Chapter 19
Integration of Digital Technologies: Collaborative Practices in Teaching Mathematics

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ABSTRACT
This chapter presents an inquiry on how to integrate digital technologies (DT) in the teaching of mathematics in primary schools. The work focused on showing how collaborative practices between teachers during professional development can improve the process of integration and enable the configuration of a suitable land to cultivate a community of practice whose common interest is precisely integrate DT. The research design was based on the Design-Based Research (DBR) methodology, and the data analysis was performed using a systematic design process with focus on reflection on the practice, and under the iterative cycle of a workshop. The results suggest features that we consider necessary for the design of a professional development program whose purpose is to improve the integration of DT from school contexts themselves and based on the situated learning.

INTRODUCTION
This research discusses the relationship between mathematics teaching in elementary school, Digital Technologies (DT), and the collective work in teacher professional development as the main axis to understand how to improve the integration of DT in teaching practice. Analyzing this relationship is relevant because it allows elaborating training proposals to encourage reflective strategies and alternative solutions to real educational problems, such as low achievement in mathematics teaching in elementary school.

Recent researches (Hoyles & Noss, 2006; Hegedus, Dalton, & Moreno, 2007) have shown a growing interest in understanding whether there are new ways of conceiving mathematics and mathematical cognition. The results from these investigations give evidence that the structure of mathematical ideas can be restated by the teacher, when using DT coactively. It has also been noticed that technologies have

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an impact on cognitive activity, provided that in such activities the individual interacts with the DT. Finally, it has been pointed out that these technologies have led to changes in perception, memory and logic operations from the learning subjects (UNESCO, 2005).

Consequently, professional development spaces deserve special attention because teachers build their cognitive processes through interactions between them and technology when interacting. These processes are established through interpretation meaning structures, dialogs and a diversity of interactions related to other teachers and the technology used (Sandoval, 2011).

Considering that peer interaction implies that the teacher can perform collective work, this research looks to promote collaborative work by developing a community of practice (Wenger, McDermott, & Snyder, 2002) related to professional development and mathematics teaching. Specifically, it aims to investigate how collaborative practices affect the integration of DT during teaching. Four conceptual axes shape the problem statement and methodological framework that guided this research: professional development, communities of practice (CoP), integration of DT and technological, pedagogical and content knowledge. To accomplish the aims, this research analyzed the collaborative practices of teachers during a professional development workshop designed to enable teachers to integrate DT in their mathematics teaching. The workshop was designed following an iterative cycle described by Design Based Research (DBR). The results show that the process of developing a community of practice, composed by twenty teachers in this case, can lead to create collaborative practices. The analysis of teachers showed evidence of changes as a result of collaborative practices in which they were immersed. The chapter ends with a discussion of the model used at the analysis.

Problem Statement: Assumptions, Questions, and Objectives

According to the research conducted by Salas (2005), the results of integrating Information and Communication Technologies (ICT) in schools has not progressed or changed significantly in the last two decades. The investments in infrastructure, equipment and programs to incorporate ICT in education have not impacted the quality of education as expected. Even though ICT cannot be seen as a single solution to the multifactorial problem of educational improvement, it is a fact that technologies have been implemented in schools under inadequate planning processes (Salas, 2005). There have been some negative attitudes of final users (teachers), frequently resulting in some resistance that prevents the proper usage of the resources. Additionally, if not considering such teachers as final users, it is very difficult to establish a mechanism of technical, educational, and administrative sustainability.

By training teachers on how to reflect about their own teaching practices using ICT (Imbernón, 2008), it becomes possible for them to integrate technologies into their teaching practices, instead of integrating their practices into the technologies as has happened in national training programs so far. In addition, the most important rationales in this research were that self-reflection can be enhanced by collective work, and that reflection and collective work can prompt the teacher to take action while working with peers (Parada, 2011). By participating in professional development programs and complementing their classroom practice, teachers can build knowledge from the community of practice. Gradually, they become more autonomous when performing activities individually and collectively to improve their teaching practice when integrating DT in mathematics.