Chapter VIII
Integrating Technology and Research in Mathematics Education:
The Case of E-Learning

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ABSTRACT

This chapter is concerned with the integration of research in mathematics education and e-learning. We provide an overview of research on learning processes related to the use of technology and a sketch of constructive and cooperative methods and their feasibility in an e-learning platform. Moreover, we introduce a framework for dealing with language and representations to interpret students’ behaviours and show examples of teaching activities. Finally, some opportunities for future research are outlined. We hope to contribute to overcome the current separation between technology and educational research, as their joint use can provide matchless opportunities for dealing with most of the learning problems related to mathematical concepts as well as to linguistic, metacognitive, and noncognitive factors.
INTRODUCTION

The main concern of this chapter is the integration of technology and research in the field of mathematics education. Currently technology is too often used with little or no concern for the results of educational research, despite the fact that they could provide valuable help to both magnify the outcomes and keep away from some unwelcome washback. Conversely, too often research in mathematics education disregards the impressive opportunities technology could provide.

Through the chapter we focus on e-learning as a domain appropriate for integrating technology and educational research. We argue that nowadays technology is flexible enough to be used within different theoretical frameworks (such as the constructivist and the socio-cultural ones) and at different levels (cognitive, metacognitive, noncognitive). We also show that technology can provide matchless opportunities for dealing with most of the learning problems related to language and representations.

In the section “Background” we give:

• A concise overview of some outcomes of research that underline the complexity of educational processes, and in particular the need for taking into account not just cognitive, but also metacognitive and noncognitive aspects;
• An overview of research on individual and personal learning processes related to the use of technology;
• A sketch of the main features of constructive and cooperative methods and their feasibility in an e-learning platform;
• A framework for dealing with language and representations in order to effectively interpret students’ behaviors.

In the section “Teaching and Learning Opportunities,” we show examples of teaching activities which fulfil some of the requirements sketched and apply some of the ideas and methods discussed there.

The section “Future Trends and Conclusions” includes some discussion of the opportunities for future research.

In all the examples described in this chapter we refer either to Moodle (Moodle, 2006) or to IWT (Intelligent Web Teacher, 2006). The latter is a distance-learning platform designed to lay the foundation for the next generation e-learning (for details, see Albano, Gaeta, & Salerno, 2006, or Intelligent Web Teacher, 2006).

BACKGROUND

Technology and Research on Mathematics Education

Currently information and communication technology (ICT) is not strictly linked to any theoretical framework in mathematics education. This was not the case in the past, as sometimes it was naively associated to some specific cognitive framework (e.g., information-processing theory) or even to some interpretation of mathematics (e.g., computational ones). This may account for the relatively poor role played by ICT in most studies in the psychology of mathematics education.

We also assume that the use of ICT is not a simple matter but requires the development of detailed teaching paths and much research to fully exploit the opportunities provided and to keep away from any potential drawbacks.

Research on mathematics education, conversely, has widely shown the complexity of teaching and learning processes, and thus the inadequacy of one-dimensional models, including the belief that the simple addition of some technology to standard teaching practices could provide considerable improvements of the outcomes.

In particular any model for mathematics education has to consider that students’ performances are affected by factors belonging to at least three different levels:
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