COMPUTER-SIMULATED PHARMACOLOGY EXPERIMENTS FOR UNDERGRADUATE PHARMACY STUDENTS: EXPERIENCE FROM AN AUSTRALIAN UNIVERSITY

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SUMMARY

Objective: To assess students’ views on computer-simulated pharmacology experiments.

Methods: A questionnaire survey was conducted in 85 undergraduate pharmacy students who completed seven computer-simulated pharmacology experiments. Students’ opinions on the objectives, effectiveness and utility of these simulated experiments were analyzed.

Result: Almost all respondents (98.7%) indicated that they achieved their learning objectives and enhanced understanding and confidence of the subject after the simulated experiments. All respondents (100%) preferred computer simulations to live animal experiments for pharmacology practical lessons, and would recommend this type of learning to other students. Provision of instruction sheets with detailed learning objectives and specific working tasks was found to facilitate students’ performance with these simulations.

Conclusion: Undergraduate pharmacy students find computer-simulated pharmacology experiments to be an effective alternative to live animal experiments since it assists them in achieving their learning objectives.

KEYWORDS Pharmacology computers pharmacy undergraduate computer assisted learning

INTRODUCTION

Pharmacology is the study of the manner in which the function of living systems is affected by chemical agents. Practical lessons are an important part of pharmacology curricula of various undergraduate courses, such as medicine, nursing, science and pharmacy. In vitro and in vivo animal experiments have been widely used in the practical lessons to help students gaining hands-on skills of pharmacological experiments, and more importantly, reinforcing their knowledge learned from lectures and textbooks.

Although traditional live animal experiments are invaluable, they do have shortcomings, and their cost-effectiveness has been questioned. Apart from being time consuming, animal experiments can only test a limited number of drugs at a given period of time. Furthermore, animal experiments, in particular whole animal studies, are often labour-intensive and costly.

A variety of computing programs have been developed for undergraduate and postgraduate teaching of pharmacology. Previous evidence has shown that this innovative educational technique, either as an adjunct to the traditional teaching methods such as lectures, or as a sole teaching tool for distance education or home studies, facilitates students’ learning and improves overall study outcomes in pharmacology. Pharmacy students’ perception on using simulated experiments as an alternative to animal experiments, however, is unclear. The purpose of this study is to evaluate pharmacy students’ views on effectiveness and utility of computer simulations at an Australian university.
Table 1. The outcomes of computer-simulated pharmacology experiments.

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall the simulations were good/excellent</td>
<td>75/75(100%)</td>
</tr>
<tr>
<td>I have achieved my learning objectives</td>
<td>74/75(98.7%)</td>
</tr>
<tr>
<td>My understanding of the subject has improved as a result of using these simulations</td>
<td>74/75(98.7%)</td>
</tr>
<tr>
<td>I enjoyed using it</td>
<td>75/75(100%)</td>
</tr>
<tr>
<td>I would recommend this form of practical to other students or friends</td>
<td>75/75(100%)</td>
</tr>
<tr>
<td>I prefer current simulations to live animal experiments</td>
<td>75/75(100%)</td>
</tr>
<tr>
<td>I prefer 1.5-2 hours per practice</td>
<td>75/75(100%)</td>
</tr>
<tr>
<td>The written instructions were helpful</td>
<td>72/75(96%)</td>
</tr>
</tbody>
</table>

MATERIALS AND METHODS

Background information: Computer-simulated pharmacology experiments were first introduced in June 1998 to a 4-year undergraduate pharmacy course at Charles Sturt University, Australia. The major teaching strategies for pharmacology, a full year subject, were formal lectures, small group tutorials and practical lessons in laboratories.

The practical lessons comprised of seven computer simulations and one live animal experiment. Computer-simulated experiments took place in the Pharmacy Laboratory at the University where 16 personal computers were equipped. Students worked in pairs on a computer for each simulation, which usually took 2-3 hours to complete. A member of academic staff was present at all times during the practical lesson to provide assistance.

The simulated experiments covered receptors in guinea pig ileum, adrenergic and cholinergic pharmacology, cardiovascular pharmacology, epilepsy, schizophrenia and drugs of abuse. The software programs used in this study were developed by the University of Bath. Some of these programs have recently been evaluated and reviewed. Detailed description and evaluation of the contents of these packages are beyond the scope of this paper. The objectives and specific working tasks for each topic were provided in written format at the beginning of the teaching semester. Students were required to read these instructions before the practical lessons.

Survey: A total of 85 students participated in the questionnaire survey. Each questionnaire had eight questions, ranging from the effectiveness to the util-

ity of the simulated experiments (Table 1). Participants had the option to remain anonymous; they were clearly informed that the survey was not a formal assessment and not related to their final grade.

Given the small number of possible respondents and diversity of answers expected, no statistical analysis or cross correlation was proposed: only descriptive statistics are therefore used.

RESULTS

Overall outcomes: Seventy-five of the 85 (88.2%) participants returned the questionnaires. All respondents found the simulated experiments either excellent or good and their understanding and confidence in pharmacology were improved by these practical lessons (Table 1).

As shown in Table 1, most students indicated that they had achieved their learning objectives in the simulated lessons, and would recommend this type of learning to other students. All respondents preferred computer simulations to live animal experiments (Table 1).

Some students provided additional comments on the simulated experiments. The contents of the additional comments were diverse, from the usefulness of the simulations to the way that academic staff members conducted these simulations. Most the comments were that the simulated experiments have made many pharmacological concepts much easier to understand and hence, to memorize.

Most respondents found that the provision of written instructions on objectives and specific working tasks of these simulations excellent strategies (Table 1), reducing the time they would have spent on the
non-essential contents in these exercises. All respondents indicated that 1.5-2 hr practical session was preferable to a 3-hour session (Table 1).

DISCUSSION

The primary finding of the study is that computer-simulated pharmacological experiments are well received by undergraduate pharmacy students, who believe that their understanding of pharmacology is enhanced by these simulations.

We have used computer-simulated experiments as a major means of practical lessons in pharmacology, because we believe that hands-on skills on live animal experiments pertinent to a pharmacological laboratory are not essential for undergraduate pharmacy students, who will largely become retail or hospital pharmacists after graduation. Computer-simulated experiments, which have been used in pharmacological teaching and research for nearly two decades, seem to have a number of advantages over the traditional live animal experiments, offering more accurate and consistent end results, and more flexibility as to when and where the experiments are conducted. Furthermore, computer simulations reduce the use of animals, which has been a concern of students and animal rights organisations.

It is important to note that our computer-simulated experiments were run in timetabled classes under close supervision of academic staff members. We found that timetabled classes are crucial to ensure the efficient and correct use of these simulation programs, and to improve overall learning outcomes. Our previous experience was that students who worked in their own pace often have difficulties in working through the experimental tasks and sometimes fail to complete assessments on time, or achieve poor scores. Studies from other universities, where similar simulation programs were used, have also shown that self-paced learning of these simulated experiments is sometimes problematic and less effective than timetabled classes.

Another important issue to be addressed is that students may experience fatigability and even frustration to some of these activities if the objectives and tasks are not clearly outlined before the simulations. The contents of the simulation programs used in the study were very comprehensive; it may take a student 4-5 hours to study every detail. In addition, some contents may have already been covered by previous lectures and there is no need to repeat them in these practical lessons. Handouts with detailed learning objectives and specific working tasks have enhanced students’ efficiency and motivation to these exercises, which in turn ensured the best use of this novel learning modality.

In conclusion, computer-simulated experiments appear to be feasible and effective as a major part of practical lessons of pharmacology. Given the learning objectives of pharmacology practical lessons in undergraduate pharmacy is to enhance students’ understanding of the subject, computer-simulations may serve as an alternative to the traditional live animal experiments.

REFERENCES