STUDENT TEACHERS’ SUBJECT MATTER KNOWLEDGE WITHIN THE DOMAIN OF AREA MEASUREMENT

ABSTRACT. This paper describes a research project whose major aim was to evaluate first-year teacher education students’ understanding of subject matter knowledge in the domain of area measurement. In contrast to many previous approaches to evaluating teacher education students’ subject matter knowledge, the approach adopted in this study not only focused on the student teachers’ substantive knowledge but also on their knowledge about the nature and discourse of mathematics, their knowledge about mathematics in society and their dispositions towards mathematics. To this end, each student was clinically interviewed whilst engaged on a set of eight tasks that were developed for the study. The development of the tasks was a major component of the study and this is described in detail. The results of the tasks are given and the paper concludes with a discussion of the findings. This discussion focuses primarily on the implications that these results have for preservice mathematics education courses.

INTRODUCTION

Recent research on teacher effectiveness (Ball, 1990; Grossman, 1991; Lampert, 1986; Leinhardt and Smith, 1986; Roth and Anderson, 1990; Wilson, 1988; Wineburg and Wilson, 1988) has investigated teachers’ thinking and decision making processes. This research has revealed ways in which teachers’ understandings of subject matter knowledge affect their students’ opportunities to learn and thus has led to a renewed interest in teachers’ subject matter knowledge.

The emergence of teachers’ subject matter knowledge as a major focus of research has been accompanied by a redefinition of what is meant by the term, ‘subject matter knowledge’. In the past, subject matter had been predominantly defined by ‘how much’ mathematics teachers had and was assessed by auditing the number of mathematics content courses the teachers had studied (and presumably passed) or by reviewing their results from norm-referenced mathematics competency tests (Ball, 1990, 1991). This definition of subject matter knowledge and its associated methods of assessment focused almost exclusively on the correctness of the teachers’ substantive knowledge (i.e., their repertoires of ‘correct’ facts, ideas, theories, explanations, concepts and processes). However, a significant number of research studies on effective teaching has found that a teacher’s understanding of the nature and epistemology of the discipline, as well as the
substance of the discipline, shapes what the teacher is trying to help his or her students learn (Ball, 1991; Ball and McDiarmid, 1989; McDiarmid, Ball and Anderson, 1990). These findings have resulted in a widening of the definition of subject matter knowledge to include other important facets of the teachers' subject matter knowledge such as: (a) their understanding of knowledge about the nature and discourse of mathematics (Ball, 1990, 1991; McDiarmid, 1988); (b) their knowledge about mathematics in culture and society (Ball, 1990, 1991; McDiarmid, 1988); and (c) their dispositions towards the subject (Ball and McDiarmid, 1989).

This redefinition of the term 'subject matter' to include facets other than substantive knowledge is reflected in the aims of this study. To this end, we set out to investigate the substantive knowledge, discourse knowledge, mathematical cultural knowledge and dispositions held by first-year Bachelor of Education (Primary) students' from the Queensland University of Technology in the domain of area measurement.

This particular domain was chosen for study because: (a) measurement is a domain of mathematics that is most closely allied with real-world application and is therefore a significant area in which to research understanding of subject matter knowledge, (b) measurement concepts and processes form a major part of the preservice teacher-education mathematics curriculum, (c) area measurement is a domain of mathematics which we felt could provide rich data about how much mathematical knowledge our first-year teacher education students have as well as what kinds of mathematical knowledge they have, and (d) previous research in this domain (e.g., Tierney, Boyd and Davis, 1990), while finding that many prospective primary teachers have limited repertoires of substantive knowledge, has provided few insights into the other three aspects of the prospective teachers' subject matter knowledge in this domain.

Substantive knowledge: not only should teachers be able to 'do' mathematics to generate 'correct' answers, they should also have a sense of the mathematical meanings underlying the concepts and processes. Furthermore, their subject matter knowledge should not be merely a collection of disparate facts and procedures; instead it should be a collection of interconnected concepts and procedures (Ball, 1990). Our investigation of the preservice students' substantive knowledge thus focused on the correctness of their knowledge, their understanding of the underlying meanings of the area measurement concepts and processes, and the degree of connectedness between the measurement concepts and processes.