Chapter 63
Computer-Based Mathematics
Instructions with MATCOS: A Pedagogical Experiment

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ABSTRACT

In this chapter, the authors describe the research and experimentation carried out and the results achieved in the last ten years in Calabrian secondary schools in the teaching/learning of Mathematics with the aid of computer programming in the MATCOS environment. The conclusions of the present work of research and experimentation are stated either in the relevant section, available in the articles mentioned in the bibliography, or can be found in the CIRD library. The chapter is organized as follows: first, the authors introduce the general background which prompted the research activity, and after, they present the MATCOS programming environment and elucidate its pedagogical-educational paradigm, technical characteristics, and use in everyday teaching through an example. Finally, the authors give a detailed description of the experimentation and the results obtained in the last few years. Future trends and conclusions round off the paper.

INTRODUCTION

For over twenty years the question of the teaching and learning of mathematics with the aid of computers has been debated in Italy and in the rest of the world. To begin with, the computer was used as a tool to be programmed through advanced languages like Pascal or Basic, and this was the only feasible option. However, the experiment did not seem to produce satisfactory results, and as a consequence didactic research began to take into consideration closed software programs, such as CAS (Derive, Maple, etc.) or dynamic geometry software (Cabri, Cinderella, Dr Geo, etc.). In the Interdepartmental Centre for Didactic Research (CIRD) of the University

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of Calabria, however, it was thought important to persist on the programming function, albeit supported by a language especially designed for this purpose. The programming environment called MATCOS (acronym of Mathematics Computer Software) was designed in this context, and it had two main objectives:

1. To introduce students to programming by teaching a mathematical syllabus suited to their age groups.
2. For the students to learn Mathematics through the aid of computers as programming tools.

The designed programming environment has specific didactic characteristics which will be described later.

After the initial research phase, an experiment began in several secondary schools in the Calabria region (Italy), which was guided and monitored throughout, and included the in-house training of the teachers involved.

The research and experimentation work carried out in the last few years appears to confirm our initial assumption. So we feel we can now state that the teaching-learning of Mathematics aided by the computer as a programming tool is not only possible, but also desirable for the positive effects it has on student education and training.

BACKGROUND

Computers, well known for their ability to solve problems effectively, can become an essential and continuous source of teaching actions in the teaching-learning of Mathematics when used in suitable contexts. In particular, the practice of programming takes the learner through a process of formative mental training (Kuzler, 2000), while at the same time the use of the computer allows the actual solution or simulation of problems in sensible reality. In the specific ambit of the learning of Mathematics, the practice of programming can successfully contribute to the development and consolidation of processes of conceptualization and abstraction. Computer programming, as has often been highlighted both at national and international level (Pea et al., 1985; Liao, 1991; Oprea, 1988), for its pedagogical-formative value cannot and should not be neglected in the setting of the teaching-learning of Mathematics. The introduction of elements of computer programming and basic notions of information technology in the Italian school syllabus was tackled at different levels of the education system through various projects and experiments (PNI1, PNI2, Brocca, etc.; see: http://www.miur.it/normativa), implemented by the Ministry of Education. The object of these initiatives was on the one hand to make basic knowledge of computing a part of the Maths syllabus, in order to encourage reflection on some key concepts such as variables, formal language, algorithm, shared both by Mathematics and Computer Science - albeit with different meanings - and, on the other, the study of aspects of Mathematics traditionally neglected by teaching. In particular, the study was conducted in a sample of schools at lower secondary level in order to extend reflections of a mathematical nature through interaction with a language. To this end practical experiments were carried out (the IRIS Project implemented by the European Centre for Education (CEDE), see: http://www.cede.it) which used a general programming language like Basic. However, despite the formal introduction of the computer in the Italian school syllabus, it seemed to us that its use had remained limited for a number of reasons, not least for the lack of facilities like computer laboratories and in-service teacher training. At this point, we felt the need to further analyse the conditions which had led to the failure to use computers, or to their limited use, in the teaching-learning of mathematics in Calabrian (Italian) lower and higher secondary schools.
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