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Analysing MOOCs in terms of teacher collaboration potential and issues: the French experience

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The main aim of this paper is to analyse the experience of a MOOC for teacher training implemented in France, in parallel with a similar experience in Italy. 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 outlined a common starting point of the research and some common research concerns (see the Introduction). Each team then reformulated the research questions and tried to answer them through specific theoretical lenses. In the case of the French MOOC eFAN Maths, we study the trainees' collaborative design of a pedagogical resource, by focusing on the efficiency of an evaluation grid designed by trainers to be used within a global process of peer evaluation. This analysis will be enriched by the comparison with the results of the Italian and other MOOC experiences shared within the TWG15.

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

Introduction

Internet communication tools have given 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 from the initiative of prestigious Universities (MIT, Harvard, Stanford, ...) that find an interest in enlarging the courses they offer to a wide audience. Since then, the MOOC phenomenon has been regularly growing and the worldwide number of MOOCs doubled from 2014 to 2015 (Shah, 2015). Although there is a wide choice of several different topics the range is limited when looking specifically for a MOOC aiming at teacher training, especially in mathematics. Nevertheless, there is a growing interest in MOOCs involving mathematics teachers as participants, as shown by TSG44 work during the 13th ICME¹. 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 collaborative work among teachers as the 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 survey of Robutti et al. (2016). The authors find that teachers can learn through discussion, conversation and reflection on their own teaching, on students' learning and on others' teaching. The methodology of the French MOOC eFAN Maths (as well as the Italian MOOC

¹ For more information, see http://www.icme13.org/files/tsg/TSG_44.pdf

Geometria) aims at creating collaborative contexts for teachers' work, where they can learn from these kinds of practices. Taking into account the necessity for teachers to be supported in exploiting the technological affordances, the objectives of both MOOCs are: 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 proper 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 similar MOOCs, one in Italy and one in France, is twofold. First, it focuses on the specific dynamics of online interactions – among trainees and between trainees and trainers – to study the trainees' use and appropriation of a tool (an evaluation grid) designed by trainers for supporting peer evaluation of collaborative projects. It is topical and urgent to analyse the efficiency of such tools and interactions in the context of distance learning, because of the increased interest in this approach in recent years. Second, it analyses such dynamics according to the cultural constraints that shape MOOCs design and development. French and Italian school environments have some remarkable differences and one of the most palpable is a wider freedom that institutional regulations traditionally give to the Italian teachers, compared to the major institutional constraints met by the French teachers. The Italian *Indicazioni*² (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). They have the character of general didactic guidelines and deliver 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*³ (syllabus) 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 the curriculum implementation in the classroom.

In this paper, in parallel with the Italian one, drawing on the common theoretical element of the Meta-Didactical Transposition (Arzarello et al., 2014), we intend to highlight how the concepts of community and of collaborative work evolve, taking new and different forms, and how this impacts on teachers' professional learning. During the conference the two teams, who are working together for comparing the data from the two MOOCs, will discuss the relevance of cultural and institutional aspects in the specific dynamics of the two experiences.

² http://www.indire.it/lucabas/lkmw_file/licei2010/indicazioni_nuovo_impaginato/_decreto_indicazioni_nazionali.pdf

³ Links to the French curriculum and supporting material are available at <http://eduscol.education.fr/>

Description of the MOOC eFAN Maths

The MOOC eFAN Maths⁴ was delivered on a French national platform (FUN, France Universités Numérique) and its target was the French-speaking community all over the world, namely mathematics teachers and teacher educators willing to improve their practices in using technology in their classrooms. The second season of the MOOC, which is reported in this paper, lasted from the 8th of March to mid-April 2016 and was organised in five weeks. The MOOC eFAN Maths is part of the *Stratégie Mathématiques* of the French Ministry of Education, which stresses the relationship of mathematics with other sciences and with the world, and aims at training teachers in this perspective in order to give students a refreshed image of mathematics. More specifically, this season of the MOOC was created with a double institutional aim: to support teachers and teacher educators in understanding and implementing the new French curriculum (since September 2016 in all French primary and secondary schools) and to promote collaboration within the French-speaking community. Courses, activities and discussion were especially focused on the new themes involved in the French curriculum, namely algorithmics and interdisciplinary work. The MOOC was grounded on a project-based pedagogy, aimed at the design and the analysis of a classroom activity involving the use of digital tools. Every week, trainees took courses on specific topics of mathematics education from three video-based lessons, answered the related quizzes and worked on specific activities. The courses were constructed to provide trainees with elements to develop their reflections and projects about teaching and learning mathematics with technology. They showed brief episodes of classroom observation and their analysis, or were based on existing resources, showing and commenting animations or programs created with technology. Regarding the activities, collective work was strongly encouraged among trainees. For this purpose, they were invited to join the “MOOC eFAN Maths 2016” group, created on Viaéduc⁵, a professional social network specifically designed for teachers’ exchanges. Viaéduc essentially allows members to post comments, to create subgroups, to create and publish documents and to comment/recommend/share them. Group members can work collaboratively either asynchronously, being authors of the same online document, or synchronously, writing on the same online collaborative board (*padlet*).

During week 0, on Viaéduc, trainees were invited to propose a theme, an idea or a project to work on and to start establishing relationships with others. Week 1 was devoted to the characterisation of digital or non-digital resources that can support teachers’ and teacher educators’ work. On Viaéduc, trainees gathered together around a project constituting public subgroups of the main “MOOC eFAN Maths 2016” group, so that any trainee could read the work of any subgroup and follow any discussion. Week 1 activity consisted in selecting resources deemed as relevant for the project of the group in order to constitute its “toolkit”. Week 2 was devoted to the analysis of students’ activity using technology in mathematical situations. On Viaéduc, each group had to design a mathematical situation and to analyse it from the student’s point of view using an analysis grid proposed by the trainers. Week 3 was devoted to the analysis of the teacher’s role in the designed

⁴ For further information, see <https://www.fun-mooc.fr/courses/ENSDeLyon/14003S02/session02/about>

⁵ See www.viaeduc.fr

mathematical situation. An analysis grid focusing on instrumental orchestration was presented through the courses and trainees were invited to apply it to their situation. During week 4 trainers organised a process of peer evaluation of the different projects (submitted as versions 0) and proposed an evaluation grid grounded on the theoretical frames presented in the courses underpinning the analysis of digital resource quality (Trgalová & Richard, 2012). Finally, every group was supposed to refine the project, using the received feedback, and to submit the version 1.

Theoretical framework

In order to analyse the MOOC eFAN Maths we combine three main theoretical frameworks: the Meta-Didactical Transposition (Arzarello et al., 2014), the documentational approach to didactics (Gueudet & Trouche, 2009) and the concept of communities of practice (Wenger, 1998).

The Meta-Didactical Transposition (MDT) model, as well as the documentational approach to didactics, giving major importance to the collective aspects of teachers' work, needed a theory for analysing the development of teachers (as well as researchers) collectives. Both approaches chose the theory of communities of practice (CoP), mainly because these communities are structures where learning occurs. CoP are formed by people who engage in a process of collective learning in a shared domain of human endeavour. For Wenger (1998), a condition for the development of such communities is to equilibrate participation and reification, where reification means producing resources, symbols, stories etc., recognised by the whole community as common goods. Such communities may develop by themselves, or be "cultivated" (Wenger et al., 2002), i.e. encouraged, supported by an organisation. Indeed, the knowledge of an organisation lives in a constellation of CoP each taking care of a specific aspect of the competence that the organisation needs.

The MDT model captures dynamic interactions between teachers' and researchers' practices when these two communities interplay, typically in training contexts, and in particular in the case of training programmes in mathematics education. Using the MDT lens, we can address research questions that imply the influence of the practices of one community on the other. Such practices are described through the notion of praxeology (Chevallard, 1999): a praxeology for a given task consists of a practical block comprising techniques to accomplish the task, and a theoretical block justifying and supporting these techniques. In a teacher education programme, trainees and trainers bring into play the components of their respective praxeologies. The objective of the programme is to transpose, in the sense of Chevallard (1985), some components of the trainers' research practices into the teachers' practices, taking into account the classroom reality and teachers' expertise for effectively enacting such components. Thus, the two communities together contribute to creating a shared praxeology, which both communities can adapt in their future practices. This occurs through the phenomenon of *internalisation*: a community internalises a component of the praxeology of the other community, that was previously external to it, entailing an evolution of practices.

The documentational approach to didactics (Gueudet & Trouche, 2009) analyses teacher professional development through the interplay of practices and resources. This interplay is modelled as a *documentational genesis*, extending the notion of instrumental genesis introduced by Verillon and Rabardel (1995) between artefact and instrument. A documentational genesis entails different steps, such as looking for resources, selecting/designing mathematical tasks, planning their

sequence, managing available artefacts, etc., for reaching a given teaching goal. This process gives birth to a document, which is a mixed entity composed of the revised and recombined resources and the associated usage scheme. Each documentational genesis is then a means of triggering teacher professional development. The genesis of a document combines two processes: *instrumentation*, when the affordances and constraints of the resources influence the subject's activity, and *instrumentalization*, when the subject shapes the resources that he/she appropriates. The documentational approach to didactics, from its beginning, and even more in its recent developments (Pepin et al., 2013), gives a major importance to the collective aspects of teachers' work with resources, evidencing the importance of interactions within teacher collectives for spurring documentational genesis and teachers' professional development.

The combination of these three frameworks allows us to analyse what happened in the MOOC, seen as a constellation of cultivated CoP. These communities are not created at once, they emerge in the dynamics of a shared project. First, the community of trainers emerges to design and implement a new teacher education programme. Then the communities of trainees emerge, each one developing all along the advancement of its own project. The elaboration of a project consists in designing a pedagogical activity from selected existing resources that are adapted, modified and combined by the group members. This process can thus be seen as a collective documentational genesis. In such a process, we are interested in analysing the efficiency of the tools designed by the trainers, as elements of their meta-didactical praxeologies, to foster both collaboration and project development. We study the phenomenon of internalisation in interaction with the process of documentational genesis as a reification process, addressing the following research questions: How does each trainees' CoP emerge through the process of documentational genesis according to CoP criteria? How do the CoP of trainers and each trainees' CoP interact through the MDT lens?

Methodology of the study

In this paper, we focus on the last week of the MOOC and in particular on the use of the evaluation grid by the trainees. Indeed, this tool was constructed by the trainers to encompass all the phases of the pedagogical design, developed in the MOOC week after week. Analysing the way trainees use it can give us insights into the way they have understood and interiorised the principles of each phase of design. Moreover, this moment represented an interesting dynamic between an individual activity (the evaluation of another project through the grid) and a collective work (of each group on the delivered version 0 for improving it).

The grid was structured around the following four criteria:

1. Accuracy of the definition and description of the project.
2. Relevance of the mobilised digital resources with respect to the educational goal of the designed mathematical task.
3. Relevance of the analysis of the students' activity.
4. Relevance of the analysis of the teacher's role.

For each criterion, aimed at evaluating the work done by a group during a specific week, some guiding questions are proposed with a double objective: to foster the production of justified

feedback and to deepen the reflection carried out in the previous weeks of the MOOC. The grid finally asked for a brief global feedback on the project and some suggestions to improve the work. Trainers provided this tool to support trainees in the process of peer evaluation, with the implicit aim of facilitating the internalisation of the evaluation criteria. Each trainee was invited to use the grid individually to evaluate the project of another group, by answering each guiding question with an appreciation: very good, satisfactory, fragile or insufficient, accompanied by a justification. Trainers gradually collected feedback and comments in a table and shared it in a specific space on Viaéduc, called “Project evaluation”, so that all the trainees could access them.

Data analysis

We collected a great amount of data coming from different sources: answers to the final questionnaire sent to all the trainees; interventions on the forum; discussions on Viaéduc within the “MOOC eFAN Maths 2016” group and within the different subgroups. Among the 2500 people enrolled in the MOOC, more than 700 registered on Viaéduc and about 11% of them contributed to the work of a group. For analysing how trainees used the evaluation grid, we focused on those who participated to the work of a group. Drawing specifically on Viaéduc discussions, we illustrate in this section the main finding of this study: the trainees’ internalisation of the evaluation criteria, through the tools provided and the process established by the trainers.

The evaluation grid became a resource for trainees. They used it both for providing feedback to other projects (instrumentation) and for reflecting on and refining their own project (instrumentalization). Let us illustrate this double action – that of the grid on the trainees and that of the trainees on the grid – through some excerpts of Viaéduc discussions. The comments, written by some trainees (EE, CC, CM) on the wall of the “MOOC eFAN Maths 2016” group, show a formative value of the peer evaluation and specifically refer to an introspective use of the grid.

- EE Yes, actually, “evaluating” the project of your peers is ultra-formative. It inevitably sends us back to ourselves and stimulates a lot of reflections. I encourage all those who can to participate in it.
- CC It is clear that the peer evaluation of the projects is also an exercise [...] I think that the aim is not marking “very good” everywhere, so I try to use the grid with its criteria that I start to understand [...]. A difficulty that I encounter is that, when I perceive a small flaw in one of the aspects of the whole structure of the project, this flaw seems to impact on several items of the grid...? [...]
- CM [answering to EE] Indeed, by evaluating another project, you discover much better how to improve yours. The evaluation grid is a great support but I join CC on the domino effect of some points.

In particular, CC’s and CM’s comments show a well-thought-out use of the grid, especially the awareness that all the criteria are interrelated to analyse the work. The double process of instrumentation and instrumentalization of the grid shows that trainees internalise the evaluation criteria using the grid also for reflecting on the quality of their own document.

Moreover, the remote collaboration on Viaéduc allowed trainees to make the version 0 of the document evolve into the version 1, taking into account both peers' external feedback and each member's introspective feedback. An example of this step in the collective documentational genesis is represented by the use of the padlet "TO DO List" within one of the groups. In this padlet, the group members organise the different tasks to be done in order to make the common document (version 0), seen as a resource, evolve into a new document (version 1). When a comment is ticked off and an author and a date are specified, this is the sign that the task has been done. This to-do list consists of feedback coming from peers but also of some personal comments, such as "For the resources I think that we must orient the reading of the first ones according to the soma cube activity". We can reconstruct the story of this proposal of reorganisation of the project resources, thanks to the parallel discussions occurred in the group. Such discussions show that trainees (JP in this case) benefited from both peers' feedback and introspective feedback, coming from the action of evaluating other projects.

JP [on the wall of the group] Hello, after having read several projects I actually expected that someone "criticises" a little bit our profusion of resources. This being said, as noticed by our (unique, sniff!) evaluator, AM's work is very rich and it would be a pity to modify our toolkit that will maybe carry on after the MOOC. Perhaps, we could prune it in the v1 of the project by keeping only those that are actually usable in the SOMA cube activity. What do you think?

In terms of remote collaboration, it is worth noting that some groups used such collaborative tools for organising their remote work. This organisation guided the transformation of the version 0 into the version 1 of the project, as a reification of the collaborative participation within the CoP.

Conclusions

Each community of practice benefited from the others' feedback and from the introspective reflections that the members, who were engaged in the design process, made during the evaluation process. Crossing the external and the introspective feedback allows the trainees to work collaboratively on the refinement of their version 0 and to produce the version 1 of their project. This new version of the document is both a stage in the documentational genesis and the result of the internalisation of the evaluation criteria which occurred through the participation in the evaluation process.

On the one hand, the evaluation grid is a technical tool of trainers' meta-didactical praxeologies, based on the theoretical concepts tackled in the courses and justified within the global process of peer evaluation. On the other hand, the trainers' choice of collaborative tools, seen as a trainers' technique, is grounded on the trainers' objectives to foster the emergence of communities of practice among trainees. Our analysis shows how these praxeological choices influence the trainees' work when they improve the version 0 of their project into the version 1. In return, this analysis influences the trainers' meta-didactical praxeologies in the perspective of a re-design of the new season of the MOOC. In particular, the organisation of the MOOC schedule will be modified taking into account the emergent question of time. Communities of practice need time for establishing an effective remote collaboration, so that participation and reification equilibrate as much as possible.

At the same time, the evaluation process and the documentational genesis need time for being effectively carried out. In that sense, we can observe the double phenomenon of internalisation: from trainers to trainees as well as from trainees to trainers.

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