



An Approach To Modeling Moocs For Science Teacher Training

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ABSTRACT

MOOCs, or Massive Open Online Courses, have emerged over the past decade as a promising alternative in education. They are rapidly making their mark on teacher training and professional development worldwide, often in formal or non-formal contexts. However, work on their conceptual frameworks remains limited, especially as they relate to a specific adult audience.

In this article, we present a conceptual approach to the design of MOOCs for teacher training and professional development, based on the consideration of various theories and models relevant to adult learning.

A conceptual framework is developed from a cross-analysis of the main models of adult learning and their implications for the design of MOOCs for teacher training. We derive a personalized and aligned MOOC model and an associated pedagogical scripting model.

This study is the first draft of an ongoing project to design and implement a MOOCs-ENS platform for the initial and in-service training of the new generation of Moroccan teachers on a national scale. It is a contribution to the growing body of research on the use of MOOCs in teacher education and professional development.

Keywords: MOOCs, Teacher Training, Professional Development, Adult Learning, Conceptual Framework, Pedagogical Scripting, Online Education, MOOCs-ENS, Lifelong Learning, Instructional Design

1. INTRODUCTION

The dominant political priority in education systems worldwide is now the initial, in-service, and career-long professional development of teachers. However, the constraints associated with teachers' participation in face-to-face training or a working situation make mobilization practically impossible. In this respect, massive open online courses (MOOCs) are emerging as a cost-effective and efficient alternative to complement traditional approaches to teacher training. This optimistic outlook is based on the idea that MOOCs will make it possible to provide mass training for teachers, tailored to their schedules and availability. Moreover, it is assumed that MOOC-based training can be easily customized to meet the individual needs and learning styles of teachers.

MOOCs, or Massive Open Online Courses, have emerged over the past decade as a promising alternative to online education. These courses are accessible to a wide audience, offering the chance to acquire quality knowledge and skills often delivered by renowned universities, without the geographical and financial constraints of traditional institutions. However, behind this apparent educational revolution lie fundamental questions and challenges.

To meet these challenges, MOOCs are evolving, and some traditional higher education establishments have even gone so far as to integrate online courses into their traditional programs, offering a more complete learning experience. This hybridization aims to combine the benefits of online education with the structure and guidance of a traditional classroom.

The need for a theoretical framework for MOOCs in adult education seems essential and crucial. Indeed, integrating adult learning models into the design of MOOCs for continuing teacher education can considerably improve the effectiveness and relevance of these online courses. By integrating these adult learning models into the design of teacher training MOOCs, developers can create more effective, relevant, and engaging online learning experiences that better meet the needs of adult learners and foster their ongoing professional development.

Most research on MOOCs deals with the issue of massive open online courses. Empirical data from observations of users' behavior in learning situations on MOOC platforms provide information on the opportunities and challenges of using MOOCs in training. Very few studies deal with the issue upstream, considering the theoretical foundations of adult learning. And even when such studies do exist, they do not provide a clear picture of the implication of learning models in improving the problems of adaptation and personalization, and in perfecting the pedagogical alignment that ensures effective learning processes.

Furthermore, this paper aims to show how support for adult learning models can contribute to the design an MOOCs that optimize teacher training. This work constitutes an upstream study for a possible project to develop a

training platform for the new generation of Moroccan teachers, at the ENS Tetouan, in alignment with the national teacher training project in Morocco.

2. LITERATURE REVIEW

The literature on the use of MOOCs in teacher training is abundant, testifying to the importance given to MOOCs as a solution to the problem of teacher training and lifelong skills development. Recently, Padmavathy (2023) examined the benefits, challenges, and considerations involved in designing MOOCs for the initial training and professional development of teachers in different disciplines, by analyzing 14 experiences of using MOOCs in training in the USA, Europe, and India. His study highlighted the significant impact of MOOCs on teacher training.

Some studies have started from the observation of teachers' behaviors and attitudes during their training via MOOCs to deduce the issues, challenges, and impacts of MOOCs (Tomte, 2018; Koukis & Jimoyiannis, 2019; Koukis et al., 2023; Vezne, 2020; Li et al., 2020), or to deduce factors to consider when designing MOOCs for teacher training (Amado et al., 2022; Smith & Brown, 2021).

Some studies of a meta-analytical nature have focused on a review of a wide range of academic publications, including journal articles, conferences, and research reports relating to the issue and status of the use of MOOCs in teacher training. This review covered pedagogical models, technologies used, learner characteristics, implications for higher education, and evaluation of the effectiveness of MOOCs (Liyanagunawaedena et al., 2013). Others on the different design approaches, implementation, and pedagogical strategies adopted to promote learner engagement on a large scale (Bonk et al., 2015). Other studies have concerned course design strategies, factors influencing teachers' adoption of MOOCs, and impacts on the learning experience (Gleeson & O'Dwyer, 2018).

Researchers such as Misra (2018), Laranjeiro et al., (2018), and Ma et al., (2023), have used data from the analysis and evaluation of literature reviews on the use of MOOCs in teacher training and professional development to deduce and implement a theoretical and conceptual framework for the design of effective and enriching MOOCs.

Schulze (2014) presented a conceptual model of MOOCs for adult learning that considers adult learner characteristics, andragogical principles, and learner self-direction as key components. The author stresses that this model should take into account the diverse needs of learners, their pre-experience, and motivation as challenging factors in the face of non-completion. The model should also incorporate instructional design factors such as accessibility, flexibility, and active engagement.

Another conceptual framework for the design of MOOCs for teacher professional development is presented by Bruno and Osório (2018). The model is structured on the interaction of three dimensions: Knowledge, Pedagogy, and Technology (TPack Model). After experimenting with the model, the authors raise the complexity of effective MOOC design and stress the importance of considering other key factors.

Recently, Amado et al., (2022) presented another conceptual framework for the design of MOOCs for in-service teacher training, structured in three main dimensions and ten sub-dimensions (figure 1). In the foreground, importance is given to the resource dimension as a guarantor and basic condition for the creation of a MOOC. The second dimension refers to the options for designing a MOOC. The third considers the quality criteria for a MOOC.

This model shows that any upstream consideration of a MOOC design is conditioned first and foremost by the availability of human resources (resource skills) and technological infrastructure (internet, studio...). The design dimension concerns the key elements to be taken into consideration in the pedagogical design of MOOCs.

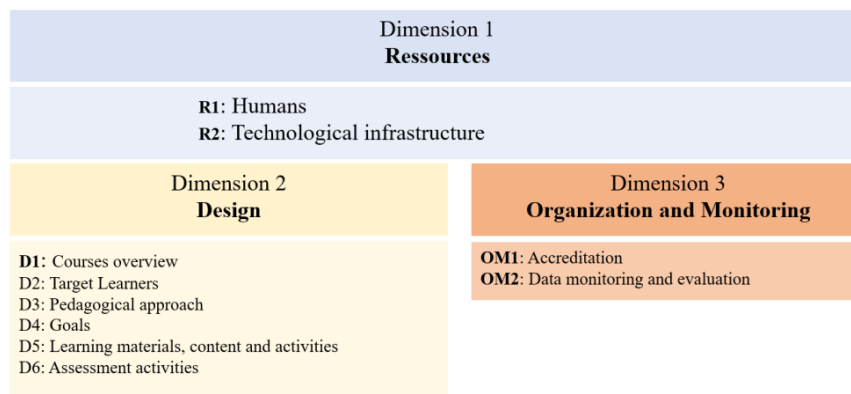


Figure 1: Conceptual framework for MOOCs design for continuous teacher training (Amado et al., 2022)

While all these models can provide and inform the designers of MOOC experiences for teacher training and professional development, on certain key elements in the design relating to knowledge, resources, or didactic materials, pedagogical approaches, technological tools that serve to support the methodologies adopted, these models

lack visibility as to firstly the adaptation of adult learning models and styles and the pedagogical strategies adopted in MOOCs and secondly as to the pedagogical alignment in the structure of the MOOCs.

3. METHODOLOGY

The methodological approach adopted in this work is a comparative and cross-analytical one. This approach is widely used in research in education (Milošević & Maksimović, 2020; Bhagirath, 2024), in the social sciences (Ghazinoory & Aghaei, 2024), and in management (Seny Kan et al., 2015).

Our comparative and cross-case analysis focused on the models of adult learning most cited in the literature, considering two dimensions: the basic principles of each model and the context of its involvement, which is initial and in-service teacher training.

Figure 2 illustrates the stages of our methodology. We begin with a comparative and cross-analysis of the different models and then draw out the implications of each model for training. We then deduce the components of the MOOCs design model, ensuring both the adaptation of training and learning strategies and the pedagogical alignment between objectives, learning tasks, and teaching aids. We conclude with a pedagogical scenario for the platform's operation.

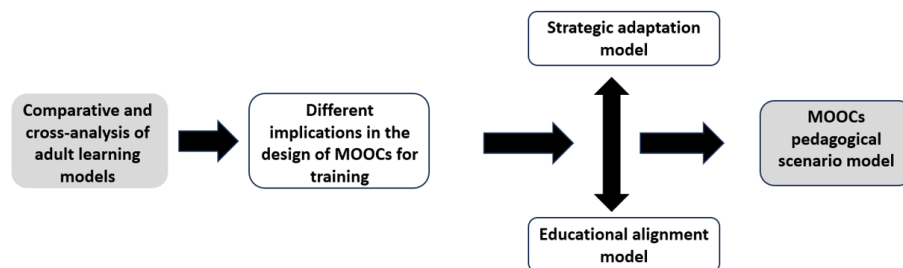


Figure 2: Adopted methodology

4. RESULTS AND DISCUSSION

In this work, we have studied the principles and key elements of the various theories and models of adult learning. In Table 1, we present the model under consideration, its principles, and the key elements we were able to identify in the literature on adult learning..

Table 1:
Basic principles of adult learning models

Model	Basic principles	Implications
Knowles Andragogy (Knowles, 1984)	- Self-directed: Adults need to be autonomous and motivated to learn. - Experience c learner input: Learning is rooted in adults' lived experiences. - Focus on learning objectives concerning their personal or professional needs.	- Learners engage in learning experiences that meet their needs and take into account their pre-experiences.
Self-directed learning from Tough (Tough, 1979)	- Focused on learners' self-control. learning processes.	- Adults determine their goals, plan their learning, implement strategies, and evaluate their progress. - Self-direction fosters autonomy, responsibility, and intrinsic motivation in adults.
Mezirow's transformative learning (Mezirow, 1991)	- Emphasizes questioning existing representations and perspectives.	- Adults learn to transform their understanding of the world by questioning and enhancing their frames of reference. - The process of critical reflection is often triggered by experiences of disorientation or cognitive conflict..
Learning KOLB (Kolb, 1984)	- Emphasizes experiential learning through a four-step cycle: concrete experience - reflective observation -	- Adult learners learn by reflecting on their experiences and integrating new knowledge within existing schemas.

	abstract conceptualization - active experimentation.	
Situated cognition Lave & Wenger, 1991)	- Learning is rooted in specific contexts and social interactions	- Adult learners acquire new knowledge by participating in activities set in authentic environments where they can directly apply what they learn.
Merrill's apprenticeship (Merrill, 2002)	- Emphasizes active learner engagement through meaningful, interactive 5-phase learning activities. - Emphasizes immediate application of knowledge in relevant contexts. - Focuses on problem-solving and complex tasks.	- Learning begins with intrinsic or extrinsic motivation on the part of the learner, to stimulate initial engagement. - Learning occurs when the learner is exposed to a stimulus, such as a problem or situation to be solved. - The learner actively reflects on the content presented and its meaning for the learner. - The learner demonstrates understanding by applying newly acquired knowledge in practical situations or by solving problems related to the learning content. - Learners receive feedback on their performance, enabling them to reinforce their understanding and adjust their learning efforts. This feedback can come from an instructor, peers or the task itself.

By superimposing the principles and key elements of each model, we can envisage the following implications for the optimized design of MOOCS intended for the training and professional development of teachers (Table 2), while taking care to integrate the relevant pedagogical and didactic approaches in the pedagogical scripting of the MOOCs' operation: the situation-based approach, through guided or semi-guided discovery, through investigation, through projects, through problem-solving, etc. (Table 3)...

Table 2 :
Implications of adult learning model principles in the design of MOOCs for teacher training and professional development

Principles	Integration aspects of MOOCs
1. Autonomy and responsibility	- Offer a variety of thematic options covering various aspects and issues of teaching and learning: planning, management, assessment, etc., various learning paths, self-assessment possibilities, etc. - Integrate diagnostic assessment situations (knowledge availability, structuring, functional aspects, representations, skills, etc.) and activation of prior experience. - Integrate immersive simulations that reproduce real classroom scenarios and virtual classroom management tasks, role-playing games, and decision-making simulations.
2. Experience and prerequisites	- Integrate videos of confusing and problematic teaching practice and others of successful and effective teaching, skills videos and allow teachers to analyze, critique, and propose solutions. - Integrate usable and functional theoretical frameworks and enable teachers to apply them to analyze and discuss the cases presented. - Put teachers in stimulating and engaging practical application situations to enhance and transfer skills in different situations.
3. Motivation and commitment	- Integrate gamification elements: real case studies of teaching-learning practices, classroom simulations, and interactive quizzes to get teachers actively involved in training.
4. Situational learning	- Integrate situations and tasks relating to the practice of pedagogical innovation, both face-to-face and online. - Integrate authentic and contextual learning situations that help to trigger teachers' curiosity and desire to learn.
5. Collaborative learning and social interaction	- Integrate into MOOCs the option of creating learning communities to enable teachers to exchange and share their own experiences (discussion forums, collaborative projects, etc.).
6. Reflective learning and feedback	- Integrate situations of socio-cognitive conflict, disorientation, and consciousness, engaging collaboration into critical reflection and stepping back from knowledge, daily practices, representations, and ideas... - Integrate relevant and constructive feedback. - Enable communication and interaction between teachers and experts (tutors).
7. Flexibility and accessibility of resources	- Integrate various resources and training aids and make them permanently accessible, enabling teachers to consult them at their convenience and progress through the modules at their own pace.

- Classify these resources by theme and index them to make it easier for teachers to find them.
8. Personalization
- Integrate needs analysis algorithms and recommendations for resources, situations, activities, and teaching materials to enable adaptive learning in the MOOC platform.

All these implications need to be incorporated in a coherent and structured way into the model we propose in this study (figure 3), and by incorporating relevant pedagogical and didactic approaches enabling the effective implication of these basic principles in the scripting of the course and operation of MOOCs (figure 4).

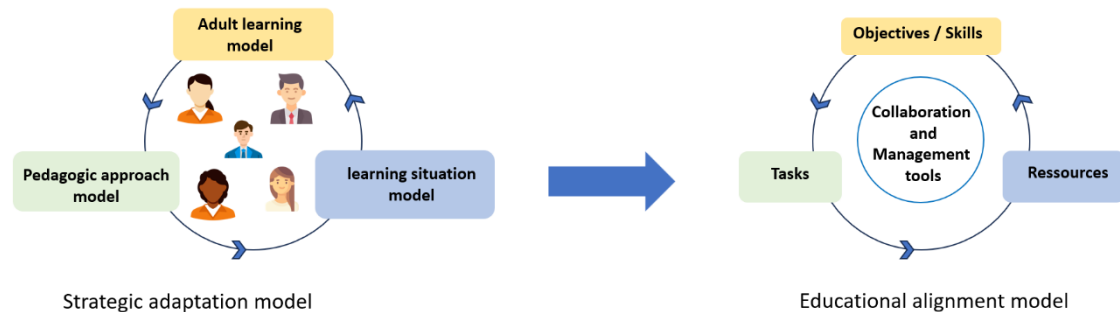


Figure 3: Conceptual framework for MOOCs design

The issues of adapting and personalizing learning by adapting learning models and pedagogical approaches to training, as well as those relating to the pedagogical alignment between objectives, learning tasks, resources, and teaching aids, are crucial in the design of MOOCs to enable its optimization and effectiveness in training. The design model we envisage in this study provides a conceptual framework for visualizing the approach to integrating adult learning principles into the design of MOOCs intended for teacher training.

These principles cannot be effectively integrated without a relevant and rewarding context. The proposed implications must be realized while incorporating relevant pedagogical and didactic approaches in adult education (Barton & Tusting, 2003), situation approach (Zeichner & Liston, 1996; Mitchelini & Vidic, 2023), skills-based approach (Tardif & Lebel, 1995; Darling Hammond & Bransford, 2005), discovery-based approach (Shulman & Shulman, 2004), inquiry-based approach (Ravid & Palacios, 2017), and by problem-solving approach (Muñoz, 2015) to enable more complete and relevant pedagogical scripting with the training of adult learners.

Integrating these different approaches into teacher training and preparation creates reflective, competent, and innovative practitioners, ready to meet the challenges of teaching in an ever-changing world. By combining a solid theoretical foundation with significant practical experience, these approaches help to train teachers capable of creating stimulating and inclusive learning environments for all students.

Figure 4 illustrates a pedagogical scripting model for a MOOC designed for teacher training and professional development. The free-choice themes cover the majority of teaching-learning situations: lesson preparation; didactic sequencing; analysis of objectives; analysis of content; design of support and assessment situations; application of different approaches and methods, processing of assessment data, analysis of learning, integration of new technologies, Etc.

The skills associated with the themes represent the core competencies that a creative, innovative, and didactic teacher should have. The real or virtual situations are based on observations of daily and future teaching-learning practices in the classroom or online. Activities are recommended based on the choice of the situation and are pedagogically and didactically relevant and aligned.

As for assessment, it covers both training objectives and the development of expected skills. It incorporates a variety of techniques: interactive, weighted, and constructive MCQs, problem-solving, etc., followed by processing of the answers, enabling the teacher to verify and validate his or her knowledge and skills.

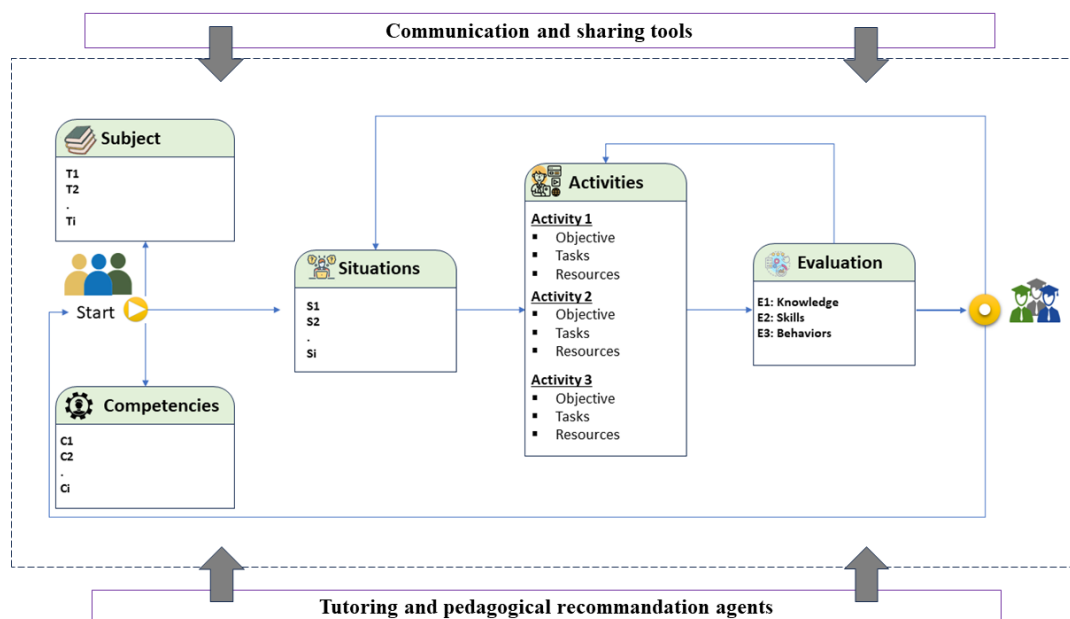


Figure 4: MOOCs pedagogical scripting model for teacher training and professional development

5. CONCLUSION

Adult learning models are important in the design of MOOCs for teacher education, as they allow the specific characteristics of adult learning to be taken into account and the learning experience to be customized to meet the needs and expectations of participants.

They provide an essential theoretical and practical framework for designing MOOCs for teacher training. By applying them appropriately, designers can create online learning environments that are engaging, relevant, and effective for this specific target audience.

The transition from modeling adult learning to modelling MOOCs for teacher education is, in fact, a complex but crucial process for designing effective and relevant online courses. Modeling MOOCs in the context of teacher training relies on a thorough understanding of adult learning patterns, to give more visibility to the pedagogical and didactic scenarios to be implemented, through the application of innovative pedagogical approaches, focused on teachers' needs, an orientation towards professional relevance, flexibility and adaptability, and an effective use of educational technologies, while ensuring pedagogical alignment.

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