CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The overall response of the students using the computer-assisted tutorial "Random Variables" was extremely positive and encouraging. The conclusions to each of the five main research questions are discussed below.

Question 1:
What corrections and modifications to the program are required?

Staff and students experienced no difficulties with regard to screen displays, text layout or use of colour. They enjoyed the colour, the graphics and the animation and found the program user-friendly. No content errors, typographical errors or technical hitches were identified, which illustrates the effectiveness of the ongoing formative evaluation process.

Question 2:
What are the cultural and language implications for the heterogeneous student population?

Concerns which had existed in connection with the effect of certain colour conventions and theme characters on members of various different ethnic groups proved to be groundless.

Similarly, the level of English language usage was acceptable for non-mother tongue speakers of English who had studied the English study guide. However, Afrikaans speaking students had some problems with the English terminology in the computer-assisted tutorials (CATs), having studied the material in the Afrikaans study guide.

No cases of vague or ambiguous language were identified.

Question 3 Does the teaching approach embodied in the program contribute to perceived learning gains?

The respondents felt that the learning material was presented in a manner which enhanced their understanding of the basic concepts, which tend to be rather abstract. They felt that the CATs make the subject of Statistics more interesting and more understandable. They definitely felt that working through the tutorials would help them with their revision before the examination.

Several students expressed the desire for more questions and exercises, of a difficulty level in keeping with that expected in the assignments and examination.

Question 4 Is it clear how to use the function keys and icons to navigate through the program?

No problems were experienced with navigation through the program. Orientation techniques such as headings, completion asterisks on the menus and the “Where am I?” feature prevented the students from becoming disorientated.

Question 5 What are the opinions, feelings and emotions of the learners on completion of the program?

The students were motivated by using the CATs and found them to be enjoyable, interesting and challenging. They found the interface to be friendly, relaxed and conversational. More than half of the students rated the tutorials as excellent and all would recommend them to other students.

6.2 Limitations of this study

This study is limited by certain issues which preclude making any generalisations from the findings. These limitations are discussed in turn below.

6.2.1 Sampling procedure

Since Unisa is a distance education institution, with many students studying part time and by correspondence, the sampling procedure for the field test needed to take into account the following issues:

- the geographic dispersion of students meant that students had to be prepared to travel to Pretoria;
- the employment conditions of students meant that they had to be able to take leave from their work places in order to attend the field test in Pretoria.

These issues indicated that a convenience sample (Cohen & Manion, 1995) was necessary. All students registered for the course (339) were notified of the research project and were invited to participate in the field test. The limitation of this method of sampling is that it does not necessarily generate a sample representative of the whole population.

6.2.2 Sample size

Due to the fact that we had to rely on a convenience sample of volunteers, we were not able to control the sample size.

Lee and Mamone (1995) recommend trying for a sample size of 10% of the population. With 339 students registered for the course, the desired size of the sample was 34. We received 35 replies to the invitation to take part in the field test, but of these, only 25 students actually participated and completed the questionnaire.

Since this is an exploratory and largely qualitative study, the small sample size did not impact on any statistical tests. The limitation of the small sample size, simply meant that the findings are not generalisable to the whole student population.

This was especially evident when the telephone interviews revealed that some students have top-of-the-range computing equipment, while others have no access to computers, except for the Unisa computer laboratories.

6.2.3 Hawthorne effect

Mouton and Marais describe the Hawthorne effect by saying*: "The mere fact that human beings are studied, leads to atypical behaviour"* (Mouton & Marais, 1993, p.86). The subjects of a research project may feel flattered to be part of the investigation and may respond in ways that they feel are desirable, admirable and rational.

In this study, in particular, the questionnaire items about learning gains asked the students' opinion as to whether they had learnt something about Statistics. Their opinion may not necessarily correlate with actual learning gains, if these had been measured.

6.3 Recommendations

6.3.1 Learning gains

In order to counteract the Hawthorne effect described in section 6.2.3, it would be desirable to implement a pre-test and a post-test to measure actual learning, irrespective of student opinion of perceived learning gains.

Gery (1988) makes the point that enjoyment of the learning experience should not be assumed to imply that learning is taking place. In this study, the students clearly found the learning experience enjoyable and interesting (see Chapter 5). This study therefore generates the hypothesis that learning gains are evident. Measuring the extent of such learning gains would be the subject of further research and would make a start with the summative evaluation of the CATs.

In such future studies with distance students, it will be necessary to investigate how to obtain a larger and therefore more representative sample. This study has shown that relying on the voluntary return of questionnaires and voluntary participation in a field test does not yield a sample large enough to enable generalisation of the findings.

6.3.2 Effectiveness of the electronic medium

Allied to the need to measure learning gains, is the need to measure the effectiveness of the electronic medium as opposed to the traditional paper-based media generally used in distance education institutions.

A follow-up study, with an experimental group (receiving the computer-assisted instruction) and a control group (receiving traditional instruction), could be considered. However, such a scenario poses two philosophical dilemmas:

- student participants should not be unduly disadvantaged by being the subject of one treatment or the other;

- the computer-assisted tutorials are intended to supplement traditional instruction and not to replace it.

Furthermore, in the light of meta-analyses done in this field (Kulik & Kulik, 1986; Kulik et al, 1980) and the "method versus media" debate (see Chapter 2), claiming that a particular medium is more effective than another is fraught with the dangers of bias, misdirected inference and questionable validity.

It would appear, therefore, that it would be more beneficial to measure learning gains as suggested in section 6.3.1, than to measure the effectiveness of the electronic medium per se.

6.3.3 Computer-based testing

With regard to the question-answer-feedback episodes, three areas needing attention emerged:

- instructions on how to answer questions;
- feedback after wrong answers;
- the number of questions provided and their difficulty level.

These three areas are discussed in turn below.

Instructions

In general when a question awaits a student answer, an arrow indicates that input is required. In rare instances, rhetorical questions are posed on presentation screens. The instructions on how and when to answer questions will be reviewed to make sure that they are clear at all times. In "Random Variables", the student is often required to complete figures in a table. In such instances, the provision of a cursor awaiting input may be helpful.

Feedback

During the design of the CATs, an attempt was made to provide specific and helpful feedback, especially after wrong answers. However, one of the peer reviewers felt

that the feedback was not particularly ambitious and students also felt that the feedback could have been more directed. The provision of more individualised and specific feedback will be considered, together with allowing the student to enter progressive results during long calculations, so that his progress can be guided with response-related feedback.

Number of questions

The design and development of computer-based tests needs to be considered to provide more practice, with immediate feedback and various difficulty levels. Since extended practice and testing is not the domain of computer-assisted tutorials (Alessi & Trollip, 1991), "Random Variables" does not attempt to provide this. However, this need was expressed by the students, and therefore needs to be investigated. Scoring and record keeping would be helpful, both for the purposes of self-assessment, and for instances when a lecturer may require details of student progress.

6.3.4 Language issues

Although it would be desirable to offer the CATs in the mother-tongue of the learner, language issues in South Africa at present are the subject of debate and change. The translation of the CATs into other languages needs to be considered in the light of the following factors:

- the translation of the study guides into African languages;
- the fact that text books and the examinations are in English or Afrikaans;
- the viability of translating a technical subject like Statistics into African languages, which may not have the necessary technical vocabulary;
- the cost of translation, development and testing.

6.4 Summary

This study has considered the analysis, design, development, implementation and formative evaluation of “Random Variables”, one of a series of nine CAI tutorials developed specifically for a first year Statistics course at Unisa.

In the distance education scenario, computer-assisted tutorials (CATs) provide an additional, supplementary learning resource. The intention is to attempt to decrease the isolation of the student studying by correspondence, and to increase their amount of interactivity with the subject material.

In the teaching of Statistics as a subject, there is a need to present underlying abstract concepts in a constructivist way (see Chapter 2), in addition to the usual formal mathematical approach. The aim is to encourage a deeper and more meaningful understanding of what these concepts and terms really mean.

Computer-assisted tutorials provide the opportunity to merge these aims and intentions, with the computer medium making possible graphics, demonstrations and animations that are not possible with other instructional media.

“Random Variables” was implemented in a field test with 25 volunteers from the student population. The responses to the questionnaire and the follow-up telephone interviews were extremely positive. Respondents made constructive suggestions for the enhancement of the CATs, which is, after all, the main purpose of formative evaluation.

The overall findings of this study are encouraging. The CATs have been through several stages of formative evaluation and extensive feedback from peers, staff members and students has been obtained. This feedback will guide the summative evaluation process and the development of further tutorials in the series.