

Analysing MOOCs in terms of their potential for teacher collaboration: The Italian experience

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The main aim of this paper is to analyze the experience of a MOOC for mathematics teacher training implemented in Italy, in parallel with a similar experience in France¹. The study focuses on teacher collaboration within such an online learning environment, in terms of co-working and co-learning. The Italian and the French teams outline a common starting point and set of concerns for the research (the two papers have a similar Introduction for this reason). Each team then reformulated the research questions and tried to answer them through specific theoretical lenses. The Italian team used a fresh theoretical framework called MOOC-MDT. We concentrate on practices implemented by teachers who attend the MOOC, in particular on their contributions to communication boards and the consequent conception and growth of their particular community. In the conclusions, we contrast our results with those of the French experience.

Keywords: MOOC, teachers' professional development, meta-didactical transposition, community, collaboration

Introduction

Internet communication tools provide the opportunity to develop new types of teaching methods that combine online courses, resources and discussions. MOOCs (Massive Open Online Courses) were born in 2008 at the initiative of prestigious American Universities (MIT, Harvard, Stanford, ...) that sought to enlarge the courses they offered to a wide audience. Since then, the MOOC phenomenon has been regularly growing and the worldwide number of MOOCs has doubled from 2014 to 2015 (Shah, 2015). Although there is a wide choice of many different topics, when looking specifically for a MOOC aimed at teacher training, the range is limited, especially in mathematics. Nevertheless, there is a growing interest in MOOCs involving mathematics teachers as participants, as shown by TSG44 work during the 13th ICME². In particular, from our experiences, there is a need for designing and implementing a MOOC for teacher training in mathematics education with a focus on the development of communities of practice (Wenger, 1998) and the collaborative work among teachers as a basis for their professional development. Indeed, when people co-work (work together collaboratively) they can also co-learn (learn together collaboratively), as highlighted in the ICME

¹ See Panero et al. (2017). Since the Italian MOOC and the French MOOC were delivered at the same period of time, even if the contents were designed independently, our teams had the opportunity to exchange and to discuss about them.

² For more information, see http://www.icme13.org/files/tsg/TSG_44.pdf

survey of Robutti et al. (2016). The authors found that teachers can learn through discussion, conversation and reflection on their own teaching, on student learning and on the teaching of others. The methodology of the Italian MOOC Geometria aims to create collaborative contexts for teachers' work, where they can learn from these kinds of practices. Taking into account this necessity for teachers to be supported in exploiting affordances of technology affordances, the objectives of both the French and Italian MOOCs are shared, namely: accompanying teachers in the production of teaching resources, by examples of activities and reflection on their ongoing resource design; fostering a reasoned use of technology, encouraging teachers to choose appropriate digital tools for the classroom. Such aims are related to the interest in the design and the implementation of teacher professional development programmes to include the role of teachers working and learning in communities (Wenger, 1998; Jaworski & Goodchild, 2006). The originality of our research based on the data collected from two MOOCs (in Italy and in France), that share similar aims and objectives, is twofold.

First, our new framework (MOOC-MDT: see below) facilitates the study of the specific dynamics of the interactions among trainees and between trainees and trainers, which occur online and in totally virtual environments. It is topical and urgent to analyze these interactions in the context of such distance learning due to the increased interest in this approach in recent years. Consequently, we reviewed and revised an existing framework that had been used to describe face-to-face meetings for teacher professional development, namely the Meta-Didactical Transposition (see below).

Second, our new framework analyzes such dynamics according to the cultural constraints that shape the MOOCs' design and development. The French and Italian school environments have some remarkable differences and one of the most palpable is a wider freedom that institutional curriculum regulations traditionally give to the Italian teachers, compared with the major institutional constraints met by the French teachers. The Italian *Indicazioni*³ (guidelines) highlight for each discipline the fundamental learning goals that students have to achieve at the end of each cycle of instruction (two or three scholastic grades). These guidelines have the character of general didactic guidelines and defer to teachers the responsibility of choosing and linking the specific mathematical contents to be developed in the classroom in order to reach the established learning goals. The French *Programmes*⁴ (syllabi) are also based on competences for a given cycle of instruction, but they appear to be more detailed and normative: for each mathematical content, they provide some examples of activities. Moreover, they are accompanied by several additional resources intended to support for the curriculum implementation in the classroom.

In this paper, and in parallel with the French one, we draw on the common theoretical element of the MDT to highlight how the concepts of community and of collaborative work evolve to new and different forms, and the impacts on teachers' professional learning. As members of the Italian team we worked alongside members of the French team to compare the data from the two MOOCs, so in the conclusion we will discuss the relevance of cultural and institutional aspects in the specific dynamics of the two experiences.

³ http://www.indire.it/lucabas/lkmw_file/licei2010/indicazioni_nuovo_impaginato/_decreto_indicazioni_nazionali.pdf

⁴ Links to the French curriculum and supporting material are available at <http://eduscol.education.fr/>

The description of MOOC Geometria

The “MOOC Geometria” is the result of a long development process over many years by the researchers of the Mathematics Department of Turin University, and characterized by many previous experiences of teacher education projects in which the team has been involved (e.g. the M@t.abel project <https://goo.gl/Q30Dn0>) alongside years of research into teacher education. The MOOC was delivered on a Moodle platform (<http://difima.i-learn.unito.it/>) between October 2015 to January 2016 (6 modules in 8 weeks), and the 424 participants, all teachers in secondary school, were from all over Italy. 36% of the teachers completed all of the MOOC activities, which compares with reported average completion rate of about 5% (Bayne & Ross, 2013).

The MOOC team comprised 13 people (university researchers and expert in-service teachers). The MOOC had two main teacher education aims: professional training and raising awareness of the possibilities for technology use in schools. Every week the trainees worked individually to become familiar with different approaches. These activities included: watching a video where an expert introduced the conceptual knot of the week; watching a “cartoon video” with some guidelines to carry out the units; reading the geometry activities based on a mathematics laboratory (and the option to experiment with these in their classroom). Trainees were invited to share thoughts and comments about the activities and their contextualization within their personal experience, using specific communication message boards (forum, padlet, and tricider: see Table 1 for an outline description of each). The team of trainer chose to limit their own interventions in these message boards to a minimum in order to support the birth of a trainees-only community. The trainers were more active within the webinars: educational online event for trainees.

TOOL	AFFORDANCES	REASON OF THE CHOICE	IN WHICH MODULE WAS IT THERE?
Forum (web 1.0 tool)	For public discussion, where everyone can read and answer to messages, using nested replies.	To give teachers a friendly and known tool for discussion.	1, 2, 3
Padlet (https://it.padlet.com/) (web 2.0 tool)	Board of collaboration/sharing material (images, videos, documents, text) on common tasks.	To give a communication mode different from the forum, for supporting teachers in participatory methods.	1, 2, 3, 4, 5, 6
Tricider (https://www.tricider.com/) (web 2.0 tool)	For easy brainstorming and voting. For decision making, crowdsourcing and idea generation.	To facilitate decision making after any discussion by the request of a vote.	2, 3

Table 1: Collaborative a-synchronous tools for interaction

Theoretical framework

As previously mentioned, we developed the MOOC-MDT framework to suitably describe and analyze the MOOC’s dynamics (presented by Taranto in TSG 44 of ICME 13). It integrates three

theoretical frameworks in a new form: the Meta-Didactical Transposition⁵ (MDT: Arzarello et al., 2014), Connectivism (Siemens, 2004; Downes, 2012), and the Instrumental Approach (Verillon & Rabardel, 1995). In what follows we give a synthetic idea of this framework.

First, a MOOC can be considered as an *artifact*, that is a static set of materials. Connectivism allows us to picture the *MOOC-artifact* with its own network-based knowledge: its nodes are the content, the ideas, the images and videos used; the connections are the links between their node pairs. When a MOOC module is activated, it dynamically generates a complex structure (Siemens, *ibid*; Downes, *ibid*) that we call *ecosystem*: “all the relations (exchange of materials, experiences and personal ideas/points of view) put in place by participants of an online community thanks to the technological tools through which they interact with each other, establishing connections within the given context”. The network-knowledge of the *MOOC-ecosystem* is dynamic: it evolves as the MOOC-artifact’s network, thanks to the participants’ contribution. Also, the network-knowledge of individuals evolves as a personal self-organization (Siemens, *ibid*, p. 4) of the ecosystem. The process of transformation from artifact to instrument (Verillon & Rabardel, *ibid*) is here replaced by the evolution artifact-ecosystem-instrument.

In a MOOC there are two communities, a community of inquiry (the researchers and designers of MOOC) and one of practice (in the sense of Wenger, 1998), that is teachers as trainees in the MOOC⁶. The trainers evolve from their meta-didactical praxeologies (*m-dp*), to new ones, to deal with the MOOC’s training in Geometry. These new *m-dp* are based on a double awareness. One is that learning within the MOOC is connectivist: each trainee is part of a community, with the opportunity to share her/his own views, self-organizing information, with which (s)he comes into contact, for creating new connections, and questioning the existing ones. The second is that what is shown in the MOOC should encourage experimentation. The trainers’ *m-dp* constitute the network of the MOOC-artifact. During the implementation of the MOOC-artifact’s network-knowledge, in fact, trainers foster its nature of ecosystem, sharing tools and posing appropriate key questions. Moreover, the tasks designed by trainers suggest to trainees, in a more or less explicit way, to use the proposed material in their classes. In such a way, the MOOC is enriched with reports about trainees’ teaching experiences: this process increases a virtuous circle that encourages other trainees to experience the same materials. For this, the trainers’ *m-dp* evolve themselves, because trainers analyze, observe and monitor the MOOC activities as an ecosystem, to understand what did work or not.

The community of trainees is not a unitary subject of learning: the MOOC-ecosystem is an *instrument* that belongs to each single trainee. The trainees have to solve multi-tasks, through multi-techniques, properly justified. In fact, they must look at the proposed material, share their thoughts through sharing tools, and experience their activities. These tasks are not predetermined, depending on the

⁵ MDT is a model that describes the process of teachers’ professional development with the aim of grasping its complexity. It is a tool to analyse the dynamic aspects of this process, namely the evolution of teachers and researchers’ activity over time. This activity is described through teachers’ and researchers’ meta-didactical praxeologies (Arzarello et al., 2014, pp. 353-355), which consist on the task in which they are engaged in the educational programme, with the techniques used to solve it, along with its theoretical justification.

⁶ In the following we use *trainers* to indicate both researchers and designers and *trainees* for participants of the MOOC.

time, approach and depth with which trainees address them. The multi-techniques are the ways in which the trainees extend and modify their network-knowledge, drawing on that of the ecosystem, and influencing it in turn (thus affecting all other trainees). The *m-dp* of each trainee trigger a “**double learning process**”: firstly the MOOC-ecosystem is a specific learning tool for the individual, and secondly the use of MOOC-instrument by the individual generates learning for the whole ecosystem. The dynamic process has the following components, intertwined and self-feeding each other:

- i. **Instrumentation/Self-organization** (from the ecosystem to the individual): process by which the network of MOOC-ecosystem expands the individual’s network-knowledge. In particular, the **instrumentation** (Verillon & Rabardel, *ibid*) is the process by which the chaos (Siemens, *ibid*) of the ecosystem network reaches the individual. The many novelties of views and experiences make sure that the individual compares himself with new usage schemes. A phase of **self-organization** (Siemens, *ibid*) of the MOOC’s information follows this process: when the individual selects which usage schemes proposed by the MOOC are valuable and which are not.
- ii. **Instrumentalization/Sharing** (from the individual to the ecosystem): process by which the individual’s network-knowledge expands the network of MOOC-ecosystem. The **instrumentalization** (Verillon & Rabardel, *ibid*) is the process by which the individual, with her/his renewed network-knowledge independently builds new connections. The individual is stimulated by a task requested by MOOC and (s)he caters to the ecosystem to turn it according to her own (new) usage schemes. (S)He wants to integrate it with her/his own cognitive structures. **Sharing** is the process by which the MOOC welcomes the contribution of the individual and makes it available to all: information goes towards all members.

Within this complex, iterative learning process lies the inherent difference between the frame of the MDT and the MOOC-MDT. In fact, in the MDT, the trainers shape their proposal according to the practices they think appropriate, and so they can realize how much the trainees learn such proposal. On the contrary, inside the MOOC-MDT the process appears to be more difficult to control. The trainers do not know “what” the user has really looked at among the presented materials, nor they can know how (s)he interpreted them. At the same time, the trainees benefit from material provided not only by trainers, but also by other trainees that share some of their own materials and ideas using the communication boards. The process evolves stochastically: a determining role is played by the individual trainees, and by their feeling as a community with whom to collaborate, to inspire and to share results. Basing on such a theoretical framework, it is now possible to suitably formulate a specific research question as follows: *How effective and in which form is the collaboration between involved teachers (trainers and trainees), and how does it develop because of the support of tools designed by the trainers?*

Data analysis

The accesses of the trainees in the MOOC (distinct from watching videos, reading materials and interventions in communication boards) have been in the order of tens of thousands. Accessing the MOOC, each trainee enters into an ecosystem, living in it through the use of free collaboratively asynchronous tools (as shown in Table 1), through which (s)he interacts with a community. Each of these interactive tools has been carefully monitored by the trainers’ team during the weeks of the MOOC delivery. The trainers’ team met regularly and, at the end of each module, they shared what

they had observed during that specific module. In particular, the most significant trainees' interventions or sharing actions were discussed. After the first few weeks we realized that we were dealing with a unique community of trainees, which we will expand on in the last section. We explain below how the trainees have used these interactive tools, showing some examples (in italics).

The forum played a predominant role with respect to the other tools. Despite being an almost out-dated mode (based on web 1.0), the trainees were very fond of it and used it to share their experiences of learning or of working. There was no moderator in the discussions: each trainee had the opportunity to read a diversity of opinions and experiences, and when (s)he understood how it worked, then (s)he introduced her/himself, became an author of posts, influenced other colleagues, or appreciated the idea expounded by a colleague. For example, in the second module of the MOOC, the geometrical topic was the widespread (at least in Italy) misconception that students have between angle and arc. Several activities have suggested to teachers to tackling this problem and a forum was inserted in this module. It collected 31 discussions, each of them with from 1 to 21 response replicas. In the following, just an extract: *“The proposed activities have made me think about (a) how the conceptual articulation “Angle vs. arc” is delicate. When the guys study trigonometry at high secondary school (b), they know the Radian that [...]allows you to no longer distinguish between (width of) angle and (length of) arc. I would like to know your thoughts (c), especially those who teach at lower secondary school”*. In (a) there is an evident phase of Instrumentalization: the trainee is creating new connections between his network-knowledge and that of the ecosystem. He was stimulated by the activities that he saw in this module and he is connecting this thinking to his classroom (b). In particular, he invites another person to share their thoughts about this topic (c).

If the forum was the right place for the trainers to talk about themselves, including their strengths and weaknesses, the Padlet was the place where the trainees began to share photos, videos and, spontaneously, their own materials. It is clear that the Padlet did not help to structure the exchange, but many trainees obtained inspiration from the exchange of materials in this place. For example, it was re-used and proposed by a participant as a tool to track her training programme with the construction of a Learning Diary: *“I am reviewing all of the course materials ... Because of my age, I can hardly remember the various proposals, ideas offered in this course surely professionally enriching and among the best I've attended to! So I thought to produce a Learning Diary with Padlet. Step by step it will enrich it, even with external links, with the materials I have looked for during this course or suggested by colleagues in the forums. Can it be useful to anyone?”*.

The Tricider had the goal of triggering simple threads, most of all confined to the approval or not of ideas, by voting through “likes”. However, the participants used it more for collecting ideas and comparing their didactical experiences – as a forum – rather than for the expected use. Practically, the trainees realized a *catathresis* (Verillon & Rabardel, 1995): an artifact is used to do something it was not conceived for. Due to the fact that they explored the tool for the first time, and also because they usually need to explain and to go in depth when they express an idea, so the simple vote would not have let them satisfied. The posts written in Tricider are rich of ideas for both trainees and trainers. The trainees were introduced to a new tool for them. The trainers acquired awareness about the necessity to be clear in writing the tasks, in exemplifying the use of the tools and in providing tutorials on their affordances.

Beyond some trainers' interventions in the forums, or email communications with administrative aims, the actual contact between trainees and trainers was realized through three online webinars (using the chamber BigBlueButton of Moodle): they supported the community with synchronous interaction. While the trainers in the webinar could use video and chat, the trainees could use only the text chat. The trainers (in this case, only the academic professors) presented themes linked to the didactics of geometry and from mathematics education research. In all the three webinars there was a high participation (from 90 participants in the first one to 50 in the last one) of trainees, who posed questions and doubts.

Discussion

The complex ecosystem structure developed as soon as the trainees had begun to access the MOOC. They are asked to enter into what, at first glance, may look like *chaos*, because of the multitude of materials and available technological resources. In fact, initially the trainees may not have enough self-confidence with the situation (*instrumentation*). Gradually they implemented the *self-organization* phase: appropriating the use of the MOOC's usage schemes, they began to use resources and materials (*instrumentalization*) and also to contribute comments to the communication boards (*sharing*). A community, in the sense of Wenger (1998), began to take shape. It is a community comprising individuals who are both looking for answers and helping others, by sharing their practices - a community that seeks to grow collaboratively. The will to establish the threads often leaks out, though it is very difficult that they take shape in a broad and articulated manner. In fact, the threads tend to split into different groups, which are formed and split locally and for a certain period of time, depending on the needs felt by the individual, but generally they contribute to give to all trainees the sense of a common participation in one unitary event, precisely the MOOC. Using a term from neuroscience, we call this property *plasticity*, which makes it possible to adapt to various situations in different groups and times. It is true that situations and times change, but within a community that preserves its global unity. This unity consists in the collaborative sharing of what happens, even if the active participation converges on more than one local theme. The sharing processes (of materials, thoughts, ideas, experiences) in fact gives life to the ecosystem, enhancing the materials and expanding the individual's network-knowledge. Even the "contact points" with trainers via webinars contribute to this purpose. Through sharing processes the ecosystem becomes more and more structured; fragments from the history of web communication (from web 1.0 on) coexist and complement each other, and are used by the trainees. This aspect is interesting and little pointed out in the literature. It is something similar to the multimodal interactions that take place in the classroom thanks to the activation of different registers: we call it *technological multimodality*.

Plasticity and *technological multimodality* are the two main properties distinguishing the evolution of a community in a MOOC from that in a traditional training course. It is primarily for this reason that we needed to change the framework of the MDT elaborating the lens of MOOC-MDT: it allowed us to give a first answer to our research question.

Comparison with the French experience and conclusion

The Italian team worked to observe a general community, studying the MOOC phenomenon at a macro level and they did not intervene in the interactions between trainees. By contrast, the French team (Panero et al., 2017) observed local communities of practice. They studied the phenomenon at

a micro level, intervening in the groups' discussions to support and encourage the development of the collaborative work. During MOOC Geometria local groups are generated "emerging from chaos" (Siemens, 2004), namely they are subject to a spontaneous generation. During MOOC eFAN Maths (the French MOOC) trainers induce the generation of local groups and regulate peer relationships. Despite the fact that the cultural aspects affect these differences for sure (as we underline in our similar introduction), for both MOOCs there is an affinity that relies on the fact that trainees' learning is often generated by self-feeding discussions and instrumentalization processes.

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