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Computer Simulated Program an Effective Tool For Understanding Physiological Concepts

KEYWORDS: Computer simulated program, Cell transport, Nerve –muscle physiology, Self directed learning

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ABSTRACT *Back ground: Practical labs are an important part of physiology curriculum. Replacement of animal dissection by computer simulated program has made physiological learning highly interactive and motivating. My aim was to correlate the theory topics for cell transport, nerve and skeletal muscle physiology with that of its practical aspect using CSP.*

Method: A study was done in fall semester for 2nd year medical students 2011 and 2012 batches at OMC, Muscat. After didactic teaching a pre test was given to assess baseline knowledge of students followed by CSP practical completed by a post test. 5 point Likert's scale feedback survey was filled by all the participants after completion of the course.

Result: Statistically significant increase in the post score were obtained for all the topics. Descriptive statistical analysis for 11 questions showed positive response by 77-84% students for considering CSP helpful to improve on human physiology concepts. 65% of students felt in control of their own learning process thus improved in self directed learning.

Conclusion: CSP allows students to redo and analyze the practical by changing variables for better understanding and motivate for self directed learning.

INTRODUCTION

The study of physiology is a keystone in every medical education curricula. A clear understanding of the concepts and principles underlying the disease process as well as normal functioning of human body is an important element in diagnosis of specific clinical case.

It is tedious to teach and learn interaction between organs and impact of modifications in a specific organ/ organ system in closed class room in spite of having recent teaching techniques. To understand the measurement of basic physiological indices & essential techniques of electrophysiology experimental practical lab is the best platform for undergraduate medical students.

Now days animal operational skills are not taken into consideration due to animal rights law so these nerve muscle & applied physiological concepts are done by the use of informational technology. Physiological models prepared by various mathematical & computational models are based on an adequate & accurate observation of the living world. These stimulating programs are very useful for teaching young medical doctors & enhance their complementary content (ColemanTG et.,al 1983).

Computer simulation program (CSP) can range from simple multimedia learning contents to complex simulation providing physical feedback through hi-tech technologies. By this students are engaged more towards the practical concept thus they enhance their motivation towards learning (LiuA et.,al 2003).

There are various prime factors which stimulated a demand for a computer simulation program for experimental physiology from an old tradition animal dissection. Firstly increase in student number with no comparable increase in resources and to reduce staff student contact time. Secondly increasing number of student's has uneasiness for the use of animal to teach known facts and principles. Alteration of variables can be done with ease in computer simulated program (Kokalaril et.,al 2012) that practical is not feasible in vivo experiments for which repeated interventions have to be done. Other than strict laws dealing with killing of animal just for teaching known facts.

There are six amphibian experiments for physiology related to cell transport, neurophysiology and muscle physiology in the practical syllabus prescribed for the fall semester of First year undergraduate medical students in OMC.

AIMS AND OBJECTIVES OF RESEARCH

To correlate the taught topic in theory with that of its practical aspect so that students can work over the CSP themselves and clarify the theoretical concepts.

LEARNING OUTCOME

- Understand the selective permeability function of the plasma membrane by changing the components of Fick's law of diffusion.
- List the criteria for active transport
- To list at least two agents capable of inhibiting an Action potential in nerve.
- To find the relationship between nerve size and conduction velocity
- To describe the phases of a skeletal muscle twitch
- To understand the effect of increases in stimulus intensity on a skeletal muscle and frequency of stimuli
- To demonstrate muscle fatigue and different types of skeletal muscle contraction

METHODOLOGY

Oman medical college is having a multimedia soft ware of CD-ROM companion for Physio-Experiment program which is developed specifically to offer an alternative student centered approach for teaching experimental physiology. The program has an introduction to each exercise explaining basic theoretical terms associated with the exercise and to describe the preparation.

Work was conducted for second year medical students in OMC during fall semester 2011 and 2012. 91 from 2011 and 100 from 2012 batch students took physiology course for that duration.

Each experiment section offers the student the choice of a

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range of investigative experiments. Direct measurement of effect by changing various variables in cell transport, nerve and skeletal muscle physiology mechanisms. Initial compulsory tutorial sessions for 2hours duration were arranged to explain how to proceed over the program, other than calculating and analyzing the results obtained.

Two instructors were with 25-30 groups of students in IT lab during the program throughout the semester. Every student was provided a computer to work upon independently. A student workbook was developed to accompany the software. The workbook directs students through a schedule of tasks designed to address the learning objectives. Students were asked to answer questions relating to the text, solve problems, perform calculations, draw graphs and offer explanation of results obtained to encourage and ensure interpretation of data.

Practical was conducted after the topic was taught in theory class. All students were given a written test before starting the lab component (pretest) to assess a baseline level of knowledge. This comprised of 10 questions as MCQ or short answer some were problem solving exercises & some interpretational question. Students were retested for the same component after completion of the lab exercises. This was conducted for every exercise. Student's attitudes were surveyed by a survey questionnaire consisting of 11 closed ended questions and one open ended question asking for the comments on the approach at the end of semester.

RESULTS

Pre & post test on cell transport, nerve and skeletal muscle physiology was conducted. The paired sample test for cell transport, muscle and nerve showed a statistical significance ($p<0.0050$) for the year 2011 as well as 2012 (Table1-3 & Figure1) The descriptive statistical analysis for 11 questions done by using SPSS-19 showed that maximum mean ranged between 1.91 to 3.93 for year 2011, 2.29-3.93 for year 2012 (Table 4 &Figure 2).

Maximum mean was for question 7 which specified that this type of learning allowed me a better understanding of physiological process and for question 11 which specified that this type of learning helped me to improve my knowledge of human physiology from batch 2011. From batch 2012 maximum mean was observed for question 10 which mentioned that this type of learning allowed me to have an integrated point of view of human body functions & question 8 which pointed out that this learning allowed me to develop better understanding of the coordinated action of several systems in the homeostatic response.

DISCUSSION

The roots of physiology lie in practical observation. Earlier animal laboratories provided a functioning example of interactions among organ systems & a source of data for student analysis and developing base of conceptual knowledge (SamsaelRW et.,al 1994). Majority of medical schools in USA are not using live animals now in any of their physiology, pharmacology or surgery courses (HansenLA et., al 2002).

Using CSP students are able to explore the function of cell transport, nerve- skeletal muscle physiology in greater depth (DavisMJ et., al 2001). It has been assessed the computer simulation program are useful for teaching concepts and are also useful for self directed learning (DavisMJ 2001, DavisTL 1990, GucluB 2007). Almost all respondents found the simulated experiments either excellent or good and they improved not only level of physiological understanding but also confidence for the taught topic (LexinW 2001).

The student learned a great deal of content from working through the CD-ROM Physio-Ex program although few difficulties were faced during the exercise specifically in isometric & isotonic contractions in skeletal muscle. The program has limitation for the load as well as length of the muscle. Re clarification of the concepts after practical was done by the instructors and then practical was repeated. Analysis of pre post test for the topic concludes that student's concepts got clarified by working repeatedly over the exercise. CSP in spite of being a powerful tool for teaching complex physiological system functioning but is not easy for students to develop an accurate understanding of how perturbing one organ provokes a system level response but definitely provides a click to his thought process.

Compared to 2011 batch 2012 batch students did better in pre test in pre test but post test did not show any significance difference. Post test from pre test showed a statistical significance in both the batches thus further enhancing that concepts are clarified by CSP to a better extend (DineshB et.,al 2009). In earlier days when animal experiments were conducted no significant mean knowledge gain was found (DewhurstDG et., al 1994).

83.5% of students from 2011 batch considered CSP helpful to improve knowledge in human physiology. 77% from batch 2012 considered this type of learning to have integrated point of view for human body function.

65% of students from both the batches agreed that they felt in control of their own learning process which directly implies improvement in self directed learning (SrinageswariK et.,al 2007).

66-72% of students from both batches were satisfied with coordinated approach of practical with the theory.

80-85% of students from the batches felt that computer simulated program was time consuming, more time should be provided to practical sessions.

Understanding the language of the program and its handling was not very difficult as agreed by 60-70% of students from both the year batches.

CONCLUSION

The computer simulated program not only avoids unnecessary animal experiments but also reduces cost of the experiments and allows student to re-do the practical, and analyze the effects of various variables by changing their concentration.

This program provides good result and is effective learning aid. It improves the theoretical knowledge via interactive teaching style. The results of the component can be recorded on the computer and print can be kept for review later.

Balance between concepts taught on one side and a fact on the other is a necessity for an effective teaching of physiology. Wide spread of electronic teaching material cannot replace classic teaching approach but fusion can make subject interesting and easier specifically for complex interactional concepts of physiology.

Finally a grateful thought goes to those researchers who built this software and made it easily available for teaching institutes and students.

In future I would like to have Power lab which has neurophysiology/electrophysiology, respiratory gas analyzer component so that students can use it not only for simulation exercises but also on patients directly for much clearer understanding of complex physiological concepts.

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TABLE 1 : Pre-post for Skeletal muscle batch 2012&11

	Paired Differences					t	ddf	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 pre test - post test 2012 batch	-3.720	1.810	.181	-4.079	-3.361	-20.558	99	.000
Pair 1 pre test - post test 2011 batch	-3.791	1.829	.192	-4.172	-3.410	-19.775	90	.000

TABLE 2: Pre-post for Cell transport batch 2012&11

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 pre - post test 2012 batch	-4.270	2.382	.238	-4.743	-3.797	-17.926	99	.000
Pair 1 pre - post test 2011 batch	-4.495	2.302	.241	-4.974	-4.015	-18.629	90	.000

TABLE 3: Pre post for Nerve physiology batch 2012&11

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 pre - post test 2012 batch	-3.660	1.919	.192	-4.041	-3.279	-19.076	99	.000
Pair 1 pre - post test 2011 batch	-3.725	1.944	.204	-4.130	-3.320	-18.280	90	.000

FIGURE 1: Pre and post test for Cell transport, skeletal muscle and nerve for 2011 &2012 batch

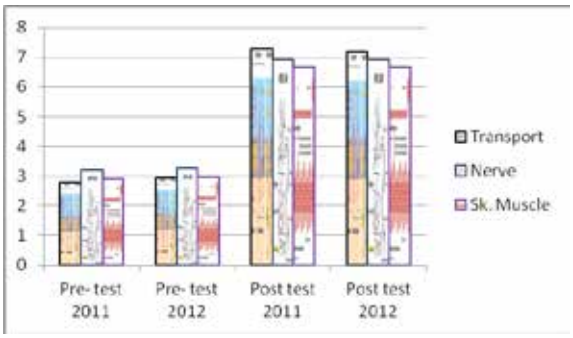

FIGURE 2: Descriptive analysis for survey questions

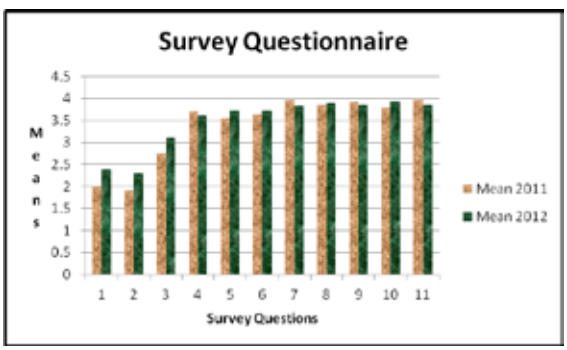

TABLE 4: Descriptive analysis for the survey questions

QNo.	Questions	Mean 2011	Mean 2012
1	Handling the program was difficult.	2	2.39
2	Understanding the language of the computer program was very difficult.	1.91	2.29
3	Completing the stimulation and preparing the final result were time consuming.	2.76	3.1
4	I am very satisfied with the co-ordinated approach of practical with the theory.	3.69	3.62
5	I felt in control of my own learning process.	3.54	3.74
6	I enjoyed this learning process.	3.64	3.74
7	This type of learning allowed me a better understanding of physiological processes.	3.98	3.83
8	This type of learning allowed me to develop better understanding of the coordinated action of several systems in the homeostatic response.	3.86	3.91
9	This type of learning allowed me a better knowledge of physiological units.	3.91	3.85
10	This type of learning allowed me to have an integrated point of view of human body functions.	3.78	3.93
11	This type of learning helped me to improve my knowledge of human physiology.	3.97	3.85

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