

## Chapter 39

# Improving Learning Strategies for Mathematics through E-Learning

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### ABSTRACT

*This chapter describes an experience concerning a mathematics course offered at university for first-year science students. The course, realized in a blended format, is aimed at supporting students in the critical stage of transition from high school to university. Beside standard materials and resources, students were provided with online tools for the achievement of learning strategies mainly based on semiotic and pragmatic aspects of mathematical language. The online activities are an effective tool from the cognitive and metacognitive perspective, promoting a shift from passive learning (listening to lectures and taking notes) to more active modalities of learning where the students were engaged in student-instructor or student-computer interaction activities. Overall, more than half of the students participated in the optional online activities, and a positive relationship between this participation and the results in the final written test serve to verify the potential effectiveness of this form of study.*

### INTRODUCTION

The learning of mathematics is a major challenge for a number of freshman students, and failure induces some of them to quit. An increasing number of students start their undergraduate courses without an adequate cultural background, and with problems both at the cognitive and metacognitive level. On the one hand, freshmen come from different kinds of schools, and on the other hand, they have to deal with a new educational environment. Our students' learning strategies are often based

solely on listening to lectures, taking notes, and repeating by heart what they have written. The standard instructional setting at the university is usually not enough to support the development of learning strategies, particularly in the critical stage of transition from high school to university.

At the University of Eastern Piedmont Amedeo Avogadro in Italy, just prior to the beginning of the academic year, an intensive introductory mathematics course is held in order to give students all of the cultural background needed to face first year mathematics courses. In recent

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years the standard course was supported by online activities introduced in a special online course implemented in the e-learning platform Moodle, in order to help students to face learning obstacles. The introduction of the online course did not require many organizational changes. Indeed, a part of the first face-to-face lesson was dedicated to introduce students the platform Moodle and to explain how to use it.

The online course had been realized to support the math bridging course and had been aimed at improving mathematics learning by bringing together the results of research in mathematics education and the opportunities provided by information and communication technology (ICT). The idea was to promote a shift from passive learning (listening to lectures and taking notes) to more active modalities of learning where the students were engaged in student-instructor or student-computer interaction activities. In particular, the online course was introduced to foster students' autonomy and to increase their ability to select appropriate resources and activities.

Special care was paid to language, according to the main principle that language is not only the carrier of pre-existing thinking but that it also fosters the development of thinking itself (Sfard, 2001). In particular, activities were designed in order to promote the coordination of different semiotic systems involved in the learning of mathematics (e.g., verbal language, symbolic expressions, visual components), thereby exploiting the opportunities provided by the e-learning platform.

E-learning platforms provided tools that allowed students to engage in active methods of learning. Several activities such as 'quiz,' 'lesson,' 'task,' 'glossary,' etc. were implemented in a structured way. Some of these activities provided self-assessment and self-reflection opportunities that were realized through an automated feedback system (quiz, lesson), as well as student-instructor interactions (quiz, lesson, task).

Both the face-to-face and the online parts of the course were designed, implemented, and

managed by one instructor and one tutor only. The students that were involved attended undergraduate programs (biology, chemistry, computer science, mathematics, environmental sciences) offered by the Faculty of Mathematical, Physical and Natural Sciences.

## **BACKGROUND**

Many studies have highlighted the need for further research into the secondary-tertiary transition, and with the emergence of technological tools, many questions about the role of technology in teaching and learning are arising. For example, Geudet (2008) wrote "The question of the effective and possible uses of technology in the secondary-tertiary transition has not been researched yet, as far as I know... Could technology be helpful to foster novice students' autonomy, for example by using appropriate online resources?" (p. 252). On the other hand, several studies, which investigated what role online environments should have in university education, drew attention to blended modalities (see for example Calvani, 2005). According to their findings, the potential of course management systems in the learning of mathematics was experienced as part of the critical secondary-tertiary transition. Moreover, the experiment was realized following the main idea that e-learning activities, in order to be effective, must be conceived taking into account pedagogical theories.

Potential benefits and constraints of online platforms have been analyzed in order to combine suggestions arising from research on mathematics education and that focusing on the tools available within e-learning environments (Albano & Ferrari, 2008; Bardelle & Ferrari, 2010). In particular, the online activities were designed taking into account the main theory that language and communication play a central role in the learning of mathematics. The terms 'language' and 'communication' are used here in a very broad sense. 'Language'

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