Chapter 8
Enhanced Interactivity in Secondary Mathematics

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ABSTRACT
This chapter outlines the background to the development of changed pedagogy by mathematics teachers within a secondary school in England. It relates this development to the enhanced understanding of the use of interactive whiteboards, initially as a presentational and motivational support but then as the basis of more effective conceptual and cognitive learning by students. The experience of teachers within the school and members of a research group points to the importance of the integration of interactive whiteboards, desk work and thinking in the planning of mathematics lessons. It also discusses emerging evidence that effective whiteboard use requires an understanding of the role of individual learning style, gesture, and artifact use in reflective and stepped teaching and learning situations.

INTRODUCTION
During the past decade the interactive whiteboard has passed from being a novelty to being part of the equipment of many mathematics teaching rooms within the UK, and to a much lesser extent, parts of Western Europe, North America, South East Asia and Australasia. In part this is a response to government educational policy aimed at learning for the globalized digital age but it is also a reflection of self-government within schools and their intention to support individualized student motivation and learning through more appropriate pedagogy. Early evidence suggests that practitioners pass through stages of developing both technology and pedagogy moving from the use of technology for presentational purposes to its use as a stimulus for interactive learning (Glover et al., 2003). The availability of equipment alone is no guarantee of enhanced teaching and learning (Miller et al., 2004). Government reports by the inspectorate and the Qualifications and Curriculum Authority (QCA) in England in 2005 point to the need for teachers to become more aware of the inherent value of interactivity at the heart of

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a changed pedagogy. This view has been reflected in a number of research reports with varying sized cohorts of users (Hall & Higgins, 2005; Hennessey et al., 2007; Smith et al., 2006). In this chapter we are concerned with establishing the basis of interactive learning and then using the outcomes of recent research undertaken at Keele University on behalf of the National Centre for Excellence in Teaching Mathematics (NCETM) to illustrate how a pedagogic emphasis on interactivity has enhanced teaching in mathematics (Miller et al., 2005; Miller et al., 2008).

Our case study traces the introduction of IWB use in a secondary comprehensive school in Cambridgeshire, England (subsequently referred to as the “school” in this chapter). The co-author of this chapter (hereafter called the lead teacher because of her role in developing new ways of working) is an Advanced Skills Teacher (AST) in the school and became involved with the research group at the University of Keele that was concerned with establishing the practical issues and teaching and learning responses in promoting interactivity in mathematics teaching. The school experience was one of several case studies underpinning the recommendations to the NCETM. Case studies are by their nature descriptive but the experience of the mathematics teachers in the school offers some valuable pointers to the management of professional development for pedagogic change.

THE BACKGROUND TO INTERACTIVE LEARNING IN MATHEMATICS

There are two levels to our understanding of the incorporation of interactive learning in mathematics teaching. These are the learning context within which IWB use is to occur and then the practical level concerned with the way in which IWB use can support interactive learning. The context is concerned with the socio-psychological basis of mathematical learning. The starting point is Vygotsky’s (1978) theory of social constructivism which argues that effective learning occurs in those situations where there is interaction between teacher and taught, or between students, so that the problem is commonly understood and the solution collaboratively determined. Tinzmann et al. (1990) extend this notion to the organization of collaborative classrooms and point to the need for teacher and students to share the knowledge, and more importantly, the authority underpinning learning. This requires teacher understanding of the process of facilitation and support, and leads, perhaps more contentiously to the view that diverse groupings of students are more effective in promoting individual development through the use of modeling responses. Ernest (1994) urges that there is a need for the human face of mathematical learning and stresses the requirement for dialogic intercourse as the basis of enjoyment and hence, learning. Taylor (1996) extends this to argue that the context within which mathematical learning occurs must promote such interactions so that learning is targeted at conceptual change. Schussler et al. (2007) relate this concept of interactivity into classroom management contexts. They offer a model called:

hypertextual function ... to consider teachers’ thinking, practice, and development in the use of technology. Hypertextual function is a multi-dimensional model linking a teacher’s knowledge about students (familiarity) and technology (facility), with a teacher’s teaching practice of integrating technology with content (transparency) and across disciplines and experiences (connectivity), and a teacher’s sense of support (collegiality). Additionally, a teacher’s context affects each of these. Such a model is important as technology becomes more pervasive and integrating technology into classrooms adds another layer of complexity to teaching. (p. 572)

This is the point at which understanding IWB integration becomes important – our second level
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