to users' quizzes success rate, the drop-out rate oriented classes can be tracked through the times series of connection history. However the task becomes more difficult when the definition of classes can not be reduced to a simple quantifiable measurement, for example the user intentions, goals and motivations. Chase and Cheng [6] aimed for a generalized method by modelling the user behaviour as a two layer hidden Markov model. They used log data to construct their characterization of the users. They cluster the transition probabilities to define the hidden states, and they compare the transitions between these hidden states for the high and low performing students. However, if we only observe the transitions probabilities, identifying an interpretation of the associated behavior is a complex task.

We aim to define general models to study any kind of user behavior without loosing the interpretability of results. We consider two different main models. In the first one, we assume that each user can adopt his own different policy. Each user has a reward function over the MOOC and tries to optimize it. We can cluster theses rewards into a finite number of classes that represent the behaviors explaining the observations. In the second one, we assume that there are a limited number of rewards the users can optimize. Each reward translates into a typical behavior and the users are switching between them along the MOOC.

2 Mathematical Preliminary

2.1 Markov Decision Process

Consider a Markov Decision Process (MDP) $\mathcal{M} = \{\mathcal{S}, \mathcal{A}, \mathcal{P}, \mathcal{R}, \nu, \mathcal{X}\}$ where $\mathcal{S} = \{1, 2, ..., N_s\}$ is a finite state space, $\mathcal{A} = \{1, 2, ..., N_a\}$ is a finite action space, $\mathcal{P} : \mathcal{S} \times \mathcal{A} \times \mathcal{S} \rightarrow [0, 1]$ is the probability distribution of state transition such as $\mathcal{P}(s, a, s') = \mathrm{P}(s_{t+1} = s' | s_t = s, a_t = a)$ is a probability of going to state s' under action a from state s , $\mathcal{R} : \mathcal{S} \times \mathcal{A} \rightarrow [0, 1]$ is the reward function, $\nu \in]0, 1[$ is a discount factor and $\mathcal{X}$ is an initial distribution over the states i.e. $\mathrm{P}(s_0 = s) = \mathcal{X}(s)$. Any transition matrix compatible with the MDP on $\mathcal{S} \times \mathcal{A}$ is referred to as a policy, and we denote $\pi : \mathcal{S} \times \mathcal{A} \rightarrow [0, 1]$ such policy. An agent following the policy π would take at time t the action $a_t = a$ at state $s_t = s$ with probability $P(a_t = a | s_t = s) = \pi(s, a)$. The value of the policy π is $V^\pi = \sum_s \mathcal{X}(s) V^\pi(s)$ where $V^\pi(s) = \mathbf{E}^\pi[\sum_t \nu^t \mathcal{R}(s_t, a_t) | s_0 = s]$ is the state value function. Similarly we denote the state-action value function by $Q^\pi(s, a)$ defined by $Q^\pi(s, a) = \mathbf{E}^\pi[\sum_t \nu^t \mathcal{R}(s_t, a_t) | s_0 = s, a_0 = a]$. We denote by π^* the optimal policy maximizing the expected discounted reward given any starting state, and by V^* and Q^* the corresponding values defined as [7]:

$$\begin{aligned} \pi^* &= \text{argmax}_\pi V^\pi(s) = \text{argmax}_\pi Q^\pi(s,a) && \forall s \in \mathcal{S}\ \forall a \in \mathcal{A} \\ V^*(s) &= V^{\pi^*}(s) && \forall s \in \mathcal{S} \\ Q^*(s,a) &= Q^{\pi^*}(s,a) && \forall s \in \mathcal{S}\ \forall a \in \mathcal{A}. \end{aligned}$$

Given an MDP $\mathcal{M}$, the optimal policy π^* can be computed using well-known methods such as Value iteration or Policy iteration [7]. We use a Value iteration approach and we refer to this procedure as $Q^* = \text{MDP}(\mathcal{M})$.

Reward Parametrized MDP: In this paper we consider the case of MDPs with linearly parametrized rewards $\mathcal{M}_\theta = \{\mathcal{S}, \mathcal{A}, \mathcal{P}, \mathcal{R}_\theta, \phi, \nu, \mathcal{X}\}$ i.e. such that:

$$\forall s \in \mathcal{S}\ \forall a \in \mathcal{A}\ \mathcal{R}_\theta(s,a) = \theta.\phi(s,a)^T,$$

where $\phi : \mathcal{S} \times \mathcal{A} \rightarrow \mathbf{R}^N$ is a feature map from the state-action space to a real valued N dimensional space and $\theta \in \mathbf{R}^N$ is an N dimensional real weights.

For a given θ, we will denote the optimal policy by π^*_θ, and the corresponding optimal value functions by V^*_θ and Q^*_θ .

2.2 Inverse Reinforcement Learning

Let be $\mathcal{M}_\theta$ a reward paramatrized MDP whose parameter θ is unknown. We denote by $\mathcal{W} = \{\mathcal{S}, \mathcal{A}, \mathcal{P}, \phi, \nu, \mathcal{X}\}$, and $\mathcal{D}_M = \{(y^i_{0:T_i})^M_{i=1}\}$ the behavioral data where $y^i_{0:T_i} = \{y^i_t = (s^i_t, a^i_t)^{T_i}_{i=1}\}$ are the i^{th} individual following an unknown policy π^*_θ. The goal of the Inverse Reinforcement Learning (IRL) problem is to identify parameters $\hat{\theta}$ such that $\pi^*_{\hat{\theta}}$ are as likely as π^*_θ to generate the observations $\mathcal{D}_M$. The IRL problem is ill-posed [8] as there exists infinitely many reward parameters that yield π^*_θ as an optimal policy. For example with $\theta = 0$, any policy is optimal for any IRL problem.

To circumvent this issue, many approaches have been proposed to define preferences over the reward space. These approaches can be broadly divided in two settings: Optimization IRL and Bayesian IRL. Optimization oriented approaches define objective function that encode such preferences [8–10]. Bayesian approaches formulate the reward preferences in the form of a prior distribution over the rewards and define behavior compatibility as a likelihood function [11–13]. We will follow the latter setting [13]. The model we consider assumes that that agents are not following an optimal policy π^*_θ but rather an aproximal one. more precisely, we assume that:

$$\begin{aligned} \tilde{\pi}^\eta_\theta(s,a) &= \frac{\exp(\eta Q^*_\theta(s,a))}{\sum_{a_i}\exp(\eta Q^*_\theta(s,a_i))} && \forall s \in \mathcal{S}\ \forall a \in \mathcal{A} \\ P(a_t = a | s_t = s, \mathcal{M}_\theta) &= \tilde{\pi}^\eta_\theta(s,a) && \forall s \in \mathcal{S}\ \forall a \in \mathcal{A} \\ P(s_{t+1} = s' | s_t = a, a_t = a, \mathcal{M}_\theta) &= \mathcal{P}(s,a,s') && \forall s, s' \in \mathcal{S}\ \forall a \in \mathcal{A} \end{aligned}$$

Therefore, under this model, the likelihood is given by:

$$P(\mathcal{D}_M|\mathcal{M}_\theta) = \prod_{i=1}^M \prod_{t=1}^{T_i} \tilde{\pi}^\eta_\theta(s,a) \times \prod_{i=1}^M \prod_{t=1}^{T_i} P(s_{t+1}|s_t, a_t, \mathcal{M}_\theta)$$

We have assumed that $(a_t, s_t)_{t\geq 0}$ is still Markovian, with transition probabilities given by $\mathcal{P}$ which does not depends on θ. Thus, $\prod_{i=1}^{M}\prod_{t=1}^{T_i} P(s_{t+1}|s_t, a_t, \mathcal{M}_\theta)$ can be treated as a multiplicative constant with respect to θ. We define:

$$\mathcal{L}(\theta; (\mathcal{D}_M, \mathcal{W})) = \prod_{i=1}^{M}\prod_{t=1}^{T_i} \frac{\exp(\eta Q^*_\theta(s^i_t, a^i_t))}{\sum_a \exp(\eta Q^*_\theta(s^i_t, a)},$$

where η can be interpreted as a confidence parameter. The bigger it gets, the closer are the policies $\tilde{\pi}^\eta_\theta$ and π^*_θ, as $\lim_{\eta\to\infty}\tilde{\pi}^\eta_\theta(s, a) = \pi^*_\theta$. The posterior distribution is given by Bayes Theorem, where we choose $\theta \to \mathrm{P}(\theta)$ to be a uniform distribution over a subset of the parameter space.

$$\mathrm{P}(\theta|\mathcal{D}_M)\ \alpha\ \mathcal{L}(\theta; (\mathcal{D}_M, \mathcal{W}))\mathrm{P}(\theta)$$

We use approximate samples from the distribution $\mathrm{P}(\theta|\mathcal{D}_M)$ to compute the a posteriori mean or median which are optimal under the square or linear loss function respectively [13,15]. Iterating Algorithm 1 generates the samples.

Algorithm 1. SampleTheta

1: **procedure** $\theta = \text{SampleTheta}(\theta^0, \mathcal{W}, P, \sigma, \eta, \mathcal{D}_M)$
2: sample$\epsilon \sim \mathcal{N}(0, 1)$ and set $\tilde{\theta} = \theta^0 + \sigma\epsilon$
3: $\tilde{Q}^*_{\tilde{\theta}} = \text{MDP}(\mathcal{M}_{\tilde{\theta}})$
4: Set $\theta = \tilde{\theta}$ with probability:
5: $\min(1, \frac{\mathcal{L}(\mathcal{D}_M, \mathcal{M}_{\tilde{\theta}} P(\tilde{\theta})}{\mathcal{L}(\mathcal{D}_M, \mathcal{M}_\theta P(\theta)})$
6: else set $\theta = \theta^0$
7: Return θ

2.3 Switched Markov Decision Process sMDP

Inspired from switched Linear Dynamical Systems [14], switched Markov Decision Process allow us to simplify complex phenomena into transitions among a set of simpler models. For example, non-linear behaviors such as an individual's movement in a crowd, can be viewed as an array of linear behavior among which the person is temporally switching [11].

Let $(\mathcal{M}_{\theta_i})_{i=1}^L$ be a set of MDP models with corresponding parameters $(\theta_i)_{i=1}^L$ and policies $(\tilde{\pi}^\eta_{\theta_i})_{i=1}^L$. Switching between these models is governed by a discrete Markov process with transitions ζ. We denote z_t as the latent mode of the system at time t, thus, it is sampled according to $\zeta_{z_{t-1},.}$. We also denote by $y_t = (s_t, a_t)$ the observations which obey to a Markov decision process model.

$$\begin{aligned} z_t|\{\zeta_i\}_{i=1}^L, z_{t-1} &\sim \zeta_{z_{t-1},.} \\ y_t|y_{t-1}, z_t, \{\theta_i\}_{i=1}^L &\sim \pi^\eta_{\theta_{z_t}}(y_t)\mathcal{P}(s_{t-1}, a_{t-1}, s_t) \end{aligned}$$

The hidden modes and the MDP associated with each one of them provide a Hidden Markov Model (HMM) structure leading to repeating simple behaviors.

A common approach to solve HMM model is the forward backward method developed by Andrew Viterbi [17]. We call Viterbi the procedure that evaluates the latent modes $\hat{z}_{1:T}$ and the transition probabilities $\mathcal{F}_{ij} = \text{P}(z_t = i, z_{t+1} = j)$ and we denote it by $[z_{1:T}, \mathcal{F}] = \text{Viterbi}(y_{1:T}, \zeta_{kk'}, \pi^{\eta}_{\theta_i})$. We denote by $\mathcal{M}^S = (\mathcal{W}, L, (\theta_i)_{i=1}^{L}, \zeta, \mathcal{X}_m)$ the sMDP model where $\mathcal{X}_m$ is the initial mode distribution. As an application we will tackle the case where the parameters $((\theta_i)_{i=1}^{L}, \zeta)$ are unknown and will be learned from the data.

2.4 Label Propagation

Let $(x_i, y_i)_{i=1}^{l}$ be a set of labeled data, and $(x_i, y_i)_{i=l+1}^{l+u}$ be a set of unlabeled data, i.e. $(y_i)_{i=l+1}^{l+u}$ are unobserved. Where $x_i \in \mathbf{R}^D$ and $y_i \in \mathcal{C}$ for $i = 1, .., l + u$ and where $\mathcal{C}$ is a finite set. We define $X = \{x_1, x_2, ...x_{l+u}\}$, $Y_L = \{y_1, ..., y_l\}$ and $Y_U = \{y_{l+1}, ..., y_{l+u}\}$. The problem is to estimate Y_U given X and Y_L. we also denote by Y the matrix of label probability where $Y_{ic} = P(y_i = c)$. We want to find a matrix Y that satisfies the following:

$$\begin{cases} Y_{i.} = \frac{(TY)_{i.}}{||(TY)_{i.}||_2} & \forall i > l + 1 \\ Y_{i.} = \delta(y_i) & \forall i \leq l \end{cases}$$

Where T is the matrix of label transition probabilities through the set X. T_{ij}, the probability that x_i will inherit the label of x_j, is proportional to the distances between the two points. Algorithm 2 [16] solves for Y.

$$\begin{aligned} T_{ij} &= P(y_j \rightarrow y_i) = \frac{w_{ij}}{\sum_{k=1}^{l+u} w_{kj}} \\ \text{and } w_{ij} &= \exp(-\frac{d_{ij}^2}{\sigma^2}) \quad = \exp(-\frac{|x_i - x_j|_2^2}{\sigma^2}) \end{aligned}$$

Algorithm 2. Label Propagation

1: **procedure** $Y = \text{LabelProp}(X, Y_L, \sigma)$
2: initialize Y with: $Y_{ic} = \delta(c = y_i)$ if $i \leq l$ and $Y_{ic} = \frac{1}{C}$ if $i > l$
3: *repeat* until convergence of Y:
4: $Y = TY$
5: row-normalize Y
6: $Y_{ic} = \delta(c = y_i)$ for $i \leq l$
7: return Y

3 Behavior Inference with IRL

We now suggest two ways to develop a classification for MOOC user behaviors. In the first one, **Static Behavior Clustering (SBC)**, we consider that each user follows a policy that optimizes his own reward function and that generates their log data. We use the reward parameter associated to each user as features and we propagate labels that experts define on a restricted set of users. In the second one, **Dynamic Behavior Clustering (DBC)**, we consider that there is a small number of behaviors a user can adopt. We model their behaviors with a sMDP, the log data is then simplified into a set of typical behavior successions. We denote in the sequel by $\mathcal{W}$ the MDP associated to the MOOC and by $\mathcal{D}_M = \{(y^i_{0:T_i})_{i=1}^M\}$ the collected observation from M users where $y^i_t = (s^i_t, a^i_t)$ indicate user i being at state s^i_t at time t and taking action a^i_t. We denote by $\mathcal{D}_M(i) = \{y^i_{0:T_i}\}$ the data associated to the i^{th} user.

3.1 Construction of the MOOC MDP

Given a MOOC, we first define some associated MDP parameters $\mathcal{W}$. The construction is straightforward: we define $\mathcal{S}$ as the different pages a user can access along with a resting state (associated to logging out of the website), $\mathcal{A}$ is associated to the different actions available to the user such as playing a video, clicking on a given link or answering a quiz. $\mathcal{X}$ and $\mathcal{P}$ are computed empirically given the data $\mathcal{D}_M$. The feature function ϕ however gives some flexibility to our approach. If we do not have much knowledge about the behaviors we are trying to track, we can define $\phi(s,a) = 1_{\mathcal{S}\times\mathcal{A}}(s,a)$ as the indicator function of each state-action combination. Unfortunately, this will become unhandy for higher dimensions as $\theta \in \mathbf{R}^{|\mathcal{S}|\times|\mathcal{A}|}$. An expert can however define a set of features to which the set of state-actions can be mapped. The discount parameter ν reflects the ability of the agents of long term planning. It should be learned along with other parameters as it might not be the same for each user. However, we will consider a shared parameter that we fix at 0.9 for the sake of simplicity.

3.2 Static Behavior Clustering

We assume the existence of a set of behavior classes $\mathcal{C} = \{1, .., N\}$. Let $(c_i)_{i=1}^M$ be the classes associated to each user in the data. With the help of a human expert, using highly restrictive conditions, we identify l users classes. Without loss of generality, we assume that $C_L = \{c_1, ..., c_l\}$ is the set of known classes. Let $\mathbf{P}^c$ be the class probability matrix where $\mathbf{P}^c_{ij} = P(c_i = j)$ We consider also that each user behaves according to the MDP $\mathcal{M}_{\theta_i} = \{\mathcal{W}, \mathcal{R}_{\theta_i}\}$ such that:

$$\forall t \leq T_i \; a^i_t \sim \pi^\eta_{\theta_i}(s^i_t, .) \text{ and } s^i_{t+1} \sim \mathcal{P}(s^i_t, a^i_t, .)$$

For user i, we propose to infer such parameters given $\mathcal{D}_M(i)$, which will allow us to infer $(\theta_i)_{i=1}^M$. The objective is then to identify $\mathbf{P}^c$ given Θ and C_L. In Algorithm 3 we suggest a method to solve this problem.

3.3 Dynamic Behavior Clustering

We suggest here a simpler version of the model of the sticky Hierarchical Dirichlet Process for sMDP [11]. To simplify the problem we assume that the number of clusters L is given. We suppose that the transition distribution from the i^{th}

Algorithm 3. Static Behavior Clustering

1: **procedure** $\mathbf{P}^c = \mathrm{SBC}(\mathcal{D}_M, \mathcal{W}, C_L, P_\theta, \eta, \sigma_{MDP}, \sigma_{LP})$
2: initialize $\Theta = \{\theta_i\}$ to void values
3: for i=1,..M:
4: $\theta_i = BIRL(\mathcal{W}, P_\theta, \sigma, \eta, N_{\max}, \mathcal{D}_M(i))$
5: $\mathbf{P}^c = \mathrm{LabelProp}(\Theta, C_L, \sigma_{LP})$
6: return $\mathbf{P}^c$

mode are generated according to a Dirichlet distribution $\mathrm{Dir}(\alpha_L + \delta_i)$ where $\alpha_L = \alpha.1_L$, δ_i is the i^{th} vector of the canonical base of $\mathbf{R}^L$, and $\alpha \in \mathbf{R}$. This avoids jumping between modes as the probability of remaining in the same mode is higher than switching to a new one. The reward parameter associated to each mode is sampled from U the uniform distribution over some subset of the parameter space. The observations obey to an sMDP model defined with $\mathcal{M}^S = (\mathcal{W}, L, \{\theta_i, \zeta_i\}_{i=1}^L, \mathcal{X}_m)$. The full generative model is given bellow:

$$
\begin{aligned}
\zeta(i,.)|\alpha &\sim Dir(\alpha_L + \delta_i) && \forall i = 1,..,L\\
\theta_i &\sim \mathrm{U} && \forall i = 1,..,L\\
z_t^i|\{\zeta(i,.)\}_{j=1}^L &\sim \zeta(z_{t-1},.) && \forall i = 1,..,M \,\mathrm{and}\, t = 1,..T_i\\
y_t^i|y_{t-1}^i, z_t^i, \{\theta_j\}_{j=1}^L &\sim \pi^\eta_{\theta_{z_t^i}}(s_t^i, a_t^i)\mathcal{P}(s_{t-1}^i, a_{t-1}^i, s_t^i) && \forall i = 1,..,M \,\mathrm{and}\, t = 1,..T_i
\end{aligned}
$$

The intuition behind this model is that each user can adopt at each time step one of the behavior modes (i.e. he behaves accordingly to one of the MDPs). To alleviate notations we denote in the following $\Pi = \{\pi^\eta_{\theta_i}\}_{i=1}^L$, and $\mathcal{D}^k = \{y_t^i \;\forall i \le L \;\forall t \le T_i | z_t^i = k\}$ the observations associated to the k^{th} behavior mode. We suggest a MCMC approach to solve this inference problem where each step looks as developed in Algorithm 4. We start by inferring the latent modes according to the previous parameters values. We define the new sample of the HMM parameters using the normalization of the frequencies probabilities $\mathcal{F}$ in step 6. In step 7, we split the data set according to the z_t^i into $\mathcal{D}^i$ and use Algorithm 1 to sample the new MDP parameters θ_i and their policies.

Algorithm 4. Dynamic Behavior Clustering

1: **procedure** $\Theta^n, \zeta^n, \Pi^n = \mathrm{DBC}(\mathcal{D}_M, \mathcal{W}, P_\theta, \eta, \sigma, \Theta^{n-1}, \zeta^{n-1}, \Pi^{n-1}, \alpha)$
2: Set $\mathcal{F} = [f_{ij}]_{i\in[1,L]\; j\in[1,L]}$ to zeros
3: for i=1,..,M:
4: $[z^i_{1:T_i}, \mathcal{F}^i] = \mathrm{Viterbi}(y^i_{1:T_i}, \zeta^{n-1}, \Pi^{n-1})$
5: $\mathcal{F} = \mathcal{F} + \mathcal{F}^i$
6: $[\zeta^n] = \mathrm{SampleHMMParam}(\mathcal{D}_M, \mathcal{F}, \zeta^{n-1}, \alpha, \sigma)$
7: $[\Theta^n, \Pi^n] = \mathrm{SampleMDPParam}(\mathcal{D}_M, \Theta^{n-1}, z^i_{1:T_i}, \eta, \sigma)$
8: return $[\Theta^n, \zeta^n, \Pi^n]$

4 Experiment

The experiments were conducted on MOOCs published in the framework of the research project #MOOCLive under the leadership of the Centre Virchow-Villermé for Public Health. The project aimed to substantially improve the efficiency of the MOOCs through a deeper understanding of the participants and their behaviors. In the modelization of the MOOC's MDP, we used an indicator feature function over the state-action space $\mathcal{S} \times \mathcal{A}$.

4.1 Static Behavior Clustering

As mentioned before, our objective is to introduce a procedure that can be applied irrespectively of the experts classification. We experimented with multiple behavior classes $\mathcal{C}$. Each time, we first defined $\mathcal{C}$ and then identified the subset C_L. For instance defining the *collaborative behavior* as users who finish all quizzes and courses, get highest scores, and participate on the forum, the *targeting behavior* which corresponds to a super student on only one chapter of the MOOC. Such perfect representation are rare, and only few users satisfy the required criterion. Afterward, we randomly select a testing set and ask experts either they agree or disagree with the classification. The experiment can have one of two possible outcomes, either we add the test set to the labeled set C_L and run the algorithm again for better accuracy, or, we find that the expert becomes aware of some limitations and improves his behavior classes $\mathcal{C}$ definitions [18]. This iterative process can be repeated as much as needed until the expert is satisfied with the outcome. In our case we converged to the following classification:

- **Participant (P)** Does all the chapters, and answer all the quizzes;
- **Collaborative (C)** Does at least 70% of all the chapters and quizzes but highly active on the forum;
- **Targeting (T)** Targets a chapter, solves the relevant quizzes;
- **Auditor (A)** Reads 70% the chapters but answers 30% of the quizzes;
- **Clicker (Cl)** Does not stay on the same page longer than 5 seconds;
- **Big Starter (BS)** Has a participant behavior up to the first 3 chapters;
- **Late Quitter (LQ)** Has a participant behavior up to the last 3 chapters.

4.2 Dynamic Behavior Clustering

The results of **SBC** motivated the development of **DBC**. We observed that the classes that were satisfactory for the analysis requirement, are actually temporally characterized by a smaller number of simple behavior.

- **Exploration** where the user is randomly skipping through the MOOC;
- **Learning** where the user pays attention to the content of pages;
- **Certification** where the user is interested in the certification and tries to fulfill the courses requirements.

We considered a three dimensional feature space where the weight in each dimension reflects the probability of following the associated behavior. As expected, the users behaviors could be explained by the succession of simple behavior, we converged to 3 modes each of them optimizes one of the behaviors $\theta_1, \theta_2, \theta_3 \in \{[1,0,0],[0,1,0],[0,0,1]\}$.

In Fig. 1 we observe the expected temporal evolution of modes $(z^i_{t=0:T_i})$ for three users. Some behaviors such as the *clicker* behavior, can be observed as an agent with the unique goal of exploration as shown in the case of user #1. Other behaviors correspond to other patterns such as the *late quitter*, whose behavior is quite similar to the *participant/collaborative* behavior. The user start exploring a little bit, oscillates between *exploring* and *learning* before adopting mostly the *certifying* behavior. We end up sometimes with an exploration phase before leaving the courses entirely. The difference between the LQ and (C/P) behaviors is the length of the sequences. For instance we observe the fact that LQ tend to explore more by the end.

Fig. 1. Three #MOOCLive users' latent behavior modes

5 Discussion

From a practical point of view, both **SBC** and **DBC** were satisfactory as the results satisfied the experts who lead the experimentation process with us. We were able to improve our understanding of the users learning behaviors without requiring additional informations when treating different sets $\mathcal{C}$ of user classes. The results of the **SBC** are easily interpretable as the outputted behaviors are defined with the help of an expert. However, in the case of **DBC**, the task is more difficult. It mainly depends of the considered feature map and our ability to identify behaviors when observing the outputted parameters. In our cases, we did not struggle as we were anticipating such results.

A big drawback of the **SBC** is the assumption that users behave according to a unique policy throughout the course. To circle around this, the behavior classes had to be specified enough to capture the nuances between the users. Even though **DBC** resolves partially this issue by allowing the users to jump among typical behaviors, a temporal explanation of the mode switching is far from being comprehensively satisfactory. In fact, the users are more likely to switch from an exploration behavior to a learning one because they visited a set of different pages (or states) rather than because they spent a certain amount of time exploring the state space. The reward is likely to be non-Markovian as it depends of the trajectory a user follows and not just the last state he visits. Indeed, for a user trying to learn the content of a MOOC, a chapter is more rewarding when visited for the first time. An interesting direction for future work would be to tackle such challenging problem.

References

1. Romero, C., Ventura, S.: Educational data science in massive open online courses. Wiley Interdisc. Rev. Data Min. Knowl. Discov. **7**, e1187 (2017)
2. Ramesh, A., Goldwasser, D., Huang, B., Daume III, H., Getoor, L.: Modeling learner engagement in MOOCs using probabilistic soft logic. In: NIPS Workshop on Data Driven Education, p. 62 (2013)
3. Corrin, L., de Barba, P., Corin, C., Kennedy, G.: Visualizing patterns of student engagement and performance in MOOCs (2014)
4. Ye, C., Biswas, G.: Early prediction of student dropout and performance in MOOCs using higher granularity temporal information. J. Learn. Anal. **1**, 169–172 (2014)
5. Thompson, C., Brooks, C., Teasley, S.: Towards a general method for building predictive models of learner success using educational time series data. In: Workshops of the International Conference on Learning Analytics and Knowledge (2014)
6. Geigle, C., Zhai, C.X.: Modeling MOOC student behavior with two-layer hidden Markov models. In: Learning at Scale (2017)
7. Sutton, R., Barto, A.: Reinforcement Learning: An Introduction. The MIT Press, Cambridge (2005)
8. Andrew, N., Russell, S.J. : Algorithms for Inverse Reinforcement Learning. In: ICML 2000 Proceedings of the Seventeenth International Conference on Machine Learning (2000)
9. Wulfmeier, M., Ondruska, P., Posner, I.: Maximum Entropy Deep Inverse Reinforcement Learning (2016)
10. Levine, S., Popovie, Z., Koltun, V.: Nonlinear inverse reinforcement learning with Gaussian processes. In: Advances in Neural Information Processing Systems 24 (NIPS) (2011)
11. Surana, A., Srivastava, K.: Bayesian nonparametric inverse reinforcement learning for switched Markov decision processes. In: ICMLA 2014 13th International Conference on Machine Learning and Applications (2014)
12. Babe, M., Marivate, V.V., Subramanian, K., Littman, M.: Apprenticeship learning about multiple intentions. In: Proceedings of the International Conference on International Conference on Machine Learning (2011)
13. Ramachandran, D., Amir, E.: Bayesian inverse reinforcement learning. In: IJCAI 2007 Proceedings of the 20th International Joint Conference on Artifical Intelligence (2007)

14. Fox, E., Sudderth, E., Jordan, M., Willsky, A.: Nonparametric bayesian learning of switching linear dynamical systems. In: Neural Information Processing Systems (2009)
15. Michini, B., How, J.: Improving the efficiency of Bayesian inverse reinforcement learning. In: ICRA (2012)
16. Zhu, X., Ghahramani, Z.: Learning from labeled and unlabeled data with label propagation. Technical Report, Carnegie Mellon University (2002)
17. Viterbi, A.: Error bounds for convolutional codes and an asymptotically optimum decoding algorithm (1967)
18. Jarboui, F., Rocchisani, V., Kirchenmann, W.: Users behavioural inference with Markovian decision process and active learning. In: IAL@PKDD/ECML (2017)

Exploring the Problems Experienced by Learners in a MOOC Implementing Active Learning Pedagogies

Paraskevi Topali(✉), Alejandro Ortega-Arranz, Erkan Er, Alejandra Martínez-Monés, Sara L. Villagrá-Sobrino, and Yannis Dimitriadis

GSIC-EMIC Research Group, Universidad de Valladolid, Valladolid, Spain
evi.topali@gsic.uva.es

Abstract. Although Massive Open Online Courses (MOOCs) have been reported as an effective educational tool offering numerous opportunities in online learning, the high dropout rates and the lack of learners' motivation are factors concerning researchers and instructors. The one-size-fits-all instructional approach that most courses follow, failing to address the individual needs of learners, has been seen as their weakest point. Recent efforts focus on the inclusion of active learning pedagogies in MOOCs to stimulate the interaction among the participants and to keep them engaged. However, taking into account that in these massive contexts the learners face several issues while trying to keep up with the course, the incorporation of active learning strategies may introduce additional problems to the learning process. This study explores the problems that learners experienced in a MOOC implementing collaboration and gamification strategies. As the results reveal, the introduction of collaborative learning activities can generate additional problems to learners and for that reason, a careful design and a proper scaffolding is needed in an early stage to overcome the problems that will occur. No significant problems were reported regarding the implementation of gamification elements.

Keywords: MOOC · Learners' problems · Active learning · Gamification · Collaboration

1 Introduction

Massive Open Online Courses (MOOCs) have transformed online learning by offering learning experiences without geographical and cost restrictions [1]. Although MOOCs present rich and diverse educational materials and enable connecting individuals all around the world, not all MOOC learners fully benefit from these opportunities. Many learners face difficulties in understanding the concepts and completing the assignments, thus leading to student disengagement and course abandonment [1]. It has been suggested that the aforementioned problems are related with the lack of solid pedagogical frameworks in MOOC environments [2]. Most courses follow a one-size-fits-all instructional approach and fail to address the individual needs of learners [1].

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 81–90, 2019.
https://doi.org/10.1007/978-3-030-19875-6_10

The application of more active learning pedagogies may help address the aforementioned problems in MOOCs. Active learning is a pedagogical approach defined as "the instructional activities involving learners in doing things and thinking about what they are doing" [3]. Recent efforts focus on the inclusion of active learning pedagogies in MOOCs to stimulate the interaction among the participants and promote their engagement [4]. However, these strategies may have some adverse effects; according to a study of [5], many students found the learning process more stressful and unpleasant due to their lack of experience in working with active learning strategies.

Common difficulties faced by MOOC learners have been previously explored [1, 6, 7], mostly using post-course surveys [8–12] or interviews [13, 14]. According to such studies, the main reasons for learners to disengage and/or to drop out of the courses are (i) the lack of time, (ii) the absence of support and feelings of isolation, (iii) the lack of previous knowledge and learning skills, (iv) unchallenging course design, and (v) the failure to understand the course content. However, most of the reviewed works did not focus on MOOCs implementing active learning strategies beyond discussion forums and peer reviews.

In this study we analyze the problems reported by the learners in a MOOC implementing a set of collaborative activities (*i.e.*, two group activities, a collaborative glossary, and two peer reviews) and gamified activities associated with optional tasks. Collaborative learning and games (currently extended to gamification[1]) are two strategies promoting the learners' active learning [3]. The underlying research question guiding this work is: ***Which problems do learners experience in a MOOC implementing active learning strategies?***

This paper is structured as follows. The next section explains the design of the study including the research methodology and the data gathering sources and techniques. Next, the findings from the analysis are presented and the results are discussed. Finally, the paper draws some conclusions along with limitations and ideas for future research.

2 Methodology

2.1 Research Design

The present study attempts to address the following research question (RQ): "***Which problems do learners experience in a MOOC implementing active learning strategies?***". To thoroughly explore this topic, the RQ has been subdivided into two informative questions (IQ): *1. What were the problems faced by the learners who completed the course successfully? 2. What were the problems faced by the learners who dropped out of the course?* In order to answer these questions we applied a mixed

[1] Gamification is defined as *the use of game design elements in non-game contexts*. Therefore, nowadays, the concept of game can be extended to gamification and therefore, it can be considered as a strategy promoting active learning.

method approach and more specifically, a Convergent Parallel Design [15]. According to this design, qualitative and quantitative data were collected and processed to provide a more comprehensive interpretation of the information gathered and a better exploration of the research question.

2.2 Context of the Study

The study was conducted in a MOOC offered by a Spanish university and deployed in the Canvas Network platform. The course topic was translation in the field of business and economics. The course spanned eight weeks. Each module mainly consisted of video lectures, readings, extra material/resources, discussion forums, optional and mandatory individual and/or collaborative activities. The certificate was issued to the participants completing all the compulsory activities (one per week). The estimated participant workload was 3 hours per week.

The course included two active learning strategies: gamification and collaborative learning. Regarding collaborative learning, the course included: one optional activity (in which learners created a collaborative glossary), two compulsory group activities (the learners were divided into groups of five-six members to prepare and submit a common proposal of (a) a set of terms and (b) a translation); and, two compulsory peer review activities (the learners had to review and evaluate activities done by other participants). Regarding the gamification component, eight badges and redeemable rewards (e.g., extra attempts in quizzes) were designed and incorporated together with optional activities (e.g., introduction of terms in the glossary, high quiz performance) in order to promote student active learning and engagement.

From a total number of 866 students who enrolled in the course, 169 of them completed the compulsory assignments and received the course completion certificate (19.52% completion rate). The three course instructors provided feedback and support to participants through private messages and discussion forums.

2.3 Data Collection and Analysis

In this mixed method study, multiple data sources were used (Table 1). To increase the rigor and the credibility of this study, several strategies were applied [16] such as: triangulation of six data sources, peer debriefing among the members of the research team especially during the refinement of the questionnaires' items and provision of deep descriptions of the context of the study.

Quantitative data were processed using the R Studio software and Microsoft Excel. Concerning the qualitative data, content analysis was employed using both etic and emic categories and themes during the coding process [17]. The emergent categories arose from the analysis of the answers of the learners and from the analysis of the course design. Following the Convergent Parallel Design, we triangulated the findings from both data sources to answer the two IQs that guided the analysis. These findings are presented in the following section, together with excerpts of evidence that support them.

Table 1. The data sources used in the study

Label	Data source	N	Description
[Post_Quest]	Post-course Questionnaire	174	Questionnaire distributed at the end of the course regarding the difficulties that the learners faced. The questionnaire was composed of open-ended and closed questions, including nine 4-point Likert-scale items (ranging from *I strongly disagree* to *I strongly agree* and an *I don't know/No answer* option)
[Drop_Quest]	Dropout Questionnaire	69	Questionnaire administered after the course to dropout learners to inquire about the reasons for such dropouts. This questionnaire consisted of two multiple choice and one openended items. The participants were required to indicate the aspects of the course that were difficult to follow and to suggest improvements that would have helped them continue with the course
[General Forums]	Discussion Forums' Posts	156	Learners' messages (entries) in the discussion forums in each module
[Group_Forums]	Discussion Group Forums	2.213	Learners' messages (entries and replies) in the group discussion forums in both collaborative activities
[Priv_Mess]	Private Messages	39	Messages sent (asynchronously) by the participants to the instructors
[Logs]	Logs	69	Trace data about learners' learning activities performed in the MOOC platform (pages visited, task submissions; time spent in the course). The data were retrieved from the Canvas Network platform. These logs were processed to generate numeric data

3 Results

This section describes the main findings associated to the IQs mentioned in the previous section. Each finding is supported with different excerpts of evidence (see Table 2).

I.Q.1. What were the problems faced by the learners who completed the course successfully?

From the evidence gathered, most of the problems reported by the learners were related to collaborative activities. At the post-questionnaire, 64% of participants reported problems regarding collaboration. Additionally, 16,9% of the learners mentioned difficulties in completing the group activities due to absence of communication among the group members and the different time-zones (see Table 2, [Post_Quest]-A, B). The analysis of the discussion forums complemented the evidence coming from the post-questionnaire; the most intensively reported problem (N = 16 out of 29 entries) was about the collaborative activity in week 4. The fourth week was the one in which the collaborative activities were introduced. Learners indicated that only a few members of the groups were working and as a result additional effort was needed from the remaining active members (see Table 2, [GeneralForums]-A, B). However, at the sixth week, in which the second collaborative activity was conducted, there were no more posts in the general forums reporting collaboration-related problems. The problems with the collaborative activities were further explored in the group forums which were created in the fourth and sixth week of the course to ease the communication among the members of the groups. During the fourth week, 944 messages were exchanged among the group members. From those, we encountered 23 posts that referred to problems with collaboration. These were posts regarding the absence of group members (out of the six members only two/three members were active) and had to do additional work to complete the activity (see Table 2, [Group_Forum]-A, B), and posts regarding the division of the workload among the members. At the sixth week a total number of 1.219 messages were exchanged in group forums and only four of them reported problems caused by non-active group members.

The workload demanded in the course was another problematic aspect reported by many learners. At the post-questionnaire, 53% of learners reported difficulties in submitting the assignments on time. 12,7% of the participants affirmed in the open-ended question of the final questionnaire that the mandatory activities took much time, thus hindering the completion of the optional tasks. Furthermore, the majority of private messages to instructors (N = 14 out of 39 messages) was related to submission issues, where the learners asked for deadline extensions (see Table 2, [Priv_Mess]-A and [GeneralForums]-D).

Among the other problems identified by the learners, activity-related issues were prominent. In the post-questionnaire, 32% of the learners stated that they faced difficulties in understanding the course concepts. Also, 7,9% of the learners reported problems related to course assignments (such as (i) too much conceptual explanations with less practical application; (ii) difficulty to understand some concepts and complete the associated activities; (iii) problems in peer-review activities regarding the evaluation received; and (iv) the feeling of not being able to assist the group members (see Table 2, [Post_Quest]-A, B). Similarly, the second most frequent reason for contacting the instructors through private messages regarded problems with the activities (N = 8 out of 39), where the participants were asking either for clarifications of the concepts, or for corrections of the obtained scores (see Table 2, [Priv_Mess]-B). Forums also revealed posts about general course clarifications related to assignments' tasks or to the correct answers of the activities (see Table 2, [GeneralForums]-C).

Additionally, many participants reported being puzzled about their next steps in the course (see Table 2, [Priv_Mess]-C, D). Problems regarding technical difficulties (such as links that didn't work) were also mentioned (see Table 2, [GeneralForums]-F and [Post_Quest]-C).

I.Q.2 What were the problems faced by the learners who dropped out of the course?

To discover if the problems mentioned above led some participants to drop out of the course in the intermediate weeks, we contacted via email with 468 dropout participants and we received 69 answers. In this study, dropout learners are considered those who filled out the first obligatory questionnaire but did not complete at least one obligatory submission by the end of the course.

The dropout learners reported insufficient time as the main reason of dropping out of the course (N = 44) stating among other reasons that "they could not combine their

Table 2. Selected excerpts of evidence

Data source	Excerpts
[Post_Quest]	***A.*** *The only problem I faced during the course was that coordination in the group was not an easy task, probably due to time differences between participants and the poor communication* ***B.*** *Group activities seem a good way to work in order to learn, but I do not think they are suitable for this type of seminar. In the end, I get the feeling that you work worse than when you work individually, due to the lack of time or the different schedules we all have* ***C.*** *As I mentioned, I do not know why the videos of the last two blocks did not open and the translations neither. In the previous blocks I accessed videos and translations without problems*
[GeneralForums]	***A.*** *Hello! What happens if from the group of 6 only two people propose terms when it is time to deliver? Are we two the responsible for gathering the 20 terms? I tried to communicate with the other members of the group, but I cannot find how to send them a message and this doubt arose for the hypothetical case that they do not appear in the group forum* ***B.*** *Hello! I have a question about the group task. In my group, for the moment, we are only two people participating. If we have to upload 20 terms, I'm afraid there will not be much to discuss. What do we do in this case? Regards* ***C.*** *Good morning, I have a question regarding the analysis of the texts. Although someone had already asked this, I still do not understand very well what we should do exactly. Do we have to do an analysis in which we compare the two texts or an analysis for each of the texts, that is, in the end we would have to complete two analyses or only one? Thanks in advance* ***D.*** *Hello! When I tried to answer the mini survey, it was not enabled. I thought that it could be done at any other moment and now I see that the survey has been closed. Isn't there any other possibility to do it? Thank you, greetings!* ***E.*** *Hello, I have tried to insert my translation, but I do not see where to deliver the task. Can you send me the link? Regards* ***F.*** *I have tried to access the texts to perform the obligatory task of this block in two different computers and in different browsers, but I cannot ac-cess any text. I do not know what to do*

(*continued*)

Table 2. (*continued*)

Data source	Excerpts
[Group_Forum]	***A.*** *As I see that nobody responds, at the risk of passing us from the delivery time limit, I will submit the following terms [..]* ***B.*** *Hello! Will someone in the group work on this group task?*
[Priv_Mess]	***A.*** *I get in touch with you to indicate a problem that has arisen to two other learners of the course and me. From the 23rd to the 30th of April we have a few days of the master's degree that we are studying in Brussels and we will not be able to complete the last task in the established time. Would there be any possibility of doing it before or after those dates?* ***B.*** *I would like to know why I am incorrect about the answer of the question 13, since it is what the article by Andrea Rosalia Olteanu says, page 30* ***C.*** *Once I have qualified in the rubric, what do I do?* ***D.*** *Hello! I made the revisions; however, I do not know if they were stored and completed. Thanks for your help*
[Post_Quest]	***A.*** *Without having experience in economic translation [..] it has been sometimes difficult to understand certain concepts/ terms. For this reason, some of the translation tasks have turned out to be more complex than expected. In general, I think it has been an intense course. [..]* ***B.*** *Difficulty in correcting others and knowing what was right/wrong of my corrections. It would have been useful at the end of the course or of each task to have the correct results from the teachers*
[Drop_Quest]	***A.*** *When I started the course, I had more time but with two jobs finally I had to leave it due to lack of time* ***B.*** *Unfortunately, I did not evaluate the required time correctly, since my availability was much more restricted*

job responsibilities with the course requirements" (see Table 2, e.g. [Drop-Quest]-A, B). The next most reported reason was the different student expectations about the course content and motivation (N = 10). A smaller group of participants (N = 9) stated learning difficulties as reasons for quitting the course such as problems with the concepts, the lower background knowledge and the need of extra support. Regarding the collaborative activities (which was reported as the main problematic issue of the learners who completed the course), posts related to that issue were not detected except from one participant expressing her preferences to work individually.

To obtain more insights about the possible reasons for dropouts, we explored their behaviour in the course. Results show that most of them (N = 35) completed the first and/or second compulsory activities (quizzes in week 1 and week 2). However, only 30 reached week 4, from which a few participated in the first collaborative activity (N = 4). Moreover 13 learners interacted with gamification by claiming and earning at least one reward.

Finally, the private messages of dropout learners were explored as well as the answers provided by the instructors. The messages were sent at weeks 4, 5 and 6 to inform the instructors about the participants' intention to leave the course.

4 Discussion and Conclusion

This study explored the problems of MOOC learners in a course implementing active learning strategies aiming at stimulating the interaction among the participants and their general engagement. The findings suggest that (a) introducing active learning strategies can generate additional problems to learners and (b) issues that can be challenging for the learners who follow and complete a course can be different from those faced by the dropout learners. The aspect reported as most problematic from the learners who completed the course regarded the collaborative activities. Yet, we did not encounter many relevant complaints about this aspect the second time they had to submit a collaborative task. This suggests that problems regarding the organization of collaboration mainly appear the first time that the learners are exposed to this method and become less prominent after they learn how to deal with them. At the same time, given that the majority of the unmotivated or non-active learners had dropped out by the second collaborative activity, groups were probably composed of learners who engage more with the activity and with each other. Further work is needed, however, to determine whether the difference of reported problems between the course weeks is related to the composition of the groups and/or the type of collaborative activities. On the other hand, no problems were reported about the gamification implemented in the course. We need to consider, nevertheless, the fact that the gamified activities were associated with optional tasks and only the learners who were interested in getting rewards were involved in their attainment. Thus, further exploration is needed to analyze if compulsory gamified activities would pose barriers to the learners during their experience in a MOOC.

The evidence gathered revealed additional problems concerning time-related, activity-related and technical issues, which are also reported in the literature [9–14]. However, while the results of the reviewed works relied on one single data source, our study followed a more thorough process, exploring the perspective of the student problems from multiple data sources. Moreover, unlike the results reported in [8, 10, 12] we found limited evidence regarding the lack of support as one of the barriers of the learners. This fact could be explained by the continuous help provided by the instructors and their timely responses to posts both in discussion forums and in private messages, an infrequent strategy in MOOCs. Among the total number of 156 messages posted in discussion forums by the learners, 269 answers were provided by the instructors with the maximum waiting time for a reply to be one day.

Our study points out that although active learning strategies can be challenging during the course, their inclusion under a careful design can help to overcome these challenges. Regarding collaborative activities, several group formation aspects and their adequate deployment for such massive, diverse and varied contexts should be taken into account. For example, one issue that should be considered is the possibility of grouping active learners with non-active ones, where a satisfactory design should come with alternatives. A study carried out in parallel to ours [18] discussed the benefits of homogeneous group formation to keep students engaged in the MOOC. Their results showed that, the second iteration of the collaborative activities were better, and that this could be partially due to the fact that the groups were formed using a better-informed data analytics algorithm, with data coming from the second half of the course (when most of the dropout learners had already abandoned). Concerning gamification, the design should challenge students and keep them motivated within the course. The positive fact of non-reported problems can be associated to design decisions, such as gamifying optional and diverse activities throughout the different weeks of the course, and to implementation decisions, such as placing the course gamification page inside the course interface and giving students the possibility of claiming the rewards once they completed the gamified conditions. Finally, a careful design should provide a proper scaffolding, as well, to overcome learners' problems. This can be achieved with the active presence of the instructor throughout the whole learning process both reactively, assisting the learners, and ideally proactively foreseeing problems that can arise and preparing the adequate reaction.

This study has limitations and further empirical work is required. First, still we need additional studies to detect learners' problems in a consistent way and to explore how to provide the adequate support. Second, self-reported data studied in this work were gathered only at the end of the course, when learners were already disengaged. During the course we only gathered evidence from the logs and the learners-to-learners and learners-to-instructor interactions. To overcome this limitation, in our next study we plan to explore learners' issues by collecting self-reported data in real-time during the course. Finally, the collaboration activities were compulsory while the gamified activities were associated with optional tasks. In short term, we will explore MOOC learners' problems in different contexts that implement active learning strategies.

Acknowledgements. This research has been partially funded by the European Regional Development Fund and the National Research Agency of the Spanish Ministry of Science, Innovations and Universities under project grants TIN2017-85179-C3-2-R and TIN2014-53199-C3-2R, by the European Regional Development Fund and the Regional Ministry of Education of Castile and Leon under project grant VA257P18, and by the European Commission under project grant 588438-EPP-1-2017-1-EL-EPPKA2-KA. The authors thank the rest of the GSIC-EMIC and Canvas Network team for their support. Special thanks to Juan I. Asensio-Pérez (Universidad de Valladolid) for his valuable ideas and his constant guidance conducting this research.

References

1. Onah, D., Sinclair, J., Boyatt, R.: Dropout rates of massive open online courses: behavioural patterns MOOC dropout and completion: existing evaluations. In: Proceedings of 6th International Conference on Education and New Learning Technologies, pp. 1–10 (2014)
2. Ferguson, R., Sharples, M.: Innovative pedagogy at massive scale: teaching and learning in MOOCs. In: Rensing, C., de Freitas, S., Ley, T., Muñoz-Merino, Pedro J. (eds.) EC-TEL 2014. LNCS, vol. 8719, pp. 98–111. Springer, Cham (2014). https://doi.org/10.1007/978-3-319-11200-8_8

3. Bonwell, C.C., Eison, J.A.: Active Learning : Creating Excitement in the Classroom. ASHE-ERIC Higher Education Reports. No. 1. Washington, DC (1991)
4. Hew, K.F.: Promoting engagement in online courses: what strategies can we learn from three highly rated MOOCS. Br. J. Educ. Technol. **47**, 320–341 (2016)
5. Chung, J.C.C., Chow, S.M.K.: Promoting student learning through a student-centred problem-based learning subject curriculum. Innov. Educ. Teach. Int. **41**, 157–168 (2004)
6. Khalil, H., Ebner, M.: MOOCs completion rates and possible methods to improve retention - a literature review. In: Proceedings of World Conference on Educational Media, Hypermedia Telecommunications 2014, pp. 1305–1313 (2014)
7. Henderikx, M., Kreijns, K., Kalz, M.: To change or not to change? That's the question… on MOOC-success, barriers and their implications. In: Delgado Kloos, C., Jermann, P., Pérez-Sanagustín, M., Seaton, D.T., White, S. (eds.) EMOOCs 2017. LNCS, vol. 10254, pp. 210–216. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-59044-8_25
8. Gütl, C., Rizzardini, R.H., Chang, V., Morales, M.: Attrition in MOOC: lessons learned from drop-out students. In: Uden, L., Sinclair, J., Tao, Y.-H., Liberona, D. (eds.) LTEC 2014. CCIS, vol. 446, pp. 37–48. Springer, Cham (2014). https://doi.org/10.1007/978-3-319-10671-7_4
9. Nawrot, I., Doucet, A.: Building engagement for MOOC students. In: Proceedings of the 23rd International Conference on World Wide Web - WWW 2014 Companion, pp. 1077–1082 (2014)
10. Hone, K.S., El Said, G.R.: Exploring the factors affecting MOOC retention: a survey study. Comput. Educ. **98**, 157–168 (2016)
11. Loizzo, J., Ertmer, P.A., Watson, W.R., Watson, S.L.: Adult MOOC learners as self-directed: perceptions of motivation, success, and completion. Online Learn. **21**, n2 (2017)
12. Henderikx, M., Kreijns, K., Kalz, M.: A classification of barriers that influence intention achievement in MOOCs. In: Pammer-Schindler, V., Pérez-Sanagustín, M., Drachsler, H., Elferink, R., Scheffel, M. (eds.) EC-TEL 2018. LNCS, vol. 11082, pp. 3–15. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-98572-5_1
13. Eriksson, T., Adawi, T., Stöhr, C.: "Time is the bottleneck": a qualitative study exploring why learners drop out of MOOCs. J. Comput. High. Educ. **29**, 133–146 (2017)
14. Shapiro, H.B., Lee, C.H., Wyman Roth, N.E., Li, K., Çetinkaya-Rundel, M., Canelas, D.A.: Understanding the massive open online course (MOOC) student experience: an examination of attitudes, motivations, and barriers. Comput. Educ. **110**, 35–50 (2017)
15. Creswell, J.W.: Research Design Qualitative quantitative and Mixed Methods Approaches (2003)
16. Guba, E.G.: Criteria for assessing the trustworthiness of naturalistic inquiries. Educ. Commun. Technol. **29**, 75 (1981)
17. Saldana, J.: An Introduction to Codes and Coding. The Coding Manual for Qualitative Researchers (2012)
18. Sanz-Martínez, L., Martínez-Monés, A., Bote-Lorenzo, M.L., Dimitriadis, Y.: Validating performance of group formation based on homogeneous engagement criteria in MOOCs. In: Proceedings of the Learning Analytics Summer Institute Spain 2018, León, Spain (2018)

Designing a MOOC – A New Channel for Teacher Professional Development?

Jean-François Van de Poël[1,2] and Dominique Verpoorten[1(✉)]

[1] IFRES, University of Liège, Traverse des Architectes, B63b, Liège, Belgium
dverpoorten@uliege.be
[2] CSE, University of Lausanne, Amphipôle 200-2, Lausanne, Switzerland

Abstract. This paper investigates the pedagogical benefits that 17 lecturers involved in the design of a MOOC reported in a questionnaire survey. Results reveal a fair amount of gains for several teaching skills and a strong appreciation of the collective training approach practiced during the 9-month MOOCs production process. These findings are of interest to staff development units, technology-enhanced learning competent bodies, and researchers concerned with collective modalities for scholarship of teaching and learning.

Keywords: MOOCs · Faculty development · SoTL · P.E.P.I.T.E. methodology · Quality teaching criteria · Chickering and gamson principles · Margaryan principles · Merrill principles

1 Introduction

1.1 Teachers as MOOC Consumers

A university MOOC policy can serve various purposes: raising international exposure, contributing to universal access to knowledge, yielding new profits, researching learning behaviors in large data sets, fostering staff pedagogical development. As for the latter outcome, teacher training literature has recently included MOOC development in its realm. However, its major concern bears on MOOCs as delivery instruments for teachers' initial or in-service training. MOOCs would open new avenues to teach large numbers of instructors (Castaño-Muñoz et al. 2018; Koutsodimou and Jimoyiannis 2015; Jobe, Östlund and Svensson 2014). Marquis (2013) sees in MOOCs a solution to fix two major hurdles inherent in training: cost and time. In the same vein, Bali (2013) enumerates 5 teaching benefits which should encourage teachers to be formed by the means of MOOCs. To this list, Rivera and Ramirez (2015) add the development of digital skills. In 2015, Dikke and Faltin (2015) locate, on various platforms, 130 MOOCs likely to train teachers' professional competences. A study of Ho et al. (2015) finds that, among 200.000 respondents to a survey of reasons to take MIT MOOCs, 39% self-identified as a past or present teacher. Surveys of 11 MITx courses on edX (Seaton et al. 2014) found that one in four respondent identified as past or present teachers. Laurillard (2016) transposes the model of MOOC consumption to

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 91–101, 2019.
https://doi.org/10.1007/978-3-030-19875-6_11

the huge amount of teachers it would be necessary to form with regard to the needs of South countries in education: "If we are to achieve the UNESCO Sustainable Development Goal (http://uis.unesco.org) of universal basic education, we need tens of millions of as-yet untrained teachers to educate school-age children. MOOCs cannot directly teach those children, but they can train non-professional adults to become those teachers. Such a "large-scale cascade model" of online learning would support the development of a much larger teaching workforce". On top of the works mentioned above, Misra (2018) adds a reflection on the institutional actions one should undertake to push MOOCs with determination as instruments of teacher development.

1.2 Teachers as MOOC Producers

Compared to the "consumption" of MOOCs in the context of teacher training, articles dealing with the "production" of MOOCs as pedagogical development opportunities for the holders of these MOOCs remain a modicum. Docq and Hamonic (2015) question the effects of MOOC design with 3 assumed added-values of blended learning: the cultivation of a student-centered approach, the modernization of the university and teachers' professionalization. The article suggests that part of the benefit for professional development would flow from the insertion of lecturers in a training community of colleagues facing similar challenges at the same time. In a convergent and rather convoluted case study, Bartoletti (2016) observes the development and the deployment of a MOOC. In conclusion, the author grants the whole process of a "reflective potential" (MOOC design as a "reflective laboratory", p. 8) stemming from an unusual level of pedagogical challenge combined with a "team-based MOOC design". Pedagogical development would be stimulated by interpersonal discussions conducive of (re-)examination in one's manner of teaching.

The relative scarcity of this second type of studies (MOOC design as a lever of pedagogical development for the lecturers-designers) might logically be explained by the limited number of involved teachers and by a certain difficulty to access the field and the subjects. This is the reason why IFRES, the staff development team for the University of Liège, has decided to document the effects of the support it has given to the holders of two MOOC cohorts. The research questions guiding this local qualitative research are:

- Do the efforts of the support team to use the MOOC production process as an incentive for professional development materialize in "feeling of learning" on the side of teachers (research question tackled by questionnaire 1)?
- To what extent do lecturers consider to have improved specific instructional skills and thanks to which element of the MOOC production process (research question tackled by questionnaire 2)?
- Are lecturers able to ascertain the pedagogical quality of their MOOC and is their opinion confirmed by professional educationalists (research question tackled by questionnaire 3)?

2 Methodology

2.1 Participants

In 2016, the vice-chancellor of the University of Liège (Belgium) launched a pilot project for MOOC production. Due to the success of the three first instances, the program was extended with a second group of MOOCs. The 17 respondents to the survey are all lecturers committed to a MOOC of the first or second season (https://www.fun-mooc.fr/universities/universite-de-liege).

2.2 MOOC Production Process

To give an adequate account of the declared effects of the MOOC design process on pedagogical development, one must describe the training approach adopted throughout the project. This approach is closely coupled with the MOOC production methodology gradually defined at Uni. Liège. Labelled with the acronym P.E.P.I.T.E. (Fig. 1, left side), each letter refers to a stage development of the MOOC:

- Preparation: lecturers outline their MOOC syllabus, taking into account existing MOOCs to avoid duplications and stipulating the audiences they plan to address.
- Elaboration: lecturers write the scripts and story-boards of the video sequences and record them.
- Production: lecturers monitor the video editing and fix the additional digital inlays. They also design appropriate learning activities.
- Implementation: lecturers upload contents on online platform (France Université Numérique, https://www.fun-mooc.fr).
- Transmission: lecturers assist the participants during the MOOC deployment.
- Evaluation: lecturers send certificates and analyze the MOOC run in order to regulate its next iteration.

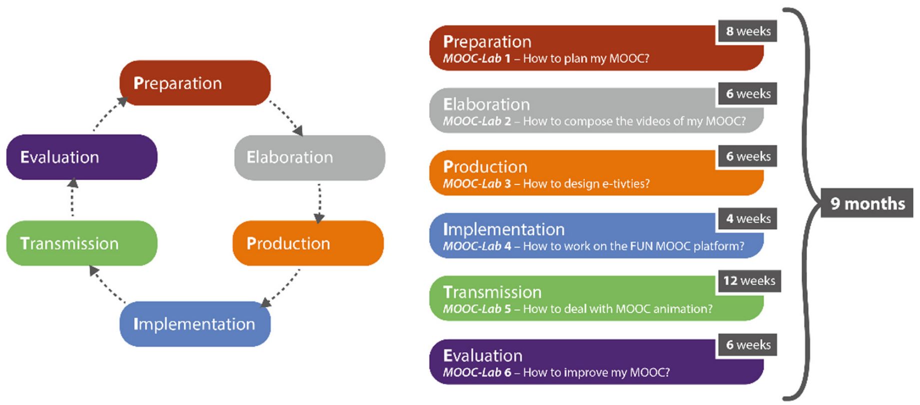

Fig. 1. Each stage of the P.E.P.I.T.E. MOOC production methodology (left side) is closely coupled with a staff development workshop ("MOOC-Lab", right side).

To each of these stages, a MOOC-Lab, i.e. a 3-hour training session, is carefully harnessed (Fig. 1, right side). Between MOOC-Labs, the support team meets personally the MOOC holders to secure progress. An articulation is thus created between collective workshops, individual counseling sessions, and personal work. Attendance to MOOC-Labs is one of the conditions for being granted the funding for the MOOC. A recurring component of the MOOC-Labs – and an expected purveyor of pedagogical development – is a table (Fig. 2) condensing and contrasting 4 lists of principles for quality teaching: Chickering and Gamson (1987), Merrill (2002), the complement to Merrill by Margaryan et al. (2015), and Hew (2016)

CHICKERING & GAMSON (1987) – Good teaching…	MERRILL (2002) - Learning is promoted when…	MARGARYAN ET AL. (2015) – Learning is promoted when…	HEW (2014) – Factors participants perceive as engaging
1 … develops reciprocity and cooperation among students		… learners collaborate with others.	Peer interaction
… encourages active learning	2 … new knowledge is applied by the learner.		Active learning
… gives prompt feedback		3 … learners are given expert feedback on their performance.	
… respects diverse talents and ways of learning		4 … different learners are provided with different avenues of learning, according to their need.	
… encourages contact between students and faculty			5 Instructor accessibility and passion
	6 … learners are engaged in solving real-world problems.		Problem-centric learning with clear expositions
… emphasizes time on task / … communicates high expectations	7 …existing knowledge is activated as a foundation for new knowledge 8 … new knowledge is demonstrated to the learner 9 … new knowledge is integrated into the learner's world.	10 …learners contribute to the collective knowledge 11 …learning resources are drawn from real-world settings.	Using helpful course resources

Fig. 2. Four quality criteria grids form the connecting thread of the MOOC-Labs series of workshops. (For colored boxes and numbers, see Sect. 3.3)

2.3 Instruments and Treatments

To collect impressions of lecturers on their commitment to pedagogy, 3 ad hoc questionnaires (Appendix 1) have been designed.

Questionnaire 1. Made of open questions, it collects spontaneous perceptions of progress in pedagogy. The treatment of answers is done in light of a well fitted model regarding technology-enhanced learning: TPACK (Koelher and Mishra 2009; Loisy et al. 2017).

Questionnaire 2. It shapes for the lecturers a reflective moment around teaching skills enhanced by their participation to MOOC design. The treatment is made in light of the IFRES local framework of competencies ("CREER" model, Verpoorten et al. 2015) structuring all staff training and support actions at Uni. Liège: competency 1: to design consistent teaching sequences/competency 2: to implement the designed sequence (resources, tools, technologies…)/competency 3: to teach/guide/support learning processes/competency 4: to assess learning and to give feed-back/competency 5: to monitor the quality of the sequence through reflective practice.

Questionnaire 3. It targets lecturers' perceptions of the pedagogical quality they achieved in their MOOC. These perceptions were expressed through 11 pedagogical quality criteria lecturers were regularly exposed to during the MOOC-Labs (Fig. 2, in orange and numbered). After their taking position for each criterion (binary choice: "applied" versus "non-applied"), faculties justified why they thought this criterion was met or not. Non justified answers were excluded. When there were several lecturers attached to a single MOOC, the criterion was considered as met when one lecturer justified it correctly. In an attempt to restrain purely subjective viewpoints, lecturers' decisions on each criterion were confronted to the aggregated score of 3 pedagogical advisors who made the same evaluation exercise on each MOOC.

2.4 Procedure

The 3 questionnaires were filled in by 17 lecturers at the end of the final MOOC-Lab, in the workshop venue.

3 Results

3.1 Spontaneous Self-reported Benefits (Questionnaire 1)

The 17 respondents stated together 26 distinct benefits coded in 4 categories (Fig. 3). Two of them can easily be labelled with TPACK framework for teacher knowledge for technology integration: "Technological knowledge" and "Pedagogical knowledge". Answers also contain frequent allusions to benefits in terms of collaboration with colleagues.

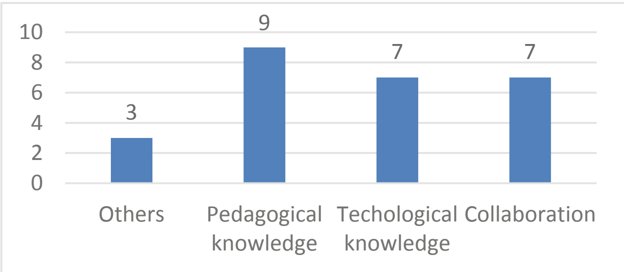

Fig. 3. Collaboration appears as an unexpected area of benefits for MOOC holders.

3.2 Perception of Progress in Teaching Skills (Questionnaire 2)

When asked to rate their progress onto the 5 skills of the CREER framework, the dominant feeling is one of progress (Fig. 4). Lecturers grant a mode of 4 (I improved this competence a lot) to skill n°2 (ability to implement a new learning sequence) and a mode of 2 (I improved this competence a bit) to skill n°4, related to assessment of

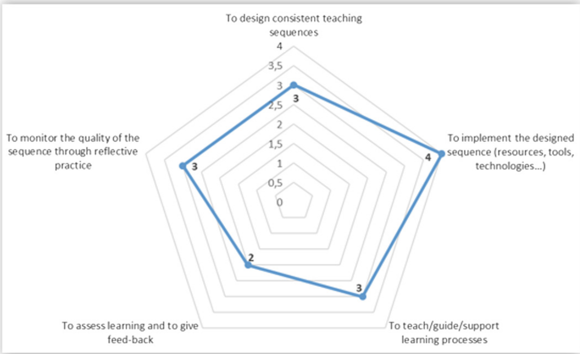

Fig. 4. All pedagogical skills are reported by lecturers to have been strengthened.

learning (Gherib et al. 2016). Other skills are rated at a mode of 3 (I fairly improved this competence).

Lecturers consider that they have already transferred variegated pedagogical concerns and skills (Fig. 5) developed in the MOOC context to regular face-to-face course practice. The most frequent transfer concerns the key pedagogical notion of constructive alignment (Biggs 1995)/triple consistency (Tyler 1949; Martone and Sireci 2009; Castaigne et al. 2007).

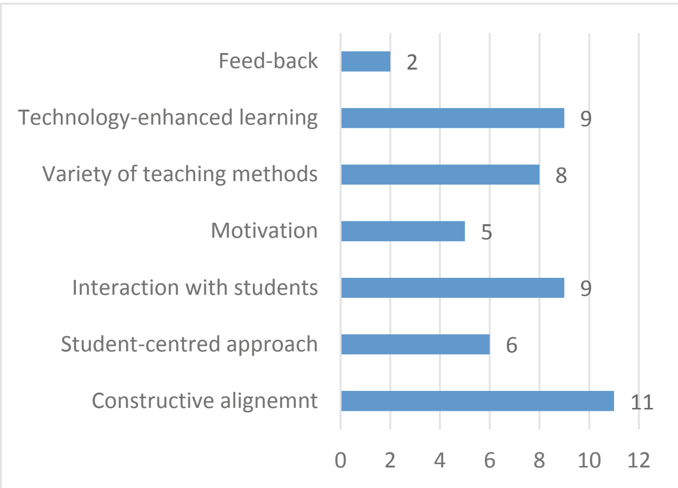

Fig. 5. Lecturers suggest that pedagogical skills and concerns sharpened in the MOOC context have diffused in other teaching activities (7 areas of transfer mentioned).

These self-reported gains have been achieved via different channels (Fig. 6). The intense, close, and individual work with pedagogical counselors is considered as the main catalyst of professional development.

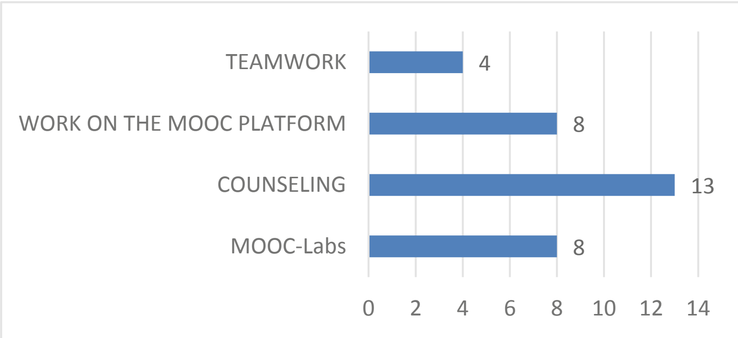

Fig. 6. Several components of the MOOC production process concur to skills development.

3.3 Quality Teaching Principles Criteria (Questionnaire 3)

When asked about which criteria of quality teaching (Fig. 2) they instantiated in their MOOC, 10 lecturers (committed to 5 MOOCs) are prone to report many of them (Fig. 7) and are able to give a pedagogical rationale as for this application.

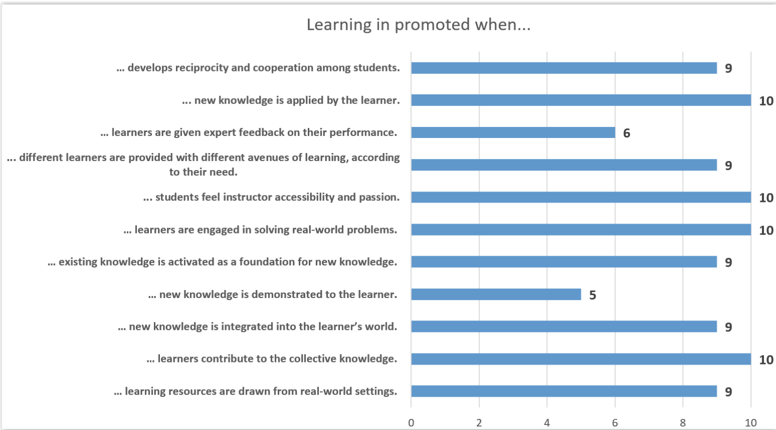

Fig. 7. MOOC-Labs regularly exposed lecturers to quality teaching principles (Fig. 2) and lecturers think most of these principles manifest in their MOOC.

When crosschecked with the agglomerate score of 3 pedagogical advisors, the level of agreement is high. Professionals are even more positive than the MOOC holders themselves (Fig. 8) about the operationalization of some pedagogical principles.

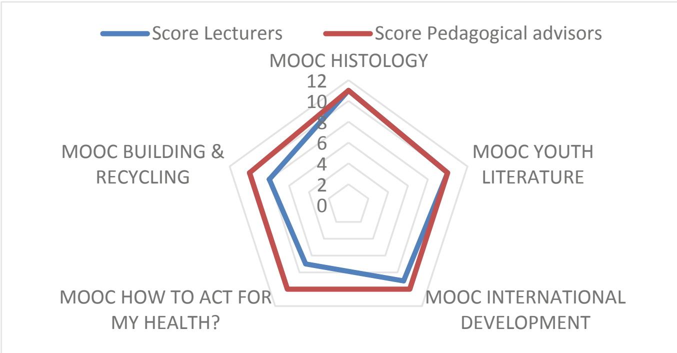

Fig. 8. The cumulated scores on quality teaching principles set by lecturers and pedagogical advisors for 5 MOOCs are rather similar and high in both cases.

4 Discussion and Limitations

Can the production of a MOOC be reasonably used as an incentive for professional development? Data give convergent indications that, at least, being involved in such a process prompts feeling of learning on the side of teachers. Perceived benefits related to technical development (Fig. 3) seem natural, as the creation of a MOOC entails taking charge of new eLearning tools. The claims of pedagogical gains (Fig. 3) were less expected, all the more so that several experienced teachers were among the respondents. (Spontaneous self-reported learning benefits of Fig. 2 receive an indirect confirmation from Figs. 7, 8, when teachers are asked to match pedagogical principles they covered in the MOOC-Labs to concrete realizations in their MOOCs).

Although collaboration is neither a dimension of the TPACK model of professional development (coding scheme of questionnaire 1) nor of the quality teaching principles (coding scheme of questionnaire 3), it consistently emerges, from teachers' answers, as a prime field of progress and a complementary channel of pedagogical development (Figs. 3 and 6). In two seasons of MOOCs production, the support team has been struck by a major tendency of lecturers to develop MOOCs in teams, which was not demanded at the start. Indeed, the huge piece of work that a MOOC represents might explain a first move towards pooling people. It can also be seen as the trigger for a collective challenge and an opportunity for joint work. SoTL literature has recently called for more attention to collective modalities of teacher professional development (Verpoorten et al. 2017). The results presented here suggest that MOOCs convey this new kind of opportunity, as already put forward by Alony et al. (2015) or Najafi et al. (2015).

Can the production of a MOOC reasonably be put in the service of a local teaching competency framework? According to the teachers, the answer is positive (Fig. 4). Mastery of the design, implementation, animation, and regulation of a teaching sequence is said to have improved throughout the 9-month process. Furthermore, these improved skills are claimed to have been transferred in face-to-face teaching contexts (Fig. 5). The vectors of this progress are manifold (Fig. 6): formal (MOOC-Labs) and tailored counseling moments, autonomous work on the platform, and team-based learning. The various elements of a MOOC development process might be mutually reinforcing and the challenging output that a MOOC embodies might act as an unexpected immersion of the lecturers into a motivating project-based pedagogy. To a certain degree of isomorphism, the quality teaching principles lecturers are encouraged to ingrain in their MOOCs also imbue the pedagogical support they receive.

As for further work, the descriptive data on teacher development provided here could favorably expand into a fine-tuned and differentiated understanding of how teachers understand MOOC design and interpret instructional design principles, beyond a rough yes/no implementation (Fig. 7) and in another time than at the end of the process when relief and satisfaction are likely to color answers.

Regarding limitations, relationships between lecturers and pedagogical advisors have developed during the 9 months of the MOOC production. Social desirability or, more to the point here, kindness to the support team, can be a shortcoming of the questionnaires. Similarly, the 3 pedagogical advisors who scored the MOOCs in the same way lecturers did (Fig. 8) are not foreign to the MOOC development process. Although inter-subjectivity was used to curb risks of self-indulgence, a review of the MOOCs quality by an independent instance would yield safer results.

Appendix 1

Questionnaire 1 aimed at collecting spontaneous ideas on progress as teachers, with 2 open questions: (1) as a teacher, what do you get out of your participation in the MOOC project?, (2) What are you proud of in your MOOC and what could you improve? Questionnaire 2 aimed to connect lecturers' experience as MOOC producers to the university teaching competencies reference framework. Questions were aligned with the 5 skills of the model CREER: do you consider that your experience of MOOC design has not/a bit/fairly/strongly developed competency 1, 2, 3, 4, 5 (Fig. 4). To complement these suggested skills, teachers were asked if/what they had already transferred from MOOCs to other courses. Lastly, lecturers were asked which component of the MOOC project contributed the most to the progress they claim. Questionnaire 3 focused on 11 quality teaching principles, asking teachers to inspect for each of them if it was materialized in their MOOC and how (Fig. 7). Three pedagogical advisors did the same for the sake of a comparison with teachers' answers (Fig. 8).

References

Alony, I., Kaye, S., Lambert, S.: MOOCs' contribution to staff development and capacity building: Australian university case study. Paper presented at the 26th ICDE World Conference, Sun City, South Africa, October 2015

Bali, M.: 5 reasons teachers should dip into MOOCs for professional development. MOOC News and Reviews, 12 July 2013

Bartoletti, R.: Learning through design: MOOC development as a method for exploring teaching methods. Curr. Issues Emerg. eLearning **3**(1), 2 (2016)

Biggs, J.: Enhancing teaching through constructive alignment. High. Educ. **32**(3), 347–364 (1995)

Castaigne, J.-L, Petit, L., Verpoorten, D.: Introducing teachers and instructional developers to learning objects four suggested shifts in prevailing discourse. In: Targamadze, A. (ed.) Proceedings of the Advanced Learning Technologies and Applications Conference (ALTA 2007), pp. 73–79. Technical University Kaunas, Kaunas (2007). http://hdl.handle.net/2268/152053

Castaño-Muñoz, J., Kalz, M., Kreijns, K., Punie, Y.: Who is taking MOOCs for teachers' professional development on the use of ICT? A cross-sectional study from Spain. Technol. Pedag. Educ. **27**(5), 607–624 (2018)

Chickering, A., Gamson, Z.: Seven principles for good practice in undergraduate education. AAHE Bull. **3**, 7 (1987)

Dikke, D., Faltin, N.: Go-Lab MOOC – an online course for teacher professional development in the field of Inquiry-based science education. Paper presented at the 7th Conference on Education and New Learning Technologies, Barcelona, Spain, July 2015

Docq, F., Hamonic, E.: Why make MOOCs? Effects on on-campus teaching and learning. Paper presented at the Conference EMOOCs 2015, Mons, Belgium, May 2015

Gherib, C., Dujardin, J.-M., Verpoorten, D.: MOOCs in business administration - an overview of assessment practice. In: Proceedings of the Conference of the European Association for Practitioner Research on Improving Learning (EAPRIL) 2015, Issue 2, pp. 258–268. EAPRIL Office, Leuven, Belgium (2016). http://hdl.handle.net/2268/194562

Hew, K.: Promoting engagement in online courses: what strategies can we learn from three highly rated MOOCs. Br. J. Edu. Technol. **47**(2), 320–341 (2016)

Ho, A.D., et al.: HarvardX and MITx: Two years of open online courses. HarvardX Working Paper No. 10 (2015)

Jobe, W., Östlund, C., Svensson, L.: MOOCs for Professional teacher development. In: Searson, M., Ochoa, M. (eds.) Proceedings of SITE 2014–Society for Information Technology and Teacher Education International Conference, pp. 1580–1586. AACE, Jacksonville, Florida (2014)

Koelher, M., Mishra, P.: Technological pedagogical content knowledge: a framework for teacher knowledge. Teach. Coll. Rec. **108**(6), 1017–1054 (2006)

Koutsodimou, K., Jimoyiannis, A.: MOOCS for teacher professional development: Investigating views and perceptions of the participants. Paper presented at the 8th International Conference of Education, Research and Innovation, Sevilla, Espana, November 2015

Marquis, J.: Why MOOCs are good for teacher professional development! OnlineUniversities.com, 21 May 2013

Misra, K.: MOOCs for teacher professional development: reflections and suggested actions. Open Prax. **10**(1), 67–77 (2018)

Laurillard, D.: The educational problem that MOOCs could solve: professional development for teachers of disadvantaged students. Res. Learn. Technol. **24** (2016)

Loisy, C., Van de Poël, J.-F., Verpoorten, D.: Regards croisés sur deux dispositifs de formation techno-pédagogique, leur outillage conceptuel et l'évaluation de leurs bénéfices. In: Detroz, P., Crahay, M., Fagnant, A. (dir.), L'évaluation à la lumière des contextes et des disciplines (p. 277–307). Louvain-la-Neuve, Belgique: De Boeck (2017). http://hdl.handle.net/2268/205471

Margaryan, A., Bianco, M., Littlejohn, A.: Instructional quality of massive open online courses (MOOCs). Comput. Educ. **80**, 77–83 (2015)

Martone, A., Sireci, S.: Evaluating alignment between curriculum, assessment, and instruction. Rev. Educ. Res. **79**(4), 1332–1361 (2009)

Merrill, M.: First principles of instruction. Educ. Technol. Res. Dev. **50**(3), 43–59 (2002)

Najafi, H., Rolheiser, C., Harrison, L., Håklev, S.: University of Toronto instructors' experiences with developing MOOCs. Int. Rev. Res. Open Distrib. Learn. **16**(3), 233–255 (2015)

Rivera N., Ramírez, M.: Digital skills development: MOOCs as a tool for teacher training. Paper presented at the 8th International Conference of Education, Research and Innovation, Sevilla, Espana, November, 2015

Seaton, D., Coleman, C., Daries, J., Chuang, I.: Teacher enrollment in MITx MOOCs: are we educating educators? Educause Rev. (2014)

Tyler, R.W.: Basic Principles of Curriculum and Instruction. University of Chicago Press, Chicago (1949)

Verpoorten, D., Jérôme, F., Delfosse, C., Detroz, P.: Infusing SoTL components in staff training - a faculty development continuum at the university of Liège. Paper presented at the 12th Annual Conference of the International Society for the Scholarship of Teaching and Learning (ISSOTL) - Leading Learning and the Scholarship of Change, Melbourne, Australia, October 2015. http://hdl.handle.net/2268/187394

Verpoorten, D., Leduc, L., Mohr, A., Marichal, E., Duchâteau, D., Detroz, P.: Feedback first year – a critical review of the strengths and shortcomings of a collective pedagogical project. In: Friberg, J., McKinney, K. (eds.) Applying the Scholarship of Teaching and Learning Beyond the Individual Classroom Level. Indiana University Press, Bloomington (2017). http://hdl.handle.net/2268/206782

Online Course Production and University Internationalization: Correlation Analysis

Ulyana S. Zakharova(✉)

Higher School of Economics, Moscow, Russia
uzakharova@hse.ru

Abstract. Universities which produce massive open online courses (MOOCs) and offer them on global e-learning platforms define internationalization as one of their main objectives. Empirical research that test the impact of MOOC production on international students' enrollment is still rare. Present study is the first stage of bridging this gap. To do so, correlation analysis is applied to two data sets, which are universities MOOC portfolio derived from Class Central aggregator and international students statistics from QS World Universities Ranking. Three hundred top MOOC producers which are universities from different countries were analyzed. No strong statistically significant correlation was found. The same is true for the US universities as a subsample. Further research regarding annual statistics is required to continue the discussion and to approach the interrelation between MOOC production and its impact on university key performance indicators.

Keywords: Massive open online course · MOOC production · International students · University internationalization · ICT in higher education · Correlation analysis

1 MOOC Production for Internationalization Purposes

Since 2012 universities have been producing massive open online courses (MOOCs) and offering them worldwide on e-learning platforms. Their administrators' objectives are diverse, but, as various studies show, one of the most popular is going global or recruiting international students [8–11, 18, 21]. Faculty agree that information and communication technologies (and MOOCs are considered one of them) contribute to university internationalization [17, 20]. Internationalization is defined by Knight as "the process of integrating an international, intercultural, or global dimension into the purpose, functions or delivery of postsecondary education" [13]. It is seen as a notion that is closely connected with the quality of education. That is why, this parameter is included into the majority of global higher education rankings (QS, Times, U.S. News). Today MOOCs are located at the slope of enlightenment or the plateau of productivity, according to the Gartner Cycle [4]. Therefore, universities must have already witnessed MOOCs' long-term impact on those spheres that were to be improved. Surprisingly, there are very few papers discussing this impact.

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 102–107, 2019.
https://doi.org/10.1007/978-3-030-19875-6_12

MOOCs result in academic mobility.[1] Students of one university may enroll for the course offered by other institution (external mobility) or other department of the same university (internal mobility). As soon as MOOC learners do not physically move between campuses, such academic mobility is called virtual. If a person studies a MOOC designed abroad, one may speak about virtual internationalization [5], because an international student enrolls for the university programs. Universities in different countries convincingly report that MOOCs attract learners from abroad [7, 16].

There are some favorable factors for internationalization potential of an online course, such as:

1. the scope of the e-learning platform where the course is offered; international platforms like *Coursera* or *edX* are better for getting international audience than national ones, like Chinese *XuetangX* or Russian *Open Profession*, for instance. That is because national e-learning platforms usually provide country-specific content that might be of lesser interest for the international audience;
2. the language of the course, which is better to be English [1, 3], but that could be not enough. This argument is discussed in more detail later;
3. the author's expertise in the subject which should be comparable to that of his or her colleagues, including those from abroad;
4. the author's scientific school associated with those existing in universities overseas;
5. the curricula correspondence to that in the universities abroad, so that learners could ask one's own university administrators to offer a credit shift for that online course.

Thinking about universities that might meet all these requirements, a person might assume that MOOCs impact on university internationalization evolves according to the Matthew effect, "the rich get richer and the poor get poorer." Those universities for whom English, modern lingua franca, is a native language are in an advantageous position for achieving internationalization objectives. Other MOOC producers aiming at going beyond the state borders rely on English as a teaching language, but they usually do not adapt courses for learners of diverse origin [22]. Choosing between two courses one of which is offered by an American or British university and another one is by a higher education institution (hereafter HEI) in some other country, a learner would sooner choose the first one. The reputation of native English universities as the best in the world which is supported by the rankings is a strong argument [6]. Altbach in his straight-forward paper "MOOCs as Neocolonialism: Who Controls Knowledge?" [2] argues that there is the US and UK bias on the MOOC market or "educational hegemony". Recent research of MOOCs offered on international platforms Coursera and edX supports this argument, claiming that USA provide 52% of all courses there [19].

What is more, language is not enough. Knight and de Wit [14] highlight that internationalization is about communication, understanding cultural peculiarities and ability to collaborate with people from abroad. Do MOOCs enable that? "Learners of MOOC or xMOOC to be precise that is its content-oriented type, even being of diverse

[1] "Academic Mobility' implies a period of study, teaching and/or research in a country other than a student's or academic staff member's country of residence ('the home country')" http://www.unesco.org/education/studyingabroad/what_is/mobility.shtml.

national background hardly ever or never communicate," claimed de Wit at the Russian Higher Education conference in October 2018. Therefore, even if a university produces a MOOC in English aiming at international learners, it is not enough, and true internationalization might not occur.

Summing this up, one may think that MOOCs are not a perfect solution for university internationalization. Still they can be used as a tool for that. Massive open online courses (as the first word of their title denotes) provide university with access to an enormous number of learners. If these learners are recruited as campus students, all the communication and collaboration requirements of a real internationalization according to Knight and de Wit are met. As for the approaches to recruiting MOOC learners for traditional university programs, they seem to be limited only by the administrators' creativity, laws and regulations. Some universities spread information about campus programs among MOOC learners using e-learning platform as an avenue of promotion, others apply data processing selecting promising learners and providing them with a special offer, such as using MOOC results as an entrance exam, for instance. However, as Ulrich and Nedelcu [22] point out, the results of such recruiting campaigns are not worth the efforts. The major reasons that might prevent the university from achieving success in recruiting MOOC learners for campus programs are close to the factors of MOOC internationalization potential, that have been discussed before. Moreover, there is a crucial factor related to the online course audience. The MOOC platform audience is presented by 25–40-year old professionals with a degree [12], so they just lack motivation for entering a university [15].

As the literature shows, MOOCs impact on university internationalization has been actively discussed. However, most studies have focused on the potential rather than on the achievements. The language, content, and audience-related challenges addressed in some of these papers give no clue, if these problems are solvable or not for the universities trying to take advantage over MOOCs for the sake of their internationalization intentions. It is not clear if those approaches that universities use are effective enough. There has been little quantitative analysis in the field, so is the reliable evidence that MOOCs do help universities to internationalize. What is more, it is unclear what is the cause and what is the effect – do MOOCs make universities more international or are they the global universities which produce MOOCs?

Therefore, to make the first step, the objective of this study is to reveal the correlation between the number of MOOCs a university produced, and the number of its international students enrolled. The hypothesis is that there is a positive correlation between these two variables. To test that the data of 300 top-ranked universities were used.

2 Methodology

The current study examined the correlation between the number of MOOCs a university produced, and its number of international students enrolled. The sample consisted of the best HEIs from 21 countries, since leading universities are those that started to produce MOOCs prior to other HEIs, and have a rich collection of online courses that may be subjected to the study. The information about their MOOCs was derived from the Class Central MOOC aggregator[2], while the data about universities total and international students' enrollments were taken from the Quacquarelli Symonds (QS) World University Rankings® 2019[3]. According to the Class Central there are 880 course producers. The sample was defined as a result of matching this list with the list of top 1000 universities from the QS World University Rankings and was limited to the top 300 MOOC producers which are universities. The sample formation has been stopped because the 95% probability coefficient has been reached.

The US universities were the first to start MOOC production and are the leaders in students' internationalization. To test the research hypothesis with them, a subsample consisted of American universities chosen from the overall sample has been built (N = 82).

Since the sizes of the universities differ, it is clear, that the research should not be based on the absolute values of international students' enrollments. That is why the share of international students in the overall number of university students is calculated for further operations. Both variables are continuous, that is why the Pearson correlation coefficient is calculated. The statistical analysis was conducted using the IBM SPSS (Statistical Package for the Social Sciences) 21 software.

3 Results

Descriptive statistics of the overall sample show that the number of MOOCs produced by these universities ranges from 1 to 201 (mean (*M)* is 21.66, standard deviation (*SD*) is 31.29); their share of international students ranges from 0.16 to 58.66 ($M = 19.93$, $SD = 11.38$). As for the US universities subsample, the number of MOOCs produced ranges from 1 to 201 ($M = 34.31$, $SD = 46.50$); their share of international students ranges from 2.63 to 47.77 ($M = 17.13$, $SD = 8.75$).

For the overall sample there is a statistically insignificant weak positive correlation between the two variables: *r* (correlation coefficient) = .09, *p* (probability value) = .13.

The Pearson coefficient for the US subsample is statistically significant but weak: $r = .33$, $p = .01$.

For the US subsample, another hypothesis has been tested: the universities with higher number of MOOCs are characterized with a higher share of international students. Since there is no accepted performance indicator for an active MOOC producer, the universities were divided into two group – those which produced less than average number of MOOCs (group 1, $N = 59$), and the rest of the subsample (group 2, $N = 22$).

In the first group the number of MOOCs ranges from 1 to 33, $M = 11.53$, $SD = 9.54$. In the second group the number of MOOCs ranges from 34 to 201, $M = 95.4$, $SD = 51.16$. The Pearson coefficient between the number of produced MOOCs and the share of international students for these two groups is different but equally statistically insignificant: $r = .06$, $p = .637$ and $r = .39$, $p = .07$.

[2] The aggregator website is https://www.class-central.com.

[3] The ranking is available at https://www.topuniversities.com/university-rankings/world-university-rankings/2019.

4 Conclusion and Discussion

Some relationship between MOOC production and recruiting international students has been reported in the literature built on the interviews of university managers and faculty [8–11, 18, 21]. In reviewing these papers, no data was found to prove this association. This study has been unable to demonstrate a strong significant correlation between MOOCs offered by a university and its international students enrolled. That is true for the global universities sample and US universities subsample. For the US universities number of produced MOOCs and share of international students in the total enrollments do correlate but weakly. No association between the variables has been revealed for more and less active MOOC producers among US universities.

Discussing the achieved results in this paper, some limitations of the data should be considered. Firstly, the sample has been built of the top-ranked universities regarding the number of MOOCs they produce. Expanding the dataset by adding the rest of the university MOOC producers from the Class Central list and their internationalization performance indicators from QS ranking is a way to overcome this limitation. At the same time, Class Central may lack some information, though being the biggest MOOC aggregator for now. Secondly, there is no guarantee that all universities in the sample and subsample has one and the same policy on reporting their MOOC learners as international students. This may lead to the fact that QS ranking indicators include this audience for some universities and exclude for others. Thirdly, MOOC production might have a delayed effect, which is not evident from these summarized data in the current study. By the "delayed effect", a change in the number of international students in a year or several years after the university offered its MOOCs to the audience is meant. Therefore, further research might be conducted on universities' annual internationalization and MOOC reports. Considering various factors international students' recruitment may be connected to, this research should have a very thought-through design, so that its results are considered reliable.

Even though the study has these limitations, its result should be considered reliable because of the data sources and sample size. The research perspectives lie in the field of enlarging the data set, calculating correlation coefficient for the annual data and as a result defining universities with stronger correlation. The next step might be on analyzing these universities' best practices of taking benefits of MOOCs for internationalization purposes. If these universities actions can be successfully realized in other higher educational institutions, such research would contribute to practical implications.

References

1. Abeer, W., Miri, B.: Students' preferences and views about learning in a MOOC. Proc. Soc. Behav. Sci. **152**, 318–323 (2014)
2. Altbach, P.G.: MOOCs as neocolonialism: who controls knowledge? Int. High. Educ. **75**, 5–7 (2014)

3. Boal, H.M.C., Stallivieri, L.: The influence of massive online open courses (MOOCs) on the internationalization process of higher education. Digital Universities V. 2 (2015). International best practices and applications (2–3), pp. 21–38 (2016)
4. Bozkurt, A., Keskin, N.O., de Waard, I.: Research trends in massive open online course (MOOC) theses and dissertations: surfing the tsunami wave. Open Prax. **8**(3), 203–221 (2016)
5. Bruhn, E.: Towards a framework for virtual internationalization. Int. J. E-Learn. Dist. Educ. **32**(1), 1 (2017). https://eric.ed.gov/?id=EJ1159898. Accessed 17 Nov 2018
6. Burd, E.L., Smith, S.P., Reisman, S.: Exploring business models for MOOCs in higher education. Innov. High. Educ. **40**(1), 37–49 (2015)
7. Chuang, I., Ho, A.: HarvardX and MITx: four years of open online courses fall 2012-summer (2016)
8. Hollands, F.M., Tirthali, D.: MOOCs: expectations and reality. Full report (2014)
9. Jansen, D., Goes-Daniels, M.: Comparing Institutional MOOC Strategies (2015)
10. Jansen, D., Konings, L.: MOOC Strategies of European Institutions/EADTU (2017)
11. Jansen, D., Schuwer, R.: Institutional MOOC strategies in Europe. Status report based on a mapping survey conducted in October–December 2014, Mimeo (2015)
12. Kaplan, A.M., Haenlein, M.: Higher education and the digital revolution: about MOOCs, SPOCs, social media, and the Cookie Monster. Bus. Horiz. **59**(4), 441–450 (2016)
13. Knight, J.: Updated definition of internationalization. Int. High. Educ. **33**, 2–3 (2015)
14. Knight, J., de Wit, H.: Internationalization of higher education: past and future. Int. High. Educ. **95**, 2–4 (2018)
15. Krause, S.D., Lowe, C.: Invasion of the MOOCs: The Promises and Perils of Massive Open Online Courses, pp. 68–72. Parlor Press, Anderson (2014)
16. Massive open online courses of National Research University Higher School of Economics 2014–2015 (2015). (in Russian)
17. O’Connor, K.: MOOCs, institutional policy and change dynamics in higher education. High. Educ. **68**(5), 623–635 (2014)
18. Sandeen, C., Jaratt, D., Parkay, C.: To MOOC or not to MOOC: strategic lessons from the pioneers. In: An Analysis of Administrator and Faculty Motivations. ACE, American Council on Education, Inside Track (2013)
19. Semenova, T., Vilkova, K., Shcheglova, I.: The MOOC market: prospects for Russia. In: Voprosy Obrazovaniya/Educational Studies Moscow, vol. 2, pp. 173–195 (2018). (in Russian). http://doi.org/10.17323/1814-9545-2018-2-173-197
20. Thune, T., Welle-Strand, A.: ICT for and in internationalisation processes: a business school case study. High. Educ. **50**(4), 593–611 (2005)
21. Tyson, C.: From MOOC to Shining MOOC. Resource Document. Inside Higher Education (2014). https://www.insidehighered.com/news/2014/06/25/can-moocs-lure-international-students-us-colleges-and-universities. Accessed 8 Nov 2018
22. Ulrich, C., Nedelcu, A.: MOOCs in our university: hopes and worries. Proc. Soc. Behav. Sci. **180**, 1541–1547 (2015)

Experience Track

Developing the Open Virtual Mobility Learning Hub

Diana Andone(✉), Andrei Ternauciuc, Vlad Mihaescu, and Silviu Vert

Politehnica University of Timisoara, Timisoara, Romania
{diana.andone,andrei.ternauciuc, vlad.mihaescu,silviu.vert}@upt.ro

Abstract. Today's globalization affects the higher education at its core system, policies, and new models of education delivery but also for students' mobility. In the era of online and mobile learning, of massive open online courses (MOOCs), adding virtual components to students and/or teacher mobility has become a requirement. Virtual Mobility (VM) has a great potential to contribute to the internationalization, innovation and inclusion in higher education. This paper presents the design and the development of the Open Virtual mobility Learning Hub (OpenVM) as a collaborative online and mobile environment for promoting VM Skills of educators and students in the European Higher Education Area. The OpenVM Learning Hub assists to enhance the Virtual Mobility readiness of higher education institutions, educators and students through achievement, assessment and recognition of VM skills. The OpenVM Learning Hub includes interactive, multiple levels MOOCs in VM Skills, the VM Skills assessment, VM Skills, Open Badges and open virtual mobilities collaboration for different stakeholders. This paper analyses different scenarios for the OpenVM Learning hub, its development based on open education principles and the inclusion of the first Open VM MOOC.

Keywords: Virtual mobility · Open education · MOOC development · Open Badges · Online learning environment · Learning scenarios

1 Introduction

The concept of "internationalization" in Higher Education exists since the end of the 20th Century, as it was very well explained in [1]. There, it is defined as "one of the ways a country responds to the impact of globalization yet, at the same time respects the individuality of the nation". Moreover, the internationalization of higher education is described as "the process of integrating an international/intercultural dimension into the teaching, research and service functions of an institution". The dynamics of internationalization makes it challenging to develop educational programs such as virtual mobilities, especially since these are shaping the new directions for higher education.

Mobilities in higher education are amongst the main topics with which the European Commission is concerned according to [2] and [3]. Mobility is considered an

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 111–120, 2019.
https://doi.org/10.1007/978-3-030-19875-6_13

important part of higher education as it supports personal development and employability, fosters respect for diversity and a capacity to deal with other cultures, encourages linguistic pluralism underpinning the multilingual tradition of Europe and increases cooperation and competition between higher education institutions [2] and [3]. Moreover, exchange, cooperation, and competition among participating institutions and individuals will increase. Such mobility of students and staff is promoted by the Erasmus program, superseded by Erasmus+. Still, statistics proof dramatic differences in the uptake of such mobility opportunities across Europe. Because of a series of factors and obstacles, mobilities have yet to reach their expected potential [4]. Obstacles found to be significant prohibitors for student mobility include social status, disability and chronical diseases, family and parental obligations, financing, language proficiency, recognition of the study period and foreign degrees. To (partly) remove such obstacles and allow full access to courses abroad, the concept of virtual mobility has been discussed as a nondiscriminatory alternative of mobility. On an institutional level, the study courses are supported by online technology to provide learning activities and participation accessible to all. Therefore, the concept of virtual mobilities could be a feasible alternative for student and staff mobility [5]. Virtual mobility is defined as "a set of ICT supported activities that realize or facilitate international, collaborative experiences in a context of teaching and/or learning" [5]. Virtual mobilities have a great potential to contribute to the internationalization of higher education.

2 Virtual Mobility Learning Hub Concept

In the Open Virtual Mobility (openVM) European strategic partnership we plan to create accessible opportunities for achievement of virtual mobility skills to ensure higher uptake of virtual mobility in higher education in Europe and is funded under the European Erasmus+ Program [6]. Additionally, we designed a Learning Hub (LH) platform on Moodle and several plugins to provide a central marketplace for teachers and students to find available virtual mobility courses, offer own courses for students, professors and network with those interested in studying or working virtually. The core part of the learning hub is an online course, assessments and certification of virtual mobility competencies and skills based on Open Badges.

This paper presents the concept, development and scenarios for the OpenVM Learning Hub.

The Open VM Learning Hub (VMLH) Concept incorporates several components, services and technologies. The design of the VMLH starts with the desired functionalities previously discussed in partner meetings and conferences, as well as with the existing technologies and e-learning infrastructures of the partners, and their desired connections with the Hub. Existing open-source entities were analyzed to see if and how they could be used to achieve the project's stated objectives. We performed a distinct analysis of several tools: XAPI, Open badges standards, Open Badges Bestr, Bestr XAPI, Learning Record Store (LRS), Enterprise Learning Ecosystem, Learning Management System – Moodle 3.4., H5P, Mahara. Based on this analysis, [7] several tools were included in the technical structure and implementation and some others were initially included and then excluded.

3 Virtual Mobility Learning Hub Methodology

The Virtual Mobility Learning Hub is an innovative multilingual (in seven languages) ICT-based environment (as a directory of virtual mobility attributes) with the main plan to promote collaborative learning, connectivism social networking as an instructional method, open educational resources OERs as the main content, open digital credentials as recognition and validation of VM skills which can be applied to all ages and levels of digital education.

The VMLH initial requirements were: to be built on a user-friendly interface, as well as a mobile interface, to encourage everyone to access it, engage in different open learning activities, connect with others and develop their VM competencies.

The applied methodology for the concept and implementation of the Virtual Mobility Learning Hub (VMLH) follows the principles of agile development [8], and sociocognitive engineering method [9, 10], with focus on frequent technical and user cases iterations and then, user tests to improve user experience.

The methodology and tools followed the AGILE development process:

- UPT Internal consultations on technical structure, user cases and functionalities, including the proposed technologies: LMS, xAPIs, Bestr and LRS.
- OpenVM Internal consultation with the technical team: Consultations with Bestr team, Beuth University team, UNIT team, UniRoma team about different technologies and infrastructures needed.
- External consultation on OpenVM LH – within the partnership with experienced former teachers and students involved in virtual mobilities, in UPT two first consultations were held in March and April 2018 with teachers and students involved in the TalkTech 2017 project [11].
- external consultation on OpenVM LH with experts in open education, open badges and virtual mobilities during the OpenVM workshop in the EDEN Annual Conference in June 2018, Genoa, Italy [6].
- Continuous adaptation and improvements of the openVM LH user cases, functionalities and technical development – based on usability evaluations.

The development of the Virtual Mobility Learning Hub as a Personal Learning Environment (PLE) furthermore focused on (a) the development of a responsive interoperable interface, (b) implementation of social software, (c) integration of tools for mobile learning, (d) development of a common working/collaboration space, (e) inclusion of features and learning analytics, (f) integrated self-assessment, and (g) validation of open digital credentials.

The development of the Virtual Mobility Learning Hub (VMLH) required an interdisciplinary approach from web technologies, mobile technologies, Web 2.0, interactive media and audio-video technologies, open access and tools for semantic technology. It exists also in all partner languages (EN, DE, IT, NL, FR, ES, RO) with a possible extension to other languages which will allow communication at European, national and regional levels.

Expected Results

The functional diagram for the Virtual Mobility Learning Hub is displayed schematic in Fig. 1. It contains most of the functionalities of the VMLH as they are envisioned at this moment.

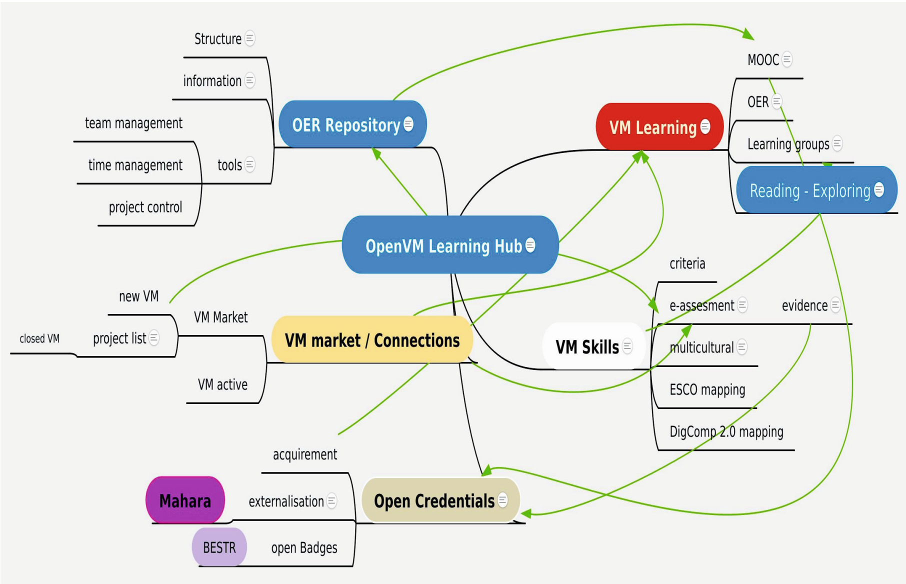

Fig. 1. VMLH structural diagram.

There are several elements in the diagram that can be viewed as sub-structures, each with their own semi-autonomous purpose:

- The VM skills – Represent the necessary abilities in order to conduct (teacher) or participate (student) in a Virtual Mobility; these skills are assessed (through the e-assessment mechanism/module), and if found lacking, can be acquired through the MOOC in the VM Learning section. This section presents the current user's currently validated skills (through the use of Open Badges?).
- The VM Learning component – ensures that participants acquire the VM skills needed to participate in a Virtual Mobility (MOOC); it also provides the structure for the deployment of the VMs themselves.
- The VM market – presents existing, past and future Virtual Mobilities to users visiting the HUB; the VMs are each described and categorized accordingly.
- The repository – is the Hub's section dedicated to Virtual Mobility creators and managers (teachers), containing a series of resources, tools and best-practice guides, in order to facilitate VM design and deployment.

4 Virtual Mobility Learning Hub Scenarios

Several solutions were investigated, most of them in the area of open-source Personal Learning Environments (PLE), but the final interface used to support the core of the OpenVM Learning Hub is the open-source Moodle [12]. The open-source learning management system Moodle is the basis for the VM Learning component, as well as, to some degree, for most of the other components. Moodle has all the features necessary to run online courses (MOOCs or otherwise), and its' open-source licensing allows the development of all the necessary extensions and improvements, as well as the use of existing third-party plugins. Also, it allows easy integration between different universities learning interfaces, as well as other types of platforms, such as Mahara or H5P.

The main advantage is that even out-of-the-box, Moodle will cover many of the requirements for the other sections. A unified user management system and access control mechanisms are already in place.

One major disadvantage is that any development in areas not adjacent to Moodle's scope will need extra effort in order to integrate the resulting functionalities into the Moodle framework.

The Open VM LH Structure comprises:

(1) VM Skills - a description of virtual mobility skills including alignment to existing competency frameworks in a competency directory;
(2) VM e-Assessment - different forms of digital self-/assessment including digital evidence (such as testimonials, digital assets, e-portfolios, crowd evidencing) applied as elements of open credentials and supporting open, evidence-based assessment;
(3) VM Open Credentials - digital recognition of VM skills based on current forms of open digital credentials such as Open Badges and Blockcerts;
(4) VM Content - User Generated Content, Open Educational Resources and other forms of Open Content to support learning about VM and developing VM Skills;
(5) VM Activities - Open Learning Activities including learning in and through MOOCs, peer-to-peer activities, virtual/blended collaborations;
(6) VM Market/Connections - finding cooperation partners for VM activities supported by such tools as the Matching Tool including matching for collaboration of groups;
(7) VM Data - data about learning pathways and learning outcomes captured by xAPI and feeding into E-Assessment, Open Credentials and recommendations for learning.

The VM LH Functionalities are described in Fig. 2 where the actions required by each module can be seen and analyzed.

The VM skills are certified using Open Badges, awarded by Bestr through integration with the VM Learning, as a recognition of accomplishments during the MOOC's or the VMs' activities. Bestr receives information from Moodle via the xAPI plugin and awards the badges according to redefined scenarios.

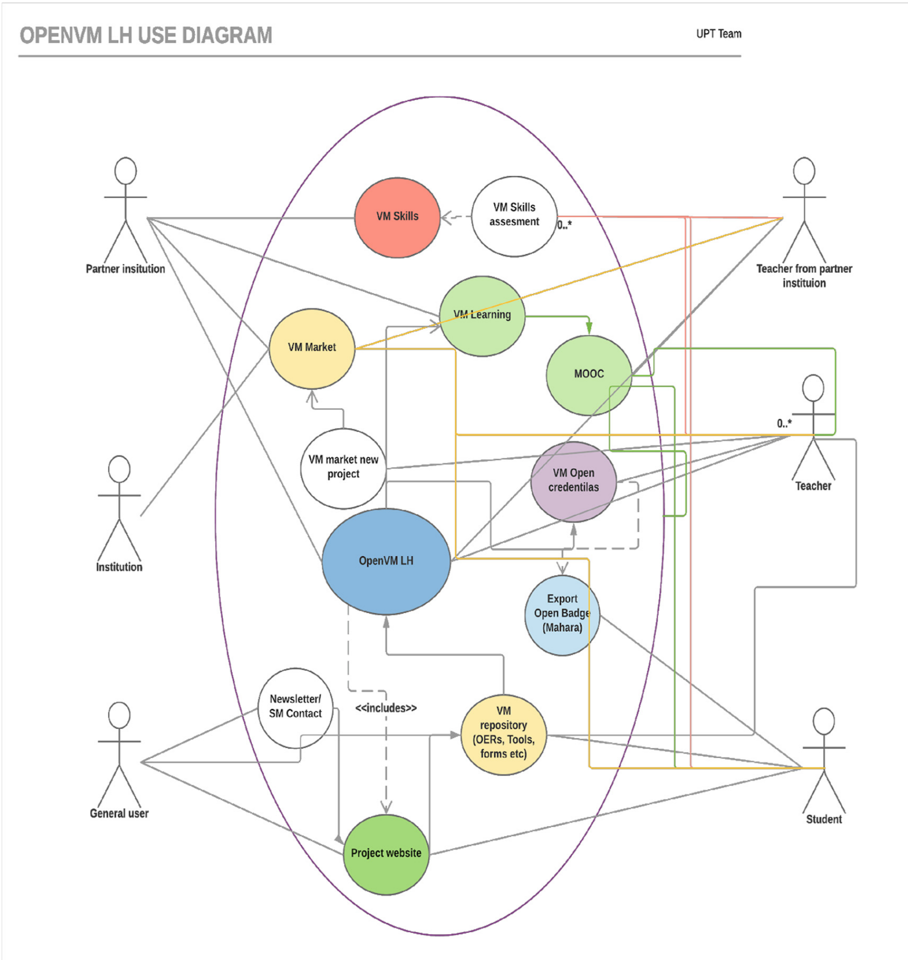

Fig. 2. VMLH functional diagram

We proposed that the VM Repository should be a dedicated category of Moodle courses. The Moodle "Single Activity" format allows the use of a single activity as the main course content (instead of topics or weeks), and the Wiki format is a good solution to bring dynamic content to any interested users.

The Reading/Exploring section of the OpenVM Learning Hub could consists of static content pages, and includes different OERs which are take form of texts, web-pages, images, videos. Each OER has included information about it's values and it is linked with the VM e-assessment area, where knowledge is evaluated using automatically personalized tests.

The Open Credentials represent the section where each user can view and manage their backpack of badges, which would be awarded, stored and then retrieved from Bestr. A possible extension of this functionality is a personal ePortfolio management system, such as Mahara.

The VM Market segment of the VMLH, as previously stated, present a list of Virtual Mobilities, either upcoming, ongoing, or archived. If these VMs are each a course in Moodle, this section could present an overview/description of each course, the starting date, the tutors, requirements (in skills, prerequisite knowledge/skills, etc.) and any other relevant information. New VMs could be proposed here, either by students or teachers, possibly through Moodle's course request mechanism.

4.1 OpenVM LH User Case Scenarios

For the integration of the VM LH user case scenarios are designed and evaluated: Teacher from a partner institution scenario - Fig. 3.

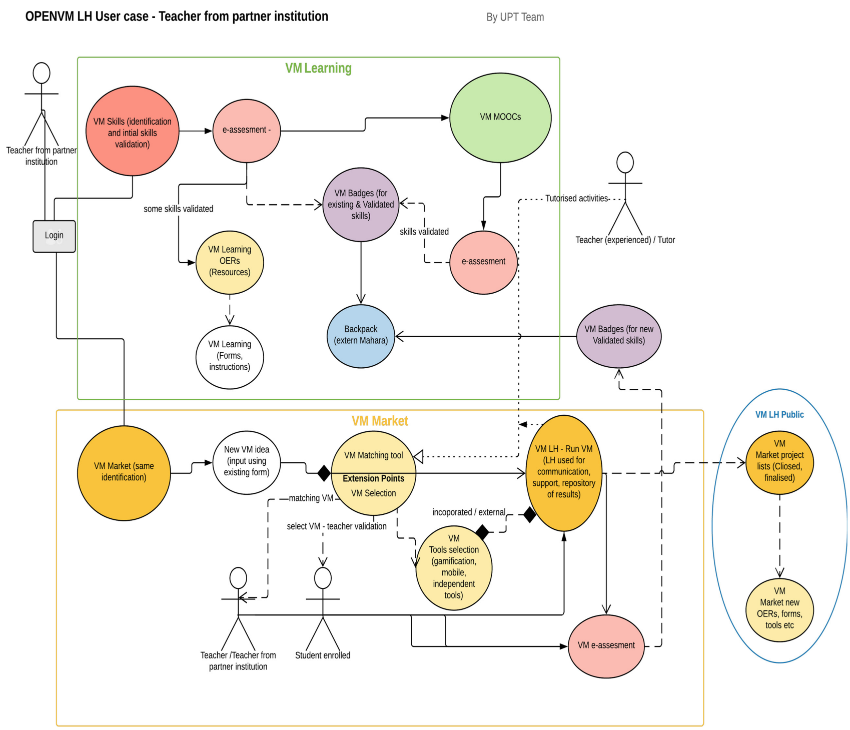

Fig. 3. VMLH Teacher from a partner institution scenario

Teacher scenario – similar with the Teacher from a partner institution scenario with the only exception that the teacher credentials will need to be verified offline by a person previously involved in OpenVM.

Student from a partner institution scenario – Fig. 4.

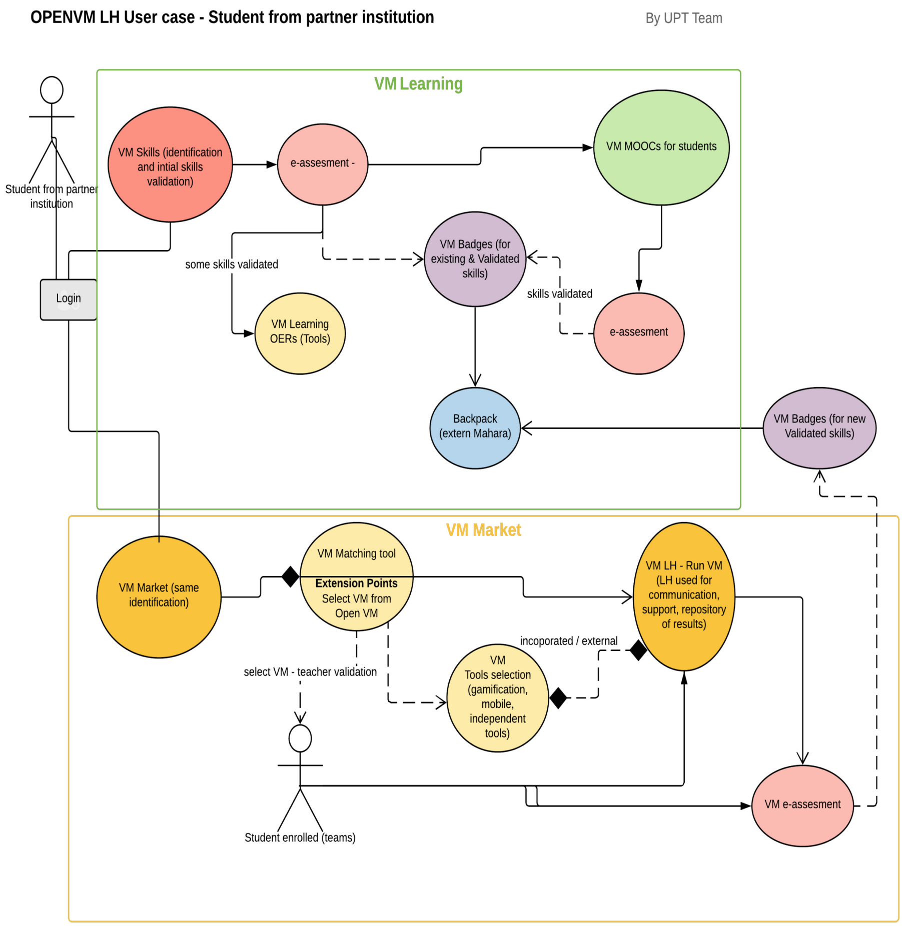

Fig. 4. VMLH Student Scenario

4.2 Virtual Mobility Learning Hub Open Badges

Open Badges provide a digital, open and flexible way to define skills and competencies, identify them visually and issue a proof of competency mastery to learners which can be accompanied by specific evidences and outcomes, and is always completed by a clear description of criteria that needed to be met to earn that Open Badge [13]. OpenVM credentials are used as a component of the OpenVM Learning Hub to recognise virtual mobility skills. Open Credentials in the OpenVM project have been designed using the Open Badge standard used to digitally valorize informal and non-formal learning and are based on the identified eight OpenVM skill types.

The OpenVM badges are based on xAPI logstore plugin and are issued by Bestr [14] to users who managed to complete all the activities in a given course on the OpenVM Learning Hub.

5 Conclusion

This paper has presented the concept, approaches, considerations and first study result relevant for designing a collaborative learning hub for promoting VM Skills of educators and students in the European Higher Education Area. While the development of the VM Learning Hub to enhance the Virtual Mobility readiness through achievement, assessment and recognition of VM skills is still at an early stage, as it was made available online to all users in March 2019 (the period October 2018 - March 2019 was a pilot and user testing phase) the authors of this paper aimed to demonstrate the complexity of designing such as collaborative learning hub with the view of integrating different software technologies into learning development, the combined use of scenarios and Agile methodology in educational development. The considerations presented here may be interesting for other online developments which aim to apply a combination of technologies for collaboration, skills assessment and validation, but mainly for the introduction of virtual mobilities at large in higher education.

References

1. Blight, D., Davis, D., Olsen, A.: The internationalisation of higher education. In: Higher Education Through Open and Distance Learning, pp. 15–31. Routledge (1999)
2. Buchem, I., et al.: Designing a collaborative learning hub for virtual mobility skills - insights from the european project *open virtual mobility*. In: Zaphiris, P., Ioannou, A. (eds.) LCT 2018. LNCS, vol. 10924, pp. 350–375. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-91743-6_27
3. Communiqué, L.: The Bologna Process 2020-The European Higher Education Area in the new decade. Leuven Louvain–Neuve (2009)
4. Kommission, E.: The European higher education area in 2012: Bologna Process implementation report. Education, Audiovisual and Culture Executive Agency, P9 Eurydice, Brussels (2012)
5. Vriens, M., de Beeck, I.O., Petegem, W.V.: Make it work! Integrating virtual mobility in international internships. In: International Association of Technology, Education and Development (IATED), Spain, pp. 5521–5527 (2013)
6. OpenVM: Open Virtual Mobility – Accessible opportunities for Virtual Mobility Skills in Higher Education. https://www.openvirtualmobility.eu/. Accessed 2 Mar 2019
7. Ternauciuc, A., Andone, D., Vasiu, R., Mihaescu, V.: Integrating Open Technologies in the Virtual Mobility Learning Hub. IEEE CPS, Brazil (2019, to be published)
8. Beck, K., Beedle, M., Van Bennekum, A., et al.: Manifesto for agile software development (2001)
9. Andone, D., Dron, J., Pemberton, L.: Developing a desirable learning environment for digital students. Technol. Instr. Cogn. Learn. **6**, 253–271 (2009)
10. Andone, D.: Ternauciuc A O2: Learning Hub – OpenVM: Open Virtual Mobility. https://www.openvirtualmobility.eu/outputs/1095-o2-learning-hub/. Accessed 2 Mar 2019
11. Andone, D., Frydenberg, M.: Creating virtual reality in a business and technology educational context. In: tom Dieck, M.C., Jung, T. (eds.) Augmented Reality and Virtual Reality. PI, pp. 147–159. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-06246-0_11
12. Moodle MOODLE. https://moodle.org/

13. Buchem, I.: Digital badges as (parts of) digital portfolios: design patterns for educational and personal learning practice. In: Ifenthaler, D., Bellin-Mularski, N., Mah, D.-K. (eds.) Foundation of Digital Badges and Micro-Credentials: Demonstrating and Recognizing Knowledge and Competencies, pp. 343–367. Springer, Cham (2016)
14. Bestr | The digital platform to value skills through Open Badges. https://bestr.it/. Accessed 2 Mar 2019

Empowering MOOC Participants: Dynamic Content Adaptation Through External Tools

Oriol Borrás-Gené(✉)

Universidad Rey Juan Carlos, Móstoles, Madrid, Spain
oriol.borras@urjc.es

Abstract. MOOC are an educational phenomenon that have become a key resource for lifelong learning in today's society. The most common MOOC model offered by the main platforms is called xMOOC, which has a behaviorist approach, where the role of the participant is minimal, being reduced to their contributions in a forum. There are proposals that try to bring the original model of MOOC or cMOOC, with a connectivist approach, through external virtual learning communities using digital social networks or any type of collaborative platform on the web. This collective knowledge, result of participation in the MOOC, has the disadvantage of being hidden in a space with excess information, disordered and alien to the MOOC platform. This paper presents and analyzes an experience that aims to solve these problems within platforms where the content cannot be modified while offering teaching, through the use of external web tools. These make it possible to integrate and organise the learning results generated throughout the MOOC, within the content itself, at the same time as they were happening, building a course that is fed in real time by the contributions of its participants, giving them greater prominence.

Keywords: MOOC · Virtual learning communities · Social networks · Content curation · Collaborative learning

1 Introduction

Society demands its citizens are constantly updating their knowledge, but at the same time the daily rhythms make it difficult to find time to learn. For this reason, formal education is challenged to seek new educational environments and experiences that are adapted to lifelong learning [1].

One of the movements that has caused a wider and more audible effect in the world of education are the MOOC (Massive Open Online Courses) [2], used by millions of people around the world, and offer an answer to continuous formation of a great number of learners [3, 4] interested in learning about a wide range of topics [5] within a course led by teachers and subject matter experts.

The classic structure of MOOC [3] is based on a series of short video lectures, a series of automated or student-involved assessment methods and a series of online forums that support interaction between students.

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 121–130, 2019.
https://doi.org/10.1007/978-3-030-19875-6_14

Although it is an attractive proposal for society and has a very positive acceptance, on the other hand there are critical and sceptical voices against this new format [5], questioning the educational design itself, the low quality of its resources, the lack of verification of the identity of its students, or the value of accreditations [3, 5].

In addition, the intrinsic nature of MOOC [6] in terms of massiveness, and therefore heterogeneity of their students, added to the impossibility of carrying out a personalized follow-up, makes it necessary to strengthen the more social part of these courses through specific tools such as internal forums, a more generalized solution; or through virtual learning communities, supported by digital social networks, external to MOOC [7–10].

This social part and the lack of interactivity is another of the great criticisms of this model of online courses [11, 12], where socialization is limited to internal forums to which only those enrolled have access [10]. Use of external communities on platforms such as Twitter, Facebook or other social spaces, will encourage interaction between students and promote the generation of resources from their contributions in form of publications, increasing collaboration between them [9, 10, 13, 14], thus overcoming the technological limitations presented by most MOOC platforms [12].

There are numerous proposals that work that social part generating conversation and content of great value for the MOOC and its participants, using social networks [5, 9, 10, 14, 15], that make it difficult to organize content; or other tools available on the web that allow content to be shared in a more structured way [13, 16]. In all these experiences, it is the student who shares the information and manages it according to his or her own criteria, giving rise to repeated content or content outside the MOOC context [17]. Furthermore, these generated resources are not integrated into the course itself, as the platforms do not always allow the MOOC content to be edited during teaching [18], being available only to those students more implied or with a greater technical mastery, who have no problem in going to see that information in another space outside the MOOC platforms.

This paper exposes and analyses a experience in Universidad Rey Juan Carlos, with the awarded MOOC "Empower yourself with social networks" on the MiriadaX platform, in which the student not only participates in the MOOC but also becomes the protagonist, taking a step further towards the use of virtual learning community, recovering the most valuable contributions made in the social space and reintegrating it into the MOOC itself in real time, using an external tool embedded within the lessons of the course, in the form of a Journal. In this way the content evolves during MOOC teaching within the platform.

Next, there will be a review of the existing theoretical background on MOOC, its types and different strategies to work the most social and interactive part; virtual learning communities; and ways to gather information before the large number of publications generated by thousands of users. Methodology section will detail the design and implementation of the experience, continuing with the results obtained and the main conclusions.

2 Background

2.1 MOOC: x and c Types

From 2008, the first MOOC [19] emerged with a pedagogical approach based on the philosophy of connectivism and networking [1, 18, 20], they are known as cMOOC and are characterized by a predominantly social component, usually through a groups of external tools that allow the recovery of conversations and content generated by its participants [17], all generated content is accessible by anyone.

On the other hand there are the xMOOC [18, 20], with a behavioral and more traditional approach, based on video classes, online questionnaires and weekly assignments. This type of MOOC are the most popular and have the highest number of registered users, platforms such as Edx, Coursera, FutureLearn, Udacity or MiriadaX [6, 12].

The disadvantage is that the xMOOC strategy is not prepared to support heterogeneity and mass use [6], and they are especially criticized, questioning their didactic methodology [2] and their lack of socialization [12].

In order to take advantage of the number of users and the infrastructure created by xMOOC platforms, and to overcome methodological shortcomings, it is common to find new models that combine both types of MOOC, obtaining hybrid results [3, 10, 18] with the help of virtual learning communities throught external tools.

2.2 Virtual Learning Communities in MOOC

A virtual learning community (VLC) is defined as a virtual space in which, people with common interests, connect whether synchronous or asynchronous [21] for an educational purpose. Allow the construction of learning from the exchange of information in different formats [10], generating learning processes such as learning by searching and studying information and learning by adding new information [22]. The result will be the generation and construction of new knowledge.

This communities are especially useful in online learning where students can feel alone [8], allowing their members to contribute with opinions or adding content [10], and interact with the already created one. In this way they offer new learning values with respect to traditional teaching [22], where both students and educators contribute by adding and sharing information.

An accurate selection of social tools will facilitate students' to participate in a MOOC and generate content [7, 9], especially in those more connective approaches (cMOOC), where interaction between participants, peer support and in general collaborative processes are encouraged [9, 18].

2.3 Content Curation

In the last decade, with the evolution of technology and internet access has changed the way of being in the Network of users, being much more active. Anyone can easily create, manage and share content through different platforms such as wikis, blogs or social networks [23]. There is an evolution from passive subjects to content producers, generating an excess of information known as infoxication, defined as "intoxication of excessive informational and communicational demands" [24]. This will hinder knowledge management in collaborative spaces such as VLC. As a consequence of this saturation of information, a new actor appears on the Internet, known as content curator, defined as "individuals who continually find, organize and share the best and most pertinent content related to specific issues on the Web" [5].

Within content curation one can distinguish between social curation and digital curation [22]. The first is based on the discovery or selection of content, the collection in a space and sharing in the social networks of any individual. The second is usually carried out by specialists and has the purpose of preserving and managing information.

2.4 Increasing Interaction in MOOC

There are many proposals in the literature that use virtual learning communities as a key element to enhance the more social part of MOOC, through different strategies, from creating new platforms or adapting existing ones [6], until using external tools to cover the gaps of the platform where the course and content are.

This second option, which requires fewer resources, is the most widespread, highlighting the use of virtual learning communities [5, 8, 9, 14, 15] through digital social networks in which to centralize the interactions and generation of content by students, some of them persisting beyond the teaching of the MOOC [10]. On these platforms, information is organized and ordered sequentially in a timeline, depending on the time when the content is published. In these spaces any member can publish, accumulating repeated content and even on other topics outside the MOOC [17, 26].

To solve the huge amount of content shared by students, there are different proposals as the use of other tools that offer more structured results in which to share content such as wikis [5, 27], Google Docs [16] or even entries from the teacher's blog [28] or the student himself [29]. Also tools for content curation as Padlet [13, 16, 30] or Diigo [13].

3 Methodology

3.1 MOOC Description

The MOOC "Empower yourself with social networks" of Universidad Rey Juan Carlos was offered on the Spanish platform MiriadaX [31] from 29 August to 25 September 2018. The course has won the First Award for Educational Innovation MiriadaX 2018 [32], highlighting its good results and acceptance.

This course aims to work the digital identity of the student from a professional point of view, creating a personal brand through the use of social networks. It is organized in 5 modules, distributed over the 4 weeks of the course. The first module presents the learning guide, and the rest of the modules are designed to work on the content, from analysing the background of the professional digital identity, to its management through social networks, including professional networks such as LinkedIn or Bebee. The last module works the digital branding of the students.

In order to strengthen the social part, a VLC was created by means of an open Facebook group with more than 2,500 members. Throughout the different modules of the MOOC, activities have been proposed to boost the work of the students in the group, advising them to share their results in the group.

3.2 Integration of the VLC into the MOOC

As has already been shown throughout the paper, in those MOOC with a connectivist philosophy, there is a problem of infoxication in their networks, due to the massive number of students publishing in the VLC where the most social part is carried out. The generated contents are in second plane separated from the MOOC.

This proposal, based on other experiences of the same team [25], goes a step further and integrates a third external platform (Padlet) to cure content in a board and embed it within the MOOC, adding it to the instructional design of the course (see Fig. 1).

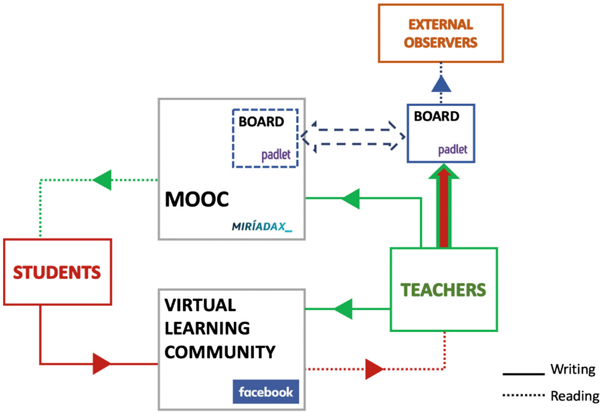

Fig. 1. Instructional design of the MOOC "Empower yourself with social networks" (Scheme).

The design basis on a continuous flow of MOOC content to the VLC on Facebook group and from there to the MOOC again.

Students' Participation. Within the MOOC is located all the content: short videos, created by the teachers, accompanied by some activities proposed to improve the engagement and understanding of the lesson. In this way, students are encouraged to publish their results at the VLC and intereact with each other. On most MOOC models there will remain these contributions in VLC, organized according to the moment in which they have been published and in many cases repeated.

Teachers' Participation. Once the contents have been created, the teachers during the MOOC are in charge of the digital curation of the contents shared by the students in VLC, every time they come in to dynamise and manage it, recovering publications in real-time to save in a specific board for each module. This process does not take up too much time and is repeated every day during MOOC.

Content Curation with Padlet Boards. To retrieve the content generated on Facebook group by MOOC participants, Padlet, an online platform for content healing, was used. This allows share contend in a board, accessible via web from a URL, and organize them by sections within the board. In each case, the link to the student's publication in the Facebook group has been shared, so as not to lose the authorship and possible additional information that might be added or the interactions of the publication itself.

Although Padlet allows a collaborative option to share information for anyone on the web, it has been disabled to ensure proper curation, and avoid the noise generated in the VLC. The criteria used by the team of teachers to choose the contents was: unique (not repeated), highly valued by other participants and in line with the MOOC theme.

In order to give protagonism to the students and their publications from the VLC, four different boards have been created in Padlet and embedded in the MOOC platform (MiriadaX), with their HTML code, at the end of each theoretical module, called "Module X Journal" (X is the module number). In this way every time a teacher added new content to the Padlet board, it was automatically seen inside the MOOC. The content on the platform becomes dynamic, including new information, in real-time.

Each board information will be accessible within the MOOC by any student, not only those who participate in the VLC, also for those who did not use it, following the course in a more traditional way. And most importantly, is no need to access to another web site to view those content.

In addition, anyone can, without having to be registered in the MOOC, access the boards, as their access is completely open, from the board URL.

3.3 Data Collection

MiriadaX platform provides information and statistics on MOOC student outcomes. Padlet also provides information for each board (number of publications, interactions and views).

At the end of the MOOC a survey was sent, answered a total of 282 students. The survey consisted of 6 questions, using a Likert scale of 1 to 5, focused on knowing the opinion and perception of usefulness and learning thanks to the innovations implemented in the MOOC.

4 Results

The MOOC, after its completion, had a total of 8532 enrollees, whom 4552 started it and finished it a total of 1655. Therefore, a percentage of 36.3% was obtained with respect to those who started and 19.4% with respect to those who enrolled. These results are quite satisfactory when compared with the usual values of between 5 and 15% [3].

4.1 Padlet Boards

Regarding the use of embedded boards in the course, as a content curation element, Table 1 shows the number of publications that were shared from the VLC to each board, the interactions within Padlet with each publication (likes or comments) and the number of visits each board had.

Table 1. Overview of Padlet boards.

Padlet boards	Number of publications	Interactions	Views
Module 1 journal	127	67	1818
Module 2 journal	60	54	1552
Module 3 journal	19	29	1731
Module 4 journal	12	13	1951

The results show how the drop-out curve of students in MOOC is repeated in the number of visits to contents of boards. Although it highlights how the last board, related to the final theme, focused on the creation of a personal brand, is the most visited.

4.2 Survey (Boards)

Out of 282 surveys answered, after a previous question on the results of the MOOC, 18 respondents did not start the MOOC, analysing the responses of the remaining 266. Three of the 6 questions have been analyzed, related to the Journal boards of the MOOC. Figure 2 shows the answers related to the perception of usefulness of these elements.

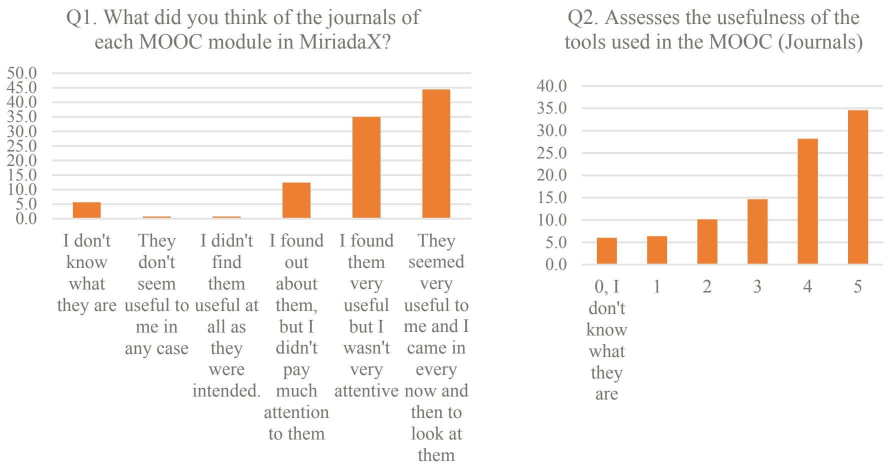

Fig. 2. Perception of usefulness of Journal boards.

Almost all MOOC students were aware of this tool, except for 5% who didn't know what was being referred to. In general, Journals are perceived as a useful element, rating them with a score of between 4 and 5 more than 60% of those surveyed, compared to almost 2% who did not find them useful.

Figure 3 compares the boards with the platform's internal forums, when asked "Do you think these tools helped you better understand MOOC?".

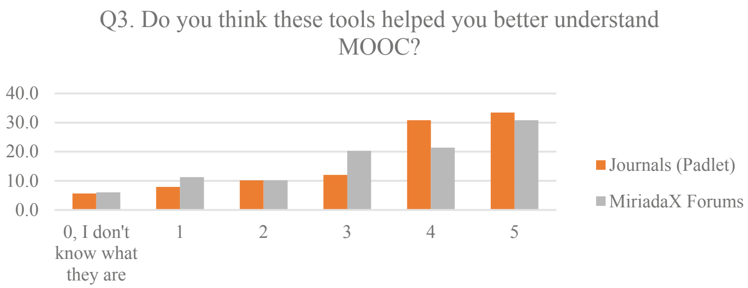

Fig. 3. Relationship between forums and Journals and their help in understanding content of MOOC.

From the answers it is extracted that the Journals are elements that helped to better understand the course for more than 60%, being a better valued element than the forums, in those higher scores.

5 Conclusions

The experience presented in this paper offers a solution to infoxication generated in the social networks that support a MOOC, allowing not to lose valuable content provided by students through a digital curation by teachers.

The fact of using an external tool such as Padlet, solves the problem of editing the content during the period in which the MOOC is working, and in turn, the possibility of embedding the boards, simplifies the work of the student, avoiding having to navigate through different websites to take advantage of the course. It is also useful for those who decide to follow the course in a more traditional way, without making use of the virtual learning community.

The result of involving the students in the content of the MOOC, through the Journal boards, has been valued as a positive element and therefore useful for them, helping them to better understand the contents. Empowers the MOOC student by making him/her the protagonist, by retrieving his/her publications at the VLC and integrating them into the course.

Although it is additional work for the MOOC team, the experience has been satisfactory and has offered good results, so we will continue to make progress along these lines.

Acknowledgments. This work was supported by research grants iProg of MINECO (ref. TIN2015-66731-C2-1-R) and e-Madrid-CM of CAM (ref. P2018/TCS-4307). Thanks to LITE group and URJC online for their help in preparing the contents of MOOC.

References

1. Stracke, C.M.: The quality of MOOCs: how to improve the design of open education and online courses for learners? In: Zaphiris, P., Ioannou, A. (eds.) LCT 2017. LNCS, vol. 10295, pp. 285–293. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-58509-3_23
2. Zapata-Ros, M.: MOOCs, una visión crítica y una alternativa complementaria: La individualización del aprendizaje y de la ayuda pedagógica (2013)
3. Daradoumis, T., Bassi, R., Xhafa, F., Caballé, S.: A review on massive e-learning (MOOC) design, delivery and assessment. In: 2013 Eighth International Conference on P2P, Parallel, Grid, Cloud and Internet Computing (3PGCIC), pp. 208–213. IEEE (2013)
4. Nawrot, I., Doucet, A.: Building engagement for MOOC students: introducing support for time management on online learning platforms. In: Proceedings of the 23rd International Conference on World Wide Web, pp. 1077–1082. ACM (2014)
5. Pelet, J.-E., Pratt, M.A., Fauvy, S.: MOOCs and the integration of social media and curation tools in e-learning. In: Uden, L., Liberona, D., Welzer, T. (eds.) LTEC 2015. CCIS, vol. 533, pp. 43–53. Springer, Cham (2015). https://doi.org/10.1007/978-3-319-22629-3_4
6. Fidalgo-Blanco, Á., Sein-Echaluce, M.L., García-Peñalvo, F.J.: Methodological Approach and Technological Framework to break the current limitations of MOOC model (2015)
7. Fidalgo-Blanco, Á., Sein-Echaluce, M.L., García-Peñalvo, F.J., Escaño, J.E.: Improving the MOOC learning outcomes throughout informal learning activities. In: Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality, pp. 611–617. ACM (2014)
8. Montes, R., Gea, M., Bergaz, R., Rojas, B.: Generating lifelong-learning communities and branding with Massive Open Online Courses. Inf. Res. Manag. J. (IRMJ) **27**(2), 27–46 (2014)
9. Alario-Hoyos, C., Pérez-Sanagustín, M., Delgado-Kloos, C., Parada G., H.A., Muñoz-Organero, M., Rodríguez-de-las-Heras, A.: Analysing the impact of built-in and external social tools in a MOOC on educational technologies. In: Hernández-Leo, D., Ley, T., Klamma, R., Harrer, A. (eds.) EC-TEL 2013. LNCS, vol. 8095, pp. 5–18. Springer, Heidelberg (2013). https://doi.org/10.1007/978-3-642-40814-4_2
10. Núñez, M.M., Gené, O.B., Blanco, Á.F.: Social community in MOOCs: practical implications and outcomes. In: Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality, pp. 147–154. ACM (2014)
11. Gómez, J.I.A.: La revolución MOOCs, ¿una nueva educación desde el paradigma tecnológico? Comunicar: Revista científica iberoamericana de comunicación y educación (41), 7–8 (2013)
12. Ramírez-Donoso, L., Pérez-Sanagustín, M., Neyem, A., Rojas-Riethmuller, J.S.: Promoviendo la colaboración efectiva en MOOCs a través de aplicaciones móviles. In: Congreso IEEE CHILECON. Santiago de Chile (2015)
13. Manathunga, K., Hernández Leo, D.: Has research on collaborative learning technologies addressed massiveness? Int. Forum Educ. Technol. Soc. **18**(4), 357–370 (2015)
14. Castano Garrido, C., Maiz Olazabalaga, I., Garay Ruiz, U.: Social networks and cooperative learning in a MOOC. Revista Complutense de Educacion **26**, 119–139 (2015)
15. Kop, R.: Information aggregation in networked learning: the human factor and serendipity. In: 8th International Conference on Networked Learning, Maastricht, The Netherlands (2012)
16. García Sastre, S., Idrissi Cao, M., Ortega Arranz, A., Cristóbal, M., Juan, A., Gómez Sánchez, E.: Marco para el Análisis de la Colaboración y la Gamificación en MOOC (2017)

17. Borrás-Gené, O., Martinez-Nuñez, M., Blázquez-Sevilla, A.: Gamified open Q&A forum model as a platform for a cMOOCs. In: INTED 2016 Proceedings, pp. 4903–4910 (2016)
18. Fidalgo-Blanco, Á., Sein-Echaluce, M.L., García-Peñalvo, F.J.: From massive access to cooperation: lessons learned and proven results of a hybrid xMOOC/cMOOC pedagogical approach to MOOCs. Int. J. Educ. Technol. High. Educ. **13**(1), 24 (2016)
19. Gros Salvat, B.: Collaborative learning through network. Revista Aula de Innovación Educativa, p. 162 (2007)
20. Siemens, G.: Massive Open Online Courses: Innovation in education, Open Educational Resources: Innovation, Research and Practice, RoryMcGreal, Athabasca. UNESCO, ed. 1, p. 268 (2013)
21. Cabero, J.: Comunidades virtuales para el aprendizaje Su utilización en la enseñanza Eduweb. Revista de Tecnología de la Información y Comunicación en Educación **1**(1), 5–22 (2007)
22. Seitzinger, J.: Curate Me! Exploring online identity through social curation in networked learning. In: 9th International Conference on Networked Learning, pp. 7–9 (2014)
23. Stanoevska-Slabeva, K., Sacco, V., Giardina, M.: Content Curation: a new form of gatewatching for social media. In: Documento electrónico. Recuperado el, vol. 16 (2012)
24. Benito-Ruiz, E.: Infoxication 2.0. In: Handbook of Research on Web 2.0 and Second Language Learning, pp. 60–79. IGI Global (2009)
25. Borras-Gene, O., Martinez-Nunez, M., Fidalgo-Blanco, Á.: New challenges for the motivation and learning in engineering education using gamification in MOOC. Int. J. Eng. Educ. **32**(1), 501–512 (2016)
26. Martinez-Nuñez, M., Borrás-Gené, O., Fidalgo-Blanco, A.: Una comunidad sostenible: Evolución del aprendizaje en una comunidad de un MOOC. In: II Congreso Internacional sobre Aprendizaje, Innovación y Competitividad (2015)
27. Fidalgo Blanco, Á., Sein-Echaluce Lacleta, M.L., Borrás Gené, O., García Peñalvo, F.J.: Educación en abierto: Integración de un MOOC con una asignatura académica. Teoría de la Educación. Educación y Cultura en la Sociedad de la Información **15**(3) (2014)
28. García-Peñalvo, F.J., Hermo, V.F., Blanco, Á.F., Sein-Echaluce, M.: Applied educational innovation MOOC: learners' experience and valorization of strengths and weaknesses. In: Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality, pp. 139–145. ACM (2014)
29. Liyanagunawardena, T.R., Adams, A.A., Williams, S.A.: MOOCs: a systematic study of the published literature 2008-2012. Int. Rev. Res. Open Distrib. Learn. **14**(3), 202–227 (2013)
30. Hudson, L., Kortuem, G., Wolff, A., Law, P.: Smart cities MOOC: teaching citizens how to co-create smart cities (2016)
31. MiriadaX. https://miriadax.net/. Accessed 02 Feb 2019
32. Salguero, A.: Telefónica premia la Innovación Educativa de los MOOCs a través de Míriadax (2019). https://comunicacionmarketing.es/actualidad/24/01/2019/telefonica-premia-la-innovacion-educativa-de-los-moocs-a-traves-de-miriadax/5389.html

Collective Resolution of Enigmas, a Meaningful and Productive Activity in Moocs

Eric Bruillard(✉) and Georges-Louis Baron

EDA Research Laboratory, Paris Descartes University, Paris, France
{eric.bruillard,
georges-louis.baron}@parisdescartes.fr

Abstract. Enigmas have been introduced in a series of MOOCs (open and massive online courses) named eFAN "Teaching and Training with Digital". In this text, we explain why we have chosen to propose enigmas in a Mooc, as a factor of interest, a driving force for learning and to foster collaboration between participants. Several enigmas are described, explaining why we consider them as important in our MOOCs series. We finally give the floor to the participants, what were their opinions on the interest of the enigmas. A coming book will provide an analysis of 25 enigmas and report on puzzle solving processes in discussion forums.

Keywords: Enigma · Mooc · Peer learning · Collaboration

1 Introduction

A series of MOOCs (open and massive online courses) named eFAN "Teaching and Training with Digital" (Bruillard 2014; 2017; Khaneboubi and Bruillard 2016; Khaneboubi and Baron 2015) has been organized since 2014, viewed as a general training on digital education issues for a wide audience, school and higher education teachers, educators, supervisory staff, adult educators, students…

The first eFAN Mooc took place in May-June 2014. There were 11,234 registrations on FUN (French platform using OpenEdX) and about 2500 registered on Moodle (for additional activities). We initially stated that all forms of participation were legitimate (from minimal participation, simple video viewing, to the completion of all proposed activities). This led to the collective creation of an instrument gallery of nearly 1000 submissions (with duplicates), the submission of 317 projects (most of them collective), more than 180 participants in peer review of concept maps and submitted texts, 133 evaluation stories (Caroline Ladage designed a complete 191-page document with evaluation stories and participants' comments).

One specific weekly activity, that we have kept in the following Moocs, has been proposed to encourage exchanges and cooperation on the forums: an enigma. Different authors (14 for the overall 25 in the five different Moocs) have come up with very different proposals, including various media (texts, videos, sounds, images, animations), around the topics covered in the series, that is, on what relates to digital in education, in a broader vision.

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 131–139, 2019.
https://doi.org/10.1007/978-3-030-19875-6_15

We will first explain why we have chosen to propose enigmas in a Mooc. We will then give some examples of enigmas by giving details of the resolution processes (discussions) and we will finally give the floor to the participants, giving their opinions on the interest of the enigmas.

2 Enigmas in Moocs: Why, How

2.1 The Enigma, a Factor of Interest and a Driving Force for Learning

The enigmas are as old as human history. It is a game of the mind, with more or less high stakes, where a more or less ambiguous statement calls for a solution requiring a trick for correctly decoding the problem. From the famous Sphinx that, according to the mythology, devoured those who failed to answer its question, to the innocent crosswords where the reward is in the resolution of a charade, the spectrum is very wide. In the educational world; it is a way of attracting attention, of spicing up tasks that are not always intrinsically very playful. Many authors, in progressive education have praised the virtue of a pedagogy based on enigmas.

A good enigma, of course, should not be too obvious or too difficult: it should be solved with the documentary tools at one's disposal and some ingenuity. From this point of view, the development of multiple online information search functionalities has changed the data of the problem: searches can be carried out on texts, images and even sounds. Search engines quickly produce results, even if they are not always relevant; the Internet opens up new horizons and prevents from feeling easily blocked.

The person who thinks he or she is discovering the solution can post it and thus have a sense of accomplishment. Any proposed solution can provoke reactions (sometimes very constructive), which can set up a debate in which people learn from each other. In online training, where there is a strong challenge to create links between people who do not know each other, enigmas are an effective way to create stimulating discussions.

2.2 Why Propose Enigmas in a Mooc?

Given the massive nature of a Mooc, overhanging tutoring is not possible; but the learners themselves can provide some tutoring. Enigmas are a good way to help bootstrap this tutoring. Indeed, the contract is clear: as it is an enigma, it is normal that the Mooc trainers do not intervene. Participants must muddle through and, as the solution is rarely found on their own, the use of the collective, exchanges with other participants becomes imperative. Diversity is therefore an important asset. Creativity, invention, enriching public propositions, such as an embryo completed by the participants, can help to develop forms of community.

Once somebody has found a solution, explaining how he/she solved it is another side of the enigma interest: sharing research methods, teaching others, providing proposals to go further are good ways to develop co-training. The enigma is also an opportunity to see things differently, to associate knowledge and skills around a case, to open up to broader questions linked to the current theme, to provide different facets of it, etc.

Thus, launching activities in a MOOC starting from enigmas, in connection with the proposed course, offers many advantages, but designing interesting puzzles is difficult: if they are too easy, they are uninteresting, too difficult, discouraging, and it is important for learners that they relate to the theme of the week. The exchanges around the enigmas proposed in the eFAN series provide a rich and interesting material to understand how participants cope with them in the Mooc.

2.3 The Puzzles in the Mooc EFAN Series

On the first day of each week (except the last), the statement of an enigma was published. The rule of the game, in a Mooc, is to respect the choice of participants, who do not want or cannot connect from the first day. It is necessary to allow time and if possible not to spoil an enigma too quickly, so that the maximum number of participants can find an interest in it.

This is why two threads have been associated with each enigma: a thread described as "exchanges around the enigma" and a thread of "proposals for answers to the enigma". Even if the enigma has been solved, a participant having not looked at the solutions thread, may debate in the other thread. Of course, this rule has not always been respected, some people thinking they had found a (the?) solution could not resist communicating this solution to everyone as quickly as possible.

In the middle of the week, if the enigma still held, we gave a clue, more rarely two. At the beginning of the following week, the solution was provided as well as an explanation to link the puzzle to the content developed in the Mooc, justifying the use of the enigmas for participants. Some of them questioned their usefulness and the time they feared they had wasted trying unsuccessfully to solve them, but overall enigmas offered a contextualization for the contents presented during the week.

The proposed puzzles have had varying fortunes and, as is the case in the vast majority of Moocs, the further the weeks went, the less participation there was. Pre-Moocs have generally produced many interventions. Indeed, as there were no courses nor activities conducted, for those who no longer had to discover the platform on which the Mooc was going to be played, enigmas were the only thing that was offered to participants before the start. It also was a time for challenges, for exchanges with other participants, to make oneself known and to take a place in the forums, etc. Some puzzles held up well and even discouraged the participants. Others were quickly revealed: the enigma of the first week of the first Mooc eFAN did not last more than a quarter of an hour. With more than 10,000 registered people, even if less than half of them do participate, it is difficult to propose a enigma that is a real puzzle for everyone.

2.4 Some Examples of Enigmas

A Curious Machine

The first enigma presented a photo containing the elements of Freinet's teaching box, designed and distributed in the 1960s. It is a non-behaviourist programmed teaching device, now largely forgotten, used by the supporters of the Freinet movement.

We published it during the first week of MOOC eFAN 1, devoted to a historical perspective on technologies in education (Fig. 1).

Fig. 1. First enigma proposed in the eFAN Mooc: *Name and use of this object*

The enigma received a correct answer almost immediately but caused a rather significant interaction: 89 different threads, 140 posts issued by 125 persons. The person who has easily identified the object, obtained the peak of responses.

> *Hello, I think it's a teaching box created for Freinet pedagogy in the 1950s or 1960s. My mother, a single-class teacher in the countryside and a follower of Freinet's pedagogy, used these boxes with her students as well as a printing press for the school newspaper.*

The enigma, even if its solution was found very quickly, gave rise to a series of rich exchanges, in particular complements on the use of the object and a link to Freinet's book on teaching tapes and boxes.

Another Curious Machine

The enigma (Fig. 2) presents a curious hybrid. Surfing on the Internet, the participants proposed several references: a system designed at the end of the 70 s for Japanese merchants, in order to facilitate the acceptance of the calculator (Sharp's commercial interest)?; an abacus for controlling the results of the calculator? a system for hybrid use: abacus (additions and subtractions) vs calculator (multiplication, divisions and square roots)? (Moderate success with 89 posts in total).

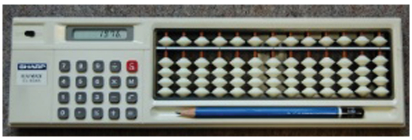

Fig. 2. Enigma proposed in the eFAN Mooc: *What is this instrument? Why was such an instrument designed? What is it used for?*

This example of the abacus calculator is interesting and helps to reflect on the trajectory of instruments in education. The calculation can be materialized and experienced physically, in the case of the abacus. With the calculator, the calculation process is invisible and inaccessible. The fact that the manipulation of calculators does not provide any information on the calculation processes themselves leads to the reintroduction of old instruments, no longer for their efficiency in performing calculations, but because their manipulation can help to better understand both the notion of numbers, but also operations on numbers (Fig. 3).

Fig. 3. Enigma proposed in the eFAN Mooc: *From which site did this tablet come from? What does it say?*

A Curious Tablet
This is a tablet image from the archaeological site of Glozel in Allier, France. The objects that were found on this site were first attributed entirely to a prehistoric period and their writings were considered by some to predate the first writings of the Middle East. Thanks to dating with carbon 14, copies and counterfeits of antique objects have been unambiguously identified. This puzzle is an illustration of a controversy at the beginning of the 20th century, and the implementation of a conspiracy theory, the theme of the week.

The other enigmas proposed are very diverse: a relativist billiard table, an experimental device for tactile exploration of visual information (for the blind or visually impaired), proving whether the people represented in three images are real or false persons, comparing two representations of the inner structure of the earth.

2.5 Methodology for Analyzing the Discussions Generated by the Enigmas

We thought it would be interesting to present, for some of the enigmas posed in the eFAN series, the discussions to which they gave rise. Our objective is multiple: to document exchanges, analyze collective problem-solving processes, and, if possible, come up with descriptions of the types of interaction that have occurred on these types of Moocs, mainly used by teachers and trainers.

Our corpus consists of the traces left on the FUN platform: enigmas, clues, solutions, reactions on the forums. We have series of public messages issued during a very limited period of time (one week) that allow us to reproduce part of the interactions. Their number is very variable: some puzzles, mainly at the beginning of the session, were very successful, others, perhaps because they were more difficult, had less.

If the succession of messages has been preserved, we did not have access to the duration between them and for some we do not know if they are not late, i.e. issued after the correct solution had been given. What is available allows us to reconstruct the dynamics that actually took place during the Mooc.

We have not conducted any specific studies on the people involved in the puzzles: no research on their other activities in the Mooc, on the possible link between participation in the puzzles and engagement in the Mooc and possible completion. On the one hand, the data recovered from the Moocs were not sufficiently reliable to conduct comparative studies (the log files recovered were incomplete). On the other hand, since the audience was mainly made up of trainers and teachers, their participation was more focused on projects for the most committed. Completion of the Mooc was rarely an important objective. Then, we were not interested in leading quantitative studies.

We tried to better understanding the dynamics of the exchanges around the puzzles; and to find ways to report on them, without making any links with the other activities proposed in the Mooc. In any case, we observe that more than a third of the exchanges in the forums are related to the enigmas. In the rest of this text, we focus on the comments and feedback from Mooc participants on the enigmas.

3 The Collective Resolution of Puzzles in a Mooc: What Do the Participants Say?

Participants expressing themselves on the forums intervenes in broad registers. There are enthusiasts, who eagerly await the following puzzles and treat them as soon as they are posted; prolixes (long-winded) who make long contributions; latecomers, who arrive too late (the enthusiasts have often already found it and have made it known), and regret it and still post an idea. Some are out of phase; some wonder what the puzzles are good for. It is similar with what happens in a classroom with a few shouts of voice, but in a rather relaxed spirit.

We will now present some of the main types of observed reactions. Our presentation is mainly qualitative but we think it sheds an interesting light on the issue of what happened with enigmas.

3.1 Exchanges in a Good Atmosphere…

There were very few trolls (they disappeared quickly), very few disputes. Thus, by taking up some reactions to the first enigma posted, they express themselves:

bravos: "*Well done, I'm not from the primary school world and I would never have found it*".

thanks: "*So following the answers of some people, I was able to understand the statement (which is already quite a bit!). Thank you to you!*"

encouragements: "*I'm taking things a week late"[…] "You're totally on time, on the contrary*".

humor: "*it seems logical to teach children about double entry boards… especially just before noon, when they are hungry…they will understand the frog well!* » ; "*To change the stamp, a waffle mould? "Signed Captain Hadock" [a character from a comic strip: Tintin]*

3.2 Progressing, Learning from Peers…

"I had a lot of fun reading all the messages you took the time to write. The humorous tracks revealed by some people made me want to look for the why of the how. Proof that it is already the manifestation of a certain collective energy, is it not? This makes learning less tedious and in any case much more enjoyable! »

Several participants agreed upon this idea; but it also sparks discussions. Some even feel like they are cheating:

"I would say that it is the echo of digital identity on the network but I had the idea after reading the commentary of my comrade [name]... but that would be cheating, so I'm not saying anything else"

What is at stake is the possibility of sharing expertise: when someone asks for explanations, participants respond. In fact, not always, as in one of the Moocs on media and information literacy, a member of the teaching team intervened to follow up on a participant who has given the answer, generating several amazed posts: "*But it would be very nice to explain how all this was found*".

What the participant willingly does….

"Thank you XX, thanks to your clear explanation; I was able to understand the deep idea of this enigma and how to make the link with the elements made available to us. Now, I can also allow myself to unlock other puzzles over time by exchanging with other people more advanced than me like you for example!"

3.3 But You Have to Be in the Stream…

Too bad for the latecomers! "*I'm always too late… sniffing*! » . Several testimonies include a sentence like: "I just registered and I'm a little late. Well, I come right after the battle and haven't found anything more than what you already mentioned" or "Being clearly late, I congratulate you all for this impressive research!", if explanations are given, it gives rise to thanks.

As one participant puts it: "*To be "out of time" will be when this "discussion thread" is over…*».

Although we systematically proposed two threads, in order to allow contributions to be published without reading the proposed solutions, this did not always work:

I've been very unavailable this week and this weekend. I come in extremis to drop off my work to give back, read the course, answer the quiz, what satisfaction: I am all right (unlike last week). So I wanted to finish off beautifully with this puzzle! […but] what was my disappointment when I discovered answers…

3.4 The Pedagogical Interest of an Enigma in a MOOC Is Sometimes Questioned

Another one solved the enigma that remains for me an enigma as to its pedagogical purposes for the students that we are… even the collaborative side of the forum is very, very limited, since the "good students" are quick to claim their good answers without having raised their finger;-)))).

Since the forum is not moderated (except for the subsequent movement of a few messages that had not been placed in the right thread), it can function as an agora, in which the fastest are happy to show themselves. There is no simple tool to regulate collective functioning in a Mooc and the process of solving puzzles collectively depends on individual behavior. The interest of the enigmas is thus questioned quite regularly in the forum threads dedicated to them.

Often when a participant expresses his doubts and questions, other answer them. A beginning of debate, beyond the enigmas, but keeping the enigma side, not forcing the pedagogical team to participate itself. Thus, the message of a disappointed person triggers a response from another participant

> *I think, for my part, that the interest of these enigmas is to create a group dynamic, to develop interactions between the participants... It is true that few people participated in the discussions this time, but I think it is because the enigma was more difficult...*

Another shared his thoughts on the place of enigmas in training, wondering whether it will "*bring anything to the training? "Who is competent here and does not need this training? Thank you, very good for you. The rest of you are dumped*".

This triggered a stream of responses, including

> *I also think that the use of research tools is part of the course... But I don't think there are on the one hand "the dumped" and on the other hand "those who don't need the training". I hope we can collaborate, help each other, learn from each other...*

A long discussion followed, some participants highlighting ways of working that the teaching team has not really imagined:

> *I'm asking myself a question! Why is this 4th puzzle so easy to find? to strengthen our self-esteem and stimulate us to continue ==) principle of teacher adaptability?*
> *This exercise is very interesting; would proposing this enigma allow the teaching team to understand something else about how we work?*

It is not clear that the pedagogical team was able to learn much about behaviors other than those we are describing.

3.5 The Consciousness that Enigmas Are not Easy to Develop

Some participants are aware of the difficulty in designing and managing enigmas and write it could be convenient to "*adapt to your audience by proposing different enigmas with progressive difficulty*".

> *Currently, advanced people find solutions in 30 s, beginners do not have time to think that the enigma is already solved. Of course, it is difficult to conceive difficult puzzles. This could be an improvement for a future class session. In any case, I congratulate you on the quality of the speakers, as well as the quantity of information, tools, debates, etc.*

One last comment:

> *I think that motivation is essential to any work, especially collaborative work. And for motivation to be present, you need a challenge that seems valuable. As Vygotski says, you have to be in the proximal development zone. You will not debate the Nobel Prizes on the result of 1 + 1 or 10-year-old children on the theory of relativity. As far as I am concerned, my motivation*

weakens as the puzzles progress, whereas on the contrary, I would like to make it a collaborative work. You will notice that I am active on the KF, and I test most of the tools of the course. I thank you for that, because they are often very rich in possibilities.
In the end, this forum is also a means of feedback on the course. The course could be adaptive, and adapt to everyone's level of requirement, in order to keep an issue in collaborative work.

This is carefully observed. For more than half a century, having an adaptive course that allows for the individualization of teaching has been a kind of Grail that many designers have sought, occasionally using artificial intelligence to offer, based on a priori modeling of learners, tailor-made courses. Over the past decade, one of the most interesting hopes of the Moocs, as argued (after many other supporters of knowledge sharing) by "connectivist" authors such as Siemens and Downes, has been to trust the community (the network) to create effective and diversified learning paths.

The recent history of MOOCs shows that sharing does not occur spontaneously, without preconditions of possibility being met. The resolution of shared enigmas may be one of these conditions. Would the traces of the collective resolution of enigmas then be an analyzer of a collective's ability to work collaboratively?

Perspectives

Everything we have just presented, in terms of co-training, exchanges but also sometimes disappointment is reflected in the discussions around the enigmas.

Some of them asked for a specific answer on a little-known subject, where the information is difficult to find. The sharing of information and the proposal of study paths then generally work quite well. When a more open elaboration is needed, exchanges contribute strongly to this openness. Even if a small number of participants offer contributions in the forums, the reading of the exchanges is in itself a potentially formative activity, the discussions that develop are nourished, sometimes amusing, always interesting.

Ideas are therefore exchanged, debates arise, cooperation is established, techniques are unveiled; some thank the participants for what they have learned.

As one participant put it in the first week of the first MOOC: *"This exercise is very interesting, would proposing this enigma allow the teaching team to understand something else about how we work?"*

References

Bruillard, É.: La formation des enseignants et les cours massifs en ligne: quelles rencontres? Adm. Éduc. **144**, 123–128 (2014)

Bruillard, É.: MOOCs as contemporary forms of books: new educational services between control and conversation. IARTEM e-J. **9**(1), 142–164 (2017)

Khaneboubi, M., Baron, G.-L.: Analyse de la participation à un cours en ligne ouvert à tous: le cas d' «enseigner et former avec le numérique (eFAN)». Revue Internationale des Technologies en Pédagogie Universitaire **12**(1 & 2), 38–51 (2015). Consulté à l'adresse. https://halshs.archives-ouvertes.fr/halshs-01248901/document

Khaneboubi, M., Bruillard, É.: An innovative MOOC for in-service teacher education in a French speaking context. In: Chamblee, G., Langub, L. (eds.) Proceedings of SITE Conference (pp. 2125–2132). Savannah, GA, United States: (AACE) (2016). https://www.learntechlib.org/primary/p/171984/. Accessed Jan 13 2019

First Year of the UQ Sustainable Energy MicroMasters Series: Evaluation of Participation and Achievement

Felicity C. Coffey(✉) and Peta Ashworth

The University of Queensland, Brisbane, QLD 4072, Australia
{felicity.coffey,p.ashworth}@uq.edu.au

Abstract. The University of Queensland's (UQ) Sustainable Energy MicroMasters series was offered for the first time in 2018 on the edX platform. The MicroMasters series is comprised of four courses with a capstone assessment. When the courses closed in December 2018, a review was undertaken of the participation levels and achievement outcomes of participants in both the verified and audit enrollment modes. The total enrollment in all courses in the MicroMasters was 22,093. The proportion of participants who enrolled in the verified enrollment mode was less than 2.5% per course. The proportion of verified participants who passed (achieved 70% or higher in the final grade) ranged between 29–67%, with the more technical courses having the lower pass rates. A total of 134 course certificates were delivered to 95 participants enrolled in one or more of the four courses, with over three quarters of participants who received a course certificate only achieving one certificate. Verified participants take time to achieve four certificates which has implications for articulation to on-campus or external Master programs and first and second semester entry points. If MOOCs are to be part of a university's delivery mode there will need to be a large increase in the number of students electing and paying to be part of the verified enrollment mode to justify the development costs and ongoing support required to run such a series. Changes to enrollment policies that affect verified enrollments, introduced by platform providers such as edX, will need to be monitored.

Keywords: MOOCs · MicroMasters · edX · Verified · Sustainable Energy

1 Introduction

In 2018, edX, a major platform provider of Massive Open Online Courses (MOOCs), offered prospective learners enrollment in either an audit or verified mode. True to the original philosophy of MOOCs (Waks 2016, p. xiii), learners in the audit mode were able to access all resources and assessment tasks for free on an ongoing basis. However, they did not receive a course certificate on successful completion without upgrading to the verified enrollment mode. All participants in the verified enrollment mode, paid a fee, had their identity checked, and upon successful completion of the course requirements, received a course certificate. This year (2019), edX has chosen to alter the rules for some courses. Only verified participants who pay the course fee

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 140–145, 2019.
https://doi.org/10.1007/978-3-030-19875-6_16

within a specified time period will be able to access assessment tasks while the course is open and the course site after the course closes.

Normally, three variables are used to describe course outcomes: course enrollment, course engagement and course completion (Maxwell et al. 2018, Table 1, p. 739). The definitions of these variables can vary between studies and within studies, depending on the available data provided by the platform. For example, Maxwell et al. calculated the course engagement rate for a course delivered through Coursera by “dividing the number of students that were ‘active’ in the course in some way by the total number of students enrolled in the course” (2018, p. 739). For a course delivered through edX, Maxwell et al. stated that the active engagement rate was “calculated by the edX platform based on the frequency of enrollee logins at various time points throughout the course” (2018, p. 740). For their third case study, the authors obtained a course engagement statistic by using “watched at least one video” (p. 741), which could be considered a low threshold for course engagement. The variable course completion was not defined in the Maxwell study. It is unclear from the Maxwell study, whether the variable course completion involved the achievement of a course certificate.

In an earlier study, Reich (2014) analyzed nine Harvard MOOC courses. The average course enrollment was 32,292. Averaged over the nine course, 65% of participants were considered engaged (where participants undertook at least one activity), 21% achieved a grade greater than 0% and 6% earned a certificate. Reich calculated certification rates by dividing the number of participants who achieved a certificate by the total number of students who enrolled in the course (2014, para. 3). Reich suggested that it may be preferable to calculate MOOC completion rates as the proportion of all participants who intended to complete the course who gained a certificate (2014, para. 3). Waks (2016) stated that the observed low completion rates, around 4% compared to around 70% for traditional on-campus and online courses, was a substantial problem for MOOC providers (Waks 2016, p. 62). The delivery of online, large enrollment MicroMaster series with course fees, proctored examinations and the possibility of articulating to on-campus Master programs (see for example, Barbosa De Almeida Cabral et al. 2017) necessitates tighter definitions of course completion and educational outcomes.

The purpose of this paper is to present the results of a review of enrollment modes, pass levels and certification of participants enrolled in the first year of the UQ Sustainable Energy MicroMasters series delivered through the edX platform in 2018. The aim and methodology of the study are described in Sect. 2. Section 3 describes the structure, delivery sequence and assessment regimes of the MicroMasters series. Section 4 outlines the results of the review and Sect. 5 highlights the implications.

2 Aim and Methodology

In contrast to the often-used evaluation variables: course enrollment; course engagement; and course completion, the aim of this study was to investigate the proportion of participants who enrolled in the verified enrollment mode, the proportion who passed (achieved at least 70% in the final grade) and the number of certificates verified participants achieved (noting that a participant required four certificates to enroll in the capstone assessment). Data were downloaded for each course delivered during 2018 once all courses had closed. The data were collated from the edX Grade Report and Student Profile Report using Microsoft Excel.

3 Background to the UQ Sustainable Energy MicroMasters

3.1 Structure of the MicroMasters

The Sustainable Energy MicroMasters series comprises four master level courses and a final capstone assessment which assesses participants on the content of all four courses. To obtain a course certificate, participants are required to enroll in the verified mode, pay the enrollment fee, have their identity checked and achieve at least 70% in the final grade. To obtain a Sustainable Energy MicroMasters' credential, participants are required to achieve all four course certificates and obtain at least 70% in their final grade in the capstone assessment. In 2019, following edX introducing a new financial model, only users who enrolled in the verified enrollment mode (paid the enrollment fee and had their identities confirmed) could access and attempt graded assessment tasks.

3.2 Delivery Sequence and Assessment Regimes

The UQ Sustainable Energy MicroMasters series was first delivered progressively throughout 2018 (Table 1). The recommended duration of the courses prior to 18 September 2018 was 11 weeks. When the fourth course opened in September 2018, we chose to rerun the earlier three courses at the same time with a duration of twelve weeks. An extra week was inserted near the end of the course (Week 11) to enable learners to research and write the written assignment.

Table 1. Delivery schedule for the UQ Sustainable Energy MicroMasters series, 2018

Course	Run	Start date (2018)	End date (2018)	Duration (weeks)	Effort (hours)	Open (weeks)	Pace[a]	Fee[b] $USD
ENGY0x	1	23 Jan	16 Dec	11	10–12	47	instr	99
ENGY1x	1	17 April	16 Dec	11	10–12	35	instr	199
ENGY2x	1	3 July	16 Dec	11	10–12	24	instr	199
ENGY3x	1	18 Sept	11 Dec	12	10–12	12	instr	199
ENGY0x	2	18 Sept	11 Dec	12	10–12	12	self	199
ENGY1x	2	18 Sept	11 Dec	12	10–12	12	self	199
ENGY2x	2	18 Sept	11 Dec	12	10–12	12	self	199

[a]A course may have all modules open at the commencement of a course allowing learners to progress at their own speed ('self-paced') or a course may have modules that are opened sequentially by the instructor ('instructor-paced' (instr)).

[b]Fee to enroll in the verified enrollment mode. Note, the capstone assessment which completes the MicroMasters series was delivered for the first time from 16 January 2019 at a cost of $799 USD.

The assessment regime of the individual courses typically involved untimed weekly multiple choice quizzes (30%), an in-depth written assignment marked by peers (35%) and an untimed final quiz on the content of the whole course (35%). The overall pass mark of the course to gain a course certificate is 70%. The capstone assessment (which opened for the first time in January 2019 for a duration of three weeks) had a proctored, timed examination. Participants were also required to prepare an extended written assignment worth 70%, marked by staff from UQ, and participate in an oral examination.

4 Results

4.1 Enrollment and Enrollment Modes

The total enrollment over all seven courses delivered during 2018 was 22,093. This number included participants who enrolled in more than one course, participants who unenrolled and staff from UQ and other institutions. The highest enrollment of all courses was in ENGY0x Energy Principles and Renewable Energy (n = 7243). The proportion of participants who enrolled in the verified enrollment mode was less than 2.5% per course.

4.2 Pass Levels and Certification

The proportion of verified participants who passed and received a certificate in each course (achieved 70% or higher) ranged between 29–67%, with the more technical courses having lower pass rates (Table 2).

Table 2. Number and proportion of verified participants who passed each course, 2018

Course	Verified participants who passed (achieved 70% or higher)		
	Passed & received a course certificate	Passed with a certificate as a proportion of all enrollments	Passed with a certificate as a proportion of all verified learners
	Number	%	%
ENGY0x 2018-1T	58	0.8	33.0
ENGY0x 2018-3T	14	0.4	29.2
ENGY1x 2018-1T	17	0.6	51.5
ENGY1x 2018-3T	8	0.5	53.3
ENGY2x 2018-1T	20	0.7	57.1
ENGY2x 2018-3T	6	0.6	66.7
ENGY3x 2018-1T	11	0.4	44.0
Total[a]	134	0.6	39.3

[a]The total may include participants who enrolled in multiple courses.

During 2018, 134 course certificates were delivered to 95 verified participants enrolled in one or more of the four courses. Only seven participants (7%) achieved four certificates and were therefore eligible to undertake the capstone assessment should they wish (Table 3). Four participants (4%) received three course certificates and ten participants (11%) received two course certificates. Over three quarters of all participants (78%) received only one course certificate. Apart from participants who were either staff or who did not have sufficient time to devote to the course/s, the low number of certificates achieved by participants within a year, may indicate the relatively slow progression time that some participants may need to complete a MicroMasters series.

Table 3. Number and proportion of participants who achieved one, two, three and four (Four course certificates was the maximum number that could be achieved) course certificates, 2018

Course certificates achieved	Participants who received the given number of certificates	Participants who received the given number of certificates as a proportion of all participants who received at least one certificate
	Number	%
1	74	77.9
2	10	10.5
3	4	4.2
4	7	7.4
Total	95	100

Participants in the audit enrollment mode had low pass levels with few participants achieving 70% or above in the final grade. In fact, less than one per cent of audit mode participants achieved 70% or higher. Over 90% of audit participants chose not to attempt any assessment tasks and thereby recorded an overall grade of zero.

4.3 Testimonials

Example testimonials, taken from the courses' discussion pages, are copied below:

"I loved the course! The variety of materials, the diversity of subjects within climate change, the incredible knowledge and teaching skills of the professors, the detailed explanations of references to illustrate points were the highlights". Participant, ENGY1x (edX 2018a).

"The content is authoritative and referenced, videos are easy to follow and comprehend and there are plenty of extra resources for further reading …". Participant, ENGY3x (edX 2018b).

5 Discussion and Conclusion

While the overall enrollment of 22,093 during 2018 could be considered adequate for a relatively niche and high level set of courses, the proportion of participants who enrolled in the verified mode was extremely low. With less than 2.5% per course, the data indicate that most participants were either not interested in obtaining a course certificate, could not afford the course fee, or perhaps were unsure of their abilities. In addition, not all participants in the course were genuine learners as some participants were staff from UQ and other institutions viewing the course offerings.

Our results provide a high level overview of learner participation and achievements. They do not go into detail or provide any in-depth analysis of qualitative comments that have been collected from students as part of the formal evaluation of the courses. However, the current data suggest that while many students may enroll to commence a MOOC MicroMasters series, very few of them complete even one of the courses. If MOOCs are to be part of a university's delivery mode there will need to be a large increase in the number of students choosing to pay to be part of the verified enrollment mode to justify the ongoing support required to run such a series.

The ongoing changes to MOOCs by platform providers, such as edX, while seeking to boost revenue will also need to be monitored as the numbers reported in this paper suggest that any reduced offerings may fail to attract the number of students required to break even, let alone make a profit. While this paper highlights some of the key challenges for online MicroMasters series the results also suggest the need to undertake further research and evaluation to really understand the learners' motivations for enrolling, expectations and under what conditions a verified course certificate has appeal.

References

Barbosa de Almeida Cabral, P., Ribeiro Jorge, N., van Valkenburg, W.: MicroMasters: the pursuit of the Holy Grail in online learning. In: Ubachs, G., Konings, L. (eds.) Proceedings of The Online, Open and Flexible Higher Education Conference: Higher Education for the Future; Accelerating and Strengthening Innovation, pp. 219–225. European Association of Distance Teaching Universities (2017)

edX: Climate Science and Policy, Boston, Massachusetts, USA (2018a). https://www.edx.org/course/climate-science-and-policy-0

edX: Low Emission Technologies and Supply Systems, Boston, MA, USA (2018b). https://www.edx.org/course/low-emission-technologies-and-supply-systems

edX: Sustainable Energy (2019). https://www.edx.org/micromasters/uqx-sustainable-energy

Maxwell, W.D., et al.: Massive open online courses in U.S. healthcare education: practical considerations and lessons learned from implementation. Curr. Pharm. Teach. Learn. **10**(6), 736–743 (2018). http://dx.doi.org/10.1016/j.cptl.2018.03.013

Reich, J.: MOOC Completion and Retention in the Context of Student Intent. Educause Review, 8 December 2014. https://er.educause.edu/articles/2014/12/mooc-completion-and-retention-in-the-context-of-student-intent

Waks, L.J.: The Evolution and Evaluation of Massive Open Online Courses: MOOCs in Motion. Palgrave Macmillan, Palgrave Pivot, New York (2016)

Reskilling Higher Education Professionals

Skills and Workflow in the Making of a MOOC

Dario De Notaris(✉)

Federica – Center for Multimedia and Distance Learning,
University of Naples Federico II, Naples, Italy
dario.denotaris@unina.it

Abstract. In the next ten years «more than a third of the core skills needed to perform most jobs will be made up of skills currently not yet considered crucial to the jobs» [1]. MOOCs are what public and private players are currently using to train their employees and workers. For that reason, producing a MOOC requires high attention to its design and must involve specialized experts with dedicated skills.

This contribution reports the production workflow at Federica, the leading MOOC platform in Italy and one of the top MOOC providers in Europe, and also describes the experts and skills engaged in it.

Keywords: MOOC · Weblearning · Digital occupation · New skills

1 A Learning Revolution

Massive Open Online Courses (MOOCs) are the main, recent, revolution in the field of digital learning, as a natural evolution of web-learning, as a result of the fusion of multimedia technology and the growing availability of open access knowledge content on the Web. The term MOOC was introduced in 2008 by George Siemens and David Cormier, at the end of the production of a course entitled Connectivism and Connective Knowledge by Stephen Downes and Siemens.

MOOCs can be differentiated into two main types: as a network of multiple resources available online, to aggregate or to remix, as in the Downes' course (cMOOCs); or as structured paths, offered by and through an online platform like Coursera or edX (xMOOCs) [2].

Course is a common term used to define a new, wider, "study-path". MOOCs were originally structured in lessons or weeks, like traditional courses at university. But MOOCs are now mostly used by a growing body of lifelong learners (LLL) to renew or update their skills profile for the jobs market, so duration and structure reflect the changing audience needs and MOOCs are frequently offered in self-paced versions.

Whether a course is used at University or in the LLL sector, the core of a MOOC might be based on a so-called "ARRFF model" [3].

Over the last few years, the MOOC trend is growing constantly: in 2018, around 20 million new learners signed up for a MOOC and 101million is the total number of

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 146–155, 2019.
https://doi.org/10.1007/978-3-030-19875-6_17

MOOC learners in the world (Fig. 1). The main MOOC providers, by registered users[1], are Coursera (founded by Stanford University), edX (MIT and Harvard), XuentangX (Chinese Tsinghua University), Udacity and Future Learn (Open University)[2]. Sixty percent of courses in the USA have been developed by only fifteen universities, while in Europe, twenty-three universities count for 60% of MOOCs. This distribution shows how the MOOC production is concentrated in a few, top, players [4].

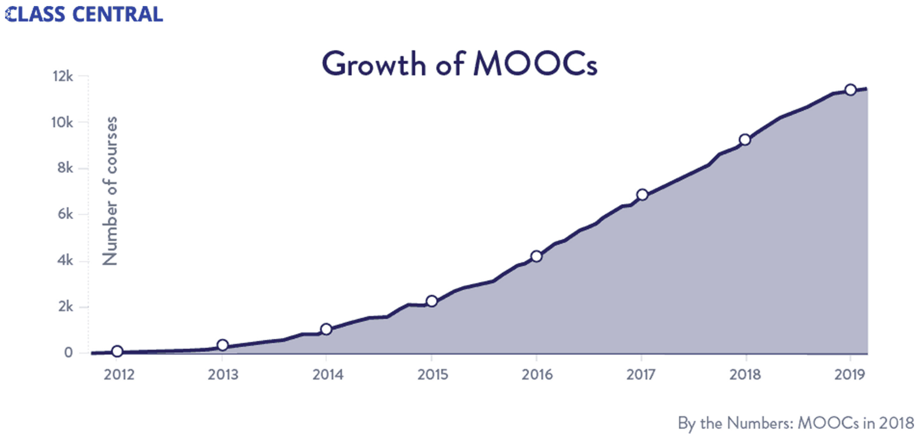

Fig. 1. Grown of MOOC production from 2012 to 2018. Source: Class Central 2018 (see footnote 1)

1.1 Design a MOOC

Designing a MOOC could involve several content specialists dedicated to the specific media to be produced. For example, the instructor has to decide how to organize the lessons: how many weeks to study, how much text to include, and how much content should be released per week. As regards assessments, the instructor needs to decide how many tests to offer learners and in what format: true/false quizzes, multiple-choice answers, advanced drag-n-drop questions, open assignments with or without peer review and whether or how to organize feedback.

And finally, how to develop a video: is it a recording of the instructor or does s/he appear only as a voiceover, while on the screen there are sliding images, texts or animations? Could it be a screen capture or what else? Over the last years, video formats are changing fast, evolving from the simple talking heads "webcam style" to more sophisticated implementation [cfr. 5], and using Virtual/Augmented reality solutions where available.

[1] https://www.class-central.com/report/mooc-stats-2018/.

[2] XuentangX use OpenEdx platform to distribute courses, while the other Providers have developed their own platforms.

Using multimedia and interactivity in learning processes has been widely analyzed: and many scholars converge on a positive evaluation [6–10]. For example, a combination of pictures and texts produces an improvement in learning compared to only text-based solutions [10]. The cognitive theory of Multimedia Learning proposes three assumptions about the presence of dual channels (humans process visual and auditory information separately), limited capacity for processing information in each channel at any one time, active processing that allows humans to organize information into coherent mental representations (ibidem).

Images and video assume a relevant role when they are used as support to texts instead of replacing it completely.

Designing, and producing, a MOOC therefore, in its complex combination of multimedia content, stimulating range of further study options, engaging learning activities, assessment activities to monitor learning, and inbuilt metrics for measuring learner participation and learning outcomes, requires the convergence of multiple skills and specialized expertise in the various stages of production. In the following paragraphs, we will introduce these skills, alongside their connected professional profiles, and show how they fit in the production process of a MOOC.

2 New Skills for New Careers

Recent analysis announces that by 2020, on average, «more than a third of the core skills needed to perform most jobs will be made up of skills currently not yet considered crucial to the jobs» [11 p. 3].

This "reskilling revolution" will not affect only economic and technological sectors but will hit the entire jobs market. Even if the Education sector seems less likely to change than others (like Business and Financial Operations, Food Preparation and Serving, and – most of all – the Healthcare sector), it *is* and *will be* the main channel where strong investment is required. To train the future workforce in these new skills, it is necessary to invest in the creation of new spaces and new environments, including digital, for the delivery of educational content; to define new ways to enable learners to practice what they learn, bearing in mind that learners could be many and stationed in several cities, countries or continents.

To analyze the aims of an instructor (at school, at university or in a Company) and the needs of learners, define the learning objectives and pathway, design the course and manage the class, requires the presence of several experts from different disciplines but with cross-skills for the creation and management of 360°/multidisciplinary learning regarding the learning management. Philosophers, social scientists, performers, designers, economists, and architects work side-by-side with engineers, computer specialists, data-analysts, video-makers and so on, to co-create a better learning path for specific learners.

2.1 Federica WebLearning

To illustrate how different experts can work together in the production of a MOOC, we will introduce the experience of Federica, the Center for Distance Multimedia learning of University Federico II in Naples (Italy). Federica was established in 2007 with European Structural Funds to design and build a platform for open access to innovative learning content. Over the last ten years, Federica has produced more than 300 courses and 5,000 lessons, which have been delivered through its portal www.federica.unina.it. More than 150 MOOCs have also been released on www.federica.eu since 2015.

2.2 Federica's Experts

Since the beginning, Federica has trained young experts in the field of WebLearning Management and, over the years, has pioneered the use of various learning formats and experimented the latest technologies and interfaces. As a result of these experiments, Federica has also refined its production workflow in terms of efficiency and quality output, and devised a framework for the required skills-sets to achieve this. To assist instructors to design and deliver their MOOC successfully, Federica proposes the following specialists, that can be combined, either totally or in part, and applied to MOOC production workflow around the world:

1. *Account Manager*: is a role typically associated with Business, responsible for sales and customer relations. The introduction of this professional in a mass MOOC production workflow reflects the need to follow the MOOC through from concept to delivery, responding to customer needs in terms of content, instructor, instructional design and assessment/certification. S/he proposes also the investment in new products such as learning analytics for more in-depth feedback, inclusion in aggregated course clusters/packages on related topics, Bachelor, Master or Specialized pathways that could attract a wider audience.
2. *Learning Experience (LX) Designer*: is a common role inside the Educational sector, with responsibility for defining how learners will interact with the course contents. The introduction of Instructional Design principles in the educational context leads to the re-shaping of a course, keeping in mind the theories and practices of graphic design, multimedia production, research, and social media too. More than the Instructional Design, the LX Designer focuses on the active role that learners must have in the development and growth of a course.
3. *Production Manager*: s/he plans the production workflow, organizing the several steps and resources assigned to a course. Usually, the Production Manager has basic skills common to the several experts that s/he coordinates, to better define the overall work. His/her main technical competence is the use of a management system as a relational database, planning software, and project management tools.
4. *Course Manager*: s/he coordinates directly the management of some courses, following the activities from production to publishing, as well as the learning community and promotion. Line-managed by the Production Manager, they are responsible for the diverse human resources engaged in the different phases of production.
5. *Course Producer*: s/he is the editor that supports the instructor in the uploading of course contents. Editors require basic skills regarding Text and Photo editing, as well as Latex.

6. *Community Manager*: follows learning activities, and learner interaction. Proposes, to instructor and tutor alike, solutions to improve learner engagement.
7. *Video Manager*: along with the Course Managers, their responsibility is to organize the workflow related to video pre- and post-production. S/he manages the work of the human resources dedicated to video-production and interacts with the Course Manager and Marketing Team to evaluate the best solution to get learners' attention.
8. *Video Editor*: this role regards assembling the various shots into a coherent movie-clip, with the help of the Video Manager, adding other graphic elements such as superimposed texts, images, extra video inserts etc. S/he also has good internet research skills to find relevant multimedia resources on the Web to insert in a MOOC video clip as content support.
9. *FX Designer*: under this label, we could put different professional figures that elaborate the clip produced by the Video Editor. S/he works on alterations of the clip's images such as color correction, composition, animation, and special effects.
10. *Recording Company*: in some situations, it may be necessary to outsource the editing of the audio, mastering or mixing, for example, or even composing specific music and soundtrack.
11. *Graphic Designer*: s/he supports the creative production at the different stages, from defining the brand identity of a course to producing graphic elements for the video editing. The Marketing team also devise and create an effective and specific communication strategy and materials.
12. *Data Analyst*: perhaps one of the top jobs of the present and future. S/he inspects, cleans, transforms and models data to understand how learners study and participate in a course: whether they read all the lessons, watch the videos, do the assessments and what is their percentage of success etc. This work is the core of all the Course Design because it helps to better understand how to improve the overall production, learner engagement, achievement of the course goals and, naturally, marketing.
13. *Weblinking Expert*: as support to Course producer, s/he contributes to search open access resources to integrate with the contents written by the Instructor. Usually, s/he has medium-high knowledge of the course topic and experience in web-searching. In some Academic contexts, this figure could be a Librarian.
14. *Gamificator/Assignments Designer*: in the last decade, a new term has been introduced in the field of education. Originally, "gamification" was used in the analysis of video-games, as a process of award-based interaction, widely used to improve the motivation of players to continue playing and complete the game. This approach has been applied to online education and MOOCs too, to encourage learner engagement and improve completion rates. A Gamificator could be considered an Assignments Designer, because s/he has to define the "gaming path" that learners need to follow to complete the course: how many and what kind of tests learners do to gain points, or collect badges - the symbolic awards that allow learners to complete the course/game.
15. *Marketing Team*: they work as support to the Account Manager and are in charge of pre-analysis of the scenario where a course will be placed, the potential audience and how the course could be "sold". Starting from a common SWAT analysis, the

Team usually need to outline a "marketing report" that shows the sustainability of each course, before starting the production work. Working with the Instructor and Course Manager, the Team set up a communication plan that goes hand in hand with the release of the individual lessons in the course. In their activities, there is also the writing of emails, social posts, motivation posts in the community etc.

16. *Instructor*: last but not least, the lead player in the educational process. The technological evolution and the consequent overload of multimedia, data and resources on the Web, require that the teacher focuses not only on contents but also on how to deliver them. S/he has to re-build the learning process considering that the classroom has changed, as well the learners, the time dedicated to studying and the methods.

The joint work of these experts allows a MOOC Team to produce a course. Clearly, MOOC producers do not necessarily require or use all these professional figures. Usually, all or part of the competencies above, merge in only one or two resources; sometimes, a selection of these professional figures is present at different hierarchical levels.

The production workflow could be graphically represented as in Appendix 1, which shows that of Federica. In the next paragraph, an example of applied research experience will be analyzed.

3 How to MOOC: The Federica Workflow

A typical schema of a workflow for a middle-high MOOC Company could be depicted as in Appendix 1, based upon a customized ADDIE model [12][3]. This schema represents Federica's Hive, which is the workflow to create a MOOC in about 90 days, and includes the Experts engaged in the different activities. In this paragraph, the five main stages required to produce a Course at Federica will be described.

3.1 Concept

The Workflow starts with an analysis of the topic that Federica's Direction wants to propose to the audience. Federica has two main production lines:

- blended-courses, that run in a University, during a specific period of the year/semester, with start and end dates;
- classless-courses, which are focused on wide topics rather than an academic discipline.

So, the Account Managers examine the market, internal and external to the University, to discover interesting topics based on the needs of the audience, analyzed personally or by third-party reports; then s/he conducts a benchmark analysis to check the presence of other similar MOOC courses and their quality. The results of the analysis are discussed with the Direction, who also propose an Instructor to engage in

[3] Analysis, Design, Development, Implementation, Evaluation.

the course production. Frequently, this person is proposed by the Account Manager too, based on the analysis of the instructor profile (academic/public role, popularity and number of publications). Another issue discussed is the option to aggregate the new course with others already present in Federica's portfolio.

Once it has been decided to proceed with production of the course, the Staff proposes the collaboration to the Instructor.

3.2 Meet the Instructor

At the first meeting, the Instructor discusses their ideas for the course development with the Account Manager and the Production Manager.

The conversation continues with the Learning Experience Designer to ensure learner interaction and engagement and improve levels of satisfaction.

Staff show the Instructor how to use the Learning Management System (LMS) to write text and upload contents on the Federica Platform and define the timeline. The Video Manager then proposes suggestions for locations where the video-lectures can be recorded (usually based on the subject). The video format is discussed too, that is, how the Instructor will be recorded on the set (i.e. long shot, American shot, close-up etc.) Usually, locations are searched and defined on the basis of the course topic or discipline, to re-create a meaningful context.

3.3 Lessons Development

Finally, the Instructor meets Course Manager and Course Designer to define how to organize and produce the work. In this meeting, the Staff explains to Instructors the Federica format, that is "how to produce a MOOC": how many lessons, videos, links and so on, to produce. In Appendix 1 we provide the quick "How To" schema given to Instructors. The Instructor can insert the contents directly in the LMS supported by a Course Producer (CP): the CP checks compliance with the Federica format and helps the instructor upload the multimedia content on LMS, verifying third-party copyright issues too. At the end of lesson production, the Weblinking Expert verifies the opportunity to insert additional links to open e-resources in the text produced by Instructor. In the meantime, the Instructor could produce the assessments, according to the recommendations of the Course Manager and discussing interactive approaches with the Gamificator Expert.

3.4 Video Production

At the fourth stage, Instructor meets the Video and Course Managers to define how to organize the videolectures production. The Video Manager (VM) proposes an analysis of the course contents to find the best formats and locations to take the shots. For example, the VM could propose filming in a Museum or in a Laboratory or in other public/private spaces related to the course topic. VM searches locations and defines a storyboard to help Instructor organize their video-lessons with an average length of seven minutes. As a recording format, proposed sets range from chromakey (a green screen for superimposing images and video in post-production), screen-capture or common tv/movie shots etc.

On the set, the video troupe organizes the lighting and sound recording, also using, where needed, other experts like director of photography, makeup artist, a drone pilot and so on. Usually, a full recording session requires three days.

One day is dedicated to producing the Course Trailer, a short video (about 2,30″) where Instructor describes the aims of the course and tries to encourage learners to enroll. The trailer production requires more attention because it will be used also by the Marketing Team to promote the course. More cameras are used and a much more detailed storyboard is written by Video Manager.

Once the recording is complete, the Video Editor (VE) sends draft videos, by a cloud-dedicated platform, to Instructor to assess the content, performance, effectiveness and to propose any modifications using accurate timecoding. In this way, VE could start to finalize the videos. Where necessary, special effects could be added to videos or sound/music could be composed by Recording Companies.

At the end of this stage, the Course Producer inserts videos in the dedicated course units, as defined by Instructor. The course production, after the last check by Instructor and Course Manager, is ended and the course is ready to be published.

3.5 Release

According to the kind of course (blended or classless) and with the Instructor, Marketing Team (MT) propose a Plan to announce and to promote the course in several ways. The promotion plan starts directly after the Instructor engagement (see Sect. 3.2) to have more time for dissemination to reach a wider audience. During the Concept phase (see Sect. 3.1), MT makes a report about possible target audience and relevant promotion channels. In blended mode, Instructor could give on-campus students a class-code to separate their activities on the platform from other learners. The Instructor can thus access their own dashboard on Federica platform to monitor learner activity (lessons opened, videos watched, quizzes answered and results etc.). All the activities can be observed and studied, with anonymous IDs, by the Data Analyst, who produces an overall report on the course and learner engagement with it, which is later used by Instructor, Course Manager, and MT to make changes/improvements to subsequent editions. Usually, at Federica, each course is released twice a year (once per semester) but, on the request of learners – interest is reflected by the number of pre-enrollments when a course is closed – or the Instructor for a specific purpose - a new edition could be activated.

The Data Analyst (DA) also keeps a record of learner activity on the course communities and reads the feedback that users leave on the platform during their navigation. In this sense, DA finds out about the *life* of learners and whether the course matches their needs: where users stop their navigation and why; which videos are watched and for how long; if certain assessments are too easy or difficult, and so on. Thanks to this analysis, DA reports to the several Managers and Experts involved in the production process, as well as the Instructor, to help them improve the course design for the next edition or improve the user experience on the platform.

4 Conclusion

This paper proposes an example of a MOOC production workflow in a sort of SME, even if located in a Public University. Federica Weblearning achieved a leading position as MOOC producer thanks to the definition of a format that is unique, but flexible, for all of the courses. A result that is due to the work of several and specialist experts that follow every stage of the production, from the definition of the concept to the release, through continuous interaction with the Instructor and a careful analysis of learner needs.

At present, the Federica workflow requires about twenty specialized skills as part of the normal workflow. In special projects, further skills may be required and other experts could be involved in the production. This kind of knowledge and expertise was not common when Federica started to produce online courses (from 2007) and MOOCs (from 2015). Federica trained its own personnel and, in many cases, a single human resource acquired more than one skill. We could consider them as “hybrid experts”, halfway between academics and professionals, with a specific skills-set thanks to the peculiarity of the product they make: MOOCs.

The complexity of MOOC production led Federica to define a series of professional profiles and the specific tasks that would be covered by each job description. The workflow, and therefore the professional skills involved, vary according to discipline and instructional design as well as target audience. The strength of the scheme we propose lies in the autonomy of the single processes that can be re-used and re-mixed by other organizations according to their own workflow and, of course, the professional figures that they have in their team.

At a time when people need to update their skills or acquire new ones, MOOCs seem to offer a strategic way, both in the public and private sectors, to achieve this. For this reason, a key point is for MOOC providers to spend time and professional competences in their design. The Federica experience reported in this paper illustrates the importance of recruiting, or training, specific professional figures who together offer the skills set necessary to produce quality MOOCs at scale.

Appendix

Appendix 1 and 2 can be downloaded from the link https://bit.ly/2UdONAU.

References

1. World Economic Forum: The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution (2016)
2. Downes, S.: Places to go: Connectivism and connective knowledge. Innovate J. Online Educ. **5**(1), 1–6 (2008). http://nsuworks.nova.edu/cgi/viewcontent.cgi?article=1037&context=innovate
3. Downes, S.: New models of open and distributed learning. In: Jemni, M., Kinshuk, K.M. (eds.) Open education from OER to MOOCs. LNET, pp. 1–22. Springer, Heidelberg (2017). https://doi.org/10.1007/978-3-662-52925-6_1

4. Reda, V., Kerr, R.: The MOOC BA, a New Frontier for Internationalization (2018). https://doi.org/10.1109/lwmoocs.2018.8534651
5. Schmidt, D.-C., McCormick, Z.: Producing and delivering a Coursera MOOC on pattern-oriented software architecture for concurrent and networked software. In: Proceedings of the 2013 Companion Publication for Conference on Systems, Programming, & Applications: Software for Humanity, pp. 167–176, October 2013. ACM
6. DeVaney, A., Butler, R.: Voices of the founders: early discourses in educational technology. In: Jonassen, D.H. (ed.) Handbook of Research for Educational Communications and Technology. Simon and Schuster MacMillan, NY (1996)
7. Molenda, M.: Historical foundations. In: Spector, J.M., Merrill, M.D., Van Merrienboer, J., Driscoll, M.P. (eds.) Handbook of Research on Educational Communications and Technology, 3rd edn, pp. 5–18. Taylor and Francis, New York (2008)
8. Norman, D.-A.: Things that Make Us Smart. Addison-Wesley, Reading (1993)
9. Cuban, L.: Oversold and Underused: Computers in the Classroom. Harvard University Press, Cambridge (2001)
10. Mayer, R.-E.: Multi-media Learning. Cambridge University Press, Cambridge (2009)
11. World Economic Forum: Towards a Reskilling Revolution. A Future of Jobs for All (2018)
12. Davis, A.L.: Using instructional design principles to develop effective information literacy instruction. Coll. Res. Libr. News **74**(4), 205–207 (2013)

How to Run a Massive Open Online Course Once the Funding is Over

Brenda Cecilia Padilla Rodriguez(✉)
and Ma Concepcion Rodriguez Nieto

Autonomous University of Nuevo Leon, 64460 Monterrey, Mexico
brenda.padillardr@uanl.edu.mx

Abstract. Massive open online courses (MOOCs) have gained traction across the higher education sector and beyond. However, there are concerns about their future and sustainability. Sometimes academics have no budget to maintain their MOOCs. This paper reports on the work in progress of redesigning a Study Skills MOOC to ensure its value past its funding period. Strategies include: (1) using discussion forums as an open space for comments and not for guided activities; (2) replacing collaborative e-tivities with multiple-choice questions with automated feedback; (3) including sample tweets to encourage participants to connect with the community beyond the boundaries of the MOOC platform; and (4) adding new multimedia resources such as brief video explanations and infographics. By shifting the focus from the learning community to interactions with the content, the Study Skills MOOC is becoming a set of massive open online resources, a MOOR. While its spirit is different, it still provides a structured sequence of materials that can help learners interested in developing their study skills. Our experience might serve as guidance for academics and institutions facing the same financial challenges. We hope that people around the world find the MOOR beneficial and use it to enhance their self-efficacy.

Keywords: Massive open online course · Sustainability · Learning design

1 Introduction

Massive open online courses (MOOCs) are learning interventions free of charge (usually), characterized by a large number of students simultaneously participating via web. Since their emergence in 2008, they have gained traction across the higher education sector and beyond [11, 20], so much so that 2012 was named ‘the year of the MOOC’ [17]. Hundreds of academic and professional institutions around the world have developed and delivered MOOCs in specialized platforms, such as Coursera, Future-Learn and edX [19]. Thousands of learners from a wide range of backgrounds and with different demographic profiles have enrolled in and studied these courses [7, 8].

After the initial excitement passed and MOOCs became prevalent in the educational scenario, concerns about their future and the suitability of their business model arose [1, 21]. Creating and delivering a MOOC can be expensive, with estimates ranging from 39,000 to 325,000 USD [10]. Less than a quarter of academic leaders

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 156–161, 2019.
https://doi.org/10.1007/978-3-030-19875-6_18

from 2800 colleges and universities in the United States believe that MOOC represent a sustainable method for offering online courses [2].

Attempts to keep low production costs have emerged [13]. The MOOCs4all European project offered a MOOC on “Making MOOCs on a budget” [12]. However, sometimes the problem is not financing the creation of a MOOC but its iterative implementations. Re-running a MOOC is cheaper than developing it but not free [10]. Academics have reported being able to obtain funding to work on new MOOCs but not to maintain current ones. Some institutions have turned to philanthropy to support ongoing MOOCs, inviting lecturers, students and alumni to donate their time to participate [14, 16]. While this volunteering scheme does not seem to be uncommon, it is unreliable and ultimately, not sustainable.

This paper reports on the work in progress of redesigning a Study Skills MOOC to ensure its value past its funding period. This course was born as part of a two-year postdoc project. It was the product of an alliance between the Autonomous University of Nuevo Leon (Mexico) and the University of Northampton (United Kingdom). It has been delivered three times in Spanish on the Blackboard Open Education platform. The Nacional Council of Science and Technology in Mexico funded the salary of a full-time postdoc researcher, who was in charge of coordinating and creating the MOOC. No other additional budget was available.

In a previous study [16], 21 European individuals involved with MOOC development and delivery offered their insights on potentially useful strategies for sustainability. Here, we describe the specific actions we are taking to change the learning design of the Study Skills MOOC. We hope our experience can provide some guidance for other academics facing similar challenges.

2 The Design of the MOOC

Although MOOCs can be designed in many different ways, the most influential categorization encompasses two main approaches, cMOOCs and xMOOCs [6]. Several early MOOCs are examples of cMOOCs. They were based on connectivism and emphasized the importance of social learning in networks. They were largely unstructured, with students generating most of their content. However, nowadays xMOOCs are prevalent. These MOOCs have a behaviorist pedagogy and rely on the transmission of content. They typically consist of videos, computer-marked assignments and, sometimes, peer assessments [5, 21].

Many courses have broken down the distinctions between cMOOCs and xMOOCs. Academics sometimes use MOOCs as a space to experiment with educational methods and strategies [20]. The Study Skills MOOC is one of these variations. Originally, it followed a constructivist approach. While it had some multiple-choice questions with automated feedback, most of its activities relied on student engagement and interactions in 29 discussion forums. It sought to help participants exchange ideas, build their own knowledge and reach their own conclusions.

The course was discipline-neutral. A general audience could benefit from it, but it aimed to address the academic needs of first-year university students. It provided a structured space where participants could practice and improve six study skills during six lessons:

1. Managing time efficiently
2. Taking effective notes
3. Searching for reliable information
4. Understanding academic texts
5. Using the APA referencing format
6. Writing academically

The MOOC fostered participative online learning through the e-tivity framework [18], which requires activities to include the following key elements:

- 'Spark' – a resource, such as an image or a video, aimed at generating interest in the topic of the activity
- Learning objective – contributing to the achievement of the lesson's overall learning outcome
- Task – with specific and clear instructions of what was expected from the learners
- Response – requiring participants to reflect and comment on others' contributions

Activities invited students to reflect on their personal experiences, identify their own mistakes, share their stories and define action plans for improvement. Additional (optional) content and exercises were included for learners who wished to explore specific topics in more depth. Two staff facilitators and three volunteer student moderators provided support, taking an active role in discussion forums. Participants received weekly follow-up emails with summaries of discussions and tips on how to optimize their learning experience. A Twitter hashtag (#hemooc) enabled interactions beyond the boundaries of the MOOC platform. Facilitators tweeted at least three times per week during the deliveries of the MOOC. The recommended study time was three hours per week.

These design features [4, 9] aimed to foster learners' self-efficacy, i.e., their beliefs about their own capabilities to produce expected outcomes [3]. At the end of each lesson, an overarching assignment encouraged learners to practice the corresponding study skill of the week. Non-credit bearing certificates of participation were available for learners who completed the six overarching assignments. The process of identifying who had met the criteria to obtain a certificate was manual and in charge of the main facilitator. This was possible because the number of students enrolled in each iteration was between 208 and 323, and only about 100 participated each time.

3 The Redesign of the MOOC

The original design of the Study Skills MOOC yielded encouraging results, as did some variations that did not alter the underlying pedagogical strategies. Participants had generally positive experiences and showed statistically significant increases in their self-efficacy [15]. Unfortunately, this design was not sustainable, as it made the course's success heavily reliant on social interactions. Students generated learning content and exchanged ideas. Facilitators and moderators monitored the course, offered guidance and stepped in when contributions were incorrect. We needed to make structural changes to ensure the MOOC could work once the funding ended and support became inconsistent.

Experienced academics have suggested a series of actions to ensure MOOCs' sustainability, some of which are reported in a previous study [16]. Many recommendations focus on obtaining revenues through the sale of completion certificates or the use of the freemium model. However, we deemed this approach unfeasible due to our contextual limitations. We needed to modify the MOOC in such a way that we could leave it as a reference material, without having to incur into new administrative tasks.

Upon a conscious examination of course design possibilities, we decided to keep many learning materials but to transform collaborative activities into content-based alternatives that required little updating. Specifically, we are incorporating the following strategies, summarized in Table 1.

Table 1. Strategies for the redesign of the Study Skills MOOC.

Strategy
Reduce the number of discussion forums, to one per lesson
Use discussion forums as open spaces for comments, not for e-tivities
Increase the number of exercises with multiple-choice questions with automated feedback
Recommend sample tweets on each unit
Add brief video explanations and varied multimedia resources
Stop offering the option of obtaining a completion certificate

Only One Discussion Forum Per Lesson. Keeping the 29 original discussion forums seemed a recipe for disaster, as future support within the MOOC is inconsistent at best. We considered deleting all of them, but we wanted to enable students to connect and talk to each other. We agreed to have a general discussion forum per lesson.

Open Space for Comments, Not E-tivities. The lessons' forums will change their purpose. Instead of being structured e-tivities with clear learning objectives and tasks, they will be open spaces for questions and comments. We will add a note to let students know that the staff will not monitor the forums. Some messages might remain unanswered, but the possibility of participants having a meaningful conversation is worth the risk.

Exercises with Multiple-Choice Questions with Automated Feedback. Learner-content interactions will replace social interactions previously enabled by e-tivities. We will create banks of questions with their corresponding feedback, keeping the learning objectives of the discussion forums and covering information that students considered relevant in past iterations of the MOOC.

Sample Tweets. We will encourage participants to connect with the wider community, beyond the boundaries of the MOOC platform. In each lesson, we will add sample tweets that students can share with a click on their Twitter accounts. These tweets summarize important points, share relevant tools or provide related advice. They will all include the MOOC's hashtag (#hemooc) and whenever possible, the link to the course.

Multimedia Resources. To compensate for content previously generated by students in the e-tivities, we will add new materials in different formats, such as infographics and podcasts. Particularly, we consider brief video explanations to be useful to guide participants while offering a human touch.

No Completion Certificates. Unfortunately, since the process of checking who met the criteria to obtain a certificate was manual, keeping this recognition for students was not feasible.

4 Final Reflections

The question of how to run a MOOC once the funding is over has varied answers. Many of them focus on articulating a business model that generates the required revenues to maintain materials up to date and help pay facilitators for their work. Course design is also an important part of sustainability. In the case of the Study Skills MOOC, it was key. Since the learning materials are mostly not time bound (i.e., study skills are not likely to change drastically over the next few years, and even if they do, most of the MOOC's content will remain valid and useful), they will likely not require updating. Nevertheless, pedagogical modifications were required to decrease the importance of the role of facilitators and to automate their teaching functions.

By shifting the focus from the learning community to interactions with the content, the Study Skills MOOC is losing its original essence. Constructivism is no longer its predominant underlying pedagogy. The course is looking more like an xMOOC. It is becoming a set of massive open online resources, a MOOR. While its spirit is different, it still offers a structured sequence of materials that can help learners interested in developing their study skills. We will add a survey to assess the results of the redesign and gain further insights on the effectiveness of the approach described on this paper. Our experience might serve as guidance for academics and institutions facing the same financial challenges. We hope that people around the world find the MOOR beneficial and use it to enhance their self-efficacy.

References

1. AlDahdouh, A.A., Osório, A.J.: Planning to design MOOC? Think first! Online J. Distance Educ. e-Learn. **4**(2), 47–57 (2016)
2. Allen, E., Seaman, J.: Grade change: tracking online education in the United States. Babson Survey Research Group Report, Quahog Research Group, LLC (2014). http://www.onlinelearningsurvey.com/reports/gradechange.pdf

3. Bandura, A.: Self-efficacy. In: Ramachaudran, V.S. (ed.) Encyclopedia of Human Behaviour, vol. 4, pp. 71–81. Academic Press, New York (1994)
4. Bartimote-Aufflick, B., Bridgeman, A., Walker, R., Sharma, M., Smith, L.: The study, evaluation, and improvement of university student self-efficacy. Stud. High. Educ. **41**(11), 1918–1942 (2015)
5. Bayne, S., Ross, J.: The pedagogy of the Massive Open Online Course: the UK view. High. Educ. Acad., York, UK (2014)
6. Daniel, J.: Making sense of MOOCs: musings in a maze of myth, paradox and possibility. J. Interact. Media Educ. 2012(3) (2012). http://jime.open.ac.uk/articles/10.5334/2012-18/
7. Grainger, B.: Massive Open Online Course (MOOC) Report. University of London, London, UK (2013). http://www.londoninternational.ac.uk/sites/default/files/documents/mooc_report2013.pdf
8. Harrison, L.: Open UToronto MOOC Initiative: Report on Second Year of Activity (2014). http://www.ocw.utoronto.ca/open-utoronto-mooc-initiative/
9. Hodges, C.: The development of learner self-efficacy in MOOCs. In: Proceedings of Global Learn 2016, pp. 517–522. Association for the Advancement of Computing in Education (AACE), Limerick, Ireland (2016)
10. Hollands, F. M., Tirthali, D.: MOOCs: expectations and reality. Full report. Center for Benefit-Cost Studies of Education, Teachers College, Columbia University, New York, USA. https://files.eric.ed.gov/fulltext/ED547237.pdf (2014)
11. Johnson, L., Adams Becker, S., Estrada, V., Freeman, A.: NMC Horizon Report: 2015 Higher, Education edn. The New Media Consortium, Austin (2015)
12. MOOCs4all Website. https://moocs4all.eu/. Accessed 25 Feb 2019
13. Nissenson, P.M., Shih, A.C.: MOOC on a budget: development and implementation of a low-cost MOOC at a state university. ASEE Comput. Educ. (CoED) J. **7**(1), 8–23 (2016)
14. Oyo, B., Kalema, B. M.: Massive open online courses for Africa by Africa. Int. Rev. of Res. Open Distrib. Learn. **15**(6) (2014) http://www.irrodl.org/index.php/irrodl/article/view/1889/3127
15. Padilla Rodriguez, B.C., Armellini, A.: Developing self-efficacy through a massive open online course on study skills. Open Praxis **9**(3), 335–343 (2017)
16. Padilla Rodriguez, B.C., Armellini, A., de la Garza Escamilla, S.L.: Sustainability of Massive Open Online Courses (MOOCs): beyond business models. In: Proceedings of EdMedia: World Conference on Educational Media and Technology, pp. 1641–1647. Association for the Advancement of Computing in Education (AACE), Amsterdam (2018)
17. Pappano, L.: The Year of the MOOC. New York Times (2012). https://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplying-at-a-rapid-pace.html
18. Salmon, G.: E-tivities: the Key to Active Online Learning. Routledge, New York (2013)
19. Shah, D.: Massive List of MOOC Providers around the World. MOOC Report. Class Central (2017). https://www.class-central.com/report/mooc-providers-list/
20. Sharples, M., et al.: Innovating Pedagogy 2014. The Open University, United Kingdom (2014)
21. Siemens, G.: Massive open online courses: innovation in education? In: McGreal, R., Kinuthia, W., Marsha, S., McNamara, T. (eds.) Open Educational Resources: innovation, research and practice, pp. 5–16. Commonwealth of Learning and Athabasca University, Vancouver, Canada (2013)

A Ubiquitous Learning Analytics Architecture for a Service-Oriented MOOC Platform

Tobias Rohloff(✉), Jan Renz, Gerardo Navarro Suarez, and Christoph Meinel

Hasso Plattner Institute, Potsdam, Germany
{tobias.rohloff,jan.renz,christoph.meinel}@hpi.de

Abstract. As Massive Open Online Courses (MOOCs) generate a huge amount of learning activity data through its thousands of users, great potential is provided to use this data to understand and optimize the learning experience and outcome, which is the goal of Learning Analytics. But first, the data needs to be collected, processed, analyzed and reported in order to gain actionable insights. Technical concepts and implementations are rarely accessible and therefore this work presents an architecture how Learning Analytics can be implemented in a service-oriented MOOC platform. To achieve that, a service based on extensible schema-agnostic processing pipelines is introduced for the HPI MOOC platform. The approach was evaluated regarding its scalability, extensibility, and versatility with real-world use cases. Also, data privacy was taken into account. Based on five years of running the service in production on several platform deployments, six design recommendations are presented which can be utilized as best practices for platform vendors and researchers when implementing Learning Analytics in MOOCs.

Keywords: MOOCs · Learning Analytics · Service-Oriented Architecture

1 Introduction

Since the peak of the Massive Open Online Course (MOOC) hype in 2012 with "The Year of the MOOC" [5] and the subsequent natural disillusionment that followed, the global phenomenon is slowly reaching the *plateau of productivity* according to Gartner's hype cycle [2]. Many higher education institutions and companies make extensive use of MOOCs, which has resulted in numerous different platforms on the market [12]. As MOOCs are used by thousands of learners, a huge amount of learning activity data is generated. With methods from the research field of Learning Analytics, this data can be utilized to understand and optimize the learning and the environments in which it occurs [13]. In order to leverage the tremendous research potential, platform providers and vendors have to establish the means and tools for collecting, processing, analyzing and accessing the produced data. However, technical concepts and insights

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 162–171, 2019.
https://doi.org/10.1007/978-3-030-19875-6_19

are rarely published especially for modern Microservice-based application architectures. Therefore, this work examines the following research question: How can Learning Analytics be implemented in a service-oriented and multi-client MOOC platform?

To investigate this question, the contribution of this work is twofold. First, we present a technical architecture to implement Learning Analytics into a service-oriented large-scale online learning environment using the example of the MOOC platform from Hasso Plattner Institute (HPI)[1] (Sect. 3), based on the previously explained requirements in Sect. 2. Second, we evaluate this work technically and practically (Sect. 4), by introducing real-world Learning Analytics use cases and features which are realized with this approach. This allows platform vendors and researchers to utilize our insights and best practices to support decision making when implementing Learning Analytics in MOOCs and similar learning platforms. Section 5 concludes the paper.

2 Platform and Requirements

This section presents the technical foundation of the HPI MOOC platform, its architecture, and design decisions. This conceptual understanding is utilized to define the requirements to implement Learning Analytics in such a context.

2.1 From LMS to SOA

The initial version of the HPI MOOC platform was based on an open-source Learning Management System (LMS), in order to quickly experiment and test the platform with first courses in 2012, which was a pioneering work in Europe [4]. Based on these first insights, a custom-tailored platform was developed from scratch which fits better to the paradigm of MOOCs, with thousands of learners in a single course and social activity, as well as a better scalability and performance. Therefore, the current platform was developed based on the principles of a Service-Oriented Architecture (SOA) with logically separated functionality in individual services [3]. For example, the *account service* is responsible for managing users accounts and the *course service* manages all information regarding courses and course enrollments. The services can communicate with each other synchronously through RESTful HTTP interfaces, or asynchronously by publishing events on a shared message queue. Currently, there are three clients available for the platform: a web client served by the *web service* and two native mobile clients for Android and iOS, which use the platform's API.

2.2 Learning Analytics Implementation Requirements

An SOA leads to a distributed data landscape because every service manages its own data persistence layer, and these layers are eventually distributed across different physical machines and rely on different database technologies. This makes

[1] https://open.hpi.de/.

it inconvenient when performing analytical tasks. Each service has to offer different analytics endpoints, which can cause heavy load on the overall system and block incoming requests, especially when the data is calculated on-demand. This is due to the fact that Microservices are designed to support an operational Online Transaction Processing (OLTP) model. However, the support for Online Analytical Processing (OLAP) is required. In order to overcome this issue, an independent service is mandatory which provides analytics and statistics on separate data stores. Thereby, it must be *extensible* to cover different Learning Analytics use cases of different stakeholders, *flexible* to gather data from different system components and clients, *avoid high system load* and performance impact when gathering and processing the data, allow *instant data availability* and *ensure data privacy*.

3 Learning Analytics Architecture

To implement and fulfill the previously introduced requirements, this section explains the concept and architecture of the realized Learning Analytics service. A complete architecture overview of all system components including the Learning Analytics service can be seen in Fig. 1. The service was realized by following the approach of an Extract, Transform, Load (ETL) process, as introduced in [7]. This process is implemented as extensible processing pipelines. Every pipeline consists of an extraction, multiple transforming, and a loading step. The extraction step processes the raw data into a container format. Afterward, the transformation steps process the data and map them to the desired data schema. At last, the loading step persists them in different analytics stores. These steps are explained in detail in the following subsections.

3.1 Event-Driven Data Collection

The data collection and extraction is implemented by taking advantage of the publish-subscribe message queue. This enables an asynchronous event-driven inter-process communication. Every service can publish events on the message queue. Here, two types of events are used. First, general model changes, like when a model record was created, updated or deleted. Second, explicit analytics events. The Learning Analytics service subscribed itself for all analytics events, as well as certain model changes. The queue then notifies and passes all corresponding events to the Learning Analytics service. In this way, the asynchronous non-blocking communication avoids performance impacts on the overall system.

The data structure of the analytics events is inspired by the xAPI[2]: «Actor» does «Verb» on «Object», with «Result» in «Context» at «Timestamp». In the context of the platform, the *Actor* is called *User* and the *Object* is called *Resource*. The *User* is the person who triggered the event, the *Verb* is the action that is being done by the *User*, the *Resource* is the entity the action was done

[2] https://xapi.com/overview/.

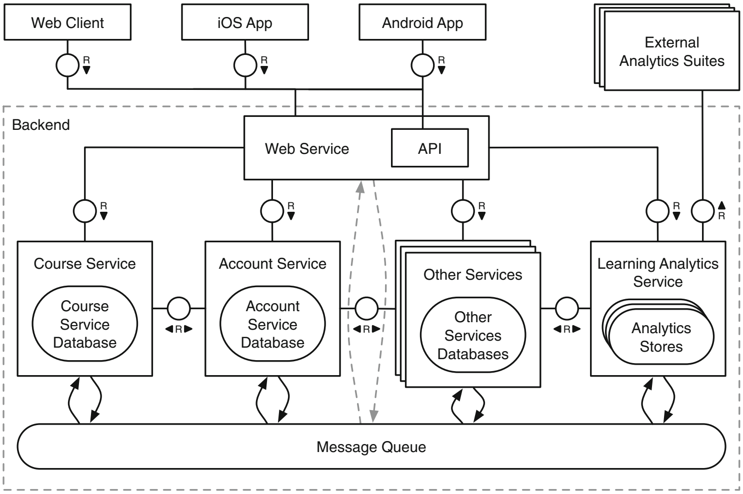

Fig. 1. The Platform's architecture with Learning Analytics service

at and the *Result* is the outcome of the action. The *Context* contains additional information which the action is related with and the *Timestamp* is the moment of the action.

3.2 Data Transformation with Processing Pipelines

The transformation steps process, enrich and clean the data. The first step processes the user-agent if the event was sent by the web client, to identify the user's operating system and browser. The next step determines a coarse location from the request's IP address to assess the country and city. The third step removes the user-agent and IP address from the event since all crucial information is already extracted from these attributes. They are classified as sensitive personal information, which makes it rather easy to identify a user when anonymized events with hashed user IDs are examined. The last step transforms the data into the appropriate schema of the targeted data storage.

3.3 Data Loading into Analytics Stores

The Learning Analytics service provides the possibility to host different data sources as analytics stores. This provides the advantage to store the same data redundantly – or different data – in various database technologies to optimize query performance. Each data source is configured with its own processing pipeline, whereby the extraction and transformation steps can be reused. The specific loading step stores the data at the end. The general concept of the service and its pipelines is shown in Fig. 2.

Currently, four different pipelines are used. User interaction events are stored redundantly in an SQL-based data source (PostgreSQL) and in a NoSQL-based data source (Elasticsearch). As an experiment also external analytics suites were tested as data stores. Therefore, a whitelisted subset of interaction events was anonymized and send to Google Analytics, which then serves as an analytics store [11]. At last, another pipeline is used to enable referrer tracking, which uses the Elasticsearch analytics store as well.

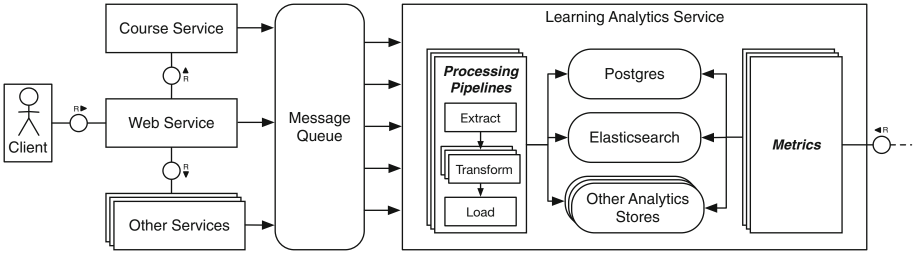

Fig. 2. The concept of the Learning Analytics service

3.4 Data Analysis with Metrics

Having the data stored in different analytics stores, it allows us to query the data, process them and expose insights as metrics within the platform. Every metric specifies its data source, optional and required parameters, and a short description with a custom Domain-Specific Language (DSL). This enables us to provide a self-documented endpoint for platform developers and researchers, introduce a standardized way to implement new metrics and support the discoverability of available metrics to increase the usage of data-driven insights, either for platform features or research studies. The calculation of a metric provides the possibility of pre- and post-processing of the data, as well as requesting the data source with its native query language.

3.5 Learning Analytics for Ubiquitous Learning

The broad availability of mobile devices has enabled Mobile Learning for online education like MOOCs [15]. By taking the user's context – like time and location – into account as well, the term Ubiquitous Learning arose. Therefore, the retrieval, analysis, and reporting of the data of mobile learners along with their contextual information is called Ubiquitous Learning Analytics [1].

To support this, two architecture components were enhanced [9]. First, a context model was defined and implemented. The contextual data is captured on the client-side and transferred to the Learning Analytics service as explained previously. The service applies additional extraction and cleaning transformation steps as part of its processing pipeline. Second, the client-side tracking capabilities were improved by supporting offline-usage and network interruptions. Therefore, all captured user interaction events are saved on a local database before transferred over the network once the device was connected again.

4 Evaluation

This section evaluates the implemented architecture based on the defined requirements. Therefore, the scalability, extensibility, and versatility are examined. Afterward, the data privacy mechanisms are reviewed. The section is closed by a presentation of compiled design recommendations and best practices.

4.1 Scalability

Since the implemented approach is used in a real-world MOOC platform with thousands of learners, it must be able to process the incoming data load and provide instant data availability. This means that a user always gets the latest data when requesting a certain metric, which is defined as a processing time for each event of at most one second. To evaluate the data load and availability, we examined a sample period of one year on the largest deployment of the platform[3]. The deployment consists of four web service nodes and four nodes with all other services, which means that the Learning Analytics service is also deployed four times redundantly for load balancing. The message queue used to publish events is hosted as a single instance, as well as the PostgreSQL database – which is one of the two analytics data stores. The other data store based on Elasticsearch is operated as a cluster with two nodes.

In the analyzed period from January 1, 2018, to December 31, 2018, a total number of 126,180,673 analytics events from 328,507 users were captured, which results in about four events per second on average. Although this number may seem low at first glance, it should be noted that the general activity on MOOC platforms varies significantly, depending on the time of day, course dates and deadlines. This results in periods of very high and low activity that must be considered separately. Therefore we examined the number of events waiting to be processed in the message queue per hour for the whole year. During the entire period, 67.6% of the time not a single event was waiting in the queue, which means every event was processed right away. In 31.1% of the captured hour intervals up to 14,400 events were waiting for a free consumer. This number was chosen since the four Learning Analytics service consumers are then theoretically stressed with one event per second on average, which is still considered as instant data availability. Based on this approximation, we achieved a total instant data availability in 98.7% of the time. The higher loads during the rest of the time are probably caused by infrastructure issues and not by activity peaks. To prevent data loss in such outages, all events are stored and kept as unacknowledged in message queue as long as the analytics stores are unavailable. All in all, we consider our architecture approach as proven to be suitable for the scale of a real-world MOOC platform.

[3] https://open.sap.com/.

4.2 Extensibility

An important requirement of the Learning Analytics service is to provide a flexible architectural design. It should be avoided to rebuild the whole architecture to include a new schema or data source. Thus, extensibility is ensured with the implemented processing pipeline design. New data which should be tracked can be published by other components through the message queue. Then, the Learning Analytics service can extract the data within its first pipeline step. A new data source can be added by providing a new load step, which maps the generic event schema to the specific database schema and executes the queries to persist the data. The modularity of the processing pipeline is the most valuable advantage. It can be easily extended or new pipelines can be created by providing additional transform or load steps. Also, every step can be reused by all pipelines.

4.3 Versatility

In this subsection, different use cases and features are explained that were implemented based on the presented Learning Analytics architecture. This is utilized to assess the versatility of the general approach.

As a typical use case, a *Teacher Dashboard* was implemented that visualizes various Learning Analytics metrics to give an overview of a course [11]. It includes enrollment numbers, active users and forum activity over time, as well as statistics about learning item visits, quiz performances, geographical learner locations, age distributions, used devices and learning times. Among other things, it supports teaching teams to identify anomalies and patterns in their courses, like too difficult learning content. Additionally, a *Learner Dashboard* was implemented and tested that gives students insights and feedback about their own learning behavior. It a based on concept to better support self-regulated learning, by providing personalized learning objectives a student can choose [10]. The dashboard should help to achieve that objective by enabling self-evaluation.

Unexperienced teaching teams or limited production times can lead to qualitative weaknesses in MOOCs. Therefore, it is valuable to assist with an *Automated Quality Assurance*, which Learning Analytics can enable [8]. Such a concept was implemented by translating best practices into machine-executable rules. These rules are checked periodically and a warning is issued if they are violated, whereby every warning is prioritized and linked with a recommendation for action. Two examples of such rules are too difficult quizzes or anomalies in student's video watching behavior, like too many rewinds. Another implemented feature enabled by Learning Analytics is the *Cluster Viewer*, which supports teachers to interactively explore meaningful subgroups of students by their learning activity to take informed action and measure the effect of performed interventions [14]. At last, the platform supports *A/B Testing*. With that, researchers can examine new features and compare the learning behavior and outcome of different test groups. This evaluation is based on Learning Analytics metrics, which are visualized and compared by their statistical differences and effect sizes [6].

The different presented use cases confirm the versatility of the implemented architecture. It allows to realize a broad range of techniques, ranging from simpler statistics and visualizations to more complex topics like data mining with clustering. Also, various stakeholder take advantage of the Learning Analytics capabilities, like teachers, learners, and researchers. This promises to be able to implement further requirements and use cases in the future as well.

4.4 Data Privacy

As the platform is developed and hosted in Germany, the European Union's General Data Protection Regulation (GDPR) is the law in force for governing processing of personal data. Since the Learning Analytic capabilities are exclusively used to improve the learning experience and optimizing the platform and its features, the data processing is considered as a legitimate interest. Therefore, no explicit consent is required from the user – as it would be for marketing purposes for example. Additionally, anonymization techniques are applied to further improve the data privacy of the tracked interaction data. Some attributes are omitted which are classified as personally identifiable information, e.g. the user's IP address and the browser's user-agent. No profile data is captured, like the user's name, email or date of birth. If some data is exported from the platform, the user IDs are additionally obfuscated. To ensure data reduction and data economy only relevant interaction events are captured, instead of tracking every single click on the platform.

4.5 Design Recommendations and Best Practices

Based on the experiences and insights we gathered in five years of running the Learning Analytics service in production on several platform deployments, we compiled a number of design recommendations for platform vendors and researchers. These best practices can support their decision making when implementing Learning Analytics capabilities into MOOC platforms.

Concurrent Data Collection and Processing Analytics, in general, can be seen as an extension to the main application. Thus, the performance impact on the overall application, caused by additional analytics tasks, should be kept to a minimum. A common technique is to execute such tasks concurrently. We realized this by utilizing an asynchronous message queue for event collection, to not block the sending components. The data processing is done by a separate service running independently from other system components.

Schema-Agnostic Pipelining Different data schemas and query requirements fit more or less well to different storage technologies. Therefore, various analytics data will eventually be stored in multiple databases. Hence, we recommend a pipeline processing architecture. By utilizing an ETL process for this, all data can be processed based on a generic data schema. Only the last load step converts the data into the database-specific format. This enables a schema-agnostic data processing and minimizes technology and vendor lock-ins.

Reusable Pipeline Components By utilizing the proposed schema-agnostic pipeline architecture, all transformation processing steps become reusable. For example, this allowed us to apply the same anonymization step to all of our analytics pipelines. This reduces implementation and maintenance efforts by applying the *don't repeat yourself* principle.

Central Interface for Data-Driven Insights Instead of having each application component providing its own analytics interface, it makes sense to have a central interface for data-driven insights. We realized this with an index of all available metrics within our Learning Analytics service. This also abstracts the underlying database technology.

Embrace Open Standards Interoperability with other applications and systems can best be achieved through the use of open standards. In the domain of Learning Analytics, the xAPI format has been accepted widely. This standard also defines the Learning Record Store. Thus, an implementation of such an analytics store could be used right away without further data transformations.

Data Protection by Design By taking data protection into account at every project stage, privacy risks can be reduced and trust increased. Users must stay in control of their data and the benefits of capturing and processing personal data should be communicated beforehand. It should also be ensured at an early stage that legal requirements like GDPR are complied with.

5 Conclusion

This work presented an architecture how Learning Analytics can be implemented in a service-oriented and multi-client MOOC platform. Based on the elaborated requirements, an ETL process was proposed to implement extensible processing pipelines within an independent Learning Analytics service. This approach utilizes an event-driven asynchronous data collection, a schema-agnostic data processing with reusable steps, and different analytics stores for optimized query performance. It was implemented for the HPI MOOC platform and deployed for real-world usage. User interaction events are captured with contextual data by different client applications, like the web client and mobile apps. This serves as the data foundation for Ubiquitous Learning Analytics, to generate data-driven insights about the learning behavior and create platform features to improve the learning experience and success.

Afterward, the architecture was evaluated to examine its scalability, extensibility, and versatility by discussing various implemented Learning Analytics use cases for different stakeholders like teachers and learners. Then, data privacy issues and mechanisms were presented, which also took the EU GDPR requirements into account. At last, six design recommendations – about concurrent data collection and processing, schema-agnostic pipelining, reusable pipeline components, centralized data-driven insights, open standards, and data protection – were introduced. These should serve as best practices for platform vendors and researchers, to support them during the implementation of Learning Analytics capabilities in MOOCs.

References

1. Aljohani, N.R., Davis, H.C.: Learning analytics in mobile and ubiquitous learning environments. In: 11th World Conference on Mobile and Contextual Learning (mLearn 2012), October 2012
2. Bozkurt, A., Keskin, N.O., de Waard, I.: Research trends in massive open online course (MOOC) theses and dissertations: surfing the tsunami wave. Open Prax. **8**(3), 203–221 (2016)
3. Meinel, C., Totschnig, M., Willems, C.: openHPI: evolution of a MOOC platform from LMS to SOA. In: Proceedings of the 5th International Conference on Computer Supported Education (CSEDU) (2013)
4. Meinel, C., Willems, C.: openHPI: the MOOC offer at Hasso Plattner Institute. Universitätsverlag Potsdam, Technical report (2013)
5. Pappano, L.: The Year of the MOOC (2012). http://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplyingat-a-rapid-pace.html
6. Renz, J., Hoffmann, D., Staubitz, T., Meinel, C.: Using A/B testing in MOOC environments. In: Proceedings of the Sixth International Conference on Learning Analytics & Knowledge, pp. 304–313. ACM (2016). https://doi.org/10.1145/2883851.2883876
7. Renz, J., Navarro-Suarez, G., Sathi, R., Staubitz, T., Meinel, C.: Enabling schema agnostic learning analytics in a service-oriented MOOC platform. In: Proceedings of the Third (2016) ACM Conference on Learning @ Scale, L@S 2016, pp. 137–140. ACM (2016). https://doi.org/10.1145/2876034.2893389
8. Renz, J., Rohloff, T., Meinel, C.: Automated quality assurance in MOOCs through learning analytics. In: Joint Proceedings of the Pre-Conference Workshops of DeLFI and GMW 2017. CEUR-WS.org (2017)
9. Rohloff, T., Bothe, M., Renz, J., Meinel, C.: Towards a better understanding of mobile learning in MOOCs. In: Learning with MOOCs 2018 (LWMOOCS V), September 2018. https://doi.org/10.1109/LWMOOCS.2018.8534685
10. Rohloff, T., Meinel, C.: Towards personalized learning objectives in MOOCs. In: Pammer-Schindler, V., Pérez-Sanagustín, M., Drachsler, H., Elferink, R., Scheffel, M. (eds.) EC-TEL 2018. LNCS, vol. 11082, pp. 202–215. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-98572-5_16
11. Rohloff, T., Oldag, S., Renz, J., Meinel, C.: Utilizing web analytics in the context of learning analytics for large-scale online learning. In: 2019 IEEE Global Engineering Education Conference (EDUCON) (2019, in press)
12. Shah, D.: Massive List of MOOC Providers Around The World (2017). https://www.class-central.com/report/mooc-providers-list/
13. Siemens, G.: Call for Papers of the 1st International Conference on Learning Analytics & Knowledge (LAK 2011) (2010). https://tekri.athabascau.ca/analytics/
14. Teusner, R., Rollmann, K.-A., Renz, J.: Taking informed action on student activity in MOOCs. In: Proceedings of the Fourth ACM Conference on Learning @ Scale, pp. 149–152. ACM (2017). https://doi.org/10.1145/3051457.3053971
15. Thüs, H., et al.: Mobile learning in context. Int. J. Technol. Enhanc. Learn. **4**(5/6), 332–344 (2012). https://doi.org/10.1504/IJTEL.2012.051818

Embracing Diversity: A Raising Awareness MOOC Experience

Susanna Sancassani(✉), Valeria Baudo(✉), and Nicoletta Trentinaglia(✉)

METID-Politecnico di Milano, Milan, MI, Italy
{susanna.sancassani, valeria.baudo, nicoletta.trentinaglia}@polimi.it

Abstract. This paper presents the experience of the MOOC "Embracing Diversity", developed for the IN2IT Project and hosted on Polimi Open Knowledge, the MOOC programme of Politecnico di Milano (https://www.pok.polimi.it/). A follow up of the MOOC, represented by an ongoing special edition of the course, focused specifically on gender and STEM, is also shortly presented.

In this paper we will present:

1- the main characteristics of the MOOC, with a special focus on the intended learning outcomes, the vision of the topic, the methodology used to develop it;
2- the data of the pilot edition of the course on the basis of the available information, represented mainly by the results of the initial and final survey;
3- the ongoing special edition of the MOOC focused on gender and STEM.

Keywords: MOOC · Gender · Soft skill · Raising awareness · Diversity · Inclusion · STEM

1 Introduction

"Embracing Diversity" MOOC has been realized for the IN2IT Erasmus+ Project aimed at promoting the internationalization of higher education through the use of new technologies. It is offered as part of a co-designed online learning experience involving all the partner universities from Europe and Israel about the topic of gender and sexual orientation. The topic of diversity is a good case in which universities can share in an open way their knowledge with the society. Moreover, the exchanges between people already active in the companies and students could be useful in order to build a deeper comprehension of the links between active policies of inclusion and innovation driven realities.

1.1 The Intended Learning Outcomes

The idea at the basis is that embracing diversity is essential for developing the talent of everyone and for promoting creativity and innovation in academic, social and corporate

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 172–177, 2019.
https://doi.org/10.1007/978-3-030-19875-6_20

environments. Both in Europe and in Israel, even with relevant differences, gender stereotypes and discriminations against LGBT people are still diffused. The course is aimed at making students aware of what the roots of these biases and stereotypes are, what solutions are possible to adopt to promote and increase the inclusion of women and LGBT people and why gender and sexual orientation diversity drives innovation. Students have the opportunity to analyze cases of businesses that have decided to apply successfully strategies aimed at promoting the inclusion of women and LGBT people to create a fertile, authentic work environment for everyone. Starting from this awareness, students can work for the acquisition and development of a sensitive attitude toward diversity as a fundamental soft skill in present context. Moreover, in the special T.I.M.E. edition of the MOOC users have also the opportunity to broaden this awareness, extending it also to the issue of gender in STEM area.

1.2 The Vision of the Topic

The idea that diversity and inclusion issues represent a crucial aspect in current work world, is proved by several researches:

"*We know that the competitiveness of the organization is at risk in a world where women are more and more the arbiters of consumption and social trends and are motivated to change their lives for the better*" (Notarnicola 2015).

"More diverse companies, we believe, are better able to win top talent and improve their customer orientation, employee satisfaction, and decision making, and all that leads to a virtuous cycle of increasing returns. This in turn suggests that other kinds of diversity—for example, in age, sexual orientation, and experience (such as a global mind-set and cultural fluency)—are also likely to bring some level of competitive advantage for companies that can attract and retain such diverse talent" (Hunt et al. 2015).

"Greater team diversity (including gender diversity) can lead to better average performance" (Credit Suisse Research Institute 2012).

"Companies with diverse executive boards enjoyed significantly higher earnings and returns on equity" (Barta et al. 2012).

2 Methodology

The international collaboration has been very productive both in the design and in the production phase of the MOOC. The challenge of collaborative design in a multicultural context has been a crucial aspect and it has been overcome through a continuous and fertile dialogue among partners. The MOOC has been organized as a pilot course, in which students participate to specific pilot activities simultaneously. In particular they experienced two geolocalization and game-based learning activities: Tarasa (http://tarasa.org) and Taleblazer (http://taleblazer.org). They used Tarasa to introduce themselves to other participants, by uploading on the map a visual object significant for their life. They used the Taleblazer geolocalization map of their city to discover significant places in the diversity and inclusive perspective and discussing about that in the Forum. The challenge of involving students in this activity has been overcome by involving students' association and asking them to break the ice. The instructional design approach used to develop contents has been based on Kolb's learning Cycle (Kolb 1984). The four weeks of the MOOC have been therefore designed following the methodology of this approach. A methodological attention in designing the MOOC has been necessary since we are dealing with very sensitive topics. To this aim contents have been managed through an accurate selection of appropriate images, avoiding stereotyped representations of presented themes.

3 Results and Discussion

This paper is based on data of the first edition of the MOOC (May–July 2017) with 527 international participants and 154 questionnaires of initial survey completed (29% completion rate) and 81 final questionnaires (15% completion rate).

The sample of users has been recruited on line on a voluntary basis and in this analysis we used the entire pre and post sample since people have not been tracked in compliance with the MOOC portal privacy policy. Although the sample can be affected by self-selection bias, and the non-response rate can affect the results presented, we can reasonably assume that they can be considered representative of the whole MOOC users population (Wright 2005).

The surveys provided to the participants were aimed at investigating mainly their profile, their satisfaction about the MOOC and their awareness about the topic before and after the course according to three main dimensions:

1. the confidence of the users in discussing the topic with other people
2. the awareness of the users about the topic and its relationship with their daily life
3. the willingness and motivation of users to learn about the topic.

About the confidence in discussing the topic with other people, we can say that - despite the sensitive topic and the multicultural context of this pilot edition in which people from different religion and culture were involved - participants expressed a

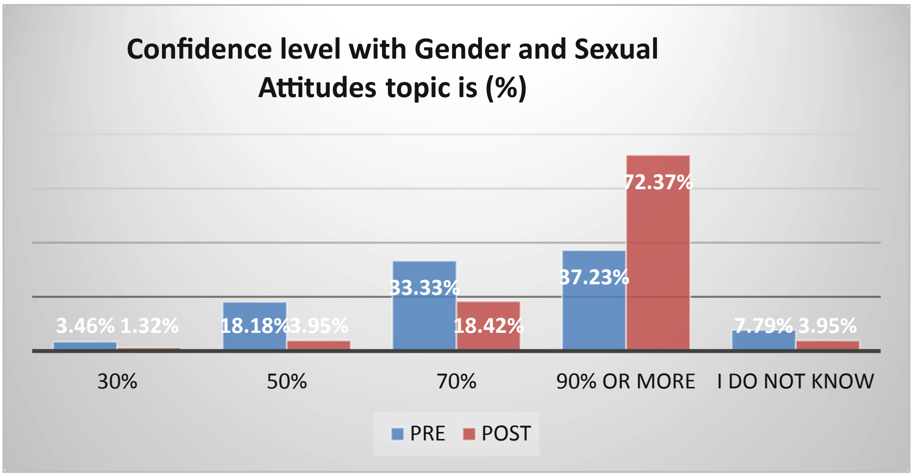

Fig. 1. Estimation of confidence level of users about the topic before and after the course.

general positive attitude with a positive shift in the confidence of the users about the topic at the beginning and at the end of the MOOC (see Fig. 1).

As regards the awareness of the topic, we can observe indicatively the same trend. We can indeed observe that the percentage of users expressing the maximum level of confidence even doubled, as showed in the Fig. 2.

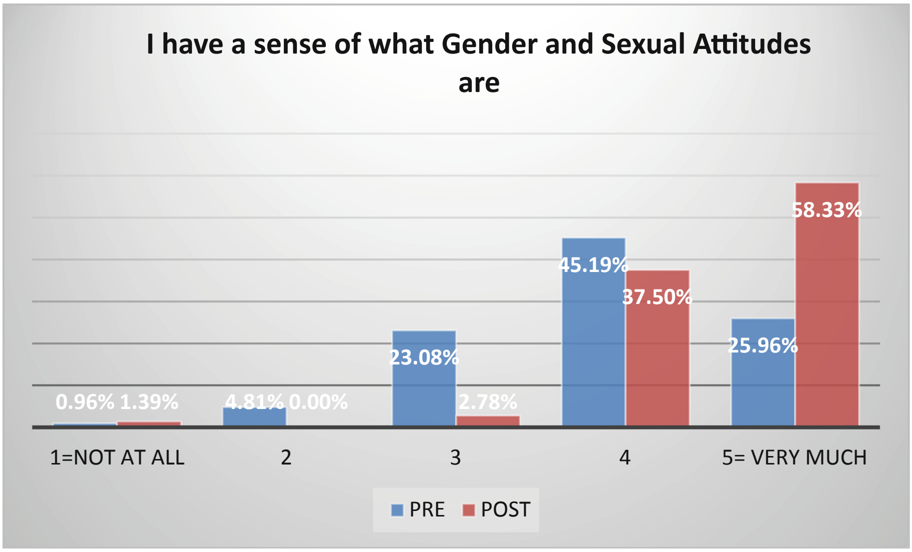

Fig. 2. Cognition of users about the topic before and after the course.

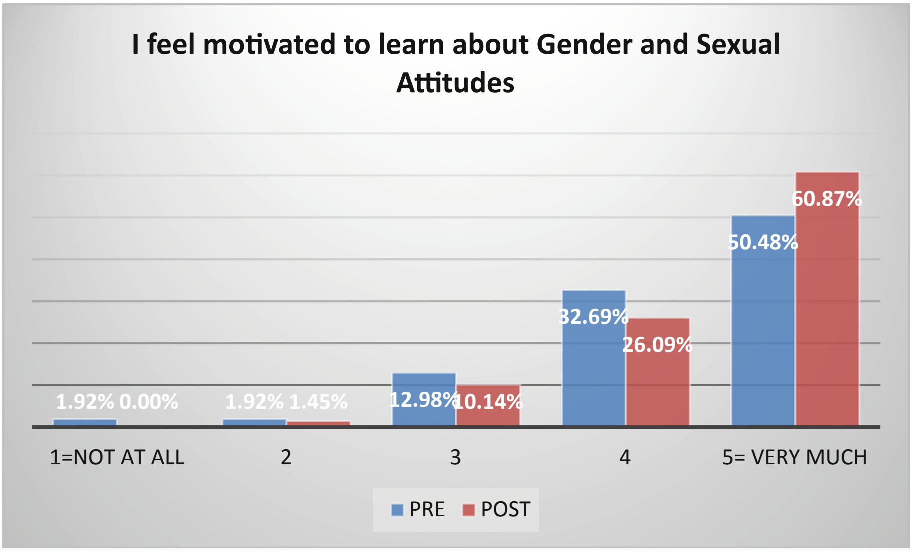

Fig. 3. Motivation of users to learn about the topic before and after the course.

Finally, as regards to the level of willingness and motivation to learn about the topic of the course, the results seem to be also positive with a shift towards the highest level of motivation at the end of the MOOC (see Fig. 3).

4 Conclusion and Follow Up

The main findings available are based on the analysis of the data of the initial and final surveys. According to these, it seems to emerge that there is a significant interest from employees to the contents of the course. This fact seems to be coherent with the idea that companies are more and more sensitive to the diversity and inclusion issues and that the soft skill related to these aspects is considered an important added value to be cherished in the selection and development processes of talents. Finally, we can also argue that, according to these results students seem to be a sensitive target.

Finally, these data gathered from the pilot edition of the MOOC, can provide us also with relevant hints useful to approach also a recent development of the MOOC: the special edition of the MOOC realized in the framework of D-STEM Project promoted by T.I.M.E. Association (Top Industrial Managers for Europe), the international network of leading technical universities to which Politecnico di Milano belongs.

D-STEM aims at promoting gender enhancement in STEM (science, technology, engineering and math) area, increasing the awareness on the widespread stereotype according to which STEM studies and carriers are a prerogative of men (Tomasetto et al. (2015); Wang et al. (2013); Robnett and Leaper (2013); Simpkins et al. (2006)). To reach this goal, the project starts from the experience represented by IN2IT Project, enriching the Embracing Diversity MOOC with contents specifically focused on gender and STEM topics. This special edition therefore on one side considers the effects of discouragement and self-exclusion on female talent in STEM and on the other side shares some actions useful to motivate girls to study STEM.

In this context, users have the opportunity to analyze these themes thanks to the additional video lectures realized, but also to the specifically designed activities: the peer discussions on the forum on the most meaningful issues starting from specific input questions proposed by the faculty and a specifically designed stimulating raising awareness activity, based on the use of a dedicated Webapp (Mybias: http://www.mybias.polimi.it/), aimed at helping users to become more aware on their personal bias on diversity, inclusion, gender and STEM.

Starting from this experience, we can therefore believe that these additional contents of the T.I.M.E. special edition will combine with the ones of the pilot edition and will therefore contribute to create a broader vision of diversity, supporting gender inclusion in academic, social and corporate environments generally speaking but also specifically in STEM area, confirming in this way the grow of awareness that has characterized the pilot edition results.

References

Barta, T., Kleiner, M., Neumann, T.: Is there a payoff from top-team diversity? McKinsey Q. **2**, 65–66 (2012)

Credit Suisse Research Institute: Gender Diversity and Corporate Performance. Credit Suisse AG, Zurich (2012)

Hunt, V., Layton, D., Prince, S.: Why Diversity Matter. McKinsey report (2015)

Notarnicola, A.: Global Inclusion. Franco Angeli, Milano (2015)

Kolb, D.: Experiential Learning: Experiential as the Source of Learning and Development. Prentice Hall, Englewood Cliffs (1984)

Robnett, R.D., Leaper, C.: Friendship groups, personal motivation and gender in relation to high school students' STEM career interest. J. Res. Adolesc. **23**(4), 652–664 (2013)

Simpkins, S.D., Davis-Kean, P.E., Eccles, J.S.: Math and science motivation: a longitudinal examination of the links between choices and beliefs. Dev. Psychol. **42**(1), 70 (2006)

Tomasetto, C., Mirisola, A., Galdi, S., Cadinu, M.: Parents' math–gender stereotypes, children's self-perception of ability, and children's appraisal of parents' evaluations in 6-year-olds. Contemp. Educ. Psychol. **42**, 186–198 (2015)

Wang, M.T., Eccles, J.S., Kenny, S.: Not lack of ability but more choice: Individual and gender differences in choice of careers in science, technology, engineering, and mathematics. Psychol. Sci. **24**, 770–775 (2013)

Wright, K.B.: Researching internet-based populations: advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. J. Comput. Mediated Commun. **10**(3), JCMC1034 (2005)

Storytelling and Innovative Digital Techniques Which Increase Motivation Levels of MOOC Participants

Maria Thirouard[1(✉)], Clement Cahagne[1], Olivier Bernaert[1], and David Jehl[2]

[1] IFP School, 232 Ave Napoléon Bonaparte, 92852 Rueil Malmaison Cedex, France
Maria-alejandra.thirouard@ifpen.fr
[2] Rise Up, 10 rue de La Boétie, 75008 Paris, France

Abstract. As the number of MOOCs increase over the years, more data has become available which show poor completion rates (on average between 5 and 10%). IFP School has been producing MOOCs since 2014 introducing innovative pedagogical techniques to improve learner motivation by integrating games into our MOOC's.

In our latest MOOC: '*Tomorrow's Mobility*', in addition to the gaming element that has proven to be successful, storytelling techniques were used that created a narrative thread which was integrated with the technical knowledge that was presented. A charming character was created that accompanied the learners throughout the entire MOOC resulting in a special relationship between the learners and the MOOC course.

In this paper we describe how this MOOC was built through the use of this character and the other pedagogical innovation that was introduced. The results show an unusual environment that increased the learners motivation to help the character. Since helping the character meant going through the different activities proposed in the MOOC, in our opinion, it was the main reason that led to the high completion rate of 20% that was obtained.

Keywords: MOOC · Completion rates · Storytelling · Serious games · Gamification · Mentoring · Augmented reality · Virtual reality

1 Introduction

IFP School offers applied graduate programs, providing students and young professionals from all over the world with education in the fields of energy and mobility which meets the needs of industry and the demands of society with particular emphasis on sustainable development and innovation.

As a well-recognized school in the fields of Oil&Gas and thermal engines, we are in the middle of a turning point where it is important to prepare for the future whilst maintaining the standards for modern day society. In this context, the content of our programs has been progressively evolving, shifting toward new, cleaner energies and cleaner forms of mobility that will reduce the environmental footprint of our society.

M. Calise et al. (Eds.): EMOOCs 2019, LNCS 11475, pp. 178–188, 2019.
https://doi.org/10.1007/978-3-030-19875-6_21

In particular, the transport sector is undergoing many changes. Some people think that we are progressively moving away from the model where the traditional, self-owned, thermal car is dominant to a model where we will be driven around in electric fleets of cars. IFP School wants to prepare the engineers who will tackle the challenges of tomorrow's society.

Aiming to improve its reputation in these new fields and, as always, to innovate in pedagogy, IFP School launched the MOOC: *'Tomorrow's Mobility'* in November 2018. Having achieved in the past surprisingly high completion rates and using the MOOCs as a laboratory to try new ideas in pedagogy, it was a challenge to experiment with different innovative tools to keep up the high completion rates.

Using what was learnt from our previous experiences, we use the possibilities offered by digital techniques to improve the learner's motivation such as: serious games, mini games, virtual reality and a mentoring system etc. In addition to these techniques, in our last MOOC story telling techniques where used together with other significant innovations like the use of sketch notes, enigmas, augmented reality, the production of a book that contains all the content of the MOOC (videos and synthesis documents).

In this article you will first be introduced to the *'Tomorrow's Mobility'* MOOC through some key figures. Then the innovations used will be presented as well as other contributing factors. Finally, we will discuss some perspectives.

2 The Tomorrow's Mobility MOOC

The MOOC: *'Tomorrow's Mobility: Sustainable Technologies for the Automotive Sector'* was launched in November 2018. This MOOC was taught in English over a 4-weeks period. The objective of this course was to understand the technical concepts and environmental issues related to the automotive industry. Using a technical approach, the basic knowledge of hybrid and electric drivetrains were presented as well as information on the autonomous and connected vehicle technologies. Some of the pedagogical goals included the ability of participants to:

- Describe the current transport situation regarding pollutant emissions and legislation.
- Design an electric drive train taking into account the electric engine, the electronics, the type of battery and control system by finding the right trade-off between performances and the constraints of weight and price.
- Design a hybrid powertrain taking into account the hybridization degree and the different architectures.
- Analyze the advantages of these technologies and their limitations. Describe how they work.

The participants rated the difficulty of the course as 5.7/10 where 1 is very easy and 10 is very difficult.

Similarly to our previous MOOCs, it was important to give the learners not only the knowledge but also the skills to apply it in real life situations. The serious games and mini games allow the combination of a fun and dynamic environment to improve the learning experience and aims to reduce as much as possible the use of standard multiple choices quizzes. Therefore, all the activities proposed were either mini games or serious games. The difference between both is that in a mini game, the questions are asked through a colorful interface that makes it look like the participants are actually playing a game. In a serious game the interface is usually the same but the questions are solved by using a simulator that implements physical equations.

In the table below (Table 1) is a summary of the different resources offered in the MOOC. Regarding the 35 video-lectures, it was important to ensure a short format of around 5 to 7 min. A study on videos produced for the MIT MOOC (GUO) showed that the shorter the videos, the higher the involvement. In total, the 35 videos correspond to 3 h 54 min of lectures. The bonus videos −38 min in total- were optional content were experts on the field of the week would discuss relevant subjects. On average, participants needed between 2 and 4 h per week to complete all the activities proposed.

Table 1. IFP School MOOC characteristics

Videos	Forum	Serious game	Mini game	Bonus videos	Enigmas
35	5	6	13	8	8

Many factors contribute to the high completion rate obtained (20%) and it is extremely difficult to separate the influence of each factor. The completion rate as used in this article is defined as follows:

$$Completion\ rate = \frac{number\ of\ certified\ participants}{total\ number\ of\ enrolled\ participants}$$

Table 2 presents additional data: total number of enrolled participants, the proportion of young learners, the male/female distribution and finally the completion rate.

Table 2. Tomorrow's Mobility - IFP School MOOC data

Total enrolled	Under 25 years old	Male/Female	Completion rate
4981	40%	83%–17%	20%

One of the factors that help explain this significant result is the intended audience: adapting the MOOC to your target population helps to improve the completion rate.

In our case our primary goal was to attract young students interested in the transport sector. Second, to show the modifications our master programs are undergoing, a shift that reflects the changes in the transport business. Finally, the MOOCs are used as a way to improve the recruitment of excellent students from all over the world.

The communication process was done through social media selecting specific countries and universities were IFP School is developing new partnerships. Alumni's network was also used as well as our industrial partners network. The MOOC was prepared in collaboration with two partners (IFP Training and Vedecom) that also helped with the marketing using their own channels.

The participants however, would not immediately benefit from the certification, like for credits certification or admission to the school. The academic reputation of the school plays a major role in the participants decision to join a course. The certification was free of charge.

3 Innovative Digital Techniques that Improve MOOC Completion Rates

3.1 Storytelling

In week 0 learners are introduced to Otto, the mad scientist. This character was created as a constant presence in the MOOC that will follow the learners during the whole course. The story goes as follows: the learners are asked to help Otto in his quest. He needs to go back home, to the future in the year 2080… Otto has been travelling through time and is now stuck in the present time because his time travel machine is broken. The learners are then asked to complete all the different activities so they can help him to fix the time travel machine. By learning the different technologies of today's transport sector they will access the reboot code that will allow Otto to fix the time travel machine and go back home.

Short videos (between 1 min and 1 min 30 s) of Otto were created that explained the situation. At the beginning of each week's activities Otto would explain to the learners what the activities were about and at the end of the week he would give a closing speech. If the learner had successfully achieved all the assignments of the week, he would receive a reboot code. To help Otto go back home, the learners needed to fill in all four reboot codes in a specific section (Fig. 1).

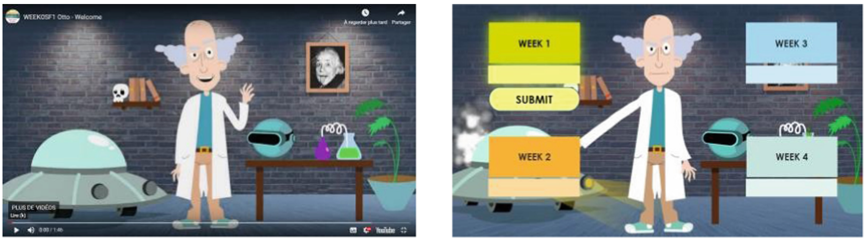

Fig. 1. Otto: the mad scientist & the reboot code section

To our biggest surprise, the character was amazingly well received by the audience. Numerous comments in the forums from participants asked questions to solve the activities of the MOOC "because they really wanted to help Otto get back home".

3.2 Enigmas

Every week Otto presented some enigmas at a fixed time (on Tuesday at 11am and Fridays at 6pm). The goal of these enigmas was to create a community and to provide some fun activities to keep up the motivation whilst learning about modern day technologies. A price was offered to the 3 quickest people who answered the enigmas (See the Sketch note section for more information on the price) (Fig. 2).

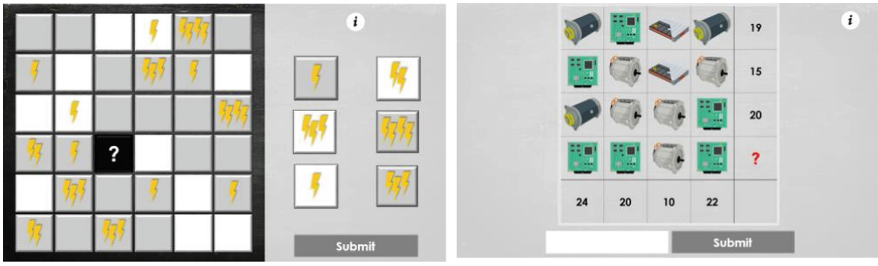

Fig. 2. Example of Enigmas

Additionally, some of the announcements were signed by Otto, and he would answer some specific questions in the dedicated forums. Otto became a friendly participant during the MOOC that generated some kind of affection for a certain number of the participants. For some types of learners it is important to be a part of a community in order to improve their learning experience. In our opinion, Otto helped to create a special relationship that was highly appreciated and created a lot of motivation and involvement for our learners.

It is important to highlight that there are more than 1300 persons (26% of the total participants) who participated in the 8 enigmas presented throughout the MOOC. Even though there is no scientific proof of the influence of the storytelling created around Otto improves the completion rate, in our opinion it had a positive influence on learner motivation.

3.3 Sketch Notes and Augmented Reality

Another digital innovation that was brought to this MOOC was the use of Sketch notes with augmented reality as a conclusion slide for each video. For all video-lectures, we chose to use a flat graphic design. Each video-lecture would finish by summarizing the main ideas explained. These summary or conclusion slides were done using sketch notes: the goal was to reinforce the learning process of those key points by using different graphic designs. The background color used for each conclusion or sketch note was chosen by subject. In the following figure you can see a few examples (Fig. 3).

Fig. 3. Sketch notes as conclusion slide for video-lectures. (Color figure online)

All of the sketch notes were gathered in a book called the “Mobilibook”. In each sketch note an augmented reality code was attached. The application for the augmented reality used is called Zappar (www.zappar.com). When used, it gives you access to either the video or handout associated to the video. In a way, with the “Mobilibook” you are able to hold all the content of a MOOC in one physical resource that you can carry around. This book was the price given to the participants that won Otto’s enigmas.

3.4 Serious Games

As was mentioned before, as an applied engineering school it was important for us to implement a “learning-by-doing” approach. Within this MOOC, that means to improve interaction and to develop an environment where the students can experiment and practice the skills learnt from the lessons. The mini games and serious games were first developed to address this issue.

The time needed to complete the exercises proposed is variable depending on the pedagogical goals. The serious games could be played an unlimited number of times. By increasing the number of times the learners play, we can ensure a better understanding of the concepts behind. It is specially the case for the electric powertrain design: first, the learners need to design each component independently, then, they are asked to define the whole system and they can see first-hand the interactions between the components.

By analyzing the answers from the initial and final survey: 54% of participants say that the serious games helped improve their comprehension, 38% say that the serious game improved their course interest. Since these two populations are mutually exclusive (only one answer was possible), it means that for 92% of the participants surveyed, the serious game had a positive impact on their learning process. This feedback confirms our previous experiences using serious games (Fig. 4).

Fig. 4. Some examples of the serious games and mini games used during the MOOC

In the graph bellow you can see the dropout rate of participants in the different activities. First, out of the 4981 people that enrolled, only 2562 (or 51%) actually log on at least once in the platform. Only 41% of the participants started the activities in the 1st week. We can see the usual dropout rate at the beginning of the courses, so only 27% of the participants started week 2. After that, 22% of the participants started the activities of week 3, 21% started the activities of week 4 and finally, 20% of the participants were certified. The results show that 3 out of 4 persons that start doing the activities in week 2 obtained the certificate.

Much research has shown the benefits of games in academic teaching. We believe that is also has an impact on the learner's motivation hence on the completion rate (Fig. 5).

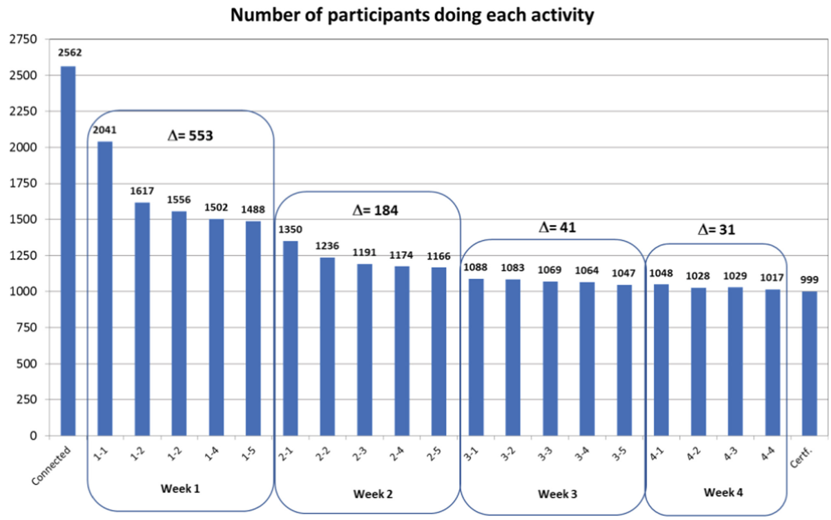

Fig. 5. Dropout rate during the MOOC

3.5 Serious Escape Game

To continue to test digital techniques in the field of learner's motivation, in our next MOOC we will implement a Serious Escape Game in a virtual environment. In a traditional escape game, you are locked up in a room and you have 60 min to go out. A Serious Escape Game uses the same gaming mechanisms and includes learning objectives.

The idea is to test a Serious Escape Game in our next MOOC at a scale of 5000 participants. We will put emphasis on the storytelling approach used with Otto by using 4 virtual 3D environment. The idea is, by using video gaming mechanisms and storytelling, it will increase both motivation and completion rate. From the introduction week, a 3D adventure will be included in the traditional MOOC's lectures (video, mini-games, enigmas) (Fig. 6).

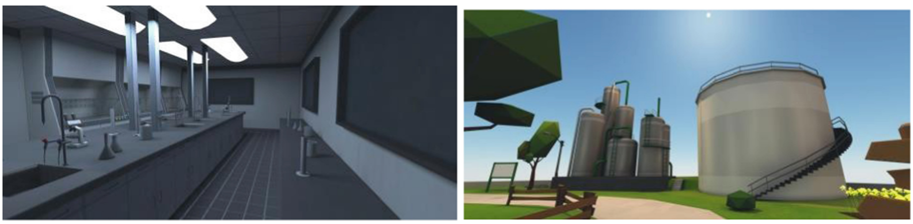

Fig. 6. Serious Escape Game

3.6 Other Contributing Factors: The Choice of the Platform "RiseUp"

A MOOC is a rather complex object to create. You must coordinate multiple actors (teachers, project managers, video producer, platform, etc.) and provide the opportunity for the learners to fully own the learning experience. A school faces unpredictable complex behaviors inside a project such as a MOOC. It is essential the platform choice meets all the project's ambition. The most important features are: broad capabilities and ergonomic.

The Software

MOOC creators generally tend to focus on one or two criteria when choosing a platform, to be fully SCORM capable or to have a great administration system with solid statistical reporting.

But, it is only required for administrative needs. The learners will use the platform in unpredictable ways. Hence, the platform must be able to handle a wide variety of functionalities. In the end, the platform needs broad reaching capabilities, activated by default, in which people can freely interact with the content or with other learners.

Also, it is important the platform has: a low-cost configuration, either in terms of pure cost or energy and time spending. It must be an easily mastered sandbox. The IFP School team was able to learn the ins and outs of the platform, being creative and building innovative solutions. It would be complicated if for every development the RiseUp Software Engineer had to intervene.

A Flexible Approach Oriented to Problem Solving

No matter how good the technology is - problems and hurdles are unavoidable. Based on that reality, when approaching this new project, the Lean and Design Thinking inspired principles were applied. They help by having the user's interests as a compass, for decision making throughout the project.

When problems arise, it's easy to make decisions that will put the least amount of constraints on the team. However, it is important to have the users in mind, a user centric approach is essential in the decision making process.

Furthermore, iterations are part of the process. It is uncomfortable, but it will enhance the project's quality.

Finally, the client must be at the core of the platform's choice. A flexible solution with a flexible mindset are mandatory.

4 Comparative Analysis of All IFP School MOOCs

In the table below a comparative analysis of all the MOOCs produced by IFP School since 2014 is presented in the fields of Mobility and Oil&Gas. The first MOOC on Mobility (called Sustainable Mobility) was opened in three editions in 2014, 2016 and 2017. The MOOC on Oil&Gas was opened in three editions as well in 2015, 2016 and 2017. The newest MOOC on Mobility* (called Tomorrow's Mobility) was opened for the first time in 2018 with a renew content and activities. The cross marks represent the activities introduced in each edition.

The difficulty is ranked here as well. Little modification is usually added to the content when re editing a MOOC. For the last edition of Oil&Gas MOOC (2017), an additional test was included to award a skill in a specific domain that the participants were asked to choose. This extra test increases the difficulty for this last edition.

Table 3 helps us identify some key parameters:

1- The use of serious games and mini games is one main parameter to engage participants and improve motivation.
2- The use the tutorial system seems to add little value for the completion the rate.
3- As the content's difficulty increases, the chances for a high completion rate decreases.
4- Story telling techniques and the sketch notes seem to enable a high completion rate when the course difficulty is increased.

Table 3. IFP School MOOCs activities

MOOC	Total enrolled	Compl. rate	Serious games	Mini game	Tutorial system	Enigmas	Difficulty	Story telling	Book & Sketch notes
Mobility 2014	3099	32%	X				+		
Oil&Gas 2015	24491	31%		X			+		
Mobility 2016	5205	33%	X		X		+		
Oil&Gas 2016	21049	28%		X	X		+		
Mobility 2017	5739	27%	X		X		+		
Oil&Gas 2017	21840	19%		X	X		++		
Mobility 2018*	4981	20%	X	X	X	X	+++	X	X

5 Conclusions

By creating MOOCs, IFP School continues to study and try, in a pragmatic approach, using different mechanisms in order to introduce and maintain the learner's motivation. After Serious Games, improved quizzes, mentoring and enigmas, we have tested the storytelling approach, augmented reality implementation and the interactive sketch notes within our latest *'Tomorrow's Mobility'* MOOC. All these experiences helped in maintaining a high completion rate of 20%.

With the information available, it is extremely difficult to produce a scientific demonstration to identify the key parameters that improve completion rate. A true comparison would be to re-edit the MOOC without all the elements that help improve learner's motivation and compare the completion rates from both experiences to isolate the impact of these elements. This experience has not been carried out and is highly unlikely that it will.

Finally, for IFP School, MOOCs are an opportunity to test digital techniques, and learn from it. It is also a way to promote our educational approach. Indeed, the “from the field” experiences are a key element. Without forgetting that the technologies tested during the MOOCs lead to our master programs enhancement.

Acknowledgements. The authors will like to thank all the IFP School faculty team, as well as IFP Training and VEDECOM for their participation in this project. We also thank aPi learning and RiseUp for their technical support. We also thank Beatrice Lhuillier for her sketch notes production for this MOOC. Finally, we thank all of those who helped and supported us in making this MOOC a success.

References

1. Bernaert, O., Dhorne, L., Crepon, R.: MOOC and serious game. An educational approach on transfer and action. In: 43 Annual SEFI Conférence, Orléans, Juillet 2015
2. Guo, P.J., Kim, J., Rubin, R.: How video production affects student engagement: an empirical study of MOOC videos. In: Proceedings of the First ACM Conference on Learning@ Scale Conference, pp. 41–50, March 2014
3. Jordan, K.: Initial trends in enrolment and completion of massive open online courses. Int. Rev. Res. Open Distance Learn. **15**(1), 133–160 (2014). http://www.irrodl.org/index.php/irrodl/article/view/1651/0
4. Thirouard, M., et al.: Learning by doing: integrating a serious game in a MOOC to promote new skills. In: eMOOC 2015 Conference, Mons, Juin 2015
5. Bulander, R.: A conceptual Framework of serious games for higher education. In: International Conference on e-Business, Athen, Greece, pp. 95–100 (2010)
6. Liu, S., Kang, J.: An overview of game based learning: motivations and authentic learning experience. Tex. Educ. Rev. **2**(2), 157–162 (2014)
7. Tsai, F., et al.: Exploring the factors influencing learning effectiveness in digital game-based learning. Educ. Technol. Society **15**(3), 240–250 (2011)

Author Index