ORIGINAL ARTICLE

ANIMAL LABORATORY, INTERACTIVE AND COMPUTER BASED LEARNING, IN ENHANCING BASIC CONCEPTS IN PHYSIOLOGY: AN OUTLOOK OF 481 UNDERGRADUATE MEDICAL STUDENTS

Najla Shore, Shireen Khawar, Miraa Qutab, Muhammad Ayub*

Department of Physiology, Fatima Jinnah Medical College, Lahore, *Ayub Medical College, Abbottabad, Pakistan

Background: Laboratory exercises are intended to illustrate concepts and add an active learning component to courses. Since 1980s, there has been a decline in animal laboratories in medical physiology courses. Other cost-effective non-animal alternatives are being sought. The present study was designed to find out the students' opinion regarding the animal versus computer lab and whether innovative teaching methodologies helped students achieve their goals. **Methods:** Opinions of 481 female medical students of 2nd and 3rd year MBBS were included in the study. A questionnaire based on animal/computer based experiments and new teaching methodologies in physiology was voluntarily filled in by the students. **Results:** Majority of students immensely benefited from both the animal lab and other teaching methodologies. **Conclusion:** Although computer based learning is considered effective in helping students acquire basic concepts, there is evidence that some students acquire a more thorough understanding of the material through more advanced and challenging experience of an animal laboratory. The fact that such labs as well various teaching methods offer distinct educational advantages should be taken into account when courses are designed.

Keywords: Animal Lab, animation, Learning technique, Physiology learning, Teaching methods

Ayub Med Coll Abbottabad 2013;25(1-2):57–9

INTRODUCTION

The animal laboratory experiments in undergraduate medical course curriculum are designed to aid comprehension and consolidate basic concepts in physiology.[1] Medical students benefit more with a hands-on training. Experts agree that dissection provides the learner with 'real material' and 'real experience'. They add that when dissection is not a part of the curriculum, students may miss the opportunity to prepare for vocations and become valuable contributors in medicine and other health related professions.[2] However, there is a global trend in reduction of animal experiments with replacement with non-animal alternatives.[3]

In our country, most of the medical schools, both in government and private sector, are not using the animal laboratory (lab) for undergraduate physiology.

Well-designed practical work has the potential to motivate students and support deeper learning of concepts, manipulative competence and cooperative approaches to learning.[4] Fatima Jinnah Medical College (FJMC) affiliated with the University of Punjab, is unique in the sense that in addition to being an only all-female government institute, there is an animal as well as a computer lab used side-by-side for physiology experiments. There are a number of amphibian experiments on frog skeletal muscle and heart in the practical syllabus prescribed for 1st and 2nd year medical students. The physiology lab is also equipped with the PowerLab®, a data acquisition system comprising of hardware and software designed for use in life science research and teaching applications.

Experts agree that teaching should be multisensory and filled with variety. Hence in accordance with modern teaching trends in medical education, students in this institute, are exposed to various interactive modes such as Problem Based Learning (PBL), Small Group Discussions (SGD) and clinical scenarios with reference to basic physiology.

The objectives of this study were to find out the students' opinion regarding animal laboratory and computer-based learning in physiology practical classes; and whether various teaching methodologies helped consolidate core concepts in physiology.

MATERIAL AND METHODS

Four-hundred-eighty-one undergraduate medical students, 231 from 2nd year and 250 from 3rd year from Fatima Jinnah Medical College were included in this study conducted in February 2013. First year MBBS was not included because they had not taken any university examination yet.

Second year students had done animal plus computer based experiments while undergoing courses in cardiovascular and respiratory physiology. They then took the university First Professional MBBS Part-1 written (multiple choice, short essay and clinical scenario based questions), *viva voce*, and practical examination.

Third year students after having passed Part-1, had done animal plus computer based experiments in nerve muscle, special senses, and central nervous system physiology. They then took the university Part-2 examination as above.

The study was conducted using a questionnaire, 11 questions in all, which was filled anonymously and voluntarily. Students were asked to choose between the 4 option: strongly agree, agree, neutral, and disagree on Likert scale. Data were analysed using SPSS-20. All variables were described in frequencies and percentage.

RESULTS

In response to the question whether the students felt that frog experiments were important, 54% from 2nd and 63% from 3rd year agreed, 33% and 23% disagreed, while 12% and 13% were neutral respectively.

In answering where they learned the facts better when the teacher used computer programs instead of demonstrating live experiments, 87% from 2nd and 72% from 3rd year disagreed.

The 3rd question asked whether animal experiments be completely replaced by computer simulations, 49% from 2nd and 58% from 3rd year disagreed, while few, 29% and 22% agreed respectively.

For LabTutor® techniques, 64% and 56% agreed, 13% and 15% were neutral, while 22% and 28% disagreed respectively.

Regarding awareness that practical skill helped secure marks at the university level, the majority, 78% from 2nd and 72% from 3rd year were fully aware of it.

Concerning the clinical examination checklists that enabled better understanding of clinical scenarios, 78% from 2nd and 86% from 3rd year agreed.

The painstaking routine taken by our staff members in preparing students for answering specific practical related questions resulted in agreement by 92% from 2nd and 3rd year students.

Simultaneous integration of practical and theory classes helped 97% of 2nd and 93% of 3rd year students. Ninety-two percent from 2nd and 93% from 3rd year agreed that small group discussions during demonstrations helped improve their performance in practical. Seventy-eight percent from 2nd and 71% from 3rd years realised importance of practical journals.

Maintaining horizontal teaching integration is a difficult job and requires good communication between the concerned departments. This achievement was appreciated by 99% from 2nd and 97% from 3rd years.

Table-1: Students' views towards the use of animal laboratory, computer-based learning and modern teaching approaches in Physiology

Items	Class Year	Students' views [n (%)]			
		Strongly Agree	Agree	Neutral	Disagree
1. In physiology, are experiments on frog important at undergraduate level?	2nd	29 (12.6)	98 (42.4)	27 (11.7)	77 (33.3)
	3rd	32 (12.8)	126 (50.4)	33 (13.2)	59 (23.6)
2. Facts are learnt better, when the teacher uses computer programs instead of demonstrating live experiments.	2nd	6 (2.6)	11 (4.8)	12 (5.2)	202 (87.4)
	3rd	10 (4.0)	29 (11.6)	31 (12.4)	180 (72.0)
3. Animal experiments should completely be replaced by computer simulations.	2nd	22 (9.5)	45 (19.5)	50 (21.6)	114 (49.4)
	3rd	13 (5.2)	42 (16.8)	49 (19.6)	146 (58.4)
4. Introduction to techniques like EEG, ECG, pulse oxymeter and blood pressure on the LabTutor® helped improve comprehension and ability to relate physiology to clinical problems.	2nd	71 (30.7)	79 (34.2)	29 (12.6)	52 (22.5)
	3rd	62 (24.8)	80 (32.0)	38 (15.2)	70 (28.0)
5. Were you aware that practical skill helped secure marks during examination?	2nd	44 (19.0)	136 (58.9)	34 (14.7)	17 (7.4)
	3rd	72 (28.8)	135 (54.0)	30 (12.0)	13 (5.2)
6. Demonstrations regarding examination checklists enabled better understanding of clinical scenario based questions.	2nd	61 (26.4)	121 (52.4)	29 (12.6)	20 (8.7)
	3rd	82 (32.8)	134 (53.6)	29 (11.6)	5 (2.0)
7. Prior preparation of specific practical skill related questions helped answering *viva voce* in examinations.	2nd	94 (40.7)	118 (51.1)	13 (5.6)	6 (2.6)
	3rd	97 (38.8)	132 (52.8)	16 (6.4)	5 (2.0)
8. Simultaneous integration of practical and theory classes helped in better understanding of the subject matter.	2nd	151 (65.4)	75 (32.5)	2 (0.9)	3 (1.3)
	3rd	133 (53.2)	102 (40.8)	9 (3.6)	6 (2.4)
9. Do you agree that small group discussions during demonstrations helped improve your practical skill?	2nd	110 (47.6)	103 (44.6)	9 (3.9)	9 (3.9)
	3rd	110 (44)	122 (48.8)	7 (2.8)	11 (4.4)
10. Meticulous Practical Journal corrections helped improve your performance during examination.	2nd	32 (13.9)	149 (64.5)	33 (14.3)	17 (7.4)
	3rd	65 (26.0)	139 (59.6)	27 (10.8)	19 (7.6)
11. Horizontal teaching integration enabled better understanding of core concepts in physiology.	2nd	169 (33.2)	60 (26.0)	1 (0.4)	1 (0.4)
	3rd	139 (55.6)	105 (42.0)	6 (2.4)	0

2nd Year (n=231), 3rd Year (n=250)

DISCUSSION

Practical sessions in physiology occupy a key role in consolidation of topics taught in lectures. They create an opportunity for discussion in a laboratory environment with smaller groups, provide students with time to acquire skills and create chances for analytical thought process.[5]

In favour of the animal lab, our study is in accordance with a number of other studies. Live animal demonstrations are pedagogically superior to any teaching modality. Harel Weinstein states that the direct experience, insight and learning achievable from an animal based lab has not yet been replaced entirely by other teaching modalities.[6] While replacing the traditional 'wet' lab work with computer assisted learning modules has educational and practical merits, there is general agreement among scientists that there can be no substitute for real wet laboratory experiments in physiology.[7] Computer simulations does not replace, although it does compliment and enrich experimental

methods.[8] Laboratory classes offer an opportunity for enforcing learning and complimenting the teaching modalities such as lecture and PBL. While PBL and lectures focus on the big picture, laboratory classes facilitate learning about details and hands-on experience.[9]

Certain studies, however, represent a different view from ours. In one of such, a majority of students felt that animal experiments involved needless pain and suffering to animals, and that computer simulations should be used as an alternative.[10] Others think that a CD-ROM consisting of the software for computer simulations of all the amphibian experiments, is an alternative for conventional animal experiments.[11]

Physiology occupies a prime position in undergraduate medical teaching. This has given curriculum planners an opportunity to be more innovative by attempting different modes of teaching.[12] Our department has been successful in adopting multiple teaching strategies to enable students' better understanding of the subject. This is in accordance with a number of other studies.[13–15]

Our horizontal integration had the highest degree of agreement rating in both second and third year. This is in accordance with Hooi SC *et al*[16] who stated that integration of physiology benefits not only horizontally across basic subjects but also vertically into the clinical years.

Since admissions in government medical colleges are strictly merit based, students in our institute come from a very diverse socioeconomic and educational background. Hence by emphasising on practical skill, clinical examination and small group tutoring, students with poor prior knowledge are able to overcome the disadvantage of their limited science exposure and achieve similar learning outcomes to those students with good science background.[17]

CONCLUSION

The present out that both the 2nd and 3rd year medical students of FJMC although supportive of computer based learning, understand the importance of the animal laboratory for acquiring a more thorough understanding of Physiology. Our innovative teaching methodologies indeed did consolidate their concepts in the subjects and helped them through examinations. The medical curricula should focus on learning approaches that enhance students' self-directed learning.

REFERENCES

1. Ra'anan AW. The evolving role of animal laboratories in physiology instruction. Adv Physiol Educ 2005;29:144–50.
2. Keiser TD, Hamm RW. Forum: Dissection –The case for. Sci Teach 1991;58(1):13–5.
3. Hansen LA, Boss GR. Use of live animals in the curricula of US medical schools: survey results from 2001. Acad Med 2002;77:1147–9.
4. Hoffstein A, Lunetta VN. The role of the laboratory in science teaching: neglected aspects of research. Rev Educ Res 1982;52:201–17.
5. Balkanci ZD, Pehlianoglu B. An overview of undergraduate physiology education in Turkish medical faculties. Adv Physiol Edu 2008;32:322–8.
6. Moss R. Physiologists Support Animal Labs. American Physiological Society; Report 2013.
7. Peat M, Taylor PM. Virtual Biology: How well can it replace authentic activities! CAL Laborate Int 2005;13:21–4.
8. Ozu M, Dorr RA, Gutierrez F, Politi MT, Toriano R. A counterpoint between computer simulations and biological experiments to train new members of a laboratory of physiological sciences. Adv Physiol Educ 2012;36:345–51.
9. Azer SA, Hasanato R, Al-Nasser S, Somily A, AlSaadi MM. Introducing clinical laboratory classes in a PBL curriculum: impact on students' learning and satisfaction. BMC Med Edu 2013;13:71.
10. Tembhurne SV, Sakarkar DM. Alternative to use of live animals in teaching pharmacology and physiology in pharmacy undergraduate curriculum: an assessment of 120 students' views. Int J Med Pharm Sci 2011;1(1):4–7.
11. Nageswari K, Syamala D. Simulation of physiology experiments –an alternative to animal use. Indian J Physiol Pharmacol 2007;51:354–60.
12. Siddiqui A. The evolving role of physiology and its teaching in undergraduate medical curriculum. [Editorial]. Al Ameen J Med Sci 2012;5:107–8.
13. Anyachi VS, Nwobodo E, Njoku CJ, Inah GA. Comparative evaluation of evaluation of active learning and the traditional lectures in physiology: a case study of 200 level medical laboratory students of Imo State University, Owerri. Niger J Physiol Sci 2007;22:117–21.
14. DeHaan RL. Teaching creativity and inventive problem solving in science. CBE Life Sci Educ 2009;8(3):172–81.
15. Tufts MA, Higgins-Opitz SB. What makes the learning of physiology in a PBL medical curriculum challenging? Student perception. Adv Physiol Edu 2009;33(3):187–95.
16. Hooi SC, Koh DR. One hundred years of physiology education in Singapore. Ann Acad Med Singapore 2005;36(6);84–6C.
17. Earnst H Colthorpe K. The efficacy of interactive lecturing for students with diverse science backgrounds. Adv Physiol Educ 2007;31(1):41–4.

Address for Correspondence:

Dr. Najla Shore, Department of Physiology, Fatima Jinnah Medical College, Lahore, Pakistan. **Cell:** +92-300-4172859.
Email: shorenajla@hotmail.com