Massive Open Online Courses (MOOC) to improve teachers' professional development

Bruno Miguel F. Gonçalves
Universidade de Trás-os-Montes e Alto Douro
bmfgoncalves@utad.pt
António J. Osório
Universidade do Minho
ajosorio@ie.uminho.pt

Abstract

Although the integration of ICT in education is currently on the agenda of educational institutions, it may be difficult to understand the technological progress and the networked society uniquely based on existing learning theories. As a kind of answer to this need, the notion of connectivism has emerged. Connectivism deals with knowledge as something distributed in a network of connections. Considering Massive Open Online Courses (MOOC) as an expression of connectivism, this research attempts to study MOOC as a way to understand the process of professional development of teachers in a connectivist environment. This research adopted Technological Pedagogical and Content Knowledge (TPACK) as a theoretical referential to examine in detail, the process of professional development of teachers in the MOOC context. Through an in-depth study of this process, it was intended to identify the innovations to be introduced into the operation of MOOC in view of improving the professional development of teachers. The results of this research reveal that the process involved in the professional development of teachers in MOOC is quite complex and therefore, determined by a variety of identified dimensions.

Keywords: Connectivism; Information and Communication Technologies (ICT); Massive Open Online Courses (MOOC); Teaching-learning process; Technological Pedagogical and Content Knowledge (TPACK) Model.

Resumo

Embora a integração das TIC na educação esteja atualmente na agenda das instituições educativas, parece ser difícil o entendimento sobre o progresso tecnológico e a sociedade em rede, exclusivamente com base nas teorias de aprendizagem existentes. Como uma espécie de resposta a essa necessidade, surgiu a noção de conectivismo. O conectivismo lida com o conhecimento como algo distribuído numa rede de conexões. Considerando os Cursos Online Abertos e Massivos (MOOC) como a expressão mais generalizada do conectivismo, nesta pesquisa procura-se estudar o MOOC como uma forma de compreender o processo de desenvolvimento profissional de professores num ambiente conectivista. Para a concretização desta pesquisa adotou-se como referencial teórico o modelo TPACK (Technological Pedagogical and Content Knowledge) para verificar detalhadamente o processo de desenvolvimento profissional de professores no contexto de MOOC. Através de um estudo aprofundado deste processo, pretendeu-se identificar

as inovações a serem introduzidas no funcionamento dos MOOC com vista a melhorar o desenvolvimento profissional dos professores. Os resultados desta pesquisa revelam que o processo de desenvolvimento profissional de professores através de MOOC é bastante complexo e envolve uma variedade de dimensões que determinam a sua concretização.

Palavras-chave: Connectivismo; Tecnologias de Informação e Comunicação (TIC); Cursos Online Abertos e Massivos (MOOC); Processo de ensino-aprendizagem; Modelo TPACK (Technological Pedagogical and Content Knowledge).

Introduction

The need for teachers to acquire competences in the field of Information and Communication Technologies (COM, 2014; UNESCO, 2008), particularly regarding the integration of technologies in the teaching-learning process (COM, 2014; UNESCO, 2008), and in order to create conditions for the exercise of the teaching profession and, consequently, for the improvement in the quality of the teaching-learning process has raised the following research question: What are the innovations to be introduced in the functioning of MOOC in order to better adapt them to the professional development process of teachers? Thus, it was considered important to investigate the process of teacher development mediated by technologies, in this case with MOOC, because in the field of teacher training one of the problem areas that needs analysis and research is precisely the one that involves the integration of ICT in teacher training programs (Schmidt et al., 2009). Considering that good teaching requires an understanding of how technology relates to pedagogy and content (Hughes, 2005; Keating & Evans, 2001; Niess, 2005), the present study adopted the Technological Pedagogical and Content Knowledge (TPACK) referential, through its knowledge dimensions (TK, PK, CK, PCK, TCK, TPK e TPACK), to answer the research question. With the answers to the research question, it was intended to identify innovations to be introduced in the functioning of MOOC to better adapt them to the professional development of teachers, namely promoting the constant updating and sharing of experiences and knowledge of teachers, considered to be essential aspects for the development of the processes of teaching-learning in the present time.

For an adequate understanding of this text, it is important to point out that in this research, the teacher is considered to be the "individual who teaches (a science, an activity, a language, etc.); [the] person whose profession is to teach in a school, a college or an university" (Infopédia, 2016)[1]. This definition took into account the fact that the teacher is someone who teaches or educates someone, formally or informally and, as such, has the right and the duty to develop his/her competences with the final objective of contributing to the improvement of teaching or of the educational process. Thus, considering that the students of the two cases that were studied (4th and 5th editions of the Digital Skills Course promoted by the Portuguese Open University - *Universidade Aberta*) were of Portuguese or Brazilian origin, in this research, it was considered as

---

[1] This definition, from a source in Portuguese, has been translated into English.

"teachers", regardless of the area of performance and knowledge, the professionals with professional teaching or educational activity in Portugal or Brazil.

Brief theoretical approach

Currently, the growth of information and its accessibility through networks is increasingly evident. Consequently, it is also a fact that professional development will increasingly be linked to learning networks not only by inherent dynamics, but especially by communication, interaction and collaboration between peers. In this sense, there are currently several changes for teachers to develop their knowledge and skills in these networks, for example, through Massive Open Online Courses (MOOC). As a result, MOOC "are a continuation of the trend in innovation, experimentation and the use of technology initiated by distance and online teaching, to offer learning opportunities in a massive way" (Siemens, 2013 p. 5). A brief analysis of the concepts underlying the acronym MOOC clarifies: *massive* – represents the breadth and geographical range that these kinds of courses have, since they allow for the registration of a large number of participants; *open* – courses open to any type of participants representing the democratization of knowledge, without any kind of restriction in both economic and prerequisite terms; *online* – available in real time, 24 hours a day, provided there exists a web connection; *course* – refers to the format of the course, which encompasses technology, pedagogy and content. It is also important to mention that connectivism is the learning theory that supports MOOC. It emerges to supply the economic, cultural and social changes that technological development entails and approaches knowledge as something distributed in a network of connections, in which learning is understood as the ability of individuals to move through those networks. Thus, considering the need of teachers to develop skills and acquire new knowledge that allows them to have an effective practice with the technologies, it is fundamental to bank on a process of professional development oriented to the educational reality - *a teaching-learning process based on several types of knowledge*. In this sense, in this research, the Technological Pedagogical and Content Knowledge (TPACK) model was adopted because "it offers several possibilities to promote research in teacher training, the professional development of teachers and the use of technology by teachers" (Koehler & Mishra, 2009, p. 67). Mishra and Koehler (2006) argue that "the basis of this theoretical framework is the understanding that teaching is an extremely complex activity that draws on various types of knowledge" (Mishra & Koehler, 2006, p. 1020). These dimensions of knowledge of the TPACK model were fundamental for the development of the present study (Figure 1):
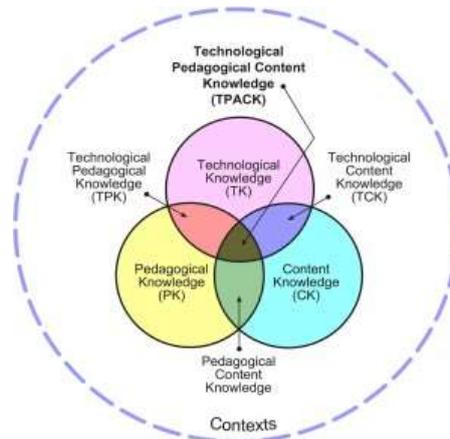
Figure 1. Technological Pedagogical and Content Knowledge (TPACK) model (Mishra & Koehler, 2006).

- Content knowledge (CK) consists of "knowledge about content that must be taught or learned" (Mishra & Koehler, 2006p. 1026). Teachers "need to know the nature of this knowledge and also how this knowledge can be used in different contexts" (Mazon, 2012 p. 31).

- Pedagogical knowledge (PK) requires the teacher to know and be able to teach certain content (Harris, Mishra, & Koehler, 2009; Koehler & Mishra, 2009; Mazon, 2012; Silva, 2009). It can be understood as "a deep knowledge about the processes, practices and methods of teaching and learning and how they are involved, among other things, in general educational purposes, values and objectives" (Mishra & Koehler, 2006 p. 1026-1027).

- Technological knowledge (TK) "involves the skills necessary to operate certain technologies... The ability to learn and adapt to new technologies will still be important" (Mishra & Koeler, 2006 p. 1027-1028).

- Pedagogical knowledge of content (PCK) "includes knowing which teaching approaches fit the content, and in the same way, knowing how elements of content can be organized for better teaching" (Mishra & Koehler, 2006, p. 1027).

- Technological knowledge of content (TCK) "is the knowledge about how technology and content are reciprocally related" (Mishra & Koehler, 2006 p. 1028). Thus, "teachers need to know not only the subject matter they teach but also change the way the subject can be taught through the application of technology" (Mishra & Koehler, 2006 p. 1028).

- Technological Pedagogical Knowledge (TPK) includes the ability to choose the specific technology that best fits the objectives and contents to be worked on, as well as the recognition or elaboration of pedagogical strategies more conducive to the use of technologies, since the form of teaching changes according to the selected technology (Graham, 2011; Lopes, 2011; Mazon, 2012).

- Pedagogical technological knowledge of content (TPACK) consists of the intersection of the three main types of knowledge (CK, PK and TK); "the integration of productive technology into teaching must consider all three questions not in isolation but within the complex relationships in the system defined by the three key elements" (Mishra & Koehler, 2006 p. 1028-1029).

In short, all the identified dimensions (TK, PK, CK, PCK, TCK, TPK and TPACK) are related to each other and are inserted in the learning context, in this case, in the MOOC. It is, with support to these dimensions, that the process of professional development of teachers was studied in order to identify a set of innovations to be introduced in the functioning of the MOOC to better adapt them to the training of teachers.

Methodology

The research question (What are the innovations to be introduced in the functioning of the MOOC to better adapt them to the professional development process of teachers?) arose from the need for teachers to acquire competences in the field of ICT, in particular with regard to the integration of technologies in the teaching-learning process, in order to create conditions for the exercise of the teaching profession and, consequently, to improve the quality in the teaching-learning process. The answers to the research question were obtained through a process of verification of four propositions, as follows:

Proposition 1 – The learning conditions in MOOC are determined by a varied set of factors: With support of qualitative data analysis, it is considered fundamental to study in depth the factors that characterize the context of learning to better understand the process of professional development of teachers in an environment in constant transformation, in this case in a MOOC.

Proposition 2 – MOOC ensure communication, interaction, and collaboration among teachers: To verify this proposition, and using quantitative data analysis, it is intended to determine the degree of professional development of teachers in MOOC, regarding the technological knowledge dimension (TK) of the TPACK model. Subsequently, through qualitative data analysis, it is intended to characterize the technological competencies of teachers for the use of technologies in the MOOC teaching-learning process.

Proposition 3 – The pedagogical model of MOOC is adequate to foster the involvement of teachers in collaborative learning: To verify this proposition, using quantitative data analysis, it is intended to determine the degree of professional development of teachers in MOOC regarding the pedagogical knowledge dimension (PK) of the TPACK model. Subsequently, through qualitative data analysis, it is intended to identify a set of factors that favor the involvement of teachers in collaborative learning in MOOC.

Proposition 4 – MOOC allow quality teaching-learning processes: using the quantitative analysis, it is intended to determine the degree of professional development of teachers in MOOC, regarding the content knowledge dimension (CK) of the TPACK model.

Subsequently, through qualitative data analysis, it is intended to identify a set of aspects that contribute to quality teaching-learning processes in MOOC

Therefore, in order to obtain the necessary evidence for the verification of the propositions made, a descriptive study of a phenomenon inserted in its context has been made, through a multiple case study of the process of professional development of teachers in MOOC.

In order to select the cases to be studied, the following set of criteria were established: (i) MOOC for the professional development of teachers; (ii) MOOC granting certification and accreditation; (iii) MOOC allowing the enrollment of different professionals in the education sector.

The definition of the criteria presented resulted in the selection of the Digital Competencies for Teachers course, promoted by the Portugueses Open University (UAb). The course follows the pedagogical model developed in the ECO project (sMOOC) for European MOOCs, validated by the European Commission and designated by ECOiMOOC. The two cases studied (4th and 5th) had as fundamental objective to trigger the reflection and debate around the development of competences for the use of digital technologies in education. In addition, they were addressing the same subject (Digital Competencies for Teachers), had a similar technical-pedagogical structure and the objectives and curriculum were identical.

With the case studies, it was intended to understand the functioning of the system, namely through the various aspects of two actual situations - through two real cases which took place between April and December 2016. The answers to the research questions were obtained with the quantitative measurement of the dimensions of knowledge of the model TPACK and also through clarification of information ensured by qualitative data analysis.

Quantitative data came from the adapted questionnaire survey of Schmidt et al. (2009) denominated 'Survey of pre-service teachers' knowledge of teaching and technology' which operationalizes the assumptions of the TPACK theoretical model. In relation to the original survey, the adapted version replaced some demographic issues by items more suited to the context of the present study: the range of questions 4 to 9 was excluded, leaving only the first three questions (email address, gender and age group) and an issue concerning the highest academic degree held by teachers was added. In addition to the modification of demographic issues, it was necessary to adapt some questions to the context of the present study, namely in the following groups: knowledge of content (CK), pedagogical knowledge of content (PCK), technological knowledge of content TCK) and technological and pedagogical content knowledge (TPACK).

The statistical analysis was performed using the IBM SPSS Software. The units of quantitative analysis are presented in Table 1.

Table 1: Units of analysis (quantitative analysis)

Knowledge dimensions of TPACK model	Units of analysis
Technology Knowledge	TK
Content Knowledge	CK
Pedagogical Knowledge	PK
Pedagogical Content Knowledge	PCK
Technological Content Knowledge	TCK
Technological Pedagogical Knowledge	TPK
Technological Pedagogical Content Knowledge	TPACK

Qualitative data resulted from semi-structured individual interviews and from information contained in the researcher's diary.

The script of the semi-structured interview to participants in the two MOOC was defined according to the following objectives: (i) To know the teachers, namely their experiences and results in the process of professional development in the MOOC; (ii) Understand the issues that reflect the explanatory factors of the professional development process of teachers in the MOOC.

The researcher's diary collected all sort of anecdotal data and also registered participant observation which resulted from the interaction of the teachers through the tools of asynchronous communication (email, discussion forums, blogs, short and favorites).

For the qualitative analysis, the units of analysis arose from the guiding questions formulated. The purpose was to determine the different meanings of the answers in order to identify factors explaining the professional development process of teachers in MOOC, thus assuring a process of methodological triangulation, in order to corroborate the same fact with the aim of increasing the reliability of the information. The units of qualitative analysis are presented in Table 2.

Table 2: Units of analysis (qualitative analysis)

Propositions	Units of analysis
The learning conditions in MOOC are determined by a varied set of factors (Context)	- Influence of academic degree. - Influence of the professional situation. - Motivation for technology-mediated learning. - Influence of temporal availability. - Motivation to participate in learning communities.
MOOC ensure communication, interaction, and collaboration among teachers (Technology)	- Domain of technologies. - Adequacy of technological tools to activities. - Potentialities of asynchronous tools. - Limitations of asynchronous tools.

	- Potential of the platform.
	- Platform limitations.
	- Preference for asynchronous tools.
The pedagogical model of MOOC is adequate to foster the involvement of teachers in collaborative learning (Pedagogy)	- Involvement and participation.
	- Habits of collaboration.
	- Interaction and collaborative work.
	- Importance of online socialization.
	- Preference for collaborative work in relation to dimension.
	- Preference for collaborative work in relation to homogeneity.
	- Function of the trainer.
	- Adequacy of the evaluation model.
	- Adequacy of the certification model.
	- Adequacy of crediting model.
MOOC allow quality teaching-learning processes (Content)	- Work volume.
	- Suitability of the contents to the theme of the course.
	- Quality of content.
	- Adequacy of platform language to learning.
	- Organization of contents.

Through the units of analysis, it was sought to relate the degree of professional development of teachers with the corresponding explanatory factors.

Compared with the total population of both cases - case 1 (231 teachers) and case 2 (98 teachers), the participation rate of teachers in the present investigation was very low (Table 3), in answering the questionnaires (IQI_C1 + IQF_C1 = 14 valid teachers and IQI_C2 + IQF_C2 = 10 valid teachers) and in interviews (EI_C1 = 8 teachers and EI_C2 = 5 teachers).

Table 3: General data of case studies

	Total Population	Surveys completed	Initial Survey (IQI)	Final Survey (IQF)	Final Sample (IQ)	Interviews held
Case 1	231	83	69	14	14	8
Case 2	98	40	30	10	10	5
Total	329	123	99	24	24	13

Discussion of results

Proposition 1 (context) - The results suggest that the learning conditions in MOOC are determined by a set of factors that can potentiate or condition the process of professional development of teachers, for example, the influence of the academic degree, the influence of the professional situation, the motivation for technology-mediated learning, the influence of temporal availability and the motivation to participate in learning

communities. On the one hand, by empowerment, these aspects become an essential contribution to the training of teachers, yet on the other, when they condition, they may also limit the exercise of the teaching profession. In this case, it is important that teachers try to overcome the constraints to which they are subject to in order to contribute to the improvement of the quality of education in general.

Proposition 2 (technology) - The results suggest that MOOC ensure the process of communication, interaction and collaboration between teachers. However, there are some aspects that seem to condition the process, for example, the domain of technologies, adequacy of the technological tools to the activities, limitations of the asynchronous tools, limitations of the platform and preference of teachers for the asynchronous tools. It is clear that these limitations can be reduced or even surpassed provided that the educational institutions and the participating teachers are predisposed to change practices, especially in the way they view their professional development.

Proposition 3 (pedagogy) - Based on the results obtained, it can be seen that, in general, there are no activities in MOOC that can be implemented collectively, so there is a tendency for the lack of involvement and participation of teachers. This question seems to show that the pedagogical model of MOOC can be substantially improved in order to encourage the involvement of groups of participants in collaborative learning activities.

Proposition 4 (content) - According to the results obtained, it is pointed out that, although MOOC allow quality teaching-learning processes, in general, there was considerable workload in the course, and the contents that were made available required improvements and adjustments to the subject, with regard to their layout and/or organization. In this sense, its improvement is suggested in order to increase its quality.

Finally, based on the comprehension of the answers to the research questions, it was possible to identify a set of innovations that might be introduced in the functioning of MOOC to better adapt them to the professional development of teachers. These innovations were grouped into three dimensions, coming from the TPACK model. The following suggestions for innovations were identified.

Technological dimension:

- To use the latest, most appealing and intuitive technologies that encourage teachers to participate and actively collaborate in MOOC.

- To train teachers to acquire technological skills. This training may possibly occur before the start of a MOOC, thus providing teachers with greater technological prowess to profit from the course.

- To design and implement a technological solution that allows selection of publications pertinent to the course is suggested; this would be done in order to filter comments published by teachers in the asynchronous tools of the platform (this has a difficult operationalization, but the issue needs to be addressed).

- To adopt synchronous tools (videoconference and chat) that allow the communication, interaction and collaboration of teachers in real time; due to reasons of bandwidth

limitations, possibly short work groups would have to be organized so that synchronous quality sessions would be possible.

- To improve the technological functioning of gamification (ELGG platform) so that teachers have the opportunity to win the badges fairly.

Pedagogical dimension:

- To foster the involvement and participation of teachers in the MOOC so that their professional development is more inclusive and participatory, through the implementation of more collective activities, sharing of experiences and reflection and debate among peers.

- To improve the MOOC evaluation model, such as peer evaluation, feedback from trainers and activities, to better tailor it to the professional development process of teachers.

- To improve the MOOC certification model by integrating the number of hours of the course in the certificate and review and/or produce legislation to make the process clearer for teachers.

- To improve the accreditation model of the MOOC, in particular with regard to the requirement to take a final face-to-face examination, the costs associated with obtaining the credits and the need to review and/or produce legislation that clarifies the operation of its process.

Content dimension:

- To reduce the number of activities and the workload, in general, in MOOC that are directed to professional development, since the teachers are not available to carry out a high number of tasks.

- To improve the image quality of the contents related to the difficulty in reading and its presentation, as well as to create more pedagogical activities that provide teachers with greater participation and involvement in the course.

- To adapt all the contents available to the Portuguese language, facilitating their understanding and promoting the involvement of all teachers in the activities of the course.

- To improve the way artefacts are explained and the organization of proposed activities. To the detriment of the theoretical activities, it is suggested to create more technical activities that motivate teachers to achieve their professional development.

We believe that the innovations identified can contribute to make the professional development process of teachers more dynamic, motivating and collaborative, and to extended better MOOC to all professionals who have the role of educating.

Conclusions

The study of the process of professional development of teachers contributed to broadening the debate on the subject, expanding the knowledge and obtaining pertinent information for the deepening of the problem. In addition to these aspects, the accomplishment of this work provided an understanding of the research questions, through which innovations were identified, to be introduced in the functioning of the MOOC to better adapt them to the professional development of teachers.

References

COM. (2014). Comunicação Da Comissão Ao Parlamento Europeu, Ao Conselho, Ao Comité Económico E Social Europeu E Ao Comité Das Regiões-Abrir a Educação: Ensino e aprendizagem para todos de maneira inovadora graças às novas tecnologias e aos Recursos Educativos Aber. *Bruxelas*, *25*, 1–14. Retrieved from http://ec.europa.eu/transparency/regdoc/rep/1/2013/PT/1-2013-654-PT-F3-1.Pdf

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education*, *57*(3), 1953–1960.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education*, *41*(4), 393–416.

Hughes, J. (2005). The role of teacher knowledge and learning experiences in forming technology-integrated pedagogy. *Journal of Technology and Teacher Education*, *13*(2), 277.

Infopédia. (2016). Dicionário infopédia da Língua Portuguesa com Acordo Ortográfico [em linha]. Porto: Porto Editora, 2003-2017. Retrieved from www.infopedia.pt/dicionarios/lingua-portuguesa/professor

Keating, T., & Evans, E. (2001). Three computers in the back of the classroom: Preservice teachers'conceptions of technology integration. In *Society for Information Technology & Teacher Education International Conference* (Vol. 2001, pp. 1671–1676).

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70.

Lopes, J. P. (2011). A tecnologia na ótica dos professores: análise da integração entre conhecimentos pedagógicos, tecnológicos e do conteúdo (CO). In *XIII ConferÊncia Interamericana de educação matemática*.

Mazon, M. (2012). *TPACK (Conhecimento Pedagógico de Conteúdo Tecnológico): Relação com as diferentes gerações de professores de Matemática*. Retrieved from http://www2.fc.unesp.br/BibliotecaVirtual/DetalhaDocumentoAction.do?idDocumento=511

Mishra, P., & Koehler, M. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. In: Teachers College Record.

Niess, M. L. (2005). Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, *21*(5), 509–523.

Rolando, L., Luz, M., & Salvador, D. (2015). O Conhecimento Tecnológico Pedagógico do Conteúdo no Contexto Lusófono: uma revisão sistemática da literatura.

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK) the development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, *42*(2), 123–149.

Siemens, G. (2013). Massive open online courses: Innovation in education. *Open Educational Resources: Innovation, Research and Practice*, *5*.

Silva, M. (2009). Curso de Informática Básica a Distância para Professores e Servidores da Escola Classe no2 do Paranoá–DF. *CEP*, *70910*, 900. Retrieved from http://monografias.cic.unb.br/dspace/handle/123456789/249

UNESCO. (2008). Competency Standards Modules. ICT competency standards for teachers: competency standards modules. . Paris: UNESCO. . Retrieved from http://unesdoc.unesco.org/images/0015/001562/156207por.pdf