ABSTRACT. This study focuses on mathematics anxiety in nine- to eleven-year-old children and compares the mathematics anxiety of pupils taught in a traditional manner with that of pupils whose teachers adopted an alternative teaching approach emphasising problem-solving and discussion of pupils’ own informal strategies. One finding is that pupils who were exposed to a traditional approach reported more mathematics anxiety than those who were exposed to the alternative approach, particularly with regard to the social, public aspects of doing mathematics. The question is raised whether it is these public aspects of doing mathematics in the presence of teachers and peers which actually evoke mathematics anxiety in many pupils, and not working with numbers or doing sums. However, the majority of pupils in this study reacted with either high or low anxiety to both aspects of doing mathematics.

BACKGROUND

The construct of ‘mathematics anxiety’ has received considerable attention among researchers and mathematics educators in recent years. Most previous studies of mathematics anxiety have focused on high school students or adults, while mathematics may also provoke strong and adverse reactions in children (e.g., the Cockcroft report, 1982). Age 9 to 11 seems to be a critical stage for the development of attitudes and emotional reactions towards mathematics (McLeod, 1993b). In addition, childhood, being a period of rapid change, may be a time when anxiety is especially evident. Although attitudes may deepen or change throughout school, generally, once formed, negative attitudes and anxiety are difficult to change and may persist into adult life, with far-reaching consequences.

Some of these consequences include avoidance of mathematics (Hembree, 1990), distress (Tobias, 1978; Buxton, 1981) and interference with conceptual thinking and memory processes (Skemp, 1986). Even for children there appears to be a negative relationship between mathematics anxiety and achievement in mathematics (Hembree, 1990). Although this relationship may be indirect and is necessarily ambiguous with respect to the direction of causality, it is often assumed that high levels of anxiety impair performance.

Some researchers expand the concept of mathematics anxiety to include both facilitative and debilitating anxiety. Wigfield and Meece (1988), for example, claim that the negative affective reactions component of mathematics anxiety may be debilitating while the cognitive component might actually have some positive motivational consequences for the amount of effort students put into mathematics and thus for mathematics performance. Depending on the individual and the task, a moderate amount of anxiety may thus actually facilitate performance. Beyond a certain point, however, anxiety becomes debilitating in terms of performance, particularly in the case of higher mental activities and conceptual processes (Skemp, 1986). Thus although mathematics anxiety may in some cases have positive effects, it is perhaps more important for educationalists to focus on its possible negative consequences for performance.

In fact, the pioneers in the study of mathematics anxiety, Richardson and Suinn (1972), defined mathematics anxiety *in terms of* the (debilitating) effect of mathematics anxiety on performance: ‘feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations’.

The suggestion that mathematics anxiety threatens both performance and participation in mathematics, together with the indications that mathematics anxiety may be a fairly widespread phenomenon (e.g., Buxton, 1981), makes studies like this concerning mathematics anxiety in children of extreme importance.

Although there seems to be sufficient evidence for a specific mathematics anxiety which cannot be adequately explained in terms of general anxiety or test anxiety (e.g., Sepie and Keeling, 1978), there is lack of agreement on the dimensions of mathematics anxiety. Richardson and Suinn (1972) originally assumed that the construct of mathematics anxiety was unidimensional. However, factor analytic studies have yielded a variety of factors of mathematics anxiety scores (see Newstead, 1995, for a review). The only factor that most studies seem to have in common is a primary factor which relates to test or evaluation anxiety. The current study investigated the dimensions of mathematics anxiety in pupils whose mathematical understanding had never been assessed using tests.

There is also some lack of agreement about the possible causes of mathematics anxiety in children (see Newstead, 1995, for a review). Suggested causes include teacher anxiety, societal, educational or environmental factors, innate characteristics of mathematics, failure and the influence of early-school experiences of mathematics. The argument that the beginnings of anxiety can often be traced to negative classroom experiences seems