SOME PROBLEMS OF THE TEACHING OF STATISTICS IN SECONDARY SCHOOLS OF HONG KONG

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In the late sixties Hong Kong took her first step in introducing statistics into the secondary school mathematics curriculum as recommended by many national end international working groups in the mid fifties and early sixties.[5] As statistics forms only a small portion of the entire mathematics syllabus, it is seldom singled out for inspection by mathematics educators in Hong Kong. We wish to take a first step in addressing this problem.

Although we do have certain general ideas and impressions of how statistics is taught in local schools, either through conversation with teachers, or through direct classroom experience (two of the authors are school teachers), we feel that a true picture of the present status of the teaching of statistics can only be obtained via a survey aimed at all secondary school mathematics teachers in Hong Kong through self-administered questionnaires. We like to find out about their training, their attitude towards the teaching of probability/statistics, their opinion of the syllabus and of the textbooks, their problems and difficulties, and the way they handle statistics lessons. The overall response rate (over schools) is 79.1%. Respondents comprise of 1321 teachers in 338 secondary schools.

Not to make this paper too lengthy (for a much expanded version, see [3]), we shall only summarise the findings of our survey as follows: (1) Teachers are basically satisfied with the syllabus, but feel that there is a large gap between the content taught in Form 3 and that taught in Form 5. (2) Teachers are fairly dissatisfied with textbooks, mainly because they lack daily-life examples in statistics, are stereotyped, dull and weak in explaining concepts. (3) Although about half of the respondents have exposure to probability/statistics in their post-secondary studies, only a small percentage further their knowledge after graduation, and only about 20% feel that they have more than sufficient knowledge in teaching statistics. (4) Teachers seldom use daily-life examples, teaching aids and almost never engage students in genuine project work.

The survey confirms much of our worries over the teaching of probability/-statistics in Hong Kong. The mathematics curriculum development committee stated in 1982 that one of the teaching objectives is "to prepare students to understand everyday applications outside the classroom – for example by teaching the fundamentals of statistics and probability".[4] The way textbooks are written and the way the subject is taught do not seem to bear this out. We can summarize the problems into four areas of concern.

1. The subject matter does not bear enough relevance to students

Compared to other topics in the mathematics curriculum, probability/statistics has by far the closest direct link with daily life. However, not enough daily-life examples are presented in class In some popular textbooks, very few local real data sets are used, and even when used, are usually outdated. One of the aims in teaching descriptive statistics in secondary schools is: "the method of, and the pursuit in, descriptive statistics may concern, probably more than other mathematical activities, the pupil's actual existence".[8] Much effort has to be made towards this goal in Hong Kong. In probability, too many examples given are related to gambling, offering students a lopsided impression of the subject.

2. The subject matter is not taught lively enough

In comparison to other topics in the mathematics curriculum, there are fewer available teaching aids in probability/statistics. In teacher training courses, there is almost no (or at least not enough) exposure to the didactics of probability/statistics. The idea of project work is not being emphasized so that this very effective teaching device which can arouse students' interest are employed much less than it should have been. Besides examination pressure and class time, we think a third reason is the lack of experience in project work by teachers themselves

3. There is a wrong emphasis on techniques rather than concepts

In the survey, when asked how much time would be spent on topics that involve conceptual understanding but are not easily examinable (e.g. abuse of statistics), 4.5% say not at all, 55.2% not much, 36.9% moderate amount and only 2.3% plenty. While computation techniques are easily examined on, concepts are not. A problem involving conceptual understanding sometimes may not have straight-forward nor unique answer, in contrast to unambiguous answers teachers are accustomed to. Since such questions rarely appear in public examination, it follows as a consequence that concepts give way to techniques in classroom teaching. Textbooks are also weak in the conceptual aspect.

4. The non-mathematical aspect of the subject is ignored

One of the aims of statistics education is to teach students how to draw conclusion from inspecting a data set But since statistics at secondary school level is mainly descriptive rather than inferential, this ability cannot be put upon a rigorous mathematical basis. However, insights into the data set can be built up and students should be able to make qualitative statements based on quantitative data, and they should be made aware of both the power and the limitation of statistics. This is also a good opportunity for students to look at a data set from other perspectives relating to their knowledge in the physical sciences, the biological sciences or the social sciences. Such an interdisciplinary approach should be stressed as it certainly contributes "to foster the general aims of education".[8]

Many of the problems outlined above lie deep within the fabric of our education system. To rectify them would mean a major overhaul of this system. Competition in securing tertiary education is fierce and a "sieving process: is in operation from primary schools onward via no less than five public examinations at various stages. Only about 3% of the age group in Hong Kong can get into the two local universities. Students, teachers and parents alike realize this fact just too well so that each public examination always brings with tremendous pressure. A visiting panel at the invitation of the Hong Kong Government did point this out in their 1982 report: "The curriculum is 'examination driven' through syllabuses designed for university preparation."[7] Thus, a large portion of teaching time is geared towards examination. Lessons structured as one continuous practice session for the public examination easily fall for rote learning and excessive drilling skills.

Besides, mathematics teachers in Hong Kong have a heavy work load and a large class size. During the Second International Mathematics Studies, it is found out that Hong Kong has the highest number of students per class (with a mean of 43.3) and the lowest teacher/student ratio (with 3.2 teachers to every 100 students).[2] A normal teaching load consists of over thirty 40-minute sessions per week.

Education system notwithstanding, a lot can still be done. The long term solution is the setting up of a committee to work on the statistics curriculum development, to coordinate the production of teaching materials suitable for the local situation. Judging from the experience of the Schools Council Project on Statistical Education introduced in U.K.,[1] such a set-up may involve large financial cost. The Education Department should take up this responsibility and act in a wider capacity, "to provide a 'professional epicentre' for school curricular" as proposed in the report of a visiting panel.[7] We also like to make some specific short term suggestions.

1. The syllabus on probability/statistics should be expanded. Considering the fact that elementary notions of descriptive statistics have already been taught in primary schools, the statistics content in Form 1 and Form 2 is too thin and fragmentary. Enlarging the content has an advantage of building up the subject matter as a whole entity. We suggest to move some of the topics currently taught in Form 3 to earlier years and introduce sampling and random number generation in their place. This has an advantage of enabling students to generate their own data set and at the same time get a feeling for the concept of uncertainty at close hand while carrying out a simulation experiment. The statistics syllabus for Form 4/5 is now usually taught in Form 5. This is a regrettable technical mistake in that this is put in the latter part of the mathematics syllabus so that textbooks follow suit. This creates a "man-made" gap between the statistics content of Form 3 and Form 5, and the additional disadvantage concerning projects Students and teachers alike are so hard-pressed by the General Certificate of Education Examination in Form 5 that project work is almost impossible.

2. Educationalists should try to produce more teaching material in the form of capsules to supplement textbooks. Writers of mathematics textbooks may not be statisticians and statisticians would rarely write a textbook

in secondary school mathematics. Hence the statistics content of textbooks lacks a statistics flavour. One solution is to ask statisticians to produce capsules, paying attention to daily life application and using local data set.

3. Bodies like the Hong Kong Statistical Society, university statistics departments, students' societies in statistics should be encouraged to organize competitions of statistics projects for secondary school students.

4. Mathematics teachers should be provided with opportunities, such as talks, workshops, refresher courses, to further their knowledge. More attention and study should be directed to effective teaching methods in probability/statistics

Amidst all the problems we are facing there are signs for optimism in the near future. Examination pressure will be diminished somewhat with the abolition of the Junior Secondary Education Assessment Test in the near future. More places in tertiary education will become available with the setting up of a third university. As Hong Hong is developing, so will the quality of education. But most important of all, it will be through motivated teachers in concerted effort that statistics education can improve.

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