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CHINESE FOREWORD

Theoretical Perspectives of Science Teacher Education

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Extended Abstract

Science teacher education is an essential component in the entire system of science education. Currently, there is a lack of appropriate theory to describe and explain the complex phenomena and problems involved in science teaching and teacher education, and to provide effective guidance for policy-makers and practitioners. However, a range of theoretical viewpoints concerning science education and teacher education in general have been articulated in recent years. The aim of this article is to summarize some of the main theoretical perspectives in this area, so that they can be referred to in practical works and future research studies on science teacher education.

First, contemporary views on the goals of science education and the principles of science teaching, assessment and teacher education have been articulated by a number of science educators and professional organizations worldwide (NRC, 2000; 2007). These theoretical viewpoints are based on a wealth of findings from research studies on students' learning of science carried out in the past few decades. It was noted that learning with understand is the focus of the latest scientific studies on students learning, that is, cognitive processes involved in learning are the main research interests.

Our new understanding of students' learning indicated that students are active learners, their attention, memory, sense-making, problem solving, understanding and acquisition new knowledge are strongly influenced by their prior knowledge, skills, and conceptions. In addition, it was found that students' inquiry skills and their understanding of basic science principles are closely related, and that meta-cognition plays an important role in science teaching and learning. The implications for science teacher education is that teacher education institutions are expected to provide opportunities for teachers to develop the knowledge, skills, and teaching approaches which will enable them to create better learning environments for their students. The importance of science teachers' development of pedagogical content knowledge in school contexts is emphasized.

Secondly, turning to literature on teacher education in general, theoretical perspectives on the purposes of teacher education, teachers' professional qualities and teachers' learning to teach are respectively discussed. Summarizing the analysis of Zeichner and Joyce, Doyle (1990) outlined five paradigms in teacher education programs, including teachers as good employees, junior professors, fully functioning persons, innovators, and reflective practitioners. Five conceptual orientations of teacher education programs are described by Feiman-Nemser (1990), including academic, practical, technological, personal, and critical/social. Doyle (1990) discussed teacher professional qualities in great length, by pointing out a sharp distinction between the professional-technical knowledge base emphasized by traditional competence-based teacher education program (informed by process-product research studies) and the kind of personal practical knowledge that teachers actively constructed within the social environment in school contexts. The former emphasizes direct instruction of generalized knowledge and skills in teaching, while the later emphasizes teachers' roles in making personal meaning, insight, and creativity within a specific context. Doyle (1990) strongly suggested that successful teacher education program and research studies can be designed if one combines fruitfully the strengths of both knowledge types mentioned above. Korthagon (2004) and coworkers have done comprehensive research studies along the same line. In addition to point out that teachers change take place successively through a layered structure from environment, behavior, competencies, beliefs, identity, to mission (the innermost layer), they proposed that in learning to teach, mathematics teachers and possibly teachers in other fields as well, develop through a sequence of three stages, namely, gestalt formation, schematization, and theory building. In general, at the gestalt stage, teachers operate or react to classroom events unconsciously and unintentionally, using their prior knowledge, experiences under similar situations as reference frames. Schemas are relatively more systematic thoughts formed by teachers when they are asked or required to reflect on their decisions and teaching behaviors explicitly, or to discuss and compare them with other teachers. The stage of theory building takes place only when teachers are conscious that their schemas are getting more complicated and that they want to make the logic and reasons involved clear.

Finally, the limitations of traditional technical-oriented teacher education programs are pointed out. For science teacher education practice and research, it is recommended that various theoretical perspectives are considered, taking into account different goals, contexts, participants and other resources. As for future research directions, it is suggested that the links between theory and practice be strengthened. For example, how to inform teachers so that they can make better use of research findings and theoretical knowledge in their classroom teaching, and how to formulate more practical research questions based on teachers' practice in classroom contexts. Hopefully, this will eventually lead to the building of more useful teachers' practical theories.

Keywords: science education, science teacher education, teacher professional qualities, teachers' learning to teach