INTRODUCING STATISTICS AT SCHOOL LEVEL IN SOUTH AFRICA

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South Africa is currently in the process of implementing C2005, a new school curriculum in South Africa. This paper focuses on the statistics content of the new school curriculum and describes some steps taken to assist teachers in coping with the imminent new data handling component. Particular emphasis is placed on the influence of ICOTS-6, on this process.

INTRODUCTION

Prior to 1998, there had been very little interaction between the professional associations to which the South African mathematics school teachers and statistics educators belong. This can be attributed to the fact that statistics virtually played no role in the South African school education system at that time. The Associated Mathematics Teachers of South Africa (AMESA) and the South African Statistical Association (SASA) independently held annual seminars, workshops, think tanks and conferences with no interaction between them. It was only in 1998, when South Africa won the bid to host the Sixth International Conference on the Teaching of Statistics (ICOTS-6), that the Education committee of SASA was tasked with reaching out to AMESA, with the intention of including school teachers in some of the proposed ICOTS-6 initiatives. The hosting of ICOTS-6 in South Africa thus dove-tailed beautifully with introduction of statistics into the school curriculum as national and international attention was focused on this initiative.

In this paper we first give an overview of the statistics content of the South African school curriculum, prior to the adoption of C2005. Secondly we give a detailed discussion of the statistics content of C2005. Finally we highlight various projects undertaken to aid with the successful implementation of the new statistics content.

SCHOOLING IN SOUTH AFRICA – THE WAY IT WAS

South Africa is a very complex society with social, economic and cultural diversity. With about 15% of South Africans being illiterate, many children are first generation readers and thus cannot hope to get guidance beyond the class room. A further problem is the level of preparation with which scholars enter the schooling program as this can differ greatly from rural to urban schools.

The situation prior to the implementation of C2005 was that virtually all children started school at the age of 6 or 7, had seven years of primary schooling, followed by 5 years of secondary schooling. Scholars were promoted on the basis of a combination of class work and formal summative testing (content-based testing played a progressively larger role in the higher grades). During their twelve years of schooling, students were introduced to graphical methods of data representation in the earlier grades (bar graphs, pictograms, etc.), but this was never developed to the next level! After this very early introduction to graphical displays of data, it was only in the grade 9 mathematics syllabus that some statistics was mentioned again! Here a small section was devoted to basic statistical measures such as mean, median, mode, range, variance and standard deviation. This was thus very much a formula-based approach, purely emphasizing the computational aspects with no reference to statistical reasoning and problem solving. Almost all schools chose to omit this section as the mathematics syllabus was so long that they could not teach it all, hence left out the part that would not be built upon in subsequent years, which is understandable but undesirable!

This reality was that students entered tertiary institutions with no prior exposure to statistics. Statistics, at South African tertiary institutions, very much mirrors what is the case in many countries – a small number of students opt to study statistics as a three year major, possibly followed by further post graduate studies in statistics. The majority of students, registering for statistics courses at tertiary institutions, register for one of the many, varied introductory statistics service courses which are compulsory to students from Engineering, Commerce, Medicine,

Pharmacy, etc. These service courses in statistics are often taught by the relevant faculty members themselves and not by statisticians. The result is that these courses are generally taught using the classic formula-based approach, as these lecturers have not kept up with developments in statistics education, and thus teach in the way that they were classically taught. It is thus not surprising that Statistics has a very negative image amongst the majority of students at tertiary institutions in South Africa.

SCHOOLING IN SOUTH AFRICA – A WHOLE NEW APPROACH

Curriculum 2005

The announcement of Curriculum 2005 (C2005), a school curriculum with outcomes based education (OBE) as fundamental building block, was the start of a whole new era in school education in South Africa. The whole structure of the school education system changed, with the grades being grouped together to form phases and bands as will subsequently become clear.

Foundation Phase:	Grade R (reception year), Grades 1 to 3
Intermediate Phase:	Grades 4 to 6
Senior Phase:	Grades 7 to 9

These phases form the GET (General Education and Training) band, which is then followed by the FET (Further Education and Training) band, which consists of grades 10 to 12.

Differences between this system and the previous one is that

- Continuous assessment plays a bigger role in C2005 - assessment was generally summative at year or term end in the previous education system.
- There are now two national exams, one at the end of grade 9 and one at the end of grade 12. Previously it was only at the end of grade 12.
- Scholars have more exit points – compulsory schooling ends at grade 9 level, i.e., scholars may either enter the workforce, do vocational training or enter the FET band.
- A further significant change was that under C2005, ALL scholars have to continue with Mathematics if they choose to do the FET band. Previously scholars could avoid doing Mathematics as it was optional. Students now have to choose between Mathematics and Mathematical Literacy (a mathematics syllabus which ensure that students have the basic Mathematics skills that are needed to function in society).

A major problem has been that C2005 requires teachers to totally change the way in which they teach, in every aspect of their task. Group work and continuous assessment play a far bigger role in C2005 than in the previous education system. Teachers are facilitators and encourage class discussions as opposed to the class quietly listening to the teacher in the previous system. This is all very different to what had been the case previously and there was thus an urgent need for in-service training for teachers to assist them in achieving the goals of this new curriculum.

Data Handling in C2005

Outcome 5 of the Mathematics syllabus of C2005 states that learners must be able to use data from various contexts to make informed judgments, while the curriculum statement of C2005 states that a student must be able to collect, summarise, display and analyse data and apply knowledge to communicate, justify, predict and critically interrogate findings and draw conclusions. In short, the student must be able to investigate and interpret situations which can be dealt with using statistical techniques. Statistics topics are thus geared towards problem solving and not just an exercise in computing statistical formulae. The goal is to ensure that by the end of compulsory schooling (grade 9), a student is able to orient himself in this age of rapid information expansion.

Throughout the data handling section of C2005, a problem solving approach is used with clear communication of findings, i.e., an attempt is made to teach statistical principles and encourage statistical reasoning rather than focusing on the computational aspects of statistics. A

summary of the Data Handling focus areas in each of the phases of C2005 mentioned above now follows.

GET: Foundation Phase: Grade R (reception year), Grades 1 to 3

At the end of this phase, it is expected that a scholar is able to

- Sort objects and data in different ways, based on their features (colour, shape, etc.)
- Represent data or objects in different forms (bar graphs, pictograghs, etc.)
- Interpret the representation of data or objects

There must be awareness that the selection of attributes used for sorting will influence how the data is represented.

GET: Intermediate Phase: Grades 4 to 6

- Different questions reveal different features of a situation
- Different forms of representation highlight some aspects of data, while hiding others
- Introduction to the idea of chance (probability):
  Developing an awareness of certainty/uncertainty
  Random experiments and associated events

No calculation of probabilities, just an awareness of the fact that some events might be more likely to occur than others, i.e., grading of levels of uncertainty of outcomes of groupings thereof.

GET: Senior Phase: Grades 7 to 9

- Application of tools and techniques already learnt to investigate and solve problems (including design of questionnaires)
- Critical awareness of use/abuse of data representations and interpretations
- Further development of probability concepts in order to engage with expressions of change in their daily lives (e.g., true understanding of uncertain in weather predictions, etc.)

The end of this phase signifies the end of compulsory schooling and scholars should have basic statistical literacy, to a degree that will ensure that they can function in our knowledge driven society.

At the end of grade 9, students either choose to leave formal academic schooling (to pursue further vocational training or enter the work force) or else enter the FET phase. A choice then has to be made between Mathematics and Mathematical Literacy, which will be taken throughout the FET phase.

Data Handling in the FET phase thus builds on what was taught in the GET phase with the following focus areas:

FET: Mathematical Literacy: Grades 10 to 12

By the end of the FET Phase the scholar should be able to

- Gather relevant data, choose appropriate methods to display the data for different purposes, build arguments and draw conclusions
- Interpret and analyse data based arguments in the media and be aware of possible sources of errors
- Understand how to work with a representative sample and interpret data-based statements in the media
- Understand the relationship between relative frequency and probability
- Compare data sets in terms of central tendency and spread (including standard deviation, variance and quartiles, but not the calculation thereof)
- Anaylse and interpret a wide variety of graphs such as stem-and-leaf plots, ogives, etc.
- Awareness of sources of bias and error
- Be able to work with contingency tables and draw meaningful conclusions
- Work confidently with representations of data in the media, related to a variety of situations and statistical measures (health, finance, environmental and other issues)

- Work with bivariate data and discuss trends
- Engage critically with probability statements related to games of chance

In each of the grades students will be required to exhibit some of the competencies acquired through doing an authentic form of assessment for example an integrated project.

The main difference between the focus of the Data Handling component of C2005 in the Mathematics and Mathematical Literacy syllabi is that there is an emphasis on the scholar as a *consumer* of statistics in the Mathematical Literacy syllabus, while the Mathematics syllabus emphasis both the producing and consuming of statistics. The Data handling component of C2005 thus would cover all the above points mentioned in the Mathematics Literacy focus, with the following additional aspects:

FET: Mathematics: Grades 10 to 12

- Choose appropriate methods to collect, organize, represent, anaylse data in order to solve a particular problem at a more advanced level than in the GET phase
- Use Venn diagrams to solve basic probability problems
- Expand the range of statistical tools to include quartiles, percentiles, variance, standard deviation (at all times emphasis to be placed on the interpretation aspect)
- Be able to recognize the strengths and weaknesses of statistical arguments and establish basic probability models to solve appropriate problems.

In each of the grades students will be required to exhibit some of the competencies acquired through doing an authentic form of assessment for example an integrated project.

As discussed in above, very little (hardly any!) statistics had been taught at school level in South Africa before C2005 was introduced, with the result that mathematics teachers had had little or no training in statistics. The dilemma arose as to how these teachers could receive training in order to cope with the vast new statistics content of C2005.

PROJECTS TO ASSIST WITH THE INTRODUCTION OF STATISTICS AT SCHOOL LEVEL IN SOUTH AFRICA

Finalizing the Statistics Content of C2005

The vast statistics component in the Data Handling section of C2005 was initially developed by the Department of Education (DOE) without any input from the South African Statistical Association (SASA). The IASE and SASA were busy with negotiations for ICOTS-6 at that time, with the result that a project was set up between SASA and some world leaders in Statistics Education to formally assess and change the proposed Data Handling component of C2005.

ICOTS-6 Local Teacher Sessions

ICOTS-6 (Cape Town, July 2002) was used to kick-start an outreach to local mathematics school teachers. A 5-day local teacher program was held as a separate stream throughout ICOTS-6. A minimum of 4 Maths teachers and Maths advisors from each of our 9 provinces were sponsored, to attend the local teacher session at ICOTS-6, with the intention of developing core groups to run follow up workshops. Sponsorship required that they present workshops in their home areas, and that they gave up 2 weeks of their vacation at no charge.

The local teacher sessions consisted of various conference talks (selected and grouped in the program so that the teachers could attend), a census@school workshop (the Royal Statistical Society Centre for Statistics Education played a major role!), a set of talks on probability (by Delia North, SASA) and on data handling (by Jackie Scheiber, AMESA), as well as sessions by the Schools Development Unit of the University of Cape Town. A workshop approach prevailed throughout, with delegates receiving “ICOTS-6 Papers for School Teachers,” a collection of papers from ICOTS-6 selected by the Local Organising Committee, as well as materials and aids to use in the class room. The sessions were captured on video and CDs and VHS tapes are being distributed.

The program was a resounding success, with over 100 follow-up workshops during the year 2003, given by the delegates. As a natural follow-on to the ICOTS-6 local teacher session, a

further course was presented as a 2-day workshop during SASA's 50th anniversary conference in Nov, 2003. A large number of books of course materials were sponsored by StatsSA, which were then used in more follow-on workshops. These workshops cover the entire data handling and probability component of Curriculum 2005 and are presented all year round, thus giving teachers all over South Africa the opportunity of upgrading their knowledge in order to achieve statistical literacy of the school leaver in South Africa.

Workshops, Talks, Seminars, Visits to Schools

Various individuals and associations are giving talks, seminars, workshops to assist with the introduction of statistics into the school syllabus in South Africa. The author, Delia North, has taken a leading role in this regard, on behalf of SASA. The activities include

1) Holding various workshops (5-day) for DOE mathematics advisors, who are then responsible for giving similar talks to teachers that fall in their area.

2) Presenting workshops (2 to 3-day) on the Data Handling content of C2005 to school teachers. These workshops are specifically aimed at a particular band, i.e., presented to either GET (grades R to 9) or the FET (grades 10 to 12) bands. These workshops generally take 2 - 3 days.

3) Giving talks to teachers at their conferences. These talks are generally aimed at a particular phase, i.e., either the Foundation, Intermediate, Senior or FET phases and are only an hour long as they are just demonstrations of the usefulness of statistics as a problem solving tool at a particular level.

4) Going to schools to give talks to the school children to demonstrate to teachers how to conduct a class discussion or lesson on statistics. This is always very enjoyable for children and teachers are very appreciative of the input.

Census@School in South Africa

The Census@School workshop was run by Statistics South Africa, the official government census office, just prior to ICOTS-6. A total of 17,000 schools and 3 to 4 million scholars participated! The results were placed on the web, along with the Census@School results from England, Australia and New Zealand. Teachers and children could compare their class results with national results as well as the international results of the other countries mentioned. The Education Centre of the Royal Statistical Society were consulted to produce a series of teacher aids, based on the Data Handling content of C2005, that teachers could use in the class room.

CONCLUSION

Curriculum2005 recognizes the cross-curricular need for statistics literacy and data analysis skills as an anticipated outcome, thus large amounts of statistical material is present in the syllabus. This content however has to be taught by teachers with little or no training in Statistics. Projects outlined above have already paid off as teachers that have attended the various initiatives mentioned are keen to learn more Statistics so that their students can function better in society.

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