

Outcome of use of a Computer-Assisted Simulation Module as teaching aid in Experimental Physiology for first-year medical students

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Abstract

Objective: This complete enumeration, prospective, before-and-after study (without controls) was conducted to evaluate the effect of a computer-assisted simulation module in Experimental Physiology on the cognitive domain scores of first-year medical students.

Methods: After theoretical teaching using charts & graphs by the facilitators, participants were administered a pre-test containing multiple choice questions. Subsequently, participants were trained using a computer-assisted learning module on amphibian experiments and administered a post-test, with identical questions and marking system as the pre-test.

Results: 60 students (30 males and 30 females) participated in the study. The difference between the pre- and post-test scores were statistically significant in both males ($p=0.00002$) and females ($p<0.00001$). Among females, minimum score in the post-test was more than the 1st quartile of pre-test. The overall difference in the median values of student scores in pre- and post-tests was highly significant ($p<0.00001$). The differences between the pre- and post-test scores were statistically significant in 7 out of 10 questions.

Conclusion: The computer-assisted simulation module covered major learning objectives in the curriculum for Experimental Physiology and helped students attain higher scores.

Keywords: Computer-Assisted Simulation Module, Experimental Physiology.

1. Introduction

Traditionally, undergraduate medical students performed animal experiments during Physiology practical classes and practical examinations to reinforce theoretical concepts of the subject [1,2]. This was replaced by demonstrations of animal experiments and later, readymade graphs and charts were shown. Lobbying by animal rights groups, ethical issues, dearth of laboratory animals and concerns about imbalance in the ecosystem led to stipulation by the Medical Council of India that animal experiments for undergraduate teaching would be

substituted with computer-assisted simulation modules [3-6].

The adoption of computer-assisted simulation modules is progressively increasing in medical institutions in India [7] and in other countries [8-12].

The present study was conducted to evaluate the effect of a computer-assisted simulation module in Experimental Physiology on the cognitive domain scores of first-year medical students.

2. Materials and Methods

This complete enumeration, prospective, before-and-after study (without controls) was conducted in Rajiv Gandhi Medical College, Kalwa, Thane, which is located about 30 kms from Mumbai city in Western India.

2.1. Inclusion criteria

Students of either sex, who gave written informed consent to participate in the study, were included.

2.2. Procedure

After obtaining approval from the Institutional Ethics Committee, the study was explained to prospective participants studying in first year of the MBBS course. After theoretical teaching using charts & graphs by the facilitators, students were administered a pre-test containing ten multiple choice questions wherein each correct response was awarded one mark (total of 10 marks). Subsequently, participants were trained using a computer-assisted learning module (Animal Simulator™, Reed Elsevier India Pvt. Ltd., Gurgaon-122002, India), which contained audio-visual amphibian experiments such as, preparation of nerve muscle, simple muscle twitch, muscle fatigue, frog dissection, normal cardiogram, effects of adrenaline, acetyl choline and nicotine on amphibian heart, heart block, properties of cardiac muscle, and Stannius ligature. Later, the students were administered a post-test, with identical questions and marking system as the pre-test.

3. Statistical Methods

The pre- and post-test scores were tabulated and statistically analysed using EpiInfo Version 7.0 (public domain software package from Centers for Disease Control and Prevention, Atlanta, GA, USA). Data were presented

as Mean and standard deviation (SD). Confidence interval (CI) was expressed in the range of (Mean – [2 x Standard Error]) to (Mean + [2 x Standard Error]). Significance of difference in parameters was calculated using standard error of difference between means at 95% confidence interval ($p < 0.05$).

4. Results

4.1. Student-wise scores

A total of 60 students (30 males and 30 females) participated in the study. The difference between the pre- and post-test scores were statistically significant in both males ($p = 0.00002$) and females ($p < 0.00001$) (Table-1) and there was a substantial increase in correct responses (minimum, first quartile, median, third quartile and maximum) in the post-test (Figures 1 & 2). The minimum score was zero in both males and females in the pre-test which improved in the post-test. Among females, minimum score in the post-test was more than the 1st quartile of pre-test. The overall difference in the median values of student scores in pre- and post-tests was highly significant ($p < 0.00001$).

4.2. Question-wise scores

The differences between the pre- and post-test scores were statistically significant in all questions except question numbers 3, 6 and 7. (Table 2) The pre-test scores were in the top quartile in 2 questions, in the 3rd quartile in 4 questions and in the 2nd quartile in 4 questions. The post-test scores were in the 2nd quartile for 8 questions and in the 2nd quartile for 4 questions.

Table 1: Gender-wise scores in pre- and post-tests

Gender	Test	Mean	SD	CI	Z value #	p value
Males (n=30)	Pre-test	4.30	1.86	3.960 - 4.639	4.23	0.00002*
	Post-test	6.28	1.77	5.959 - 6.607		
Females (n=30)	Pre-test	4.37	1.80	4.038 - 4.695	5.67	<0.00001*
	Post-test	6.78	1.48	6.513 - 7.053		

SD = Standard Deviation; CI = Confidence interval

Standard Error of Difference between Means *Statistically significant

Figure 1: Box plot of gender-wise scores in pre- and post-tests

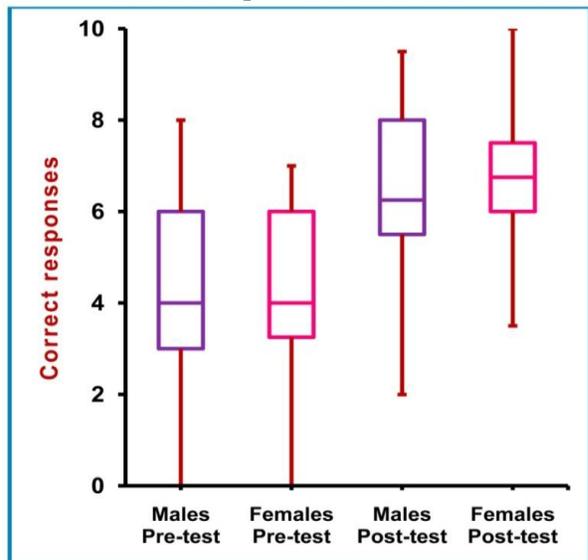


Figure 2: Box plot of student-wise scores in pre- and post-tests

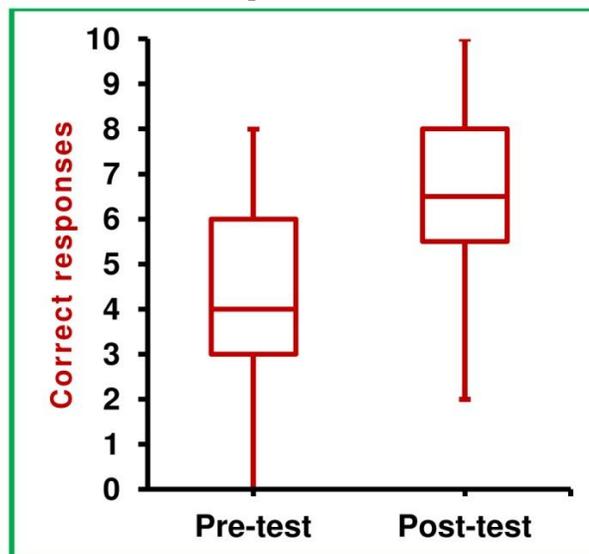


Table 2: Question-wise scores in pre- and post-tests

Question Number	Pre-test			Post-test			Z value #	p value
	Mean	SD	CI	Mean	SD	CI		
Q.1.	0.217	0.415	0.163 - 0.271	0.967	0.181	0.944 - 0.990	12.831	<0.0001*
Q.2.	0.250	0.437	0.194 - 0.306	0.567	0.500	0.502 - 0.632	3.698	0.0002*
Q.3.	0.467	0.503	0.402 - 0.532	0.617	0.490	0.554 - 0.680	1.655	0.0979
Q.4.	0.367	0.486	0.304 - 0.430	0.617	0.490	0.554 - 0.680	2.806	0.0050*
Q.5.	0.650	0.481	0.588 - 0.712	0.967	0.181	0.944 - 0.990	4.778	<0.0001*
Q.6.	0.250	0.437	0.194 - 0.306	0.417	0.497	0.353 - 0.481	1.955	0.0506
Q.7.	0.717	0.454	0.658 - 0.776	0.800	0.403	0.748 - 0.852	1.059	0.2896
Q.8.	0.633	0.468	0.573 - 0.693	0.442	0.346	0.397 - 0.487	2.542	0.0110*
Q.9.	0.033	0.181	0.010 - 0.056	0.217	0.395	0.166 - 0.268	3.280	0.0010*
Q.10.	0.733	0.446	0.675 - 0.791	0.950	0.220	0.922 - 0.978	3.380	0.0007*

SD = Standard Deviation; CI = Confidence interval

Standard Error of Difference between Means *Statistically significant

5. Discussion

The objective of practical classes in Experimental Physiology is to supplement theoretical concepts in this subject [1, 2]. Due to discontinuation of animal experiments, some medical colleges in India initially started with demonstration of readymade graphs and charts and later switched over to use of computer-assisted simulation modules [7]. This study was conducted to determine the outcome of using a commercially available computer-assisted simulation module (Animal Simulator™) on the cognitive domain scores of first-year medical students.

As compared to the pre-test, there was a considerable increase in correct responses in the post-test in this study. Similar significant difference in scores has also been reported by an Amritsar-based study [2].

Studies on computer-assisted simulation technologies have reported better visualization [16] and

improvement in quantifiable comprehension by students [1, 14, 15].

Since these simulation modules imitate the actual laboratory setting [8, 9] and can be frequently repeated without sacrificing animals [1], these could be useful alternatives to live animal experiments [15].

6. Limitations

The outcome of only one commercially available computer-assisted simulation module was studied on a single batch of first-year medical students.

7. Conclusion

The computer-assisted simulation module covered major learning objectives in the curriculum for Experimental Physiology and helped students attain higher scores. Computer simulation modules have the potential to

encourage self-learning at a time and place of their choice because of extensive use of computers by medical students.

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Conflict of Interest: None

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