Fidalgo-Blanco *et al. International Journal of Educational Technology in Higher Education* (2016) 13:24
DOI 10.1186/s41239-016-0024-z

International Journal of Educational Technology in Higher Education

RESEARCH ARTICLE Open Access

From massive access to cooperation: lessons learned and proven results of a hybrid xMOOC/cMOOC pedagogical approach to MOOCs

Ángel Fidalgo-Blanco[1*], María Luisa Sein-Echaluce[2] and Francisco José García-Peñalvo[3]

* Correspondence: angel.fidalgo@upm.es
[1]Department of Geological and Mining Engineering, School of Mining and Energy Engineering, Technical University of Madrid, Ríos Rosas, 21, 28003 Madrid, Spain
Full list of author information is available at the end of the article

Abstract

The low completion rate for Massive Open Online Courses (MOOCs), averaging 10 % across total enrolment, highlights a need for close analysis of the underlying formative model. The methodology used here involves cooperation among MOOC participants to introduce new resources through social networks and the integration of these resources with previous teacher materials. The paper describes two MOOCs on distinct topics using this methodology and implemented on the same platform. The observed outcomes indicate increased completion rates for both courses as compared with other MOOCs developed on the same platform. Additionally, although participants in the two MOOCs differed in profile and personal goals, they reported similar perceptions of the quality of the learning experience, which was influenced by the knowledge management approach developed in the proposed methodology.

Keywords: MOOC, Collaborative learning, Learning communities, Online education, Informal learning, Learning environments, Educational strategies, Case studies, Social networks

Introduction

In 1999, online technologies enabled one of the most important disruptive innovations in education (García-Peñalvo & Seoane-Pardo, 2015), allowing many people to access learning opportunities that would not otherwise have been possible (Weise & Christensen, 2014). The recent emergence of Massive Open Online Courses (MOOCs) represents a major step forward for education. Hundreds of thousands of users access these online learning platforms, with thousands of enrolees in each MOOC and academic offerings from some of the world's most prestigious universities (Sharples et al. 2013).

There is a widespread view that MOOCs are a disruptive innovation with the potential to revolutionize and transform training (DiSalvio, 2012; Harden, 2012; Mazoue, 2013). The social success of MOOCs has emerged alongside open training (open source software and open resources) (Atenas, 2015; Fidalgo-Blanco, Sein-Echaluce, Borrás Gené & García- Peñalvo, 2014; García-Peñalvo, García de Figuerola, & Merlo-Vega, 2010), the growth of social networks and the drive for universal education (Downes, 2012; Yuan &

Powell, 2013). These emerging ideas of change promise mid-term consequences such as new economic models for universities, new models of academic-social accreditation, improvement in the quality of university branding and a tendency towards democratization and improved training for all (Daniel, Vázquez Cano, & Gisbert, 2015).

However, another strand of thought, mainly academic, questions the validity of the MOOC model as transformative for training and learning. This view is based on evidence of low MOOC completion rates, difficulties in verifying the identity of participants, low validity of accreditations, low quality of educational resources, among other issues (Bartolomé-Pina & Steffens, 2015; Zapata-Ros, 2013) and essentially highlights the absence of any clear pedagogical model in this type of training (Aceto, Borotis, Devine, & Fischer, 2014; Guàrdia, Maina, & Sangrà, 2013). In this regard, proposals have been developed for indicators of the pedagogical quality of MOOCs. These specify dimensions that include pedagogical approach, tutorial activity, evaluation, user experience, motivation and resources (Alemán, Sancho-Vinuesa, & Gómez Zermeño, 2015), planning and management, learning design and communication/interaction (Guerrero, 2015).

Transformer of training or education bubble, new learning or marketing model (Cabero, 2015; Salzberg, 2015)—whatever one's view, MOOCs feature prominently in conferences and scientific journals (Chiappe Laverde, Hine, & Martínez Silva, 2015; Jacoby, 2014; Martínez Abad, Rodríguez Conde, & García-Peñalvo, 2014), with huge interest in acquiring reliable data to better understand the MOOC phenomenon and its possible impact on learning strategy.

As noted above, one of the most negative aspects of MOOCs is the low completion rate; according to various studies, this varies between 5 and 15 % (Belanger & Thornton, 2013; Jordan, 2013). Although there are other definitions of "completion" (Jordan, 2013), for present purposes, the term is taken to mean completion of specified activities that enable participants to obtain a certificate. This cannot be interpreted as a direct indicator of MOOC quality, but it is not the main reason for criticism of underlying model. The failure is often attributed to MOOC methodology, to the theme, to the heterogeneity of participants, to massification or to the curiosity aroused in people who have no real intention of taking the course (Aguaded Gómez, 2013). The most characteristic features of MOOCs—massification, heterogeneity and the absence of a tutor, differ entirely from online academic training, and these extreme training characteristics present greater difficulties for the design of MOOCs than for other online courses (Fidalgo-Blanco, García-Peñalvo & Sein-Echaluce, 2013).

The two main types of MOOCs are xMOOCs and cMOOCs. While xMOOCs are instructivist and individualist, use classic e-learning platforms and are based on resources, cMOOCs are connectivist and are based on social learning, cooperation and use of web 2.0 (Castaño Garrido, Maiz, & Garay Ruiz 2015; Downes, 2012, Fidalgo-Blanco, Sein-Echaluce & García-Peñalvo, 2015b). Technologies for xMOOCs (X platforms) offer classic learning (e.g. Coursera, MiriadaX) and focus on improving technologies rather than pedagogical models (Zapata-Ros, 2013).

Technologies based on social software, such as social networks (C platforms), enable new ways of learning. In that sense, Adell and Castañeda (2010) suggested that social networks have directed our attention to informal learning, which occurs outside the institution or classroom.

Table 1 summarises the main features of formal, informal and non-formal learning in relation to the environment in which it occurs, the existence or otherwise of learning planification and training structure (objectives, duration, or educational resources), the intentionality of the learner and the course's accreditation (CEDEFOP 2014; Muñoz, 2016).

Given the blurred boundary between these types of learning when it comes to virtual learning (Adell & Castañeda, 2010; García-Peñalvo & Griffiths, 2014; Griffiths & García-Peñalvo, 2016), the present research examines MOOCs as non-formal training that enhances informal learning through social interactions in practical communities and social networks. Llorens and Capdeferro (2011) showed that social networks promote informal learning, in turn enabling knowledge construction and skills development. This also offers individuals a user-managed approach to open and cooperative learning. Beyond the interaction between students (Gros Salvat 2007), the cooperative model has been shown to be superior to other educational approaches based on competitiveness. This is especially the case in respect of academic performance, higher order thinking, knowledge generation and transfer of ideas to different contexts (Barkley, Major, & Cross 2014; Bauerova & Sein-Echaluce, 2007).

With due regard to all the above concerns, the objective of this paper is to propose a new pedagogical model for MOOCs, supported by empirical investigation of questions related to dropout rate, including the following. What MOOC factors exert greater influence on dropout rate: participant profile or the underlying model? Are current models valid or should more specific models be generated? Does cooperation affect completion rates? Can MOOCs be made sustainable over time?

The proposed hybrid pedagogical model incorporates cooperation to create knowledge sharing among participants and combines characteristics of xMOOCs and cMOOCs. An analysis is presented of the model's impact on perceptions of learning and cooperation in two real cases. The following section describes the research method and the proposed pedagogical model.

Method

Hybrid pedagogical model: xMOOC/cMOOC

The proposed model is based on the use of an X platform (for e-learning) and a C platform (e.g. a social network), combining formal and non-formal learning activities (in the X platform) with informal learning (in the C platform) and cooperation among participants to generate a continuous flow of knowledge between platforms.

Cooperation is a pedagogical resource that directly involves participants and reduces MOOC dropout rate, focusing on three dimensions described by Suárez Guerrero (2010):

Table 1 Characteristics of formal, informal and non-formal learning

Learning	Environment	Planning	Training structure	Intentional	Academic certificate
Formal	Classroom in regulated institution	YES	YES	YES	YES
Informal	Out of classroom (work, family, leisure, etc.)	NO	NO	NO	NO
Non-formal	Classroom in non-regulated institution	YES	YES/NO	YES	NO

1. Measured achievement: here, the rate of participants who successfully complete the course and fulfil their objectives;
2. Social integration: promotion of relationships through participation in the social network (the social component of the MOOC);
3. Personal development: here, the achievement of learning objectives by combining course content with cooperative interaction, as structured and defined by faculty.

The flow of knowledge resources generated in the model is based on the following steps (see Fig. 1).

1. The teaching team adds learning resources to the X platform (e.g. e-learning platform) or to the C platform (e.g. social network). These resources can also be provided by professionals in the sector.
2. MOOC participants generate new resources and add these to the C platform, both through activities planned by the teaching team on the X platform and during social network use. The teaching team may choose to incorporate these to enrich the available resources on the X platform before commencing the MOOC, which can be simultaneously added to C platforms.

In this way, cooperation creates a continuous flow of knowledge between the X and C platforms. The more varied the resources generated, the more effective they become, enhanced by the massification and heterogeneity of MOOC participants Two case studies using this model are described below.

Cases

The present study is based on case studies of two MOOCs implemented on the MiriadaX platform (MiríadaX 2015), providing data for comparison of completion rates against the average for MiriadaX MOOCs. These data were obtained from MiriadaX, based on its own criteria, and from a survey of participants to assess their satisfaction with the learning experience.

Case 1. MOOC Free Software and Open Knowledge (FS&OK). *Objectives*: Training in the concepts and components of free software and open knowledge; participation in the free software movement (training to create open knowledge in blogs and wikis); provision of criteria and recommendations for application of course themes in

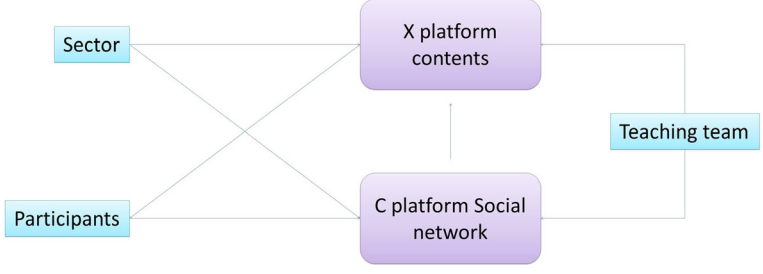

Fig. 1 Flow of resource creation for the proposed hybrid model

different contexts. *Duration*: 6 weeks (12 March–23 April 2013). *Composition*: Five modules, the first of which is the presentation. *Platform*: MiriadaX.
Case 2. MOOC Applied Educational Innovation (AEI). *Objectives*: Identification and relation of the components of educational innovation; learning about the latest methods and techniques for educational innovation in daily teaching. *Duration*: Six weeks (6 March–10 April 2014). *Composition*: Six modules, the first of which is the presentation. *Platform*: MiriadaX.

With regard to technology, MiriadaX was used as the X platform in both cases; the C platform differed in each case.

- Case 1. Four social networks (Linkedin, Elgg, Identi.ca and Twitter) and a wiki were used to organize and integrate results from the learning community with course educational resources.
- Case 2. Using the social network Google+, the following resources were integrated and organized: results from the learning community, some teaching resources from the course and a blog to provide an element of reflection.

The applied learning strategy was identical in both cases: integration of non-formal learning activities (i.e. not regulated courses) in MiriadaX with informal learning activities in the social network, generating a flow of knowledge among participants, faculty and professionals from the sector. In this sense, each module involved a linked spiral of between 2 and 6 groups of non-formal and informal activities.

For the cooperative strategy, resources generated by participants, faculty and industry professionals were integrated in both cases, but there was significant variation between them.

- Case 1. The spiral for each module was continuously created as the course proceeded. The most meaningful content generated in the social network (case studies, discussions, tools) was incorporated into MiriadaX to complement the initial resources (videos, presentations, etc.).
- Case 2. Once the course began, the teaching team not could edit it (a new MiriadaX policy). This affected the flow by including in MiriadaX those resources generated within the social network. Similarly, the wiki was not used to organize content, as the social network Google + enabled better organization of content provided by participants.

Results

Participants' data

The data in Table 2 were obtained from the MiriadaX platform and a survey administered to participants in each MOOC. These data reflect the heterogeneous profiles within each course in terms of participants' age, origin, profession, learning preferences and academic level.

In both cases, participation by country is similar, but there are very significant differences between cases on the remaining input variables. One possible explanation for this

Table 2 Entry data of participants in MOOCs FS&OK and AEI

Case 1. FS&OK		Case 2. AEI	
Number of enrolees	3,754	Number of enrolees	6,149
Completed surveys	1,708	Completed surveys	3,236
Gender		Gender	
Male	72.04 %	Male	58.03 %
Female	27.96 %	Female	41.97 %
Country. Top 7		Country. Top 7	
Spain	60.29 %	Spain	55.62 %
Colombia	8.56 %	Mexico	10.35 %
Mexico	7.04 %	Colombia	7.69 %
Peru	6.62 %	Peru	5.62 %
Argentina	3.16 %	Argentina	3.71 %
Venezuela	2.73 %	Venezuela	2.69 %
Bolivia	1.76 %	Brasil	2.44 %
Job		Job	
Teacher	11.18 %	Teacher	50.40 %
Student	21.20 %	Student	21.82 %
No activity	22.05 %	Non-teacher	27.78 %
Various	45.57 %		
Learning interest in FS&OK (multiple options)		Learning interest in AEI (single option)	
• To gain basic knowledge	36.71 %	• To gain basic knowledge	16.01 %
• To apply to studies	42.21 %	• To apply in other contexts	53.92 %
• To apply in a job context	63.64 %	• To gain a new perspective	24.07 %
• To apply in an organization	25.06 %	• To obtain course materials	6 %
• To publish in open access	18.68 %		
Qualification		Qualification	
Primary	1.47 %	Primary	0.34 %
Secondary	25.06 %	Secondary	5.62 %
University	28 %	University	52.75 %
Post-university	13.94 %	Post-university	31.15 %
Vocational	31.54 %	Vocational	10.14 %
Age		Age	
< 20	4.21 %	<20	0.88 %
20–29	39.88 %	20–29	30.47 %
30–39	30.61 %	30–39	31.12 %
40–49	18.54 %	40–49	24.23 %
50–59	5.91 %	50–59	11.30 %
> 60	0.85 %	>60	2 %

effect is that while FS&OK has a technological theme (free software), AEI's focus is social (educational innovation). This may explain why FS&OK attracted more male participants (72.04 %) than AEI (58.03 %). In relation to profession, 50.40 % of participants in AEI were teachers, as against 11.18 % for FS&OK. With regard to qualifications, 13.94 % of FS&OK participants were postgraduates, as against 31.15 % for AEI. As to educational interests, 53.92 % sought to apply AEI in any context while 63.64 % of FS&OK participants (even those marking several options) hoped to apply what they learned to their work, 42.21 to their studies and 25.06 % to their organisation.

There was a marked difference in the number of enrolees, with 3,754 in FS&OK and 6,149 in AEI. Curiously, while the primary AEI stakeholders would be teachers, 21.82 of participants were students and 27.78 % were non-teachers.

Two information sources were used to compare the two cases: results from the platform itself (completion rates and dropout trend) and results of a satisfaction survey in both cases.

Completion rates and dropout trend

Using MiríadaX statistics, Table 3 shows completion rates for total enrolment, the number of participants who entered the course at least once and the number who started at least the first training module. Similarly, Table 3 includes the average rate of completion, for total enrolment in MiriadaX international MOOCs.

The main indicator generally used as a standard measure of a MOOC's success is the completion rate for enrolees on the X platform. The global rate ranges from 5 % to 15 % (Jordan, 2013). The rate for MiriadaX MOOCs is in the upper part, with 13.47 in April 2013 (for 58 courses) and 13.95 % in February 2014 (for 121 courses). For both cases presented here, completion rates are very similar at 27.8 and 28.2 % (see Table 3) roughly double the average rate of completion for other MiriadaX MOOCs.

The most significant difference between the two cases relates to participation in social networks in terms of total enrolment in the course (28.3 for FS&OK and 32.2 % for AEI). The FS&OK course allowed participants to use several C platforms, which caused some dispersion. In contrast, AEI offered only one C platform, leading to increased involvement.

Figures 2 and 3 show dropout patterns, reflecting participation of enrolees in both MOOCs at the beginning of each module. In both cases, there is dropout relative to number of modules and elapsed time. Figures 2 and 3 show that the most significant decline appears in the presentation + module 1. After module 1, the dropout rate decreases considerably, although it remains progressive throughout.

Participant satisfaction

At the end of each case, a satisfaction survey was sent to all students enrolled in either MOOC. This was an adaptation of the Student Evaluation of Educational Quality (SEEQ) questionnaire, designed and validated by Marsh and Roche (1997). Tables 4, 5 and 6 show the results for questions measuring participation level, learning perception and cooperation level, respectively, for C platforms included in each course.

Table 3 Completion and participation rates for FS&OK and AEI MOOCs

	Case 1 FS&OK	Case 2 AEI
Enrolled in the course	3,754	6,149
Percentage completion among enrolees on X platform	27.8 %	28.2 %
Percentage completion among all who watched the presentation on X platform	45.7 %	46.4 %
Percentage completion among all who started training modules on X platform	54.4 %	53.7 %
Percentage participation on C platforms among enrolees on X platfom (C platforms data)	28.3 %	32.8 %

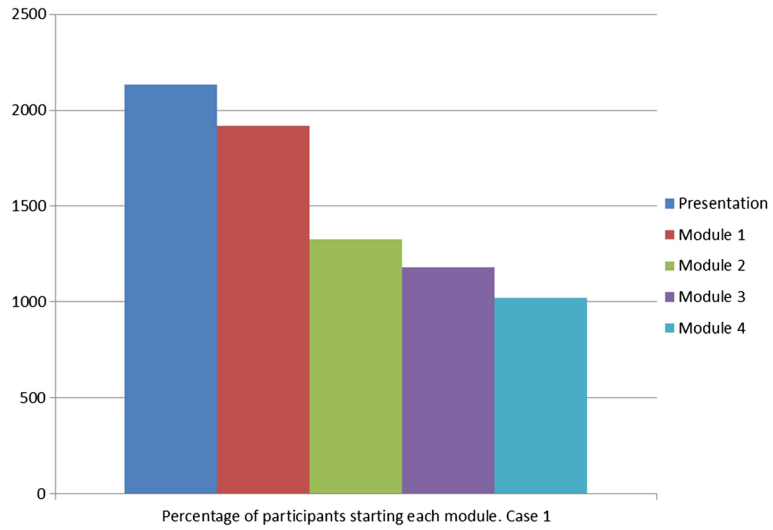

Fig. 2 Dropout pattern during implementation of the MOOC Free Software and Open Knowledge (case 1)

Percentage survey completion is similar in both cases (17.20 and 17.08 %). Likewise, the results for participation level in each MOOC (from "no participation" to "very regularly") are also almost identical (see Table 4).

Table 5 includes answers to questions about participants' perceptions in terms of their learning and interests (5-point Likert scale, from 1 = *strongly disagree* to 5 = *strongly agree*). For example:

Q1. I have learned and understood the contents of the course;

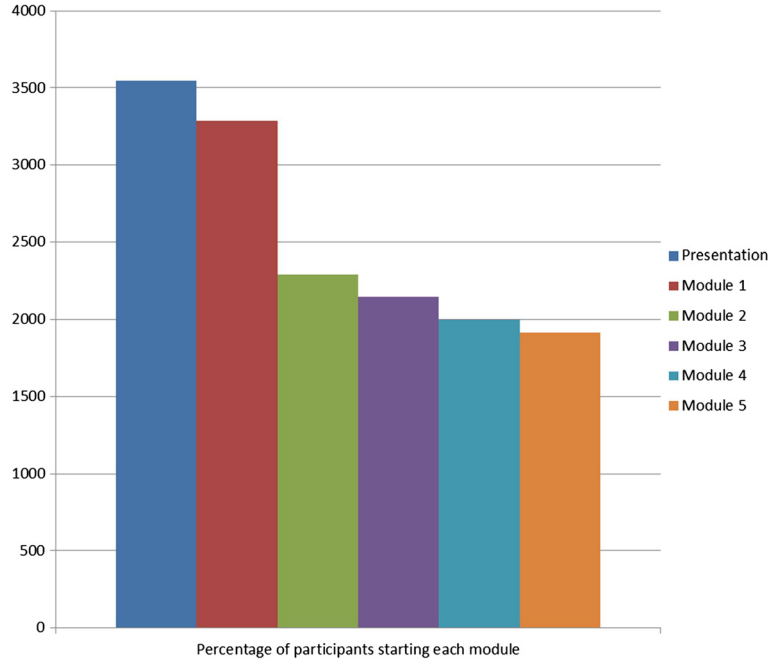

Fig. 3 Dropout pattern during the implementation of the MOOC Applied Educational Innovation (case 2)

Table 4 Participation on C platforms

Participation data	Case 1 (FS&OK)	Case 2 (AEI)
Number of enrolees	3,754	6,149
Completed surveys/(percentage of enrolees)	641/17.20 %	1,050/17.08 %
Participation level in cooperative activities (based on completed surveys)		
No participation	3 %	3 %
Low participation	10 %	10 %
Regular participation	27 %	27 %
Rather regular participation	33 %	32 %
Very regular participation	27 %	28 %

Q2. I have learned things that I consider valuable;
Q3. My interest in the topics covered has increased with the course.

Table 6 includes answers to questions about cooperation grade in the social networks used for course activities for each MOOC (5-point Likert scale, from 1 = strongly disagree to 5 = strongly agree):

Q36/Q44. Q36 (FS&OK) I have cooperated with other participants in the proposed activities. Q44 (AEI) I have participated in the suggested social networks.
Q38 (FS&OK)/Q51 (AEI). Sharing resources and interacting through social networks improve learning.
Q39 (FS&OK)/Q52 (AEI). Sharing resources and interacting through social networks improve initial course resources.

The results are again almost identical, with percentage differences of less than 1 % in all cases. The results for similar questions Q36/Q44 indicate that participation was similar in both cases. Regarding Q38, 85 % of FS&OK participants and 53 % of AEI participants believed that their learning had improved somewhat or a lot (Likert values 4 or 5). For Q39, 78 % of participants in FS&OK thought that cooperation had influenced their learning a lot or enough (5 or 4), as against only 54 % in AEI. The better results for FS&OK reflect the availability of significant resources, created cooperatively in social networks, for inclusion in MiriadaX, which was not the case for AEI.

Final resources

Finally, this methodology generates two products: a learning community and a space where the generated resources are organized.

Table 5 Perception of learning

Likert	Q1 (FS&OK)	Q1 (AEI)	Q2 (FS&OK)	Q2 (AEI)	Q3 (FS&OK)	Q3 (AEI)
1	0.30 %	0.10 %	0.15 %	0.29 %	0.31 %	0.48 %
2	0.77 %	0.67 %	0.92 %	1.43 %	1.39 %	2.10 %
3	6.03 %	7.24 %	7.59 %	7.05 %	10.53 %	9.62 %
4	39.93 %	39.71 %	32.82 %	33.33 %	32.82 %	33.43 %
5	52.94 %	52.00 %	58.51 %	57.90 %	54.95 %	54.38 %

Table 6 Cooperation results

Likert	Q36 (FS&OK)	Q44 (AEI)	Q38 (FS&OK)	Q51 (AEI)	Q39 (FS&OK)	Q52 (AEI)
1	14.09 %	14.29 %	1.55 %	9.10 %	1.08 %	8.42 %
2	15.48 %	16.57 %	1.55 %	13.00 %	1.70 %	12.02 %
3	23.84 %	25.90 %	11.76 %	24.80 %	12.38 %	25.75 %
4	26.78 %	24.67 %	37.62 %	30.10 %	35.45 %	30.86 %
5	19.81 %	18.57 %	47.52 %	23.00 %	49.38 %	22.95 %

Case 1 (*FS&OK*). Learning community from Linkedin and Twitter; Wiki acts as the storage space for resources generated during the course.
Case 2 (*AEI*). Learning community and organization of resources in Google+; this social network allows combination of tags with categories to index all resources created before and during the course.

In both cases, social networks continued to grow independently. In the case of FS&OK, from April 2013 (when the course ended) to November 2015, LinkedIn has grown from 698 to 1100 participants and Twitter from 200 to 456. Two editions of AEI have been implemented. In April 2014 (when the course ended), the learning community had 2,107 participants, increasing to 10,889 in November 2015. About 3,700 participants came from the two editions of AEI, and about 7,100 have been included in the learning community in various ways. The learning community and generated resources have proved useful and efficient for use both during the MOOC and afterwards.

Discussion

With respect to the research questions, these results suggest that MOOC completion rate relates more to methodology than to the platform, theme or profile of enrolled participants. In both study cases, the proposed hybrid methodology produced very similar results (i.e. participation and completion rates) and doubled the completion rate for MiriadaX MOOCs (Table 3). This effect was independent of the input variables (i.e. heterogeneous profiles, Table 1) and supports other claims about the influence of course design and social relations on completion rate (Sánchez-Vera, León-Urrutia, & Davis, 2015). To that extent, it justifies the generation of models adapted to particular features of MOOCs and addressing their shortcomings (Zapata-Ros, 2013).

These two distinct study cases show that the highest dropout rate occurs after the first module and then stabilizes to the end of the course (regardless of the number of modules). This suggests that the number of dropouts decreases as cooperation level increases. Furthermore, collaboration is not confined to shared resources—in fact, the creation of knowledge sharing underlies the collaborative strategy (Fidalgo-Blanco, Sein-Echaluce, & García-Peñalvo 2015a). This is performed through the interaction and integration of learning resources between X and C platforms, significantly influencing cooperation and completion rates (Suárez Guerrero 2010).

The proposed hybrid model can be said to have generated sustainable resources during MOOC implementation and subsequently through social networks. Llorens and

Capdeferro (2011) noted that social networks that include learning guides and facilitators can support lifelong learning. In the FS&OK case only, the transfer of resources generated by participants from the social network to MiriadaX positively influenced both the participation level in C platforms and participants' perceptions of the influence of cooperation on their learning.

Limitations

Some weak points were detected in the model, and the research team is addressing these in light of previous experiences.

- *High rate of commencing participants who drop out after the first module* (*54.4 and 53.7% in FS&OK and AEI, respectively*). This may be related to the heterogeneity of participants' profiles; if, after the first module, they detect the absence of learning resources and objectives appropriate to their learning style and other characteristics, they may drop out. This explanation finds support in the low dropout rate from the second module. The requirement is to prove that an X platform, adapted to the differing profiles and interests of MOOC participants, can reduce the dropout rate.
- *Difficulty in managing flows of knowledge in learning cooperatively*. It has been shown that the flow of cooperatively created knowledge between platforms affects perceptions of learning outcomes. However, social networks do not facilitate the organization of resources cooperatively generated by participants. This difficulty increases in attempting to organize resources between X and C platforms. Future research must focus on how best to use knowledge management systems in MOOCs to classify and organize resources, as well as to facilitate search and subsequent implementation.

Acknowledgements

We would like to thank the support of the Government of Aragon, the European Social Fund and the Ministry of Education of the Region of Castilla-León for their support, as well as the research groups (LITI, http://www.liti.es; GIDTIC, http://gidtic.com and GRIAL, http://grial.usal.es).

Authors' information

Ángel Fidalgo-Blanco is Director of the Laboratory for Innovation in Information Technology at the Polytechnic University of Madrid and has participated actively as principal investigator in R&D projects. He has organised seminars and conferences over many years and is currently President of the organising committee for the International Conference of Learning, Innovation and Competitiveness (CINAIC, Spanish abbreviation). His work as an active researcher in educational innovation, knowledge management, educational technologies and educational communities based on social networks has generated numerous publications and information products.

María Luisa Sein-Echaluce is Director of Virtual Campus and Professor of Applied Mathematics in the School of Engineering and Architecture at the University of Zaragoza. She is principal researcher in the "Research and Innovation Group in Training supported by Information and Communication Technology" (GIDTIC, Spanish abbreviation). She is President of the Scientific Committee of the International Conference of Learning, Innovation and Competitiveness (CINAIC, Spanish abbreviation) and sits on evaluation committees for calls for local innovation projects and for international conferences. Her research currently focuses on the application of technologies to cooperative methodologies and usage of Open Source LMS and other tools for online adaptive learning.

Francisco José, García-Peñalvo completed his undergraduate studies in Informatics at the University of Salamanca and the University of Valladolid and his PhD at the University of Salamanca. He is head of the GRIAL research group (Research Group on Interaction and eLearning). His main research interests include eLearning, Computers and Education, Adaptive Systems, Web Engineering, Semantic Web and Software Reuse. He has led and participated in more than 50 research and innovation projects and was Vice Chancellor Innovation at the University of Salamanca between March 2007 and December 2009. He has published more than 300 articles in international journals and conferences and has been guest editor of several special issues of international journals, including *Online Information Review*, *Computers in Human Behaviour* and *Interactive Learning Environments*. He is also a member of the program committee of several international conferences and is a reviewer for several international journals. He is currently coordinator of the Education in Knowledge Society PhD Programme at the University of Salamanca.

Author details
[1]Department of Geological and Mining Engineering, School of Mining and Energy Engineering, Technical University of Madrid, Ríos Rosas, 21, 28003 Madrid, Spain. [2]Department of Applied Mathematics, School of Engineering and Architecture, University of Zaragoza, María de Luna, 3, 50018 Zaragoza, Spain. [3]Department of Computer Science, Faculty of Science, University of Salamanca, Plaza de los Caídos s/n, 37008 Salamanca, Spain.

Received: 27 November 2015 Accepted: 30 March 2016
Published online: 29 June 2016

References

Aceto, S., Borotis, S., Devine, J., & Fischer, T. (2014). *Mapping and Analysing Prospective Technologies for Learning*. Sevilla, Spain: Joint Research Centre, Institute for Prospective Technological Studies.

Adell, J., & Castañeda, L. (2010). In R. En Roig Vila & M. Fiorucci (Eds.), *Personal Learning Environments (PLEs): a new way of understanding learning*.

Aguaded Gómez, J. I. (2013). The MOOC Revolution: A New Form of Education from the Technological Paradigm? *Comunicar, 41*, 7–8.

Alemán, L. Y., Sancho-Vinuesa, T., & Gómez Zermeño, M. G. (2015). Indicators of pedagogical quality for the design of a Massive Open Online Course for teacher training. *RUSC. Universities and Knowledge Society Journal, 12*(1), 104–119. http://dx.doi.org/10.7238/rusc.v12i1.2260.

Atenas, J. (2015). Model for democratisation of the contents hosted in MOOCs. *RUSC. Universities and Knowledge Society Journal, 12*(1), 3–14. http://dx.doi.org/10.7238/rusc.v12i1.2031.

Barkley, E. F., Major, C. H., & Cross, K. P. (2014). *Collaborative learning techniques: A handbook for college faculty* (2nd ed.). San Francisco, CA, USA: Jossey-Bass.

Bartolomé-Pina, A. R., & Steffens, K. (2015). Are MOOC promising learning environments? *Comunicar, 22*(44), 91–99.

Bauerova, D., & Sein-Echaluce, M. L. (2007). Online tools and methodologies for cooperative work at university. *Revista Interuniversitaria de Formación del profesorado, 21*, 69–84.

Belanger, Y., & Thornton, J. (2013). *Bioelectricity: A Quantitative Approach. Duke University's First MOOC*. Retrieved from http://dukespace.lib.duke.edu/dspace/handle/10161/6216.

Cabero, J. (2015). Educational visions of MOOC. *RIED, 18*(2), 39–60.

Castaño Garrido, C., Maiz, I., & Garay Ruiz, U. (2015). Design, Motivation and Performance in a Cooperative MOOC Course. *Comunicar, 44*, 19–26. http://dx.doi.org/10.3916/C44-2015-02.

1CEDEFOP. (2014). *Terminology of European education and training policy. A selection of 100 key* (termsth ed.). Luxembourg: Office for Official Publications of the European Communities. Retrieved from www.cedefop.europa.eu/files/4064_en.pdf.

Chiappe Laverde, A., Hine, N., & Martínez Silva, J. A. (2015). Literature and Practice: A Critical Review of MOOCs. *Comunicar, 44*, 9–18.

Daniel, J., Vázquez Cano, E., & Gisbert, M. (2015). The Future of MOOCs: Adaptive Learning or Business Model? *RUSC. Universities and Knowledge Society Journal, 12*(1), 64–74. http://dx.doi.org/10.7238/rusc.v12i1.2475.

DiSalvio, P. (2012). *Pardon the Disruption … Innovation Changes How We Think About Higher Education* (New England Journal of Higher Education). (September). Retrieved from http://www.nebhe.org/thejournal/disruptive-innovation-changing-how-we-think-about-higher-education/.

Downes, S. (2012). *The Rise of MOOCs*. Retrieved from http://www.downes.ca/post/57911.

Fidalgo Blanco, A., García-Peñalvo, F. J., & Sein-Echaluce Lacleta, M. L. (2013). A methodology proposal for developing adaptive cMOOC. In F. J. García-Peñalvo (Ed.), *Proceedings of the First International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'13)* (pp. 553–558). New York, NY, USA: ACM.

Fidalgo Blanco, A., Sein-Echaluce Lacleta, M. L., Borrás Gené, O., & García-Peñalvo, F. J. (2014). Open education: integration of a MOOC with an academic subject. *Education in the Knowledge Society (formerly Revista Teoría de la Educación: Educación y Cultura en la Sociedad de la Información), 15*(3), 233–255.

Fidalgo-Blanco, A., Sein-Echaluce, M. L., & García-Peñalvo, F. J. (2015a). Epistemological and ontological spirals: From individual experience in educational innovation to the organisational knowledge in the university sector. *Program: Electronic library and information systems, 49*(3), 266–288. http://dx.doi.org/10.1108/PROG-06-2014-0033.

Fidalgo-Blanco, A., Sein-Echaluce, M. L., & García-Peñalvo, F. J. (2015b). Methodological approach and technological framework to break the current limitations of MOOC model. *Journal of Universal Computer Science, 21*(5), 712–734.

García-Peñalvo, F. J., García de Figuerola, C., & Merlo-Vega, J. A. (2010). Open knowledge: challenges and facts. *Online Information Review, 34*(4), 520–539.

García-Peñalvo, F. J., & Griffiths, D. (2014). Transferring knowledge and experiences from informal to formal learning contexts. In F. J. García-Peñalvo (Ed.), *Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'14)* (pp. 569–572). New York, USA: ACM.

García-Peñalvo, F. J., & Seoane-Pardo, A. M. (2015). An updated review of the concept of eLearning. Tenth anniversary. *Education in the Knowledge Society, 16*(1), 119–144.

Griffiths, D., & García-Peñalvo, F. J. (2016). Informal learning recognition and management. *Computers in Human Behavior, 55A*, 501–503. doi:10.1016/j.chb.2015.10.019.

Gros Salvat, B. (2007). *Collaborative learning through network* (Revista Aula de Innovación Educativa, p. 162). Retrieved from http://www.grao.com/revistas/aula/162-las-competencias-lectoras-el-aprendizaje-colaborativo-a-traves-de-la-red/el-aprendizaje-colaborativo-a-traves-de-la-red.

Guàrdia, L., Maina, M., & Sangrà, A. (2013). MOOC design principles. A pedagogical approach from the Learner's perspective. *eLearning Papers, In-Depth, 33*(4), 1–6. Retrieved from http://www.openeducationeuropa.eu/en/article/MOOC-Design-Principles.-A-Pedagogical-Approach-from-the-Learner%E2%80%99s-Perspective.

Guerrero, C. (2015). UMUMOOC A proposed teaching quality indicators for conducting courses MOOC. *Campus Virtuales. Revista Científica Iberoamericana de Tecnología Educativa, 4*(2), 70–76.

Harden, N. (2012). The End of the university as We know It. *The American Interest, 8*(3), 1–8. Retrieved from http://www.the-american-interest.com/2012/12/11/the-end-of-the-university-as-we-know-it/.

Jacoby, J. (2014). The disruptive potential of the massive open online course: a literature review. *Journal of Open, Flexible and Distance Learning, 18*(1), 73–85.
Jordan, K. (2013). *MOOC Completion Rates: The Data*. Retrieved from http://www.katyjordan.com/MOOCproject.html.
Llorens, F., & Capdeferro, N. (2011). Facebook's Potential for Collaborative e-Learning. *Revista de Universidad y Sociedad del Conocimiento (RUSC), 8*(2), 31–45. Retrieved from http://rusc.uoc.edu/ojs/index.php/rusc/article/view/v8n2-llorens-capdeferro/v8n2-llorens-capdeferro.
Marsh, H. W., & Roche, L. A. (1997). Making Students' evaluations of teaching effectiveness effective the critical issues of validity, bias, and utility. *American Psychologist, 52*(11), 1187–1197.
Martínez Abad, F., Rodríguez Conde, M. J., & García-Peñalvo, F. J. (2014). Assessing the impact of the term "MOOC" vs "eLearning" in scientific literature and dissemination. *Profesorado. Revista de currículum y formación del profesorado, 18*(1), 185–201. Retrieved from http://www.ugr.es/local/recfpro/rev181ART11.pdf.
Mazoue, J. G. (2013). *The MOOC Model: Challenging Traditional Education* (Educase Review Online). (Jan/Feb). Retrieved from http://er.educause.edu/articles/2013/1/the-mooc-model-challenging-traditional-education.
MiríadaX (2015) https://www.miriadax.net/
Muñoz, J. L. (2016). *Informal learning in training at work. Formación XXI. Revista de Formación y empleo*. Retrieved from http://formacionxxi.com/porqualMagazine/do/get/magazineArticle/2010/12/text/xml/El_aprendizaje_informal_en_la_formacion_en_el_trabajo.xml.html.
Salzberg, S. (2015). How Disruptive Are MOOCs? Hopkins Genomics MOOC Launches. In *June* (Forbes). Retrieved from http://www.forbes.com/sites/stevensalzberg/2015/04/13/how-disruptive-aremoocs-hopkins-genomics-mooc-launches-in-june/#7a6d97e31e3f.
Sánchez-Vera, M. M., León-Urrutia, M., & Davis, H. (2015). Challenges in the Creation, Development and Implementation of MOOCs: Web Science Course at the University of Southampton. *Comunicar, 22*(44), 37–44.
Sharples, M., McAndrew P., Weller M., Ferguson R., FitzGerald E., Hirst T., & Gaved M. (2013). *Innovating Pedagogy 2013*. Open University Innovation Report 2. Retrieved from https://oerknowledgecloud.org/content/innovating-pedagogy-2013-open-university-innovation-report-2.
Suárez Guerrero, C. (2010). *Cooperation as learning social status*. Barcelona, España: Editorial UOC.
Weise, M. R., & Christensen, C. M. (2014). *Hire Education. Mastery, modularization, and the workforce revolution*. Clayton Christensen Institute: EEUU.
Yuan, L., & Powell, S. (2013). *MOOCs and Open Education: Implications for Higher Education*. Cetis Whitepaper, Retrieved from http://publications.cetis.ac.uk/2013/667.
Zapata-Ros, M. (2013). MOOCs, a critical view and a complementary alternative: the individualization of learning and pedagogical support. *Campus Virtuales. Revista Científica Iberoamericana de Tecnología Educativa, 2*(1), 20–38.