TRAINING TEACHERS TO TEACH STATISTICS IN SOUTH AFRICA: REALITIES AND ATTITUDES

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A new school curriculum, with substantial statistics content, has recently been introduced in South Africa. This gave rise to an extensive project by the national statistics office to upgrade the statistics knowledge of in-service teachers. The authors attempt to come to grips with the impact of the training that has taken place, taking into account the attitude of teachers and the reality of the South African classroom setting.

INTRODUCTION

With the advance of technology, the need for the statistical literacy is becoming more and more essential. Accordingly, statistics is being included in the mathematics curricula of primary and secondary schools in many countries (Gal, 2002).

Literature on statistics education bears evidence that statistics should ideally be taught using a data-driven approach, using real data to emphasize statistical principles and procedures, rather than the traditional theoretical approach where the emphasis is on identifying the correct formula and performing a calculation (Rossman, 1995).

Statistics calls for problem solving skills where there are multiple possible solutions, whilst problem solving in the mathematics classroom is characterized by one single correct answer (Gattuso & Pannonne, 2002). Mathematics school teachers are generally not trained to cope with this totally different mindset, with the result that statistics is often taught by emphasizing algorithms and formulas, with very few real applications (Gattuso, 2006). Accordingly, it is well documented that mathematics teachers all over the world need special training in order to be in a position to promote statistical literacy meaningfully in the classroom (Batanero, Godino & Roa, 2004).

National statistics offices around the world have a commitment to promote statistics literacy in society so as to promote engagement with their output and confidence in their publications. National statistics offices in many countries have therefore become involved with projects aimed at training mathematics school teachers and developing materials to promote more meaning teaching of statistics at school level (Forbes, 2008).

It has been well documented that non-cognitive factors such as negative attitudes or beliefs towards statistics have a detrimental effect on the understanding of the discipline (Gal & Ginsberg, 1994). It is thus a major challenge, all over the world, to overcome the fear that teachers have of statistics. Teachers often feel uncomfortable teaching it and consequently reduce the content or omit it altogether in the class room (Watson, 2001).

Developing countries, such as South Africa, have added challenges such as large classes and language issues to overcome in order to achieve effective statistics training at school level. This paper attempts to come to grips with the reality of the South Africa class room by investigating the effect of a typical statistics training session for mathematics school teachers, run by the national statistics office, Stats SA.

THE SOUTH AFRICAN SITUATION

Legacy of Apartheid

South Africa is a very complex society with social, economic and cultural diversity. The 41 years of Apartheid had a devastating effect on the levels of education in South Africa, as policies were specifically designed to assert white domination and black inferiority. The Report of the Inter-Departmental Committee on "Native Education", 1935–6, is a highly instructive document, giving clear insight into the educational policy of the South African government at that time

In C. Reading (Ed.), *Data and context in statistics education: Towards an evidence-based society. Proceedings of the Eighth International Conference on Teaching Statistics (ICOTS8, July, 2010), Ljubljana, Slovenia*. Voorburg, The Netherlands: International Statistical Institute. www.stat.auckland.ac.nz/~iase/publications.php

(Wilcox, 2003). In this report it is specifically mentioned that "the education of the white child prepares him for life in a dominant society and the education of a black child for a subordinate society". The Bantu Education Act, Act no 47 of 1953, established a Black Education Department in the Department of Native Affairs, which was responsible for compiling a curriculum that ensured that black school children of that era were prevented from receiving an education in keeping with the advances of the twentieth century. Though Apartheid was abolished in 1994, the after effects of the deprivation of the majority of citizens in South Africa continues to have a devastating effect today, as the ban on the mathematics education of black school children from the 50's to the early 90's, has resulted in a critical shortage of mathematics teachers, even today.

Statistics at school level in the Post Apartheid era

Following the abolishment of Apartheid in 1994, education and training in South Africa was restructured in order to reflect the values and principles of a democratic society. This resulted in a new school curriculum with Outcome Based Education (OBE) as fundamental building block. This curriculum was specifically designed to overcome the legacy of apartheid and catapult South Africa into the 21st century (Chisholm,et al. 2000). This curriculum has subsequently been revised and renamed as the National Curriculum Statement (NCS) (DOE 2002, 2003).

The NCS compels all pupils to either do mathematics or mathematical literacy each year–a major shift from what had traditionally been the case in South African schools as it had previously been possible to complete schooling without doing any form of mathematics in the last three years of schooling.

Statistics (Data Handling) forms an integral part of both the mathematics and mathematical literacy syllabi of the NCS, calling for the pupil to master the "use of data from various contexts to make informed judgments" (North and Zewotir 2006). Accordingly, the assessment criteria of the NCS includes the collection of data (methods such as interviews and sampling), the application of statistical tools and the communication and critical evaluation of findings .

Prior to the adoption of the NCS, statistics was not taught at school level, with the result that teachers were not trained in the discipline. This resulted in South Africa being faced with the dilemma firstly of training many more mathematics teachers to overcome the shortage caused by Apartheid and also the introduction of mathematical literacy, and secondly of training in-service mathematics and mathematical literacy teachers to be able to teach statistics meaningfully.

The training of in-service mathematics and mathematical literacy teachers is officially done by the subject advisers of the Department of Education, themselves products of the previous system, with the result that they have had no training in statistics. There was thus a desperate need for the development of a training programme to address statistics training at grass root level.

The maths4stats campaign

Stats SA, the national statistics office of South Africa, launched the *maths4stats* campaign in July, 2006. This project defines a roll-out plan, with associated financial support, to address the need for statistics training of mathematics educators from roughly 28 000 schools. It aims to create a specialized body of educators with a passion for mathematics, and to instil the love of and interest in mathematics and statistics in educators and learners. Details of the project can be found in North & Scheiber (2008). The long term aim of this project is to strengthen the expertise in statistics at all levels, thus setting the scene to successfully incorporate statistics into the core curricula. A conscious attempt is made to involve all stakeholders (such as the Department of Education) in *maths4stats* activities, so as to ensure maximum impact. Full details of the maths4stats programme may be found in North and Scheiber (2008), the main points being:

- the appointment of master trainers (Delia North and Jackie Scheiber);
- the creation of suitable training material by the master trainers;
- the selection of a group of trainers – via a national statistics competition;
- the appointment of national and provincial co-ordinators;
- the extensive training of selected teachers;
- the assessment of trained teachers – both written tests and orals in order to become fully endorsed trainers;

- the presentation of workshops to in-service teachers by fully endorsed trainers;
- conference presentations by the trained teachers;
- the setting up of provincial steering committees.

In short, the project aims at training a core group of mathematics teachers, representative of all provinces and all racial groups, who will then run workshops for other teachers. A major focal point has been ensuring that the *maths4stats* trainers have the necessary content knowledge, confidence and presentation skills to successfully feed into the *maths4stats* roll-out plan. Once fully endorsed *maths4stats* trainers, they are then eligible to run workshops in their provinces for teachers, using the material prepared by the two master trainers.

Since the inception of the program, a vast number of workshops and training courses have been held all over South Africa. At these workshops, feedback questionnaires were given to the *maths4stats* teachers.

ATTITUDES, FEARS AND REALITY

During the Joint ICMI/IASE Conference in Monterrey, Mexico in 2008, an entire topic (Topic 2) was devoted to investigating teachers' attitudes, knowledge, conceptions and beliefs in relation to statistics education (www.stat.auckland.ac.nz/~iase/publications) as it has been well documented that teacher's beliefs, and fears of statistics might be shared with students (Stohl, 2005). In this paper we present the results from a questionnaire survey of the *maths4stats* workshop held at Roodevallei in Pretoria in March, 2007. The workshop was attended by 35 educators and two facilitators (Delia North and Jackie Scheiber, the master trainers of the *maths4stats* program).

Profiling the teachers and their schools

The 26 mathematics teachers originally selected to promote the *maths4stats* campaign in their province formed the core group attending this workshop, and a further 9 teachers were added so that each of the nine provinces in South Africa were well represented at the workshop. The workshop had a good mix of urban and rural attendees, with 18 teachers coming from schools in rural areas whilst 17 were from schools in urban areas. The gender question revealed that 17 male and 18 female teachers attended the workshop, ages ranging from 24 to 57 years, with experience as given in figure 1.

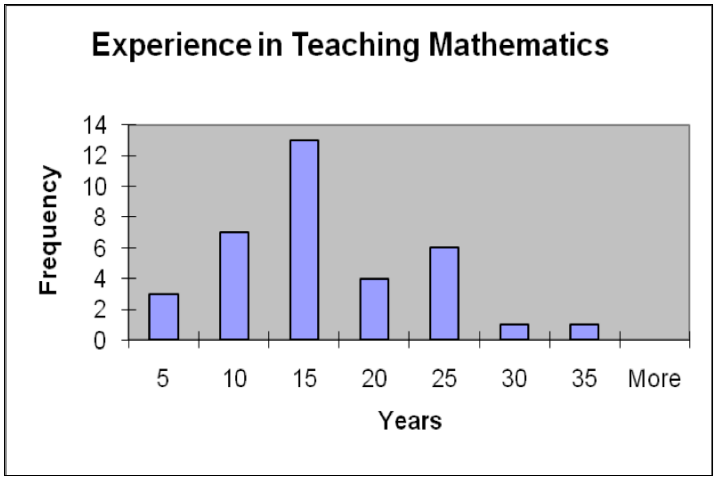

Figure 1. Experience of teachers investigated

The teachers were thus generally fairly experienced, the average experience being 14.45 years. Most of the teachers (71%) taught mathematics to grade 12 pupils. The question on typical class sizes revealed that the average class size was 47.7 with a standard deviation of 21.7 (the maximum class size mentioned was 128). These class sizes are a great concern and are the result of a shortage of mathematics teachers.

South Africa has eleven official languages, making instruction in home language a huge problem with the external examination at the end of Grade 12 being offered only in English and Afrikaans. Figure 2 indicates the primary language of instruction at the school of the participants.

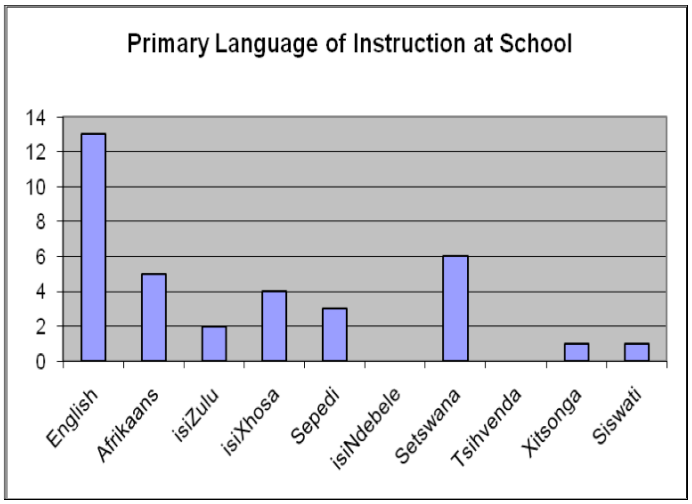

Figure 2. Language instruction prevelant at participants' schools

A question on instruction in home language of pupils, revealed that in 26 out of the 35 schools represented, mathematics (and hence statistics), is taught in a language other than the home language of the pupils. Clearly not the ideal scenario for teaching statistics!

It further became evident that 16 (46%) of the teachers in the group were not teaching the statistics content of the school syllabus at all. This is not surprising as when they were asked about their previous exposure to statistics and probability, it was noted that 16 (46%) had not had any training in statistics and probability, whilst 16 (46%) had had mild exposure, but no proper training. Only 3 (9%) felt that they had received adequate training in statistics and probability prior to the workshop.

The effect of the workshop

The teachers were asked whether they felt empowered to teach statistics and probability in the class room. This was asked both before and after the workshop. Figure 3 bears evidence that the number of teachers that felt empowered to teach statistics and probability went from 6 (17%) before the workshop, to 30 (86%) after the workshop, while the number who did not feel empowered to teach statistics and probability decreased from 19 (55%) before the workshop, to 2 (6%) after the workshop, clearly indicating that the workshop had given them confidence in their ability to teach statistics and probability in the class room.

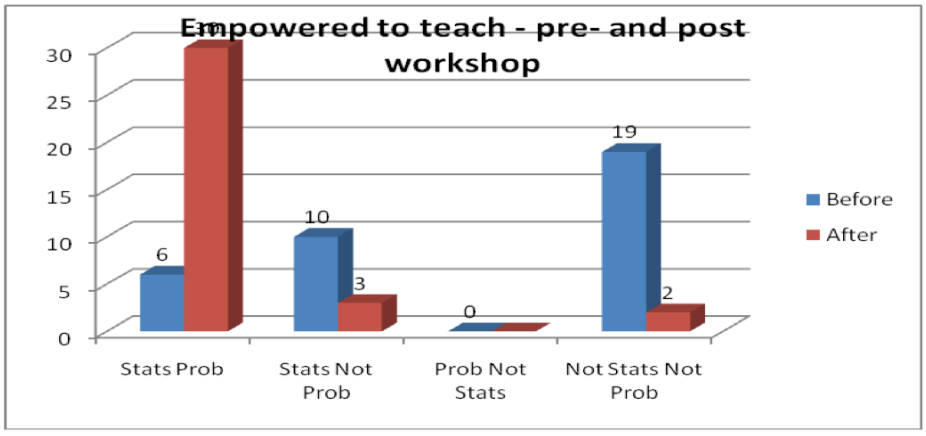

Figure 3. Number of teachers that feel empowered to teach Statistics and Probability: pre-workshop and post-workshop

After the workshop, the teachers were asked to react to the following statement "All citizens need a basic understanding of statistical concepts and graphs to operate effectively in the world that we live in today". A total of 7 (20%) teachers agreed with the statement, while 27 (77%) strongly agreed with the statement, indicating that the teachers could see the value of teaching statistics at school level.

On the completion of the workshop the teachers were asked to express an opinion on how they felt pupils in their class would cope with the statistics content of the school syllabus. Their answers reflect a sense of reality as 29% felt that the students would cope with ease, 71% felt that the pupils would manage with some degree of difficulty and no one felt that the pupils would generally not be able to cope with the statistics content of the new school syllabus. Bearing in mind that the teachers generally are faced with large classes, pupils who are learning in a language other than their home language, and that teachers have generally not had formal training in statistics, it is an indication that the results of this final question reflects a very positive attitude towards the teaching of statistics amongst workshop participants.

CONCLUSION

South Africa has introduced statistics into the school syllabus at a later stage than most other countries, thus benefiting from the rich research material that is available to optimize the teaching of statistics at school level. The *maths4stats* project, sponsored by the national statistics office, is delivering remarkable results in schools despite the problems such as large classes, and language of instruction. Teachers attending the *maths4stats* workshops generally have not had prior exposure to statistics training, and were often not teaching statistics in the class room, but indications are that the workshops result in a very positive attitude towards teaching statistics as they see value and relevance of teaching statistics in the class room, and feel empowered to do so.

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