

SCIENCE TEACHER EDUCATION: ISSUES AND PROPOSALS

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ABSTRACT

Research in science teacher thinking and constructivist pedagogy calls for an expanded knowledge base of teaching, and raising the issue of teaching and understanding of such knowledge by students during teacher education. In the present paper we discuss certain recent studies concerning teachers' knowledge base; besides we present and discuss a framework for developing and investigating courses in science teacher education; finally, in the third part, we present aspects of a case study illustrating the suggested framework.

1. INTRODUCTION

Influenced by the conception of teaching as a thinking profession, teacher education researchers have displayed great interest in the basis of teachers' knowledge and cognition (Clark & Peterson, 1986, Gess-Newsome & Lederman, 1999). Moreover, in the field of science education, research into students' conceptions of natural phenomena influenced researchers' interests in science teachers' conceptions about scientific concepts and phenomena, as well as about teaching and learning science (Cochran & Jones, 1998, Hewson, Kerby & Cook, 1995). Researchers investigating the character of teachers' knowledge have advocated a broad conception of the expert teacher knowledge base, suggesting that such knowledge is grounded in acts of pedagogical reasoning (Van Driel, Beijaard & Verloop, 2001). From the perspective of pedagogy, constructivist approaches, as the practices of teaching for student learning with understanding, commonly call for a greatly expanded knowledge base for teaching. How an extensive knowledge of teaching, can be developed at all, and what courses are favourable to it during the brief period allotted to teacher preparation, are critical research and development issues (Hewson et. al., 1999). In this context the main purposes of the present paper are to discuss recent studies concerning teachers' knowledge base and to present a framework for developing and investigating courses in science teacher education, including scientific and pedagogical knowledge.

2. SCIENCE TEACHERS KNOWLEDGE AND VIEWS ON SCIENCE AND SCIENCE TEACHING

Central issues in teachers' knowledge base are the importance of the subject that teachers teach and their views on teaching and learning science.

Knowledge of subject matter is an area that only recently has drawn the interest of researchers who have started to investigate the complex issues related to the development of it by science teachers. One consistent, striking result from several studies is that many student teachers are deficient in their understanding of important aspects of scientific knowledge that they learn to teach, despite having previously completed a number of scientific courses (De Jong, Korthagen & Wubbels, 1998). Specifically, primary teachers hold conceptions about physical phenomena and scientific concepts similar to those held by school children, although to a lesser degree and expressed in a more sophisticated language (Cochran & Jones, 1998). To some extent this applies to novice secondary teachers, particularly when they are questioned outside their major subject. Certain studies suggest that the subject matter knowledge structures of prospective teachers are often vague and fragmented, and in some cases it has been noted that student teachers are unable to present their subject matter knowledge in a coherent manner (Gess-Newsome, 1999).

Other studies all over the world, consistently point out that teachers hold a variety of conceptions on teaching and learning science (Gao & Watkins, 2002, Koballa et al., 2000). These can be merged into two broad orientations (Marentic-Pozarnik, 2002). In the first, called didactic/reproductive, teaching is regarded as a process of transmitting knowledge and learning as a process of absorbing scientific content. In the second, called facilitative/transformative, teaching is the process of facilitating learning, which involves the construction or transformation of knowledge by students, leading possibly to conceptual change. It is remarkable that student teachers' views on the teaching of science are largely determined by their learning experiences in scientific course during schooling and even during teacher education. Student teachers seem in practice to pay scarce attention to academic theories they are told about, such as constructivist approaches. This may be an explanation for the contradiction between exposed facilitative-constructivist views and underlying didactic practices in actual teaching, or even in planning instruction (De Jong, Korthagen & Wubbels, 1998).

It appears that teachers' beliefs and conceptions on teaching and learning act as a filter in relation to the learning of new approaches, with the result that these are frequently rejected either in whole or in part (Gunstone et al., 1993). However, there is ample evidence to suggest that science teachers have difficulties in developing constructivist views; in teaching they perform in terms of an expository model (Stofflet & Stoddart, 1994). For example, studies have pointed out that while students following a research base course appeared to have understood constructivist strategies, few of them challenged their initial conceptions, falling into the didactic/reproductive orientation (Mintrop, 2001). Yet learning a variety of teaching approaches (and the theoretical positions underlying them) can make a substantial