

Chapter 6

Distance Technologies and the Teaching and Learning of Mathematics in the Era of MOOC

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ABSTRACT

This chapter reviews conceptual elements expanding study of recent theoretical frameworks for analyzing online courses for mathematics teaching and learning. A critical analysis is conducted about the peculiarities of the current online teaching and learning courses called Massive Open Online Courses (MOOC) available for supporting teachers in the teaching of mathematics with technologies. Analysis is based on the extension and implementation of key concepts of the didactic theory of mathematics, namely didactic transposition and teaching contract. Theory extensions, as computational transposition and epistemological and didactic validity, support reflections of online professional development of mathematics teachers from results of innovative experiences in distance education. The overall analysis highlights problems associated with the physical distance between actors involved in online educative modalities related to teaching and learning of mathematics with technologies and the virtual character of educational Internet resources and its impact on the type of acquired knowledge.

INTRODUCTION

“Distance learning is provocative because it is a source of restrictions that have their origin in a series of questions and rethinking of common practices”¹ (Balacheff, 2012). According to Balacheff (2015) the idea of distance is at the core of the problems of teaching and learning mathematics. For example, in the *Didactic of Mathematic*² the issue of distance is implicit in two of its key concepts, such as *didactic transposition* (Chevallard, 1991) and *didactic contract* (Brousseau, 1981). In general terms, didactic transposition indicates the distance between what students must learn in relationship to a body

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of knowledge and the scientific knowledge itself. Think, for example, about the mathematical notion of *ratio*. What must a student learn about this notion? That depends on what is prescribed in the official curricula. On the other hand, what is established from a purely mathematical point of view about the notion of ratio? Are these two views the same?

In the situation of mathematics learning or teaching, the concept of didactic contract indicates the distance (or proximity) between what students know about a specific topic versus what the teacher knows about this same topic. Although didactic transposition and didactic contract are born from the observation of teaching and learning in the classroom, as well as from the theoretical development coupled to it (as noted in Margolinas, 1998), it is interesting to approach and consider the richness of the theoretical development that results from the extension of these two concepts regarding online distance education now. Finally, it is worthwhile to examine the progress of applying them to their potential use in the specific case of some specific courses or online programs for professional development for mathematics teachers.

In his doctoral thesis, Bayle (2014) focused on the didactic contract and observing situations of virtual interaction between future teachers of French as a Foreign Language (FLE) with students of French language from the United States. He found that “future teachers tended to create a hierarchical relationship while trying to develop a relationship of closeness, while on the other hand, the students accepted the hierarchical dimension but kept their distance.” Bayle identified the construction of a teaching contract close to what is usually seen in an institutional context in which the roles of teacher and students are markedly different. On the other hand, he also considered that the theoretical foundations of the study laid in the interaction analysis and sociology of Goffman (1922-1982). Schematically, Goffman (1959, Preface) considered that

... the way in which the individual in ordinary work situations presents himself and his activity to others, the ways in which he guides and controls the impression they form of him, and the kinds of things he may and may not do while sustaining his performance before them [...] the part one individual plays is tailored to the parts played by the others present.

Accordingly, he justified that this approach was to provide students of sociology with a guide for observing case studies of institutional social life (Goffman, 1959, Preface).

In general, in building a hypothesis on the functioning of social communication (or in the construction of common social representations) in current distance education, an adaptation of processes previously operating in face-to-face situations can be perceived to subsequently apply it into the consideration of the generation of online educational processes or into its experimentation. For example, according to Bayle (2014),

... we rely on concepts extracted from social interactions in face-to-face situations, educative or not, to determine how the online pedagogical relationship is built in the context of language situations that emerge in communication contexts. Social interactions are our privileged object and it is through them that we seek to identify some observable relative to the horizontal and vertical dimension of the relationship.

In Bayle’s study virtual worlds were used because from that point of view, these worlds attract practitioners and researchers for their potential to recreate remote presence “in effect these allow recreating a ‘here and now’ thanks to the visual representation of the environment in three dimensions and a projection of oneself through an avatar” (2014, p. 212). Following Goffman, Bayle (2014) considered the distance

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