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UNCERTAINTY IN MATHEMATICS EDUCATION: WHAT TO DO WITH STATISTICS?

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INTRODUCTION

The use of the word ‘uncertainty’ in the title of this chapter is intended to convey both the dilemma in the question and the challenge that statistics presents to the deterministic foundations of mathematics. The growth in the field of statistics over the past century, especially in the light of advancing technology, has resulted in a downward curriculum thrust from tertiary education, to secondary education, to primary education.

In the New Zealand Curriculum (Ministry of Education, 2007) the relative importance of statistics has been elevated in a number of ways, the most obvious being the renaming of the learning area from Mathematics to Mathematics and Statistics. Frankcom (2008) indicated:

The change was made to reflect the difference between deterministic (mathematical) and stochastic (statistical) thinking. The inclusion of statistics in the title of this teaching area reflects the increasing importance of using and interpreting data as part of critical citizenship. (p. 3)

The recent development of the Australian Curriculum: Mathematics (Australian Curriculum, Assessment and Reporting Authority [ACARA], 2011) has also emphasised the importance of statistics in a modern school curriculum. One content strand of the mathematics curriculum is titled “Statistics and Probability”, in recognition of the increased emphasis on statistical knowledge in the 21st century, but there has been no apparent desire to rename the curriculum itself in Australia.

At the same time, however, the inclusion of statistics and probability as a content strand of the mathematics curriculum has ignited discussion about similarities and differences between the two disciplines of mathematics and statistics. Although the claims on curriculum space have existed in both Australia and New Zealand since the early 1990s, acceptance has not been universal. There has been considerable discussion in the press about the development of the Australian curriculum, with many articles criticising the perceived emphasis on statistics (e.g., Polster & Ross, 2010; Slattery & Perpitch, 2010). Examples of textbook series with little or no statistics (Brown et al, 2006) and strong views by
mathematicians to reduce the quantity of statistics in the Australian curriculum (e.g., Dean, 2010) indicate that, at least in Australia, there is still resentment in some circles about the encroachment of this newcomer into the traditional mathematics club. Such discussions suggest that the curriculum values of mathematics and statistics may be different, leading inevitably to tensions for teachers and curriculum designers.

In this chapter we aim to explore the issues around the synergies and tensions between mathematics and statistics and the implications for mathematics education. The chapter is not intended to be an exhaustive review of the domain of statistics education research in Australia and the surrounding region. Nevertheless, there is a significant body of research from Australian and New Zealand researchers that is beginning to inform both curriculum development and the teaching of statistics, especially at the school level. The chapter, hence, begins with a brief consideration of the current state of statistics education research in the region to place the later discussion within a context. Following this examination, the chapter scrutinises research surrounding the differing perceptions of mathematics and statistics from the viewpoints of students and teachers. This scrutiny leads to a consideration of teaching statistics and mathematics and some observations on student outcomes. One of the major differences between statistics and mathematics is the place of context. It is particularly relevant at the school and introductory tertiary level, and is the focus of the next major section of the chapter. The challenge for teachers in integrating various aspects of content knowledge, context knowledge, pedagogical knowledge, and student knowledge in mathematics and statistics is considered under the general heading of pedagogical content knowledge. The chapter concludes with a discussion of the implications of the debate for mathematics education in Australasia, focusing on the synergies and tensions.

The chapter draws on recent published research from Australasia. Sources for this review come from primary, secondary, and tertiary education levels. In addition to the Mathematics Education Research Group of Australasia (MERGA) publications (MERJ, MTED and Annual Conference Proceedings), the authors considered the International Group for the Psychology of Mathematics Education (PME) proceedings and conducted a key word search in key mathematics and statistics education journals. In addition they relied heavily on the proceedings from two conferences: the 2008 Joint ICMI/IASE Study conference and the related book: Teaching Statistics in School Mathematics—Challenges for Teaching and Teacher Education; and the 8th International Conference on Teaching Statistics in 2010.

STATISTICS EDUCATION RESEARCH IN AUSTRALASIA

Australasian researchers have been particularly active in the field of statistics education and this work is well recognised internationally. As a discipline, statistics education is still developing, and much of the current research focuses on the development of students’ understanding of specific statistical concepts. Ideas