CURRICULUM MATTERS

The Future of Statistics Within the Curriculum

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Summary
This article sets out a vision for the general nature of the statistics curriculum in the medium to long term.

The Qualifications and Curriculum Authority (QCA) in England has recently invited considerations about the future shape of the English school curriculum in the medium to long term. The Royal Statistical Society asked the author to provide a set of views that it could endorse. The following is a slightly revised version of the prepared paper, which it is hoped will stimulate discussion among people concerned with statistics and mathematics education. It develops ideas that have emerged from recent debates around the role of statistics within the mathematics 14–19 curriculum (Royal Statistical Society 2005). Although written for the situation in England, it should have wide international currency. *Teaching Statistics* invites responses which it will consider for publication.

The QCA document (QCA, 2005) refers to the importance of 'numeracy' and 'problem solving' and, when discussing mathematics, stresses the underlying structural coherence that mathematics brings to many areas of learning. Many others have also pointed out that the ability to understand and utilize quantitative skills is a key to understanding local, national and global institutions, societies and movements. In practice, all of these things typically resolve themselves into a consideration of statistics. Whether dealing with topics such as finance, poverty, economic, educational and social comparisons, or with future predictions, statistical reasoning and modelling are core features: even a cursory study of public debate reveals the pervasiveness of statistical discourse. Within the educational system the ubiquity and importance of statistics is well recognized in curriculum areas such as geography, science, citizenship and increasingly within humanities subjects such as history. In these areas it is increasingly well understood that failure to recognize the inherent statistical uncertainty of real life problems can invalidate conclusions. Furthermore, developments in IT have revolutionized the interactive ability to utilize statistics, graphically and computationally, so that very large, complex and hence, intrinsically interesting data sets, can be handled within the curriculum. A good example is the extensive and enthusiastic use of the Royal Statistical Society Centre for Statistical Education's 'Statistics-at-School' data base in many school subject areas (http://www.censusatschool.ntu.ac.uk/).

A basic understanding of statistical ideas, and especially the idea of statistical modelling involving exposure to statistical data analysis, is as fundamental to an understanding of modern society and its artefacts as is language literacy. From this it follows that statistical knowledge and practice should suffuse the school curriculum. How can we bring this about?

First, it is important to argue for the retention of statistics (a broader discipline than just 'data handling') within the school mathematics curriculum for the foreseeable future. As well as this, there should be a long-term aim to provide properly resourced statistical coordination across the curriculum so that confusing differences in terminology, notation and application are avoided. In

addition, extensive initial teacher education and continuing professional development need to be developed in order to deliver high quality teaching and learning. None of this, however, is without cost. The time available for training and teaching is finite, indeed fixed, and extra time for statistics ultimately must be found from elsewhere.

Undoubtedly, some limited resources for a coordinated approach can be taken from where statistics is currently delivered within separate subject areas. Nevertheless, to achieve real progress the nature of the mathematics curriculum itself needs to be reconsidered, in terms of content, balance and training. The view of the Smith report (Smith, 2004; recommendation 4.4) is that topics such as algebra and geometry are 'core' skills for which more time needs to be made available. This view, however, is mistaken, and certainly has little evidential support; it confuses the role of such topics within the logical structure of mathematics itself with the ways in which students actually learn mathematics. The guiding objective for the curriculum is that students should become familiar and comfortable with mathematically grounded understandings in such a way that they can follow logical-quantitative reasoning and have adequate facility for quantitative manipulation.

In many ways, statistics can be considered a more appropriate vehicle for motivating the learning of mathematics than those topics traditionally considered as 'core'. Not only is it close to real-life applications and to problems already of concern to students or familiar to them from various subject areas; as an area of applied mathematics it incorporates a wide variety of manipulative and interpretational skills. Because of this it can be used as a vehicle for learning as well as applying important aspects of such skills, whether these are arithmetic, graphical, or those that involve symbolic manipulation.

Thus, statistics should become a central feature of the mathematics curriculum. This implies, among other things, that teachers of mathematics have to involve themselves and their students in genuine real-life problems. While mathematics teachers can also be expected to take responsibility for the coordination of statistical activity across the curriculum, other subject areas have a key contribution to make, and the importance of cross-curriculum collaboration is very clear. What implications does this have?

Undoubtedly, the most important practical issue concerns the training of teachers in the relevant statistical knowledge and pedagogy. Within the area of training, the most important long-term task is to incorporate appropriate resources within initial teacher education. Given the meagre resources currently devoted to statistics, for example within PGCE courses, this seems to be a formidable, but not impossible, task. Most existing courses are crowded, and incorporating statistics will necessitate the replacement of other topics or activities, especially within the speciality of mathematics. Because of the importance of statistics across the curriculum, statistical teacher training needs to be coordinated across subject disciplines, and this raises further difficulties. Since great rewards are unlikely to occur in the short term, a long-term perspective is needed. A useful way forward would be for a small number of well-resourced pilot schemes to be funded, and evaluated, for a period of 3 to 5 years in institutions where there is appropriate expertise. Similar arguments can be made for in-service trials whose main aim should be to re-skill existing teachers of both mathematics and other subjects.

In the area of statistics education, the UK, and especially England, is arguably in the forefront. There exists a wealth of materials and expertise that can be utilized for such training, and the suggestions outlined in this article have the potential to bring great benefits both for statistical understanding and for the learning of mathematics itself.

References

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