Sharing CAL Applications Cross-Tasman: A Curtin-Massey Experience

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Abstract

Osmosis Program (OP) is a CAL application presented to ASCILITE (Fyfe and Fyfe, 1992; Fyfe, Fyfe and Thornton, 1993) and has been widely used in health science courses at Curtin University. OP was used and assessed in the veterinary preclinical course at Massey University this year.

Access to suitable computers was restricted, so a group of 24 students completed the OP whilst another group of 37 students completed a conventional practical based on red blood cell membrane dynamics. An assessment provided information on the following: computer experience, prior expectations, ease of use, information level, likes and dislikes. The majority found the OP enjoyable and easy to use. They thought the information level appropriate and considered that the CAL effectively replaced the wet-lab. They believed the "hands-on" aspect of the lab did not justify the time spent in obtaining the data. Formal performance assessment was by multiple choice questionnaire (MCQ). No unexplained differences were found in student performance between the two groups.

Keywords

osmosis, CAL, assessment, veterinary-education, shared-applications

1. Introduction

1.1 Background

Courses aiming to teach principles of cell physiology traditionally are based on lectures and practical exercises that inform students about the fundamental principles of movement of ions across membranes and maintenance of normal cell integrity in varying conditions of health and disease. Such practical exercises typically use biological material, such as human, or sheep, red blood cells (RBC), and students work through a series of exercises in which they prepare solutions of varying osmolarity and study the effects on the cell membrane. Also, various chemicals are added to suspensions of RBC that simulate diseased states and students are encouraged to make predictions about the possible outcomes. A thorough understanding of the behaviour of ions crossing the cell membrane is fundamental to understanding the principles of pathophysiology.

1.2 Justification

Large classes of students with variable basic science background meant poor educational outcomes from the conventional practical laboratory run as part of the first semester Human Biology unit in the School of Biological Sciences at Curtin University**.** These educational problems parallelled the movement away from using animal tissue or human blood products in general practical classes. This led to the investigation of alternative ways to gain the benefits of the practical classes but eliminate the distracting benchtop procedures (Fyfe and Fyfe, 1992). At Massey University, the veterinary students study the theoretical principles of osmosis in their first semester and revisit the concepts in a third-semester clinical practical laboratory. This practical class aims to consolidate the students learning of the basic concepts and to apply them to clinical situations. It also aims to provide practice in the use of benchtop apparatus. However the objectives of the practical classes are poorly met. Most students do not prepare and revise their first-semester notes sufficiently to successfully gain from the revision of osmosis concepts, and the technical procedures are largely irrelevant in modern general veterinary practice. The time was ripe to reconstruct this veterinary student practical class taking advantage of the possibilities of interactive multimedia (IMM).

1.3 The solution?

A successful CAUT grant in 1993 funded the development of the Osmosis Program at Curtin University . The program was trialled, modified and evaluated and now forms part of the practical curriculum of the large first-semester Health Science common core unit in Human Biology. OP is a SuperCard stack that comprises three modules; a background tutorial covering required concepts, a practical simulation and a post-laboratory tutorial. The program is linear in its presentation, as students need to master basic skills and concepts before the practical class. They access the Background tutorial in the 2 weeks prior to their scheduled laboratory class, then participate in the Laboratory Practical in their usual practical group with a tutor in attendance. The OP provides benefits of after-hours and remote access unavailable when students performed the benchtop practical, and the implementation has been particularly successful (Fyfe, Fyfe and Thornton, 93).

Figure1. Main Menu card of the Osmosis Program, showing the three modules.

The Osmosis Program was purpose-built to satisfy a very particular need at Curtin University, and the development team considered it too specific to be of much use generally to other institutions. Surprisingly, after the OP was displayed at the Ascilite ‘93 Lismore conference, a number of delegates expressed interest in using the OP in their various paramedical and science courses. Of these, the veterinary course at Massey developed the idea sufficiently to tailor the OP to suit its particular needs. We monitored this process and closely evaluated the Veterinary student usage to study the implications of repurposing courseware.

2. Methods

2.1. OP needed modification

Veterinary students have a strong background in cellular physiology, but their 3rd semester preclinical course requires revision of membrane transport of ions in a clinical setting. OP was considered to be a suitable replacement for a traditional benchtop practical laboratory (wet-lab) that has run, essentially unchanged, for the last 20 years. However, it required modification.

Veterinary students utilised the background modules to refresh their memories if necessary but were then required to concentrate on those modules which related closely to the practical class. Such modification was made by staff in the Computing Centre at Curtin University.

During the 40 minutes allocated to run OP, the students were advised to check through the background material (figure 2) to verify that their background knowledge was adequate. The various self-assessment tests allowed the students to assess competently their presumed or actual knowledge level and to work through the background material more diligently if necessary. This aspect of OP was considered to be a great strength of the program.

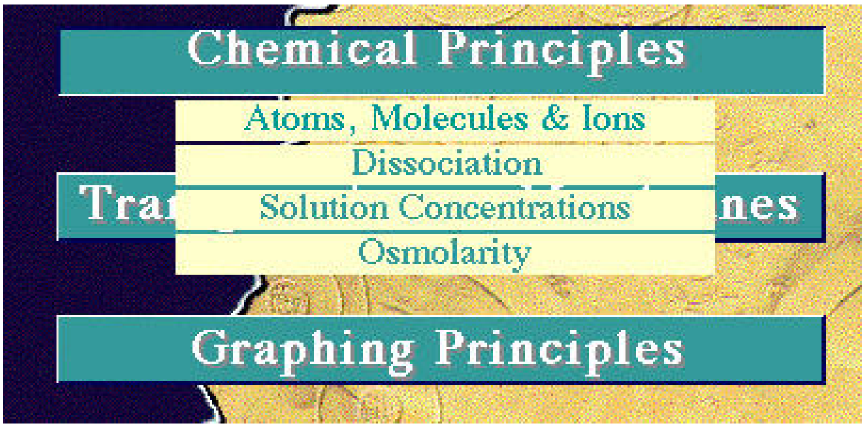


Figure 2. Pull-down menu from the Background Tutorial.

2.2 Design of protocol

The practical sessions ran over a three week period. Each week, one third of the students were allocated to study the principles of osmosis. Only 8 computers were available to run OP (PowerMac 6100) and there were approximately 21 students in this group, so a sub-group of 8 students were taken at random and worked on OP for a 40 minute period. They were briefed at the start of the session about the need to work through the background material to the level of detail thought necessary. After the 40 minute period a short tutorial was conducted to summarise the main objectives of the lab (Figure 3). They were given a set of notes that complemented the material presented in OP and provided a take-away hard-copy for future reference. One of the objectives of OP is to enable students to understand the formulation of common electrolyte replacements to preserve the integrity of cells. This requires calculations of osmolarity of solutions into which RBC are suspended. Some solutions will be hypo-osmotic or hyperosmotic and will damage body cells. Students measure the degree of damage and plot graphs to emphasise these important concepts. The tutorial also explained any differences in learning approach between the traditional benchtop practical and CAL. At the completion of the session the students were asked to fill in an assessment form.

Objectives

Upon completion of this practical you will be able to:

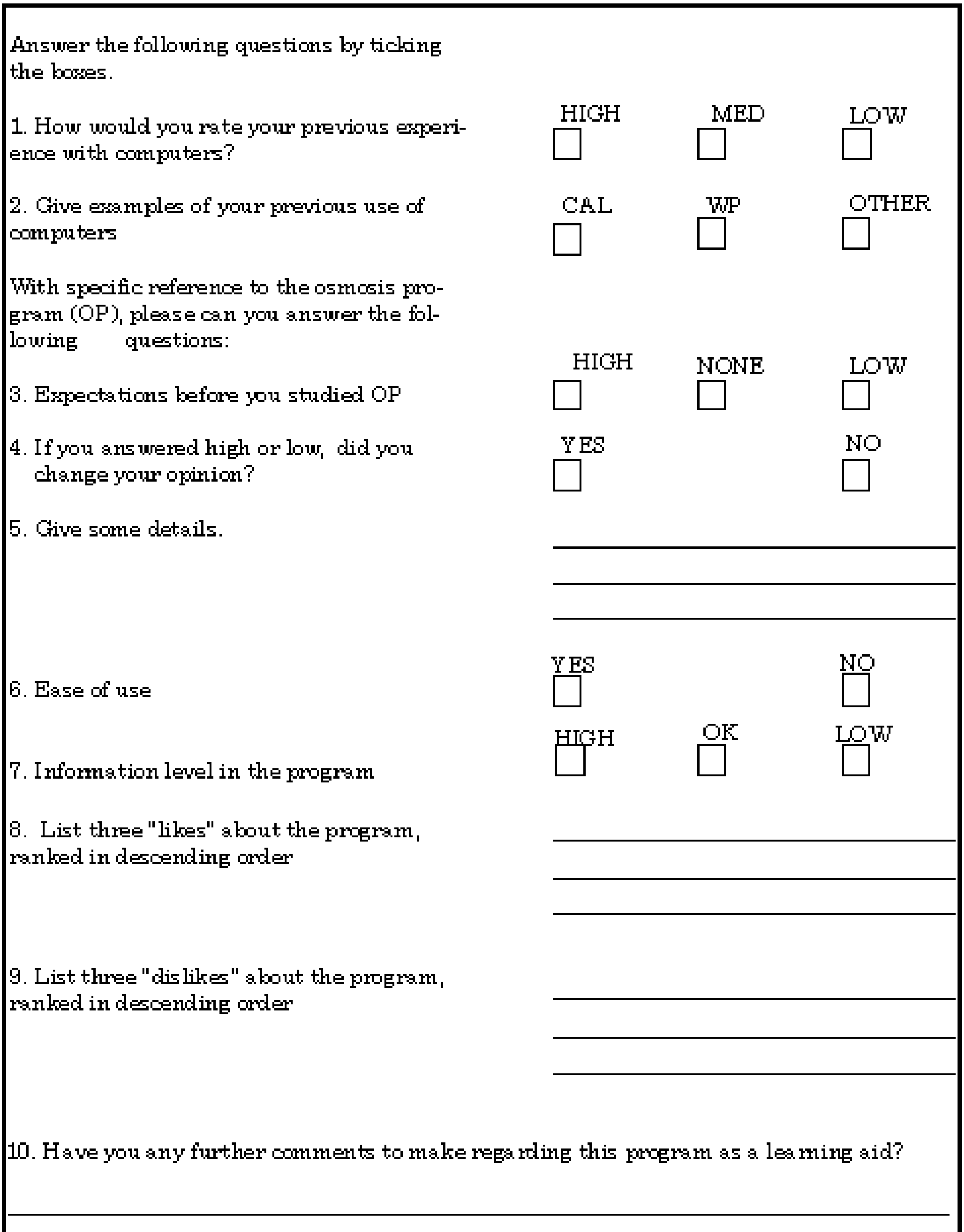
1. Define: diffusion, semi-permeable membrane, osmosis, osmotic pressure, dialysis and haemolysis.
2. Describe the principal ways in which lipid soluble, polar and ionic molecules cross the cell membrane.
3. Compare and contrast the processes of facilitated diffusion and active transport.
4. Distinguish between phagocytosis and pinocytosis, endocytosis and exocytosis.
5. Calculate the concentration and osmolarity of glucose and NaCl solutions given appropriate data.
6. Describe the effects of hypertonic, isotonic and hypotonic solutions on cells.

Figure 3. Objectives of the laboratory practical.

2.3 Design of the assessment

The lay-out of the assessment is given in Figure 4. It was designed to be completed in 5 minutes and to give information on previous computer use, expectations, ease of use, information level and to enable students to describe things they liked and disliked. This was based upon a similar, but more extensive, assessment used to evaluate computer familiarity in Curtin students (Fyfe, Fyfe and Thornton, 1993).

An end of semester written examination was given to both groups of students. Questions requiring short answers were deliberately chosen to cover topics that were in the objectives for the CAL and the “wet-lab.” Scripts were marked blind and then the results were compared and are presented graphically in Figure 6.



Answer the following questions by ticking the boxes.

1. How would you rate your previous experience with computers? HIGH ☐ MED ☐ LOW ☐

2. Give examples of your previous use of computers CAL ☐ WP ☐ OTHER ☐

With specific reference to the osmosis program (OP), please can you answer the following questions:

3. Expectations before you studied OP HIGH ☐ NONE ☐ LOW ☐

4. If you answered high or low, did you change your opinion? YES ☐ NO ☐

5. Give some details.

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6. Ease of use YES ☐ NO ☐

7. Information level in the program HIGH ☐ OK ☐ LOW ☐

8. List three "likes" about the program, ranked in descending order

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9. List three "dislikes" about the program, ranked in descending order

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10. Have you any further comments to make regarding this program as a learning aid?

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Fig 4.

3. Results

Twenty-four students completed OP and handed in an assessment form. Data were loaded into an Excel spreadsheet and analysed by working out the percentage of responses to each of the questions which allowed a mathematical description. The data is graphically illustrated below (Figure 5). A summary of typical responses to the questions 8 and 9 about likes and dislikes is given below.

3.1 Previous experience

67 % low, 19 % Medium, 14 % high

3.2 Expectations

79 % had no expectations. Of those that had expectations (4), three said they thought it would be difficult: two changed their mind after completing the assignment**.** One student expected it to be easy and thought it was.

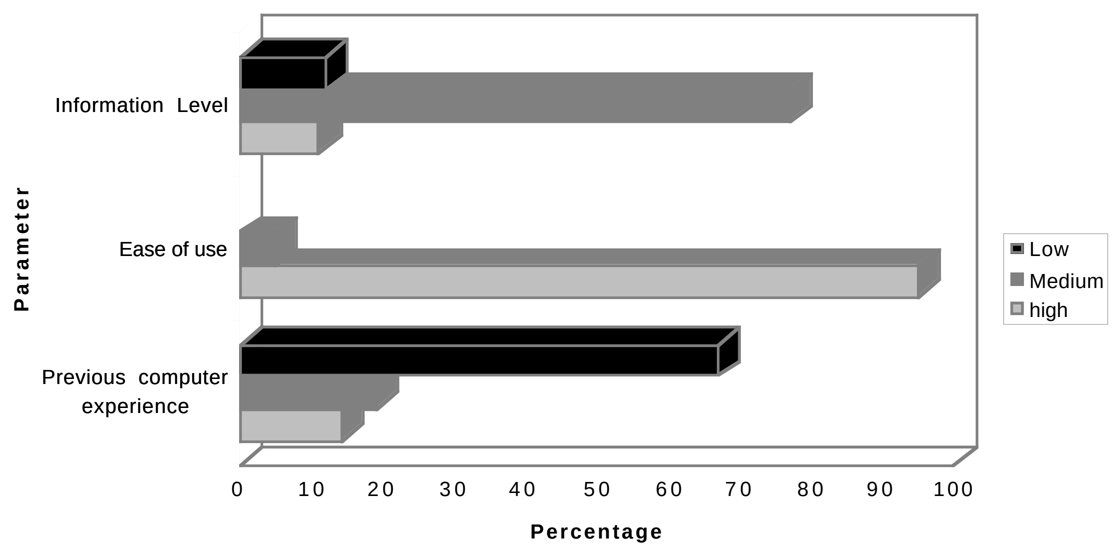
3.3 Ease of use

95 % expressed total satisfaction as to the interface and ease of use.

3.4 Information level

77 % thought it was about right, 11 % thought it too high and 12 % thought it too low.

Fig. 5



3.5 Likes, in order of prevalence

The quality of the graphics impressed most of the students. Others commented positively on the clear explanations of the text and the quizzes. We find that students do like the frequent assessment which gives them the best feedback as to the level of comprehension and retention at the time of the study.

3.6 Dislikes, in order of prevalence

Students disliked the bell sound that rang to indicate a correct response in the test sections. We had to turn down the sound on all the computers to obviate this problem. This was also a prevalent disliked feature in the assessments made by Curtin students.

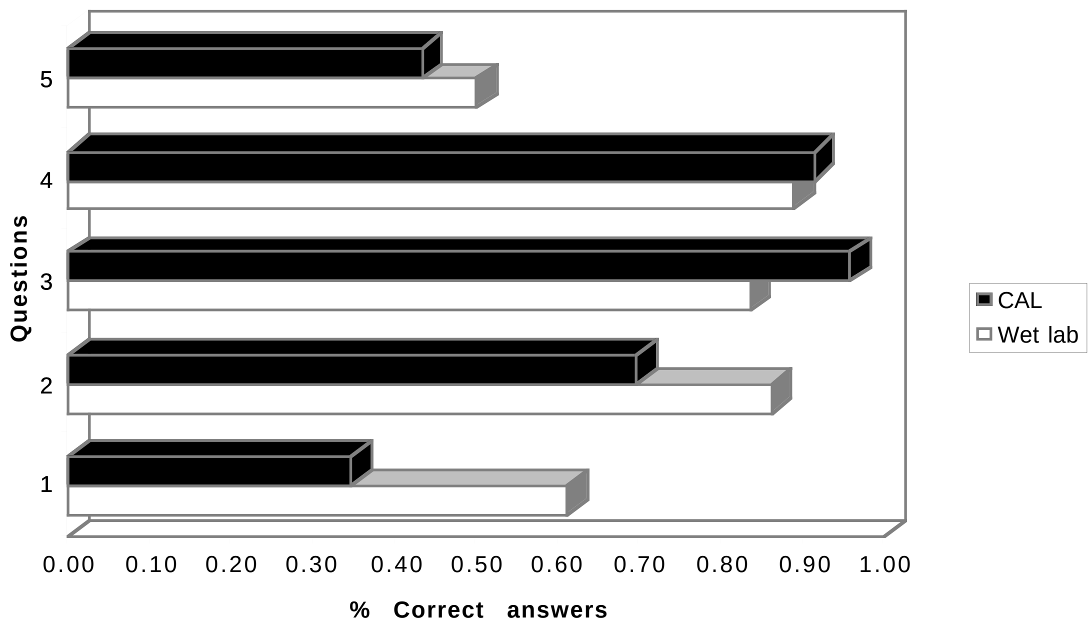
3.7 Written test

The results of the written test are illustrated in Figure 6.

The test was to write short notes on the following

1. Iso-osmotic
2. Isotonic
3. What determines the osmolarity of a solution?
4. Can a solution of salts be both iso-osmotic and hypotonic?
5. Explain your answer

Fig 6
Comparison between CAL and wet-lab exam results



4. Discussion

The evaluation of the learning that occurs in tertiary education is a difficult process, made no easier by the use of IMM. Earlier evaluation of the OP at Curtin university took a quantitative approach, possibly due to our scientific training and culture, but was also driven by pressure to show that students were achieving more using IMM than with the traditional methods. This was difficult to do, and our results could only say that students performed no worse using OP than using the traditional benchtop practical. Our evaluation raised more questions in our minds about how we assess learning *per se* and since that time we have used a more qualitative approach. This approach is being used more widely in the evaluation of learning and can be usefully applied to the evaluation of IMM. We found that the results from these instruments didn't really give us meaningful information about how students learnt with the programs. We could show that students had done just as well on exam papers and our evaluation gave us data about whether they liked the screen design, the navigational structure and so on: useful information but only a part of the story (Fyfe et al., 1995)

The use of the OP with the veterinary students was evaluated in a similar way, using conventional pen and paper tests involving responses scored on Likert scales, and comments using open ended questions. We were aware that the novelty value of IMM may be sufficient to engage students' attention, and that staff in attendance may be more enthusiastic and motivated. However, the results expressed above did have some clear trends.

Most students had low experience of computer use. Most of the previous CAL experiences were in the Massey first semester in an applied statistics course. Although questions related to this exercise were not asked, some students volunteered the information but didn't think the computer based learning (CBL) was very successful. This experience might have made the students somewhat apprehensive about starting the present CAL exercise but most stated they had no expectations at the start of the lab. The majority found the interface was good and commented on the ease of use. The information level was also considered "about right" for the majority of the class.

The most common comment when asked about their "likes" was the quality of the graphics. And the major "dislike" was the bell sound when a button was clicked.

The written test was a simple attempt to see if there were any differences in comprehension in this small sample of students. Questions 1 and 5 were generally answered badly. However only in question 1 were there any marked differences between the "wet-lab" and the CAL group, with this latter group scoring low. A possible reason was that the answer to this question was clearly stated in the notes that accompanied the wet-lab.

5. Conclusion

Using customised versions of courseware designed to meet very specific needs does compromise the wishes of CAL developers to design courseware from scratch to suit particular needs, and the concept of a generic courseware platform. Our trans-Tasman co-operative effort shows, however, that purpose-built courseware can be repurposed to suit the needs of quite different groups of students, and that this represents resources to be plundered in an atmosphere of increasing constrictions of time and budgets in tertiary education. The increasing use of the World-Wide Web to share resources will allow even more opportunities for developers with a magpie mentality.

6. Summary

OP has proven its value at Curtin University. Its use in the third semester preclinical course in the Veterinary School at Massey University was evaluated as a possible replacement for a conventional practical laboratory. An assessment proved that this CBL was highly valued for its ease of use and adequate information level and proved to be a pleasant learning experience, even thought the majority of students ranked their prior computer experience as low. A conventional MCQ test showed a similar performance level to another group of students who completed a conventional practical.

7. References

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