Chapter 1 Introduction

> ***May 10th 2011***
> *While setting up for a twilight INSET session in a classroom, I was confronted by a 7-year old who asked me, "Who are you teaching?" I replied that I was teaching the teachers. He looked aghast and with wide eyes announced, "But I thought teachers knew everything."*

The balance of subject knowledge and pedagogical knowledge needed to teach mathematics effectively is an issue for teachers in primary schools, with research findings in the past twenty years highlighting subject knowledge as a weakness in primary mathematics teaching (DES 1992, Aubrey 1997a, Askew *et al.* 1997, Ofsted 2008). The final report for the *Independent Review of Mathematics Teaching in Primary Schools* (Williams, 2008) gathered evidence to highlight the importance of deep subject knowledge and pedagogical skill to promote effective learning, and a key recommendation was that every primary school should have a maths specialist teacher within the next ten years. According to the report these teachers, following a two-year Maths Specialist Teachers (MaST) Programme, would become 'Maths Champions' in their school. In response to this, the MaST programme was introduced nationally in 2010 to train selected teachers to become specialists in primary mathematics teaching, with the skills and attributes needed to mentor and coach other staff in their schools.

This link between subject knowledge training and subsequent subject leadership in schools is a familiar recommendation that has been regularly repeated over the past 30 years. One of the findings of the Cockcroft Report, *Mathematics Counts* (Cockcroft 1982) was that there was a need to develop the role of a mathematics coordinator in each primary school, with an overriding task to 'provide support for all who teach mathematics and so improve the quality and continuity of mathematics teaching throughout the school' (paragraph 356). The Diploma in Mathematics Education was recommended by Cockcroft as part of the drive to increase the expertise of subject coordinators. As a participant in the Diploma in 1984, I certainly deepened my mathematical knowledge. The Department of Education and Science then commissioned a report (DES 1992) that included a debate on the role of subject specialists and the importance of subject knowledge in the primary school. It described an acute shortage

of subject specialists and recommended that primary schools should consider a continuum of teaching roles:
generalist → generalist/consultant → consultant → semi-specialist → specialist
This recommendation has been re-stated in the Cambridge Primary Review (Alexander 2010).

The Numeracy Task Force report: *Numeracy Matters* (DfEE1998), emphasised the need for the most effective coordinators to become 'Leading Mathematics Teachers' to provide demonstration lessons and to work in schools to raise standards of teaching and levels of attainment. Also in 1998 the DfEE introduced the role of 'Advanced Skills Teacher' (AST), with the aim for these teachers to become role models to teachers in their own school and in other schools in their local area. In 2005 the Excellent Teacher Scheme (ETS) was introduced as a step towards AST status. Along with other professional skills and attributes, ASTs and teachers on the ETS were expected to have an extensive and deep subject knowledge (TDA 2007). However, the ETS struggled to attract teachers, with only 59 teachers from an anticipated 3000 teachers successfully assessed by December 2008 (DCSF 2009).

Perhaps significantly, at around the time of the publication of the Primary National Strategies in 2006, the term 'Coordinator' was dropped in favour of 'Subject Leader'. This may have been an attempt to raise the perceived status of this role, but the name change arrived without any formal declaration. The Schools White Paper, *The Importance of Teaching* (DfE 2010), stated that it aims to clarify and merge the roles of 'Excellent Teacher', 'Advanced Skills Teacher' and 'Leading Teacher', by developing 'Leading Practitioner' to support others in schools. They also aim to designate 'Specialist Leaders of Education' – excellent teachers in leadership positions.

Increased subject and pedagogical knowledge is explicit in the role of subject leader. Working as an Advisory Teacher with Lincolnshire schools twenty years ago, I ran maths courses specifically on subject knowledge, taking areas of mathematics that teachers found the most difficult to teach. One course on algebra up to National Curriculum Level 5 was particularly challenging for many of the teachers. They argued that, as primary teachers, they should not be expected to teach at this level. It created a heated debate on the role of generalist versus specialist teachers in primary schools, which ended when one very experienced headteacher stood up and stated that primary teachers are all specialist teachers – specialists in primary education.

That statement encapsulates one of the problems facing primary education. Teachers hold on to the generalist approach with understandable pride, with the many positive aspects centred

on the education of the whole child. A specialist teacher may be seen as acceptable for perhaps PE and music, but not for a core subject such as mathematics, which would diminish the role of the generalist primary class teacher (Alexander 2010). However, a lack of deep mathematical knowledge needed for teaching is an issue for many primary teachers that I have worked with and supported. *The Williams Report* (Williams 2008) based key recommendations around the need to increase teachers' subject knowledge, and *The Cambridge Primary Review* (Alexander 2010) acknowledged that primary teachers' subject knowledge is their greatest vulnerability. The Schools White Paper, *The Importance of Teaching* (DfE 2010), cited evidence of the need for high academic attainment to increase teachers' subject knowledge. This focuses on the basic mathematical knowledge that a teacher brings to the classroom, rather than the mathematics needed for teaching. It is also perhaps significant that the focus is on academic attainment with no reference to pedagogy throughout the document. In contrast, Robin Alexander in the *Cambridge Primary Review* (2010) discusses the importance of subject expertise, but in relation to its impact on pedagogy. The report highlights that subject expertise is rated more highly by pupils than by teachers, with lessons more exciting and engaging if a teacher has good subject knowledge. However, it is interesting that, according to the findings of the *Cambridge Primary Review*, it is not enough to simply know a subject well to be an effective teacher, it is dependent on the way this knowledge is adapted and presented to a class. When teaching place value to a group of nine year olds, for example, is it the depth of subject knowledge of place value or the related pedagogical skills acquired by the teacher that determines the effectiveness of the teaching and the subsequent understanding of the pupils?

The literature review identifies some of the possible characteristics of deep subject knowledge in primary mathematics, and the elements that make this different from the basic mathematical knowledge that teachers bring to the classroom. Related to this, the study also explores the relationship between subject knowledge and pedagogy.

Using a *Deep Subject Knowledge* model developed as an analytical framework to collect evidence of subject knowledge, three participants from the first cohort of the MaST programme in the East Midlands were interviewed following observations of their teaching. The study analyses the effectiveness of the *Deep Subject Knowledge* model in identifying the nature of deep subject knowledge and evaluates the impact of the MaST Programme on the teachers' subject knowledge.

This study attempts to answer the following questions:

- **How does deep subject knowledge differ from the basic mathematical knowledge that primary teachers bring to the classroom?**

- **How does deep subject knowledge impact on pedagogy?**

- **How does the Maths Specialist Teachers (MaST) programme develop deep subject knowledge in the participants?**