Interactive multimedia in medical microbiology?

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This paper discusses a study which aimed to investigate whether a Computer Assisted Learning (CAL) program of *Microbiology Case Studies* can facilitate the learning of Medical Microbiology in the Nursing program at Curtin University.

An attempt was made to introduce innovations into the teaching and learning techniques of this partially self-paced unit, in order to help students with their heavy study load. A set of interactive computer case studies for second year Microbiology was produced using consequential pathways to promote problem-solving skills.

The interviews and questionnaires showed that there was a significant difference in attitude and in assessment outcomes between those students who agreed that computer-based learning was stimulating and those who disagreed.

The results indicate no overall difference between the results of the mid-semester test for those students who used the CAL program and those who chose to avoid it. The question "Does interactive multimedia benefit the learner of Medical Microbiology?" must be answered as follows: "Not directly and not in isolation from other learning and teaching modes."

Introduction

This paper discusses a study which aimed to investigate whether the Computer Assisted Learning (CAL) program of *Microbiology Case Studies* can facilitate the learning of Medical Microbiology in the Nursing program at Curtin University. This project was part of the 1993 and 1994 Committee for the Advancement of University Teaching (CAUT) grant to produce a set of interactive computer case studies for second year Microbiology, as well as to construct a Computer Managed Learning (CML) test bank, interactive lecture sessions and video clips.

Since Nursing became a Bachelor of Science degree course during the 1980s, it has been a concern that the relevance of the infectious process has remained of minor conceptual importance to students in their preclinical years. It is essential that student nurses study the *Microbiology* course before entering the clinical setting. The major aim of the computer program was to increase student interest in microbiology and thereby encourage evaluation and application of knowledge to a clinical setting.

It is important that student nurses are cognisant of the limits involved in diagnosing infections and the importance of correct and relevant specimen collection and processing. Because microbiology is introduced early in the course, before the student realises that the theoretical material provided is applicable on the ward and before the student has had any contact with patients suffering infectious diseases, unit coordinators wanted to increase the relevance of the unit by providing students with de facto case studies. The opportunity to solve real problems they might come across later in their careers, would encourage them to acquire new knowledge as well as to apply what they had already learnt. This provided the rationale for developing the Computer Assisted Learning (CAL) program of Microbiology Case Studies.

Background

In view of the short time available for contact with the students, and in consideration of their huge study load, innovations in the teaching and learning techniques of this unit was introduced (Edwards, 1995). The theoretical component of the Medical Microbiology unit is partially self-paced and contains interactive, small group discovery sessions in the lecture program. Hence there are fewer formal lectures. Video tapes of all lectures and practical sessions are freely available.

The workplace today requires communication skills, group work and inquiry-based, problem-solving abilities (Bate & Sharpe, 1990; Candy, 1994). Many students entering Curtin university are ill-equipped to meet these demands and expect assessment that reflects rote learning and regurgitation of facts (Latchem et al, 1995).

The Microbiology Case Studies is a mixed hierarchical structure with topics and subtopics leading to linear sequences of screens. However, the individual case study sections of each module have a hypermedia structure.

Literature review

Computers are used as a resource in teaching and learning by data analysis, databases, problem-solving techniques and as tutors for new concepts (Winship, 1990). Milton, (1992) emphasised the value of computer technology as a way of improving student learning in the tertiary sector.

The use of computer-aided learning (CAL) in medical education has grown considerably in recent years. At the Queensland University of Technology, one of the teachers was concerned with the high failure rate of his first year nursing students in anatomy, which, like microbiology, is taught as a service unit (Loh, 1993). One of the strategies that he introduced to overcome this problem was CAL in which a bank of multiple choice questions was used for revision and self-assessment.

The complexities of higher education and the availability of creative invention led to the use of technologies to simplify and to help with teaching difficult subjects (Reeves, 1992). In computer-based medical education, there is frequently a need to present students with pictorial data representative of the natural variation associated with disease presentations as well as the progression of disease within an individual (Bergeron, et al 1994).

In an evaluation of multimedia for nurses which dealt with medical and surgical asepsis principles (Brigham et al, 1991), it was found that students evaluation of this learning module was positive. In another study, Fung et al, 1995 describes a computer program for instruction in the principles of clinical epidemiology. A questionnaire was used to evaluate student satisfaction with the program and the responses indicated good acceptance of the concepts presented in the program and an interest in further computer-aided instruction. As these studies show, the use of multimedia which allows the link of information from text and graphics is a very suitable tool for the study of microbiology.

Methodology

Microbiology Case Studies were developed as a hypertext program, linked to a database of relevant background information, a self-assessment quiz and a short tutorial in Medical Microbiology.

This study involved a class of second year nurses which met once a fortnight for a two-hour practical laboratory in Medical Microbiology. Contact time with students was limited to ten hours of practical laboratory work and students' attendance at these practicals was mandatory. The researcher's role was as a demonstrator in these practical classes when simulated case studies of a clinical microbiological nature were examined. The computer program was offered to all students in addition to the lectures and was attempted in their own time on a voluntary basis. The researcher was available for consultation and guidance.

Selection process

Ninety-eight students were enrolled in this unit and were given the opportunity to use the computer based case studies as an adjunct to the lectures and practicals. Ninety-two students participated in this study. They responded to a survey which asked who had used the computer program, who had intentions of using and who

had no wish to use the program.

Ten students was selected for interview in order to determine their feelings about microbiology and the computer Microbiology Case Studies. Eight were selected randomly and two students were selected because they indicated that they had no intention of using the program. The two were interviewed for comparison and contrast. This yielded a total of ten, short, audio-taped interviews.

Instrument

Ten open-ended questions adopted from the CAUT evaluation report were used in these interviews. In addition, a questionnaire containing five questions and nineteen statements using a five-point Likert scale was used to identify students' attitude, and was completed by all students present during the last practical session. This questionnaire also was a modified version of the one used for the CAUT report.

Data collection

Short interviews were conducted during the first part of the semester. The open-ended questions included:

- Are you comfortable working with computers?
- Describe what you liked most about the Microbiology Case Studies. Students' answers were audiotaped and transcribed for analysis.

During the last practical session, the Likert-type questionnaire was completed by all the students present. Examples from the questionnaire are:

- I found the clinical case studies helped me understand more about microbiology and the areas under study.
- I found the clinical case studies helped me to apply my knowledge of microbiology and the areas under study.

Data analysis

In the initial survey, all the students were asked to identify their intention of use of the Microbiology Case Studies program. Interviews conducted with the ten selected students were recorded and transcribed for analysis. The researcher was looking for patterns in attitude towards the use of the program. Based on the categories derived from the initial survey, we examined the students' answers in the open interviews.

The next stage in data analysis was to look at mid-semester test results of the ten interviewees in relation to the categories from the survey. This result gave some indication of the influence of the use of the computer program on students' achievement.

In order to determine student attitudes the Microbiology Case Studies, an analysis of variance (ANOVA) was then conducted to find the relationship between the following six statements from the Likert-type questionnaire and the test result.

- I kept getting lost in the program.
- I don't like working with computers.
- I found computer based learning of this content stimulating.
- Compared with normal, face-to-face practicals, I learnt more using the program.
- I found the clinical case studies helped me understand more about microbiology and the areas under study.
- I found the clinical case studies helped me to apply my knowledge of microbiology and the areas under study.

In addition, the Scheffe procedure, performed between these statements and the ANOVA, was conducted to confirm that pairs of groups are significantly different at the 0.050 level.

Limitations of the study

Although large number of students were involved in the unit, there were only five meetings during the semester and therefore not enough time to conduct post-test interviews. Only mid-semester test results have been used in the evaluation and not the final examination results because of time constraints. The ANOVA and the Scheffe procedure were conducted only on six statements on the Likert form.

Results

Students perceptions of the Microbiology Case Studies based on the interviews

Interviewed students were clearly divided into three categories: students who were "happy user of computers", students who had "too little time to use computers", and students who were "not intending to use the computer at all".

During the interviews, three students stated explicitly that they intended using the program only for revision purposes before the examination period. They didn't see the program as a first priority.

Use of the program as a revision tool was expressed by a student who commented on the value of the revision:

> The multiple choice questions after the case studies were good because it sort of tested you, and I went through in order, and did the references. Good revision. (student interview).

Another student wanted more emphasis on revision which according to him enabled him to analyse the information. He expressed it in the interview as follows:

> I'd like it if there were more multiple choice questions; once you've done them a couple of times, you just never forget them - with the feedback of the answers-you actually remember. You are actually analysing the information (student interview).

Two students decided not to use the computer because it was too time consuming for them and therefore they confessed during the interview that they would not use it. One said:

> The study that I'm doing now I find is enough. I can understand it without going to the computer. I'm using the video programs and texts and come to lectures.

According to one student the use of the program enhanced her view of microbiology and she had benefited by using the program: "It helps everything connect together for the study and its really beneficial."The student also commented on other people use of the program: "I think people who don't use it are quite disadvantaged in a way." This student did not use computers before she came to university but according to her opinion "one does not need any previous knowledge on computers to manage the program."

A deeper insight of the program was revealed by a student who reported:

> Perhaps it is in the gastrointestinal tract section that there is a description together with a diagram of the organism causing the disease and that is really helpful. I'd like to see that in other section too (interview).

The value of the program for this student was its visual impact: "I find visual aids help me connect and remember the description and the picture of the actual organism."

A different student commented:

> I like the case studies most because there is such variety...I enjoy the challenge of it all, except the long names-its virtually another language which I'll never master.

Students also described some limitation in using the program. One student said that the use of the program did not influence the perception of microbiology - it actually helped her/him to revise the material.

A major constraint for some of the students was the ability to use computer:

I would be motivated to use a computer if I'd been taught how to use them. I had no idea even how to turn one on.
I'm just not a computer person, I'm totally computer illiterate....

These comments from undergraduate university students call for attention and deserve some further consideration.

Students' use of computer and test results

Students' achievements in the mid-semester test are presented in the following figure.

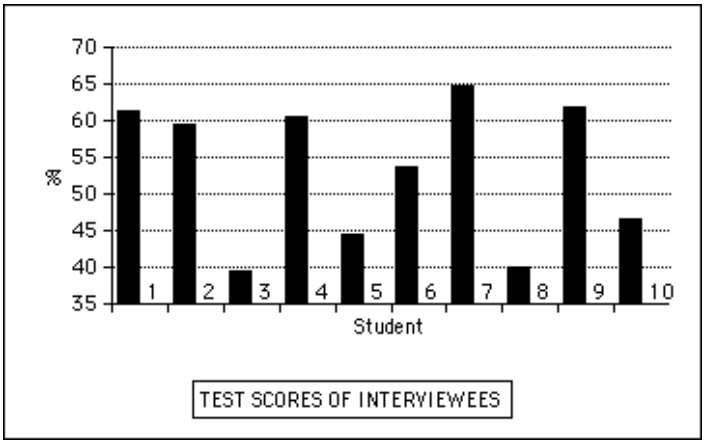

Figure 1: Test results of students' interviewed.

The test results of the students who were interviewed, as shown in Figure 1, indicate that half of the students scored above the class average.

Three of these students, affirmed non-users of the program, did very well in the mid-semester test, well over the non-users average of 53%. The other interviewed non-user scored less well. Intuitively, it would therefore seem that there is no correlation between use of the program and test scores.

Two interviewed users, had scores that were considerably higher than those achieved by the other two users of the computer case studies (well below the class average of 52%). There did not appear to be any obvious difference or pattern between the students interviewed and the general population of the class.

Table 1: Test result in relation to the initial survey

Students	Computers	Test results	Student identification
4	Will NOT use	47, 61, 54 & 62%	10, 4, 6, 9
2	Too little time to	39% & 61%	3, 1
4	Happy user	40, 44, 59 & 65%	8, 5, 2, 7

The result presented in Table 1 further supports our assertion that there was no direct influence on the achievement of those students who used the program and those who did not. However, the highest score for the mid-semester test was 78% attained by a student who had intended using the program when first approached. Unfortunately, she had not been selected for interview.

Students' attitude to the program based on the Likert questionnaire

The Likert Questionnaire was used to assess students' attitude towards the use of the Microbiology Case Studies computer program at the end of the semester. For example, 45% of the respondents strongly agreed

with "the purpose of the program was clearly stated" and 54% agreed with "the program is relevant to the course and to future employment."

Individual statements were examined in relation to the test results. The relationship between the following six statements and the mid-semester test results was examined by Analysis of Variance (ANOVA).

- I kept getting lost in the program.
- I don't like working with computers.
- I found computer based learning of this content stimulating.
- Compared with normal face-to-face practicals, I learnt more using the program.
- I found the clinical case studies helped me understand more about microbiology and the areas under study.
- I found the clinical case studies helped me to apply my knowledge of microbiology and the areas under study.

The results showed a significant difference, at the 0.050 level, between the test scores of those students who agreed that they kept getting lost in the program and those of the students who disagreed with that statement (p =0.023). There was also a significant difference in the marks gained by those students who agreed that computer based learning was stimulating and those who disagreed, when compared with the results of the mid-semester test. Those who scored higher in the mid-semester test than those who did not, find the computer Microbiology Case Studies stimulating, to a significant degree (p =0.008).

In addition, the multiple range test by the Scheffe procedure confirmed that the pairs of groups are significantly different at the 0.050 level. Students who stated that they do not get lost in the program scored significantly higher marks in the mid-semester test, as did those students who confirmed that computer-based learning was stimulating.

The highest score of a student to submit a Likert questionnaire was 73%. This student had not been selected for interview, but had indicated on the initial survey that the computer program was being used. This student had attempted all the Case Studies, was very positive about the program, found it both relevant and applicable and was guided by the feedback provided by the program.

Discussion

The test results of the students who were interviewed suggested that there is no direct influence between students' success in the mid term examinations and the use of the computer program. This outcome weakens the educational value of the program.

The highest score of those students interviewed was obtained by one who was then an intending user. When interviewed, the student had stated that the program was seen as beneficial for revision, often used and enjoyed. The responses to the Likert questions confirmed these comments and the applicability and relevance to the course.

This compares and contrasts with the Likert responses of the two lowest scores in the mid-semester test. The students who achieved least in the test were to a large extent negative about using the program. They did not agree that the Microbiology Case Studies were helpful or relevant and did not like using the computer program.

Although it appears that there is no overall significant difference in the results of the mid-semester test for those students who have used the program and those who chose not to, students who stated that they found computer-based learning stimulating achieved higher scores. Therefore, there is no answer to the general question whether interactive multimedia benefits the learner of Medical Microbiology. This must be answered in the context of students' attitudes and other learning and teaching modes.

In summary, it seems the Microbiology Case Studies computer program which was designed to increase motivation of nursing students and to help them to prepare for their practical work in hospitals achieved some of its goals. In particular, it helped students with their heavy study load by introducing computer-based learning which was stimulating and useful as a revision tool.

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