

THE CURRENT TEACHING OF STATISTICS IN SCHOOLS IN UGANDA

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This paper describes the current state of teaching statistics in Ugandan schools at different levels. Different emphasis is placed on teaching statistics at primary, secondary and tertiary levels. Official documents on curricula and examination make explicit statements on what statistical ideas and techniques are to be taught in schools and suggest useful skills and capabilities that school graduates should acquire, but little of the qualities are visible on the ground. There is little emphasis on the application of these techniques in the context of real life problems. Various challenges on the teaching of mathematics and statistics in schools and the school-university transition are identified, which include the curricula, the teaching force, and the nature of the students and the shortage of teaching resources. These challenges maybe addressed through synchronising students with varied mathematics school backgrounds in their study of statistics, policy adjustments and continuous professional development.

INTRODUCTION

This paper discusses the current situation of teaching statistics in Uganda. It then presents a conceptual framework that guides the discussion. It addresses several key questions to provide information on the teaching of statistics in the country for possible future educational planning: (1) How is statistics taught at the different school levels in the country?; (2) What are the challenges and problems of teaching statistics in schools in Uganda?; and (3) What are the challenges of the training for the school-university transition?

The Conceptual Framework

Educators in most countries of the world face a number of educational challenges. The current prominent challenges include “innovative teaching strategies; various measures to improve...the quality of teachers; greater attention to ‘constructivist’-inspired forms of teaching and learning; and the advent and impact of new technologies on classroom practices” (Hargreaves, Lieberman, Fullan & Hopkins, 1998, p.2). Research in schools has provided elements of practice that work and those that do not work. For example, “constructivism leads to new beliefs about excellence in teaching and learning and about the roles of both teachers and students in the process (Stein et al., 1994, p.26). Students learn mathematics with meaning when they activate their existing knowledge through motivation and relate it to existing educational experiences to develop new concepts as new knowledge is constructed. Active participation is therefore imperative for learning.

Empirical studies of the teaching of statistics in different countries at different levels mainly in the African region have centred on different aspects. For example, Odhiambo (2002) focussed on teaching approaches; while Ogum (1998), Polaki (2006) and Zewotir (2006) concentrated on the performance of students and matters of teaching resources, the understanding of statistical concepts and the mathematics curriculum; and Asar (2002), Kobus de Wet (1998) and Ogum (1998) examined the challenges and problems in developing effective statistical information systems as an avenue for national development.

THE TEACHING OF STATISTICS IN UGANDA

To understand the education system in Uganda we consider the basic education levels, the nature of the students and the teaching practices. The education system in the country has a pyramidal structure. At the bottom of the system is the primary level that lasts seven years; second, the secondary level that lasts six years; and third, the tertiary level that lasts two to five years and includes teacher training. The majority of the schools and the students come from medium to low socio-economic status (SES) families. The teaching of statistics in schools in Uganda is covered under mathematics. In other words, at the primary level mathematics is

taken as a single subject. At the lower secondary level mathematics is taken as two separate options namely 456 Mathematics and 475 Mathematics. It is at the advanced secondary level and tertiary levels that statistics stands as a subject in its own right.

Teaching Statistics at Primary School level

At the primary school level the mathematics syllabus emphasises the teaching of integrated production skills. According to the National Curriculum Development Centre (NCDC, 1990, pp. 220-221) the “overall aim of teaching [mathematics] must be to develop in children a positive attitude towards mathematics and an awareness of its great power to communicate and to provide explanations in matters of daily phenomena” that the teachers are expected to achieve. Furthermore, teachers are challenged to make mathematics a reality in life through practical experience of the learners. They are also encouraged to integrate mathematics with other subjects and make it practical (Asar, 2002). It may be noted that the emphasis is not on the teaching of statistics but mathematics. This is unlike the case in Egyptian schools where statistics has become a major part of the mathematics curriculum (Asar, 2002). At this level the mathematics syllabus in Uganda contains ten topics including Graphs and Interpretation of Information (NCDC, 1990) that are taught to all primary school classes. Unfortunately the use of technology such as calculators is not emphasised at this level as is also the case in Nigeria (Ogum, 1998).

Teaching Statistics at Secondary School level

The Uganda National Examinations Board [UNEB] syllabi for both Ordinary (O-level) and Advanced (A-level) levels (UNEB, 2003; 2005) make explicit statements on what statistical ideas and techniques ought to be taught in schools. However, there is no emphasis on the application of these techniques to understand and to interpret data in the context of real life problems. Meanwhile, teachers cover data handling mechanically or instrumentally, which is usually restricted to tallying information. At the same time, the use of Information and Communication Technology (ICT) in data processing has not taken off in schools because of financial constraints in acquiring and maintaining the necessary technology due to frequent power failure or on complete non-existence of electricity. Interestingly, the use of calculators is permitted at this level but not formally taught. This means the current status of teaching statistics is far from satisfactory. Certainly it is not like the practice in countries like South Africa where computer literacy and the use of technology are promoted as an aid for teaching statistics (Kobus de Wet, 1998) or in China where the junior school curriculum includes statistical literacy (Li, 2005).

Whereas the UNEB (2005, p. 106) syllabus argues that at O-level, “mathematics should be visualized as a vehicle for aiding a student to think, reason and articulate logically” (UNEB, 2005, p. 106), statistics does not stand out as a major topic in its own right but rather is imbedded in what is called ‘miscellaneous applications’. In this section an attempt is made to emphasise statistical literacy for citizenship, though it is not explicitly covered in the syllabus and teachers give it less emphasis. The same scenario persists in the 475-Additional Mathematics syllabus (UNEB, 2005). The major limitation of these syllabi is therefore the lack of emphasis on the use of genuine data collection and analysis by students, which is at variance with the call to use sound statistical reasoning (Franklin, et al., 2007). The contents of the courses that are taught reflect the emphasis that is placed on teaching formulae for calculating statistics. There is little concern towards using data in context or for interpretive activities or in daily life.

Teaching Statistics at Tertiary level

Future primary school teachers are prepared in the Primary Teachers Colleges (PTCs). At the PTCs students follow a mathematics syllabus that includes statistics and probability among other topics (MOES, 1995). This structure is similar to the practice in some other countries like Ethiopia (Zewotir, 2006), Ghana (Nana, 1998), Kenya (Odhiambo, 2002), Lesotho (Polaki, 2006), and Nigeria (Ogum, 1998). The PTC syllabus aims at enabling student teachers to acquire statistical techniques (Ministry of Education and Sports (MOES), 1995).

The MOES continues to expect that if the content of the syllabus is carefully taught, then the student will be able to develop specific skills and competences to enable them teach effectively. However, eventually student teachers are unable to demonstrate what they know, they understand and they can do. Meanwhile students continue to perform unsatisfactorily in mathematics in general.

At the university level different universities in Africa offer statistics in different courses such as population studies, business studies, economics, in social science and biological sciences (Tulya-Muhika, 1990). However, students join universities with different backgrounds in mathematics in general and statistics in particular. When students enter university they are confronted by educational systems with different expectations from those with which they are familiar. This means there is usually a gap between school and the first-year university courses. The preparation in the mathematical and logical concepts at school, which form the basis of statistical reasoning required at universities, appears inadequate, and students bring anxieties about the subject to the university from school as Brewer (1990) identified.

HOW STATISTICS IS TAUGHT IN SCHOOLS

Generally, looking at the teaching of statistics in the schools, as intimated earlier, is done as a component of the mathematics curriculum by teachers who have pedagogical knowledge to teach mathematics but hardly ever had an opportunity to develop sound knowledge on the principles and concepts underlying good practices of teaching statistics. However, there is some integration of statistics in the curriculum of other subjects, but it is oriented towards passing examinations. It is clearly observable that statistics education in Uganda is similar to that of other African countries like Benin (Accrombessy, 2006), Nigeria (Ogum, 1998), Kenya, (Odhiambo, 2002), and Lesotho (Polaki, 2006). For example, at the lower school levels statistics is characterised by the classic formula based approach with emphasis on computation and little reference to statistical reasoning and problem solving.

As described earlier, a close scrutiny of primary school mathematics syllabus, the 456-Mathematics syllabus for O-level and the UNEB past examination papers (UNEB, 2005) reveals that the teaching of statistics receives less attention than it deserves in terms of the proportion of content devoted to it, compared to other topics in the syllabi. Similarly, at A-level statistics constitutes about 25% of the content of both P425 and P475 mathematics syllabi. Thus, at A-level statistics teaching competes favourably for time with the teaching of other topics in the syllabi as there is some integration of statistics in the curriculum of other subjects such as geography, biology, and economics.

In most schools statistics is learned by rote from mathematics textbooks and discussed only during the mathematics time, because statistics is very often taught in a cookbook fashion directly from a textbook (Iversen, 1992). Unfortunately, textbook-based teaching does not offer challenges to the students since the tasks are often laid out for the students step-by-step. Whereas Cobb (1992) and Moore and Roberts (1989) have argued that exemplary teaching of statistics should have nine characteristics of practices including: (i) introducing students to statistics through genuine data centred approaches; (ii) promoting collaborative learning among students through group work; and (iii) introducing data analysis by hand and moving gradually on to automation to alleviate difficulties with computations among others. This unfortunately is not the current situation in Uganda. Instead mathematics teaching does not follow these characteristics, perhaps because the teachers lack relevant training. The use of technology, especially calculators and computers that play a role in the teaching of statistics, is minimal. In fact at the primary school level these technologies are prohibited in Uganda as is the case in Nigeria (Ogum, 1998) and Benin (Accrombessy, 2006).

Challenges of teaching statistics in schools

A number of challenges face the teaching of statistics in schools in the country. Three of these challenges include: (i) the nature and shortage of the mathematics teachers; (ii) the attitudes of students to mathematics; and (iii) shortage and sometimes complete lack of teaching and learning materials and resources like suitable textbooks (MOES, 2004). These

challenges are similar to those reported in other countries such as Benin (Accrombessy, 2006), Ghana (Nana, 1998), Kenya (Odhiambo, 2002) and Nigeria (Ogum, 1998).

There is an acute shortage of mathematics teachers and hardly any teachers of statistics per se in the country at all levels, according to the Ministry of Education and Sports statistics (MOES, 2004). The mass media reports that even the few mathematics teachers who are trained move to better paid jobs outside education. The few teachers who remain in service are usually overloaded and poorly remunerated and therefore have low morale and are disinterested because they are expected to teach over 28 periods per week, and they earn low pay. Students also vary in their primary mathematics background, and they originate from different home family backgrounds and socio-economic status (SES). The SES level of the school dictates the type of facilities that may be available to both the teachers and the students for teaching and learning.

CHALLENGES OF TRAINING STUDENTS FOR THE SCHOOL-UNIVERSITY TRANSITION

There are several challenges of school-university transition. These challenges include the nature of the syllabus followed; lack of collaboration between the school teachers and university lecturers and the minimal use of technology. A key challenge to smooth transition from school to university statistics is the content of the school syllabi. A number of important statistical concepts, such as sampling variability, survey and experimental design, statistical inference, and ability to judge the validity of arguments that are based on data are often not integrated in the mathematics course outlines. At university level, classes in introductory statistics are usually large, and the teaching approach is restricted to lecture method, “talk and chalk” or “stand and deliver” approach (Martin, 1990) with little discussion, if any. These schools and universities have a challenge to improve teaching approaches because it is difficult to find teachers and lecturers with a good grounding in statistics as is the case in France (Laurent-Duhamel, 1990).

Another challenge to smooth transition from school to university statistics teaching is the lack of collaborative effort amongst schools, universities, statisticians, the Uganda National Bureau of Statistics (UNBOS) to share and facilitate dissemination of statistics education research that is aimed at curriculum development, writing textbooks and other instructional materials relevant to the local environment. Each of these individuals or entities works in isolation of the others. The importance of statistics in all walks of life can no longer be underestimated.

To bridge the gap of differences among university students’ needs, introductory courses should be designed to build on their background. Students’ backgrounds are strongly related and contribute to the students’ development in statistical thinking. Unfortunately, teachers in schools lack or have very little knowledge of statistics curriculum in universities. They lack knowledge of what their students are going to do and what preparation they need because there is a weak link between the university lecturers and school teachers.

Another challenge of transition is the move to increase the use of technology at the university level. Technology has a role to play in the teaching of statistics. In schools hardly any computers are used in teaching in general and in teaching of statistics in particular because of their unavailability. Students begin to get exposed to Information and Communication Technology (ICT) when they join university. Related to the lack of computers is the teachers’ lack of training in the use of computers for instruction. However, the School of Education at Makerere, in collaboration with the Open University in the United Kingdom, has now started to address this problem through the E-learning and Teacher Education Project (ELATE) by training their pre-service teachers in the use of ICT. In spite of this effort there is still an urgent need to integrate the use of technology in the instruction of statistics at all levels.

CONCLUSION

The education system in the country is structured into three main levels. The teaching of statistics in Uganda schools at the lower levels is masked under mathematics and does not yet stand out on its own right. The statistics that is covered is contained in the various official

documents like the syllabi and curriculum for the different levels. Although statistics is taken as a subject on its own at the higher levels the skills and capabilities that are advocated in various documents are not translated to practice due to several challenges for teaching. The challenges of teaching statistics are enormous, but with facilitation, support and goodwill they can be overcome to improve statistical literacy. The key challenges at the school level are the inadequacy of suitably qualified statistics teachers and the low morale of those few who are there; the negative attitudes of the students towards mathematics in general; and the lack of teaching materials and resources. Furthermore, the challenges in the school-university transition include the nature of the school and university curricula and syllabi; the isolated nature of working between school teachers and the university dons; and the widespread use of ICT that is not well developed at the school level. These challenges are not unique to Uganda as they have been identified in several other countries in Africa and beyond. However, African scholars continue to struggle to improve the quality of statistics teaching in its schools and eventually have a statistics stand as a subject on its own right at all levels. There is great potential to improve the teaching of statistics by treating it as an independent subject and applying various friendly teaching exemplary approaches, such as project work, to attract more students. It is therefore recommended that there is a need to address the teaching of statistics at policy level so that the creation of a single statistics subject at the lower level is embraced and the inclusion of ICT becomes mandatory. Furthermore the shortcomings of the nature of the trained teachers currently in the field teaching statistics should be addressed through continuous professional development.

REFERENCES

- Accrombessy, F. D. E. T. (2006). An evaluation study of the process of reform of statistics teaching at the secondary level in Benin: Assessment and perspectives. In A. Rossman & B. Chance (Eds.), *Proceedings of the Seventh International Conference on Teaching Statistics*. [CD-ROM]. Salvador (Bahia), Brazil: International Association for Statistical Education and International Statistical Institute.
- Asar, R. M. E., (2002). *An experimental approach for teaching statistics in the Egyptian schools*. In B. Phillips (Ed.), *Proceedings of the Sixth International Conference on Teaching Statistics*. [CD-ROM]. Cape Town, South Africa: International Association for Statistical Education and International Statistical Institute.
- Brewer, J. K. (1990). Teaching introductory statistics to graduate students in the behavioural and social sciences: Unique problems and instructional methods. In D. Vere Jones (Ed.), *Proceedings of the Third International Conference on Teaching Statistics*. .Online www.stat.auckland.ac.nz/~iase/publications/.
- Cobb, G. W. (1992). Teaching statistics. In A. S. Lynn (Ed.), *Heeding the call for change: Suggestions for curricular action, MAA notes*, 22, 3-43.
- Franklin, C., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M., & Scheaffer, R. L. (2007). *Guidelines for assessment and instruction in statistics education (GIASE) report*. Alexandria: American Statistical Association.
- Hargreaves, A., Lieberman, A., Fullan, M., & Hopkins, D. (1998). Introduction. In A. Hargreaves, A. Lieberman, M. Fullan & D. Hopkins (Eds.), *International handbook of educational change* (Part 1, pp. 1-7). Dordrecht: Kluwer.
- Iversen, G. R. (1992). Mathematics and statistics: An uneasy marriage. In F. S. Gordon & S. P. Gordon (Eds.), *Statistics in the 21st Century* (pp. 37-44). Mathematical Association of America.
- Korbus de Wet, J. I. (1998). Teaching of statistics to historically disadvantaged students: The South African experience. In B. Phillips (Ed.), *Proceedings of the Sixth International Conference on Teaching Statistics*. [CD-ROM]. Cape Town, South Africa: International Association for Statistical Education and International Statistical Institute.
- Laurent-Duhamel, M. J. (1990). Teaching statistics in the tertiary Institutes of Technology in France. In D. Vere Jones (Ed.), *Proceedings of the Third International Conference on Teaching Statistics, ICOTS 3*. Online: www.stat.auckland.ac.nz/~iase/publications/.
- Li, J. (2005). Statistics education for junior high schools in China. In G. Burrill & M. Camden

- (Eds.) *Curriculum development in statistics education: International Association for Statistical Education 2004 Roundtable* (pp. 219-229). Online: www.stat.auckland.ac.nz/~iase/publications.
- Martin, P. (1990). *Teaching introductory statistics at tertiary level: A shift in emphasis*. In D. Vere Jones (Ed.), *Proceedings of the Third International Conference on Teaching Statistics*. Online: www.stat.auckland.ac.nz/~iase/publications/.
- Ministry of Education and Sports (1995). *Syllabuses for primary teachers colleges*. Kampala: Author.
- Ministry of Education and Sports (2004). *Uganda Education Statistics Abstract 2003*. Kampala: Author.
- Moore, T. L., & Roberts, R. A. (1989). Statistics at liberal arts colleges. *The American Statistician*, 43, 80-85.
- Nana, N. N. N. N. (1998). The teaching of statistics at the tertiary level in Ghana. The science statistics: An introductory lecture to first year. In L. Pereira-Mendoza (Ed.), *Proceedings of the Fifth International Conference on Teaching*. Singapore: International Statistical Institute. Online: www.stat.auckland.ac.nz/~iase/publications/.
- National Curriculum Development Centre (1990). *Primary School Mathematics Syllabus*. Kampala: Author.
- Odhiambo, J. W. (2002). Teaching statistics in Kenya. In B. Phillips (Ed.), *Proceedings of the Sixth International Conference on Teaching Statistics*. [CD-ROM]. Cape Town, South Africa: International Association for Statistical Education and International Statistical Institute.
- Ogum, G. E. O. (1998). Statistics education in Nigeria: Problems and prospects. In L. Pereira-Mendoza (Ed.), *Proceedings of the Fifth International Conference on Teaching*. Singapore: International Statistical Institute. Online: www.stat.auckland.ac.nz/~iase/publications/.
- Polaki, M. V. (2006). Looking at the mathematics curriculum and mathematics textbook to identify statistical concepts that Lesotho's high school students experience. In A. Rossman & B. Chance (Eds.), *Proceedings of the Seventh International Conference on Teaching Statistics*. [CD-ROM]. Salvador (Bahia), Brazil: International Association for Statistical Education and International Statistical Institute.
- Stein, M., Edwards, T., Norman, J., Roberts, S., Sales, J., Alec, R., & Chambers, J. (1994). *A constructivist vision for teaching, learning and staff development*. Unpublished manuscript, Detroit, MI: Wayne State University.
- Tulya-Muhika, S. (1990). Teaching statistics for future government statistical services in Africa. In D. Vere Jones (Ed.), *Proceedings of the Third International Conference on Teaching Statistics*. Online: www.stat.auckland.ac.nz/~iase/publications/.
- Uganda National Examinations Board (2003). *Uganda advanced certificate of education: Regulations and syllabuses 2004-2008*. Kampala: Author.
- Uganda National Examinations Board (2005). *Uganda certificate of education: Regulations and syllabuses 2005-2010*. Kampala: Author.
- Zewotir, T. (2006). *Status of statistics in Africa: The case of Ethiopia*. In A. Rossman & B. Chance (Eds.), *Proceedings of the Seventh International Conference on Teaching Statistics*. [CD-ROM]. Salvador (Bahia), Brazil: International Association for Statistical Education and International Statistical Institute.