Chapter 29: Didactics of Mathematics and the Professional Knowledge of Teachers

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ABSTRACT

This chapter will deal with the problem of the relationships between didactics of mathematics as a rapidly developing field of investigation and the professional knowledge of mathematics teachers as an individual and social construction. We will focus on teachers' pre-service and in-service education as the situations where systematic contacts may be established between research in didactics of mathematics and the construction of teachers' professional knowledge.

We will discuss present difficulties in establishing a productive relationship between teachers' education and different strands of research in didactics of mathematics, and different perspectives about how to establish such a relationship.

1. INTRODUCTION

In less than one century, mathematics changed from a set of elementary tools needed in everyday life and a specialised domain of investigation, to a pervasive component of today's culture: mathematics is deeply embedded in technology and in many aspects of today's manner of viewing natural and social phenomena. Mathematics became a general language to represent reality and a powerful, flexible simulation tool. This increasing need for mathematics education developed in parallel with another, rather contrasting orientation: in many countries mathematics took the place of Latin (or Greek) as the subject matter responsible for school orientation and selection.

After the Second World War mathematics teacher education became more and more complex for other, different reasons: the increasing number of students for each age group made the profession of teaching more difficult (if the teacher wants to or is required to ensure efficiency in his activity)—especially in the case of mathematics because of its specific difficulties. In the field of mathematics, like in other fields, the impact of new technologies has changed some priorities within the educational aims (making the previous curriculum partly obsolete); it has also brought on the need for new competencies on the teacher's part, in order to take advantage of the new educational opportunities.

The speed of changes (in mathematics, and in the school system) in itself provoked a crisis in the old manner of conceiving the profession of the teacher as an art, personally developed through apprenticeship in the school environment and based on a good knowledge of mathematics. Another reason for crisis depends on the fact that in many countries some teachers become teachers for reasons which are very far from a genuine vocation to teach mathematics. Their apprenticeship as mathematics teachers may be strongly influenced by this lack of specific motivation to teach mathematics.

A crucial point of our chapter will concern the need for research in didactics of mathematics in relationship with today’s situation of mathematics education and the profession of mathematics teaching, and the related need that pre-service and in-service teacher education introduce teachers to and involve them in research methods and results.

Present research in didactics of mathematics (a rapidly developing field with different trends and schools) may offer some tools in order to increase the effectiveness of pre-service and in-service mathematics teacher education and provide support to the profession (see: Arzarello & Bartolini, 1994; Boero & Szendrei, 1994; Cobb, Wood & Yackel, 1990; Cooney, 1994, 1994 b; Krainer, 1994; Wittman, 1991).

In this chapter we will consider the relationships between didactics of mathematics as a domain of investigation and the professional knowledge of mathematics teachers as an individual construction, socially situated (in the school system and society contexts) and a social construction (performed inside formal or informal groups of teachers).

We will try to move from our personal experiences and points of view towards a more general perspective, including other points of view. Some examples will be taken from our direct experiences of cooperative work with teachers, concerning research and innovation in the teaching of mathematics, other examples will derive from the Italian situation. The aim of these examples is to provide concrete references for general statements and perspectives; the reader may find similar examples in the reality of other countries (and some references will be provided in this direction).

The subject matter of this chapter will be organized according to two criteria:

– a classification of different strands of research in didactics of mathematics, based on the different nature of research results. This criterion was chosen because we think that both the involvement of teachers in research and the exploitation of research results in the school system strongly depend on the characteristics of the different strands of research (especially for what concerns the nature of their results);

– the idea that the relationships between didactics of mathematics and the professional knowledge of mathematics teachers especially concern pre-