FROM STATISTICAL LITERACY TO FUNDAMENTAL IDEAS IN MATHEMATICS: HOW CAN WE BRIDGE THE TENSION IN ORDER TO SUPPORT TEACHERS OF STATISTICS

Rolf Biehler
Universität Kassel, Germany
biehler@mathematik.uni-kassel.de

School curricula are always designed between the contradictory contexts of a scientific discipline on the one hand and the use of scientific knowledge in society on the other. Literacy in the literal sense, graphical literacy, quantitative literacy, mathematical literacy, and numeracy have become key concepts for defining the competence students should gain from attending general education.

In many countries the subject matter education of teachers of statistics at school level is more oriented towards the scientific discipline of statistics, stochastics, probability or even mainly mathematics rather than to statistical literacy. Teacher education has many tasks to do, pedagogical content knowledge for teachers is not enough; teachers also have to be enabled to reflect on possible tensions between scholarly knowledge in mathematics and statistical literacy.

This paper intends to bring to the foreground more or less implicit tensions between mathematical ideas and ideas from statistics and from statistical literacy. The selection of examples below will be extended in the presentation.

First of all there is tension between the basic understanding of mathematics and statistics. In many countries future statistics teachers are brought up as mathematics teachers, and there are differences and commonalities between the disciplines. If mathematical modelling is regarded as part of mathematics (teaching) and of mathematical literacy in particular, this may serve as a bridge. However, many ‘models of mathematical modelling’ do not give the attention to collecting and analysing data that would be necessary from the perspective of statistics.

If mathematics is presented at school level not only as a deductive science but also as emerging mathematics, where inductive reasoning is employed, then better relations to statistics can be drawn. For instance, we may systematically perform geometric experiments and data collection with dynamic geometry software and analyse these data with statistical methods, such as fitting functions to data. Certainly the concept of function is one of the big ideas in mathematics teaching. It would be a very good bridging domain to statistical data analysis, in particular to bivariate quantitative data analysis. However, this potential is seldom exploited; on the contrary, the teaching of functions often undermines ideas of statistics and of statistical literacy, for instance, when data lie exactly on a function graph or when discrete data graphs too easily are interpreted as graphs of continuous functions.

In mathematics, the average is mainly represented by the mean, whereas the median seems to be foreign to mathematics teachers. Mathematics teachers like–if at all–to teach the method of least squares as THE mathematical method to fit functions to data, without any knowledge about robust alternatives based on the median, for instance, the simple median-median-line, or simple approaches to smoothing data by local averaging.

Another domain is proportional reasoning and percentages. We find many simplistic ‘inferences’ from ‘sample’ to ‘population’, where exact proportionality is assumed as given. The uncertainty and the variability are often ignored. The statistically literal person will always ask ‘percentage of what’ as ignorance of this is a source of many misunderstandings. However, percentages in mathematics are often applied in simple contexts, where the reference set and the unit are clear and constant.

Graphical displays and how to convince and to lie with graphs is an important topic in statistical literacy, and the design of graphs is part of the statistical sciences. Graphs and the design of graphs have not played a prominent role in mathematics teaching. Some potential for change is possible due to the use of technology in mathematics teaching. The use of automatically generated (function and data) graphs on graphical calculators and computers

© ICMI/IASE 2008. In C. Batanero, G. Burrill, C. Reading & A. Rossman (Eds.), *Joint ICMI/IASE Study: Teaching Statistics in School Mathematics. Challenges for Teaching and Teacher Education. Proceedings of the ICMI Study 18 and 2008 IASE Round Table Conference.*

requires new forms of attention. Selecting adequate windows and scales becomes fundamental and may establish new impacts for relating statistics and mathematics.

The idea of measurement is fundamental to school mathematics: length, areas and volumes serve as prototypical examples. The development of increasingly complex number systems reflects this importance. If measurement error is part of mathematics teaching, this can serve as a bridge to statistics. Moreover, designing new procedures of measuring properties is fundamental to statistics: How can we measure ‘who is unemployed’, ‘the size of a family’ etc.? If mathematics redefines the topic ‘measurement’ in a more extended way, new roads of relating mathematics to statistics will open up.