

STATISTICS IN UGANDAN SCHOOLS: CHALLENGES ON INSTRUCTION AND ASSESSMENT

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This paper reports part of a study that investigated teacher profiles, assessment and grading practices in statistics classrooms and challenges faced by teachers of statistics in primary and secondary schools in Uganda. The study suggests possible directions for future research. The study employed a survey research design using both quantitative and qualitative approaches. Eighty primary and 120 secondary school teachers participated in the study. Interviews were for probing teachers' assessment practices and challenges they face, and a questionnaire was for capturing their demographic information and attitudes towards teaching statistics. The findings of this study indicate that non-statisticians teach statistics. Teachers face numerous challenges in the teaching statistics. Teachers rely on paper-and-pencil assessment but do not provide feedback to students. These findings have implications for statistics curriculum developers, policy makers, teacher educators, examiners, and teachers, and for further research.

INTRODUCTION

In fulfilling their role as instructors, teachers work in different environments, face numerous challenges, and engage in various activities using different approaches, and hold diverse feelings, beliefs and attitudes toward their work, their students and the subject. Several researchers, notably Bingimlas (2009), Mustafa and Cullingford (2008), Opolot-Okurut (2007), and Oyelese (1982) have described challenges that teachers face in the course of their work in different environments and subjects. In Uganda, teachers face common problems including pressure to complete the syllabus. Mustafa and Cullingford (2008) pointed out that “teachers have little control regarding what and when they teach and these have an impact on how they teach” (p. 87). Similarly, Oyelese (1982) identified problems of teaching statistics in Nigerian schools to include lack of qualified teachers, non-existent elementary textbooks for teaching in primary and secondary schools, lack of appropriate teaching aids, non-existent curriculum for statistics, and lack of visiting specialist lecturers to generate interest in the teaching of statistics. Meanwhile, Bingimlas (2009) identified minimum use of Information and Communication Technology (ICT) and its associated barriers in teaching statistics, which deny students opportunities to operate effectively in an information age. This situation prompts an interesting and important question of what challenges teachers actually face in teaching statistics in their schools. There are few studies available from the literature in Uganda that addresses the issue except Opolot-Okurut's (2007) study on challenges of teaching mathematics. The present study attempted to fill the knowledge gap on teaching statistics.

Furthermore, literature shows that teachers assess students for a variety of purposes using different approaches. Assessment is an integral part of teaching (Cockcroft, 1982) that serves several functions like enabling teachers judge students' progress, measuring and diagnosing the effectiveness of the instruction, and reporting student progress to interested clients. Black and William (1998) have explained the use of assessment for effective learning, its negative impact and its managerial role. Yet, students value only what is assessed and ignore what they would probably need later in the workplace (Garfield, 1995). Black and William (1998) sum up the managerial role of assessment situation as “the collection of marks to fill in records [which] is given higher priority than the analysis of pupils' work to discern learning needs; furthermore, some teachers pay no attention to the assessment records of their pupils' previous teachers” (p.142). Feedback from teachers to students as part of formative assessment is a prime requirement for progress in learning. Teachers need to team up and to draw on external sources to collect or develop good questions or worthwhile tasks (NCTM, 1991) that are not easy to create.

Teaching should stimulate and satisfy the thirst for learning, which is not always the case. Several researchers have focused on the study of teachers' assessment practices and instruction. One key question is: ‘What is it that we want teachers and students to know and be able to do with respect to statistics teaching and learning?’ What teachers and students do in classrooms enhance learning (Ball, 1991; Charalambous, Panaoura & Philippou, 2009). Ball (1991) posited that

effective teaching results in measurable student learning resulting from effective teachers. Effective teachers involve students in their own learning and stimulate them to learn new concepts with understanding. This argument could extend to teaching of statistics as students try to understand statistical concepts. Arguably, teacher attitudes, beliefs and knowledge determine what they teach.

In the education system in Uganda, primary schools offer a seven-year course leading to the award of the Primary Leaving Examination certificate. Lower secondary (ordinary level) offer a four-year course leading to the Uganda Certificate of Education examinations. All schools follow a national curriculum in each subject. The Ministry of Education and Sports (MoES) oversees education. The National Curriculum Development Centre (NCDC, 1999) prepares the subject syllabi for the primary and secondary schools. The Uganda National Examinations Board (UNEB, 2005) prepares, organises and administers public examinations at the end of each level of education. Unfortunately, public examinations, including statistics examinations, encourage a high level of fact-transmission teaching. Schools offer elements of statistics embedded in the mathematics syllabi. Teachers trained for Mathematics teaching double at teachers of statistics. These teachers bring in mathematics perspectives into the teaching of statistics. Textbooks are the *de facto* curriculum in schools. Thus, understanding the challenges that teachers face and the assessment practices they employ can contribute to better understanding of teachers' work in classrooms and could contribute to statistics educators' efforts to work effectively with teachers.

The purpose of this study was to investigate the characteristics of teachers of statistics, the challenges they face in teaching statistics and their assessment practices to teaching statistics at the primary and secondary school level. This study addressed three questions:

1. *What are the characteristics of the teachers who teach statistics in schools?*
2. *What are the challenges that teachers face in teaching statistics in schools?*
3. *What are teacher assessment and grading practices for statistics?*

METHODOLOGY

A survey research design and an interpretive exploratory research methodology was used. Qualitative data emerged from interviews with teachers and from tests and examination papers.

Sample

The study used a sample of 200 participants stratified by school levels, 80 primary (62.5% male and 37.5% females) and 120 (75% male and 25% females). Participants were secondary mathematics teachers registered students on a distance education Bachelors degree programme at a public university in Uganda. In addition, other teachers from Kampala district participated in the study. A purposive sample of 20 primary and 30 secondary school teachers participated in the interviews. The teachers drawn were either heads of department or directors of studies in their schools, and had taught for more than 10 years.

Instruments

Teachers completed a survey questionnaire consisting of two sections based on the Henke et al. (1997) profile of a profession of America's teachers. Section A captured the demographic information of the teachers. Section B contained 20 items—one-half positively worded and the other negatively worded—on teachers' opinions on teaching statistics in primary and secondary schools. For each item, the teachers indicated their degree of agreement or disagreement. The choices were on a 5-point Likert scale ranging from one (strongly disagree) to five (strongly agree). A second source of data was the interview guide that provided opportunity to dig into teachers' experiences of the challenges they face and assessment practices in their schools. Finally, documentary analysis involved looking at sample question items for the tests, examinations assignments and homework.

Procedure

The participants of the study completed the *Teachers attitudes to teaching statistics questionnaire* distributed by research assistants. The data were organised, analysed and descriptive statistics computed for each item. Later, each purposively selected teacher participated in half-hour interview held at a convenient place within the university campus. Detailed notes were made of the interviews and later transcripts prepared for analysis. The transcripts of interview responses were

qualitatively analysed. Documentary analysis of the test papers, examination questions and the system of award of marks that these teachers use in their classrooms provided additional data.

Data Analysis

Quantitative data were analysed using descriptive statistics while qualitative data were analysed using the constant comparative thematic analysis approach (Merriam, 1998; Miles & Hurbeman, 1994; Strauss & Cobin, 1990). The field notes from interviews provided an account of the challenges and assessment practices in different classrooms and schools.

RESULTS

In this section, presents the results of the analysis. First, it discusses the demographic characteristics of teachers involved in teaching statistics (mathematics) in primary and secondary schools. Second, it examines the challenges that teachers face in teaching statistics. Finally, it examines the assessment practices teachers use in schools.

1. What are the characteristics of the teachers who teach statistics in schools?

Table 1 shows the demographic characteristics of participant primary and secondary teachers by gender, age, teaching experience and highest academic qualification and reveals that more men than women teach mathematics in both primary and secondary schools. Primary teachers have teaching experience ranging from two or fewer years to 21 or more years and the majority fall in the 26 to 30 years age-bracket. Most of these teachers have been in service for nine to 14 years. Fifty-five percent of the primary school teachers hold a Grade III teaching certificate. Meanwhile, secondary school teachers have teaching experience ranging from three to 21 or more years, with the majority falling in the 21 to 35 years age-bracket. Most teachers in secondary schools have been in service for 15 to 20 years. Sixty percent of the secondary school teachers have Diplomas in Education. However, as expected, there are no Grade III teachers teaching in secondary schools.

Table 1. Demographic Characteristics of Teachers who teach Statistics in Schools

	Primary School Teachers (%) N = 80	Secondary School Teachers (%) N = 120
Gender: Male	62.5	75.0
Female	37.5	25.0
Age in years		
20 or fewer	6.3	7.5
21 – 25	32.5	27.5
26 – 30	40.0	33.3
31 – 35	12.5	16.7
36 – 40	5.0	10.0
41 or more	3.8	5.0
Teaching Experience in years		
2 or fewer	6.3	0.0
3 – 8	15.0	16.7
9 – 14	41.3	25.8
15 – 20	26.3	45.8
21 or more years	11.3	11.7
Highest Academic Qualification		
Grade III	55.0	0.0
Grade V (Diploma certificate)	30.0	60.0
Graduate (Bachelors degree)	15.0	40.0

2. What are the challenges that teachers face in teaching statistics in schools?

Interview data provided answers to this question. The findings show that the patterns of responses teachers gave as challenges faced in teaching statistics fell into four categories centred on the teachers, students, resources and the education system. Table 2 illustrates typical responses respondents gave.

The following responses mentioned highlight the challenges and practices that teachers experience and use. Among the primary school teachers, the following responses were typical.

‘... there is no clear syllabus for statistics. We teach mainly averages as part of mathematics, which is also very wide’.

‘The textbooks we use are basically mathematics textbooks that do not develop the statistics concepts in a practical way. We mainly deal with theoretical calculations of averages and drawing of simple graphs’.

‘The examinations questions we use test procedural knowledge for awarding marks and grading purposes only’.

Similarly, among the secondary school teachers, the following responses were typical.

‘The method of assessment is an obstacle to teaching of statistics as students try to give answers that teachers expect to see. We just pick problems from either textbooks or UNEB past papers’

‘Technology: calculators and computers are rarely used in teaching statistics. We do not use statistical packages that seem to provide a great potential to enrich, enlighten, and expand students learning of statistics’.

Table 2. Challenges on teaching Statistics

Challenges	Primary schools	Secondary schools
Teachers	Inadequate general training, Lack of sound content and pedagogical knowledge base, Textbook-driven teaching, Lack of motivation and competence, Lack of external support and in-service professional development, Shortage of qualified teachers	Lack of statistics teaching training, Shortage of qualified statistics teachers, Use of basic teaching approaches, Isolation from colleagues, Negative attitudes towards statistics, Lack of professional development, Heavy workload, Lack of time, No technical support,
Students	Poor attitudes of learners to the subject, Poor communication skills, Poor reading skills for comprehension	Negative attitudes towards the subject, Lack of feedback on work done, Poor primary background, lack of statistical skills for daily life
Resources	Uncertainty of what books to follow and use, Use of calculators prohibited, No textbooks for statistics teaching, Infrastructure	Insufficient resources, Little use of educational technology and access, Lack of appropriate textbooks and reading materials
Education system	Large volume of content to cover under mathematics, Large class sizes, Regular transfers, The nature of national assessment with virtually no formative assessment, No clear statistics syllabus	No stand-alone statistics curriculum, Pressure to complete syllabus, Nature of assessment tasks and functions, Examination-oriented curriculum, Curriculum and instruction in schools outdated

3. *What are teacher assessment and grading practices for statistics?*

Interview and documentary analysis data provided the answers to this question. Table 3 shows the patterns of responses on assessment practices in teaching statistics. They fell into three categories centred on the purpose, methods, and grading system. Documentary analysis of the tests and examination questions used by primary school teachers reveal that teachers used textbook-based items. In contrast, the test and examinations that secondary school teachers used are derived from the UNEB past papers. Also noteworthy is the fact that the setting of tests and examinations for all students of different abilities is the same. Teachers replicated the national grading system at both levels using the Distinction-to-Fail numerical system and the A to E and O letter grades for secondary students. Obviously, what is included in assessment appears what teachers teach.

DISCUSSION

As expected, the findings of this study indicate that in primary and secondary schools, teachers of statistics are mathematics teachers. This is because no pre-service training programmes offers statistics teaching methods. More grade III teachers are in primary schools and more diplomas in education holders in secondary schools. This is because the minimum requirement for teaching in Ugandan primary schools is a grade III certificate and for teaching in secondary schools

is a diploma in education. Numbers show that there are more women teachers in the primary schools while more men teachers in the secondary schools. This is because of the small number of girls who offer mathematics and science at higher levels of education.

Table 3. Assessment and Grading Practices

Assessment	Primary	Secondary
Purpose	Teachers prepare student reports for administration and parents, For reporting to parents and administration	For judging students progress, For grading, For comparisons, Accountability, Measure effectiveness of instruction
Methods	Written assignments from textbooks, Tests (Paper-and-pencil), School-based tests, Timed examinations, Individual school-based, teacher-set questions, Homework,	Written assignments from textbooks and UNEB past papers, School-based, teacher-set, BOT, MOT, EOT
Grading	D1, D2, C3-C6, P7, P8 & F9	D1-F9 and letter grades A-E & O

Legend: D-distinction, C-credit, P-pass and F-fail; BOT - beginning of term, MOT - middle of term, EOT - end of term examinations. Principal passes A-E and subsidiary pass O

Answers to the question, “what challenges do you face in teaching statistics?” fell into four broad categories, covering (1) teachers, (2) students, (3) resources, and (4) education system. Regarding teachers, participants expressed inadequacy of their own training to teach statistics. This finding supports Mustafa and Cullingford’s (2008) finding that lack of training affects teachers’ choice of instructional methods including deficiencies in the ways teachers are prepared.

Responses on resources ranged from inadequacy to complete lack of teaching materials as in Nigeria (Oyelese, 1982). In addition, some of the responses echo Mustafa and Cullingford’s (2008) findings relating to shortage of teaching materials. In addition, the study revealed shortage of ICT resources for teaching, which concurs with Bingimlas’ (2009) findings on school-level and teacher-level barriers to the use of ICT in science education. Regarding the education system, there is more emphasis on theoretical work than practical work. To compound this, there is not statistics curriculum. The implication of this finding is that it is necessary to consider developing and using alternative forms of assessment aligned with the curriculum and instructional practices.

Another finding is that there is no diagnostic, oral and differentiated assessment for students of different abilities. The beginning-of-term, middle-of-term and end-of-term examinations are a replica of final UNEB examinations that congest instruction. Despite these examinations, teachers rarely provide feedback to students. One possible explanation for the hurry is that UNEB examinations policy pressures teachers to complete the syllabus. In addition, teachers are not clear of why they assess. Assessment is predominantly used for grading and promotion. All students sit the same examinations allegedly to maintain comparable standards across schools. This finding is at odds with the assessment practices in mathematics classrooms Singapore (Kaur, Kiam & Hoon, 2006) where students get teacher support to enhance their learning. In contrast, in Singapore, homework serves the function of review practice and drills of material learnt, provide students opportunity to amplify, elaborate and enrich earlier learnt work, and to prepare in advance material to be learnt in future lessons (Hong & Migram, 2000) but not only for grading. Perhaps establishing appropriate standards for assessing statistics needs to be stressed.

There are several limitations of this study that need to be acknowledged. The sample of the study was small and not selected to be representative of the large population of primary and secondary school teachers in the country. Even with the limitations of this study, there are implications from the results for pre-service training of schoolteachers, teachers’ assessment practices and policy formulation.

The results presented here have a number of interesting implications for teacher educators, policy makers, practical applications and further research. From a teacher education perspective, three implications are apparent. First, teacher education programmes should address the deficiency of teachers’ content and pedagogical statistical knowledge needs. Second, from a policy point of view, introducing a stand-alone statistics curriculum and a modified assessment practice is long overdue. In terms of additional research, corresponding questions emerge. First, what factors might account for, or at least be associated with the differences in teachers’ attitudes to teaching statistics? Second, what assessment methods might be more productive in improving the teaching of statistics? We hope that the results reported here will stimulate further research required to answer these and similar questions.

CONCLUSION

To assist teachers in thinking about teaching statistics today and tomorrow, the following tenets are for consideration: The teaching, assessment needs to be meaningful to the learner. Introducing project work and statistical investigations, problem solving and modelling may help students learn to pose questions, collect data, analyse data and interpret the results. It is necessary to provide appropriate training of teachers to teach statistics during pre-serve and in-serve programme courses. The challenges to teaching statistics are numerous but surmountable if given necessary attention and action by those in position of authority.

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