

## Chapter 20

# Flying a Math Class?

## Using Web-Based Simulations in Primary Teacher Training and Education

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### ABSTRACT

*This chapter presents a pilot exploratory case study that seeks to bridge the classic gap between teacher preparation and practice by exploiting the affordances offered by digital simulations for contextualizing novice teachers' learning and pedagogy. Using the simulated classroom SimSchool as a virtual field experience, a teaching intervention focused on mathematics education and the use of technology was conducted in order to determine best practices. Both undergraduate and graduate education students participated in the study. The study explored participants' views on the experiences with the simulated environment. Interviews and self-reflection reports were used for data collection. Findings suggest that participants appreciated simulations as virtual environments that provide the opportunity to practice and experiment on particular teaching approaches in a safe environment. Nevertheless, they also express a number of concerns related to how they compare simulations with real classroom experiences and their interaction with virtual students, as well as some technical considerations. Simulations have a great potential to create reality-based learning contexts that foster opportunities for pre- and in-service teachers to improve their pedagogy. Thus, further research is required to unfold all aspects of such approaches.*

### INTRODUCTION

Despite the extensive calls for the uptake of learner-centered, inquiry-based pedagogical models in mathematics education, changing teaching practices is proving to be quite difficult. The research

literature indicates a disconnection between curricula initiatives and calls for reform and actual classroom practice and suggests the persistence of traditional, teacher-centered approaches (European Commission, 2007; Barab, Hay, Barnett & Squire, 2001; Klette, 2009; Tiberghien & Buty, 2007). There is strong evidence that, in practice, inquiry-based teaching and learning of mathematics is not widely implemented (Euler, 2011).

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The methods of instruction have been identified as contributing to students' falling interest in mathematics (Van Langen, 2005). Empirical classroom research over several decades shows that, with some notable exceptions, mathematics instruction has been characterized by traditional, abstract formulation which seems to be readily understood by only a small fraction of students (Mor, Winters, Cerulli & Björk, 2006). The teaching of mathematics is viewed as unappealing to the majority of students, as outdated and unconnected with their interests and experiences (Goodrum, Hackling & Rennie 2001). Ideas are presented in an overly theoretical and abstract manner without sufficient opportunities for students to engage in problem-solving and experimentation.

Pedagogical approaches to teaching mathematics cannot be considered in isolation from the people who implement pedagogy in classrooms. Teachers are probably the most important actors in promoting a change in the way mathematics is taught (Euler, 2011). Although many factors affect a teacher's effectiveness, teacher knowledge is one of the biggest influences on student achievement (Fennema & Franke, 1992). Recognizing that the blend of content knowledge and pedagogical content knowledge is most critical for effective instruction, leaders in mathematics education have highlighted the need for improving teachers' pedagogical content knowledge of the subjects (e.g. Ball, Lubienski & Mewborn, 2001). Pedagogical content knowledge refers to the ability of teachers to transform formal subject matter knowledge into pedagogically powerful forms that are appropriate for a particular group of students (Shulman, 1986). It includes knowledge of students' typical conceptions and preconceptions regarding main mathematical ideas, understanding of what makes the learning of specific topics easy or difficult, knowledge of effective strategies for helping students re-organise their understanding, as well as the ability to be adaptive to the varia-

tions in ability, prior knowledge, and individual characteristics presented by students (Fennema et al., 1996).

Teacher education programs do their best, through the mathematics methods courses they typically provide, to equip future educators with the skills and knowledge necessary for effective, standards-based teaching of mathematics (Zibit & Gibson, 2005). In recent years, however, they have been criticized for failing to equip their graduates with the knowledge and skills required to teach quality mathematics and to produce reform-based classroom change. Research indicates that the majority of teachers entering the profession lack substantial mathematics content knowledge, knowledge of what to teach, and of how to effectively represent the subject matter to learners (e.g. Parker & Heywood, 2000). A chief criticism of teacher education programs is that they are disconnected from the school system (Kirby, McCombs, Barney & Naftel, 2006), overly theoretical (Darling-Hammond et al., 2005) and not as relevant as practitioners demand (Crocker & Dibbon, 2008). Methods courses tend to predominantly deal with the visible parts of knowledge—the “know-what” of teaching mathematics – and not with the tacit knowledge—the “know-how”— which is essential to becoming a professional (Zibit & Gibson, 2005). The opportunities that pre-service mathematics teachers have to practice teaching are limited. Much of what they are taught about teaching can be likened to being told how to fly an airplane without ever having taken one off the ground (Christensen, Knezek, Tyler-Wood & Gibson, 2011).

Education scholars and policymakers have called for the contextualization of pre-service teachers' learning of pedagogy and content within the complex context of schools (Oakes, Franke, Quartz & Rogers, 2002). Many countries have taken up the task of redesigning teacher education programs in order to better prepare teach-

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