STATISTICS MADE ALIVE

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This paper examines briefly some of the problems of teaching statistics to agriculture students in the traditional manner. The current teaching has consisted of foundation courses on the statistical concepts at undergraduate level followed by a design and analysis of experiments course at postgraduate level. This is compared with a newer approach which comprises a change at both levels. With the traditional approach the students found it difficult to integrate the statistical concepts into their project work, and this undermined the quality of their research. The new approach concentrates on exploring the whole process of planning and implementing research projects and includes an intensive course in basic statistical concepts, with emphasis on critical thinking in problem solving. The paper ends with an evaluation of the impact of this approach at both undergraduate and postgraduate levels and with plans for the future.

INTRODUCTION

The Faculty of Agriculture, at the University of Nairobi, admits about 130 to 150 students at the undergraduate level and about 20 to 50 students at the Masters level every year. Though the students register with various agriculture disciplines such as Crop Science, Soil Science, Agriculture Economics, Agriculture Engineering, Range Management, and Crop Protection, all students get a number of general core courses. The mathematics and statistics courses form a part of the core courses for all Agriculture students.

At the Nairobi University, as in other universities in the region, and in fact, generally within the agriculture community within the region, there has been a growing concern over the poor quality of research aimed at increasing food security and poverty alleviation. This has to a large extent been blamed on the lack of adequate biometry support for agriculture research (Riley, 1998). Sporadic efforts, both within the universities and donor initiated, have met with indifferent success, either because of the magnitude of the problem or because the interventions have, out of necessity, only looked at specific aspects of the problem.

We feel that the best way to handle this problem is to attack the underlying problem, which is the curriculum and the approach, at both levels. For postgraduates the curriculum needs to include an understanding of the way statistical and technological developments can be used to handle the current research trends; the approach should facilitate their use in the actual research process, through practical application. For the undergraduates, the foundation needs to be strengthened by concentrating on the underlying statistical concepts, without losing sight of the fact that statistics is a tool in the research process. The use of postgraduates to assist in the undergraduate training can further strengthen the understanding of both the groups.

ISSUES OF TRADITIONAL APPROACH

Among the issues facing the trainers in developing countries, the biggest by far is the severe lack of resources: this is reflected not only in the almost total lack of computers for students (and in some cases even the staff) but in the absence of simpler facilities such as teaching aids, teaching assistants, resource and reference materials; often "talk and chalk" is the only option available and for students who can afford neither books nor photocopies, class notes are the only point of reference. When this is combined with students who look on statistics as a necessary evil, a subject to *pass* rather than enjoy, the status of statistics vis a vis other more *agricultural* subjects, the position of biometricians in the institution hierarchy, the problem of providing adequate biometrical support is almost insurmountable. Overcrowded undergraduate schedules, only help to aggravate an already bad situation. At postgraduate level, the situation is little better, though the smaller numbers make the classes more manageable.

General issues of providing statistical training to non mathematicians are not limited to developing countries, as can be seen from a vast amount of literature on statistics education reform and current statistical practice (e.g. Barahona, 1997; Cobb & Moore, 1997; Gordon &

Gordon, 1992; Hoaglin & Moore, 1992; Hogg, 1991; and Iman, 1994 and among others); but whereas in countries where resources are more readily available, the focus is on tackling the root problem of curriculum and approach, in many developing countries which depend on donor support, the concentration has been on addressing specific needs at higher levels only. A major issue identified at one such intervention at the University of Nairobi was the absence of a firm foundation of basic statistical concepts among the postgraduate students.

The traditional approach to the foundation courses is to expose the students to the mechanics of the statistical calculation, assuming that the data is available, with only a passing reference to the problem that is being addressed or the objectives of the study; and owing to the constraints of time and other resources, putting only cosmetic touches to totally unrealistic but classroom-manageable data as a sop to making them more *applied*. Again the approach, especially at the postgraduate level, relies on giving all the *necessary* information to the students at the beginning of their study and then letting them loose on their projects! As a result the student concentrates on finding a *method* to fit the problem, rather than concentrating on solving the research problem.

The students apply *statistics* mechanically, in a simplistic and often indiscriminate manner, and tend to rely on software *experts* rather than on the statistical concepts or statisticians. This approach is therefore neither preparing the students to understand the role of statistics as an important tool in the research process, nor teaching them how to use it correctly; and it is definitely not promoting the development of necessary skills, such as communication and teamwork to enable them to work effectively. The repercussions of this are not only on the students, who are totally unprepared to be absorbed into the job market but also have a negative impact on the credibility of the Faculty. The problem that needs to be treated as a matter of priority is therefore of getting the students interested in understanding the place of statistics in the research process, of using the tool appropriately; and simultaneously, developing necessary skills of critical thinking, teamwork and communication to enable them to fit into today's world of multidisciplinary research.

NEW APPROACH

The approach of teaching statistics through problem solving is being tested on the second year students in the Agriculture Faculty, receiving their first course in Statistics, and also on the fresh postgraduate students for their statistics bridging course. The undergraduate course is designed to teach basic statistical concepts through statistical games and student designed experiments, with emphasis on understanding how the method is used and how to interpret the results, rather than the techniques of calculation; though the students were given practice in the calculations where necessary. The other major change was the use of teaching assistants, current postgraduate students, to break the practical classes into more manageable numbers. The introduction of the concepts is through their occurrence in solving the research problem, rather than the other way round. The students are encouraged to discuss questions amongst themselves, both in class and during practicals, presentations, both oral and written, where assessment by the peers are the norm, and respect and fair hearing for all contributions is encouraged.

For the postgraduates, the first major change was in the timing of the training (see Figure 1) as was explained in Akundabweni (1999); the second intervention is the introduction of a *foundation strengthening* course. This will be in the form of a three-day intense program, covering material approach similar to the one that is being used for the undergraduate course. This will not only emphasize the basic statistical concepts and the need for data exploration but it will benefit those students who come from the field. The main difference at the postgraduate level will be the use of computers for the assignments.

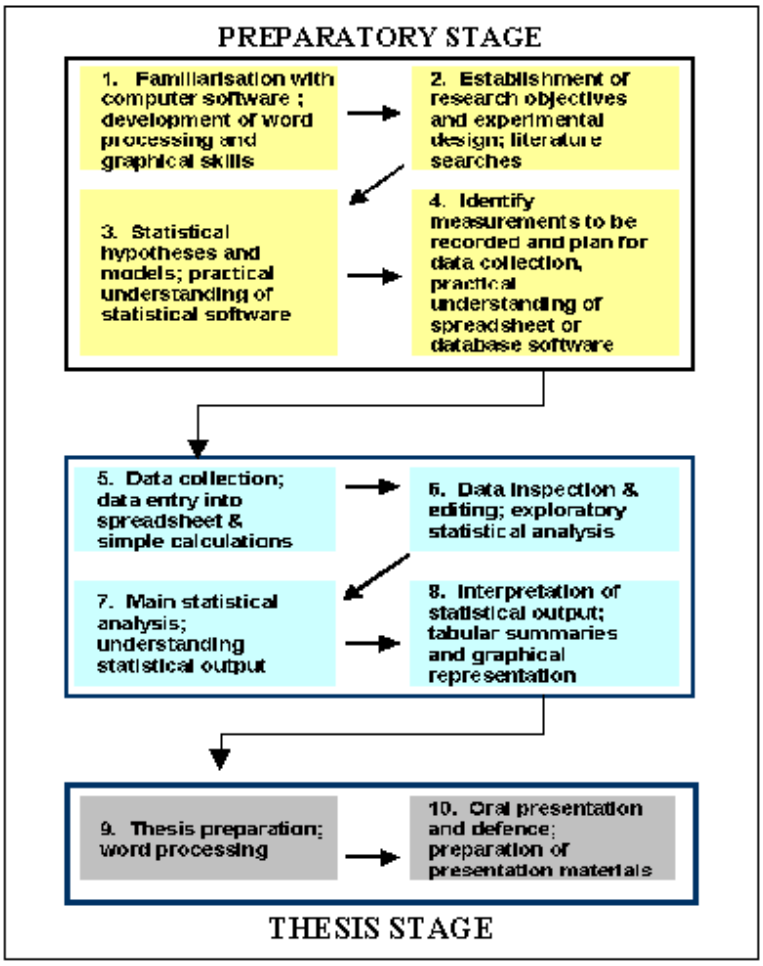

Figure 1. Approach to the Design of Experiments Course for the Postgraduate Students at the Faculty of Agriculture, University of Nairobi.
Source: Akundabweni, L. (1999)

RESULTS

The results of the mid course assessment for the undergraduates (Table 1), showed that over 95% of the students felt that they were actively involved in the learning process and out of the 13 responses which specifically commented on the new approach, 12 had positive comments and only 1 lamented the old traditional approach. The most heartening result of this approach was the enthusiasm with which the students are approaching the subject. The classes, lectures and practical sessions are lively, with a much greater proportion of students willing to contribute in the discussions. The confidence with which the oral presentations are made is remarkable though the students lack discernment in what they include in the presentations. There has also been a gradual improvement in the tolerance which is shown by students towards those expressing different opinions. The students find the use of teaching assistants of great help in addressing individual queries, though there has been some confusion regarding the exact role of these assistants. Individual strengths and weaknesses of the teaching assistants have also caused dissatisfaction among some of the groups.

On the down side, the biggest problem has been the very slow pace of learning, especially since a lot of the learning is not of the form with which the students are familiar, that is, formulae and calculations. Students also require a lot more sophisticated statistics in other courses, where the approach is traditional, thus confusing the students and diluting the effect of the way learning is being introduced in the statistics course.

Table 1
The summarized results and some of the comments on the approach from responses received from the end of term evaluation form given to the Second Year agriculture students

Response	*Lecturer organization and preparation*	*Lecturer clarity*	*Student feeling of involvement*	*Teaching Assistants useful*
Yes	95	92	95	93
No	5	8	5	7

SOME OF THE COMMENTS NOTED ON THE QUESTIONNAIRE

- The survey of woods was a good example for the statistics and therefore such assignments should be given to more understanding of statistics.
- Statistics is and will continue to be good fun. We hope to get the best from this approach.
- Statistics so far is well thought out and I am enjoying it.
- I have really enjoyed every class in statistics this term.
- Appreciated your teaching methods and let us continue the same way.
- The relationship between the students, lecturer and the teaching assistants should be maintained as it is good and appealing.
- A good way of learning since it integrates everyone into the learning process.
- Mode of teaching was perfect and the involvement of teaching assistants was fruitful.
- The new approach is a splendid idea and should be encouraged.
- Statistics is a course relevant to our lives. It needs more commitment and practice and total participation in order to make it enjoyable.
- I feel the system we have had so far was the best and should be extended to other topics; strongly feel that nobody will have a good reason for failing in statistics.

DISCUSSION

If the aim of the new approach is to make the students want to learn statistics, then there is no doubt that this approach is working; if the aim of the new approach is to let the students understand that statistics is a tool, albeit an important one, but nevertheless a tool in the research process, then this approach is succeeding; if the aim of this approach is to build student confidence in voicing and defending their ideas, then this approach is the right one. And these were some of the aims of trying this new approach.

However there are some major difficulties which have to be overcome. The students come from a teacher centered education background and so there is a tendency to revert to this way of learning. The fact that other subjects are taught in that way, does not facilitate an easy changeover to student centered learning. This approach is resource intensive, requiring financial, time and material resources. These resources are limited and yet funds to continue employing teaching assistants, have adequate teaching aids to make the subject interesting and understandable, provide the necessary structure to maintain uniformity in the teaching are all essential for the success of this method of teaching.

There is no doubt that the advantages of changing the traditional approach to the current approaches far outweigh the objections to it: helping the students to expand their thinking to solve problems, developing their confidence and communication skills, teaching them how to apply statistics in a meaningful way and generally inspiring a love for learning are results worth aiming at. The environment is ripe for change and there is, in principle, tremendous support from the

Faculty and policy makers. A lot of effort will need to be put in to develop a right mix of pedagogical techniques to suit the particular needs of the students, promote active co-operation between the biometricians and other Faculty dealing with the *agricultural subjects*, generate funds to sustain this approach to teaching , and promote its adoption to other areas. Our hope is that a student group which can portray confidence and enjoyment for learning can bring about this change.

ACKNOWLEDGEMENTS

This study was carried out with a grant from the Rockefeller Foundation . I would also like to thank the Statistical service Center, University of Reading, and especially Dr. Roger Stern, for the assistance in developing a curriculum for the Second Year Agriculture Students, and for the use of their statistical games in this curriculum.

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