EFFECT OF COMPUTER BASED ANIMATIONS ON LEARNING OF PHYSIOLOGY

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ABSTRACT

Objective: To find out the effect of computer based animations on learning of Physiology.

Study Design: Randomized control trial.

Place and Duration of Study: Army Medical College Rawalpindi, from Jan to Sep 2016.

Material and Methods: Sixty students of first year MBBS class were selected through simple random sampling and then randomly assigned into two groups of 30 each; group I and II. A pre-test was given to both the groups to assess their basal knowledge about the systems to be taught. In 1st teaching session, experimental group was taught with and control without animations. In 2nd teaching session, control group became experimental and previously experimental group became control. After both the teaching sessions MCQ tests of C2, C3 and C4 level were given to the groups and marks obtained were compared.

Results: There were 20 (33.3%) male and 40 (66.7%) female students with mean age of 18.92 ± 0.56 years. Comparison of pre-test scores confirmed that basal level of knowledge was equal between the two groups (*p*-value=0.19). Post-test score comparison showed that experimental group scored significantly higher marks as compared to the controls (*p*-value=0.001 for post-test I and 0.02 for post-test II).

Conclusion: Level of understanding of student increases if they are shown computer based animations during the physiology lectures. Hence, animations have positive effect on student's academic performance.

Keywords: Animations, Learning, Medical education, Teaching.

INTRODUCTION

Physiology is a subject that deals with functioning of the human body. Many of the processes taught to medical students are dynamic in nature like physiologic mechanisms. Complexities of these dynamic processes and three-dimensional structure of body parts make comprehension difficult when presented verbally or through static graphics. By portraying the physiologic process in dynamic two or three dimensional imagery, computer based animations facilitate the deep understanding of the topic and lead to long term retention of the subject matter[1]. Explicit visual cues lead to associative learning making retrieval of the information easy at later stage[2]. Computer based animations are one of the latest genre of computer assisted learning. Inclusion of computer based animations in the 'tool kit' of a teacher adds diversity to the teaching methodology. This is a step forward in the pursuit of 'holistic learning environment'[3]. Animations have the potential to serve both, affective domain and the cognitive domain of the learner. Stirring the affective domain, the animations engage the students by maintaining their interest, attention and motivation[4]. Attention gaining, the first step of Gagne's nine events of instruction, provides an obvious rationale for the use of computer animations[5]. With the advancement of technology, computer based animations are designed in line with cognitive processes of the brain to obtain their full educational potential. In this role, animations support students' cognitive domain that ultimately results in clear understanding of the complex mechanistic process[6]. A disadvantage that is commonly attributed to computer based animations is that the animations consume a lot of time and also act as distracters. Evidence suggests that students get frustrated when the

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animations do not run properly or when there are audio or video related problems due to the lack of technical expertise on the part of teacher[7].

Many studies have been carried out to evaluate the effects of computer based animations but with contrasting results. Attributes of the animation and the subject taught are the two key elements which determine how beneficial the animations could be in the learning process[8]. There are multiple factors pertaining to computer based animations which are the basis of conflicting opinions regarding their effect on learning. Some of the most important factors are, how well the animation is professionally and technically designed, quality of the animated video graphics, quality of the audio, excessively high or slow frame rate (frames per second) and whether the interface is interactive or simple non-interactive[9]. These factors should be focused upon not only to get maximum benefit of the computer based animations but also to obtain comparable results from the different research studies. Due to this, findings of the previous researchers differ and their conclusions exhibit a wide range of divergence. Hence, it is not possible to generalize their results on one common scale or staunchly state the superiority of computer based animations over static graphics. Disciplines for which the computer based animations are used also had profound effect on determining the value of animations for learning purposes. Animations seem to be most effective for the disciplines which involve learning of dynamic processes, like Physiology[10]. Studies conducted by Schnotz et al and Kantor, revealed that animations have no superior edge over static graphics in learning process whereas many other studies reported the opposing results[11]. Due to the conflicting findings of various studies, the real effect of computer based animations on learning process is still uncertain. The present study was planned to find out the effect of computer based animations on learning of Physiology. Results of the study will help teachers in deciding whether they should include the computer based animations in their lectures or not.

MATERIAL AND METHODS

This randomized control trial was conducted at Army Medical College, Rawalpindi from January to September 2016 after getting formal approval from Ethical Review Committee of the institution. Written informed consent was also obtained from all the participants involved in the study. Sample size was calculated using "G Power 3.1.9.2" software. By keeping the values of effect size (d), alpha error probability and power (1-Beta error probability) as 0.7, 0.05 and 0.80, a sample size of 52 was calculated, however, a sample size of 60 was used in the present study. Sixty students of first year MBBS class were selected through simple random sampling which were then randomly assigned into two groups of 30 students each; experimental (group I) and control (group II). Random sampling and random assignment was achieved through statistical software SPSS. Data collection tool was single best type multiple choice questions covering C2, C3 and C4 levels of Bloom's Taxonomy[12]. The MCQs were vetted by a medical educationist to assess their soundness in technical terms. Validity of MCQs were confirmed by a subject specialist whereas reliability was adjusted through pilot testing and using SPSS. Medical animations from McGraw Hill Company were used in the project.

A pre-test was given to both the groups to assess their basal level of knowledge. After this, the first teaching session was started whereby experimental group (group I) was taught Physiology of Cardiovascular System with animations whereas control group (group II) was taught the same topics by the same teacher without animations. One-hour interactive lecture using power point presentation was used. Both the groups were shown pictures, flow charts and written slides. Exactly the same pattern of information transfer was used in the two groups except the use of computer animations. Computer animations explaining the mechanisms of physiological processes were shown to

experimental group only. At the end of teaching session, both the groups were given MCQ test (post-test I).

For crossing over a new teaching session was started whereby previously control group, group II (now experimental) was taught Physiology of respiratory system with the help of animations but previously experimental group, group I (now control) was taught same topics by the same teacher without the animations. At the end of second teaching session both the groups were again given MCQ test (post-test II). Teaching protocol in both the sessions was exactly similar in both the groups with only difference of computer animations.

Data were analysed using SPSS version 23. Frequency and percentage were calculated for categorical variables like gender whereas mean and standard deviation were calculated for numerical variables like exam scores. Independent students' t test was used to compare scores between the two groups at an alpha level of 0.05.

RESULTS

Out of 60 participants, there were 20 (33.3%) male and 40 (66.7%) female students with mean age of 18.92 ± 0.56 years. Mean age of group I was 18.80 years whereas that of group II was 19 years and the difference in mean age of the two groups was statistically insignificant (p-value=0.22).

group) and group II (control group) is significant at p-value of 0.001. Comparison of post-test scores (post test II) after crossing over, between group II (experimental group) and group I (control group) is significant at p-value of 0.02.

In fig comparisons of pre-test, post-test I and post-test II scores between the two groups are shown graphically as bar charts. Error bars represent one standard deviation.

DISCUSSION

Results of our study showed that group of students that was taught with the help of computer based animations scored significantly higher marks as compared to the other group that was taught without the animations. Pre-test ensured that both the groups were at same level of basal knowledge before starting the intervention. Although there are controversies in the literature about effectiveness of animations, however, a number of studies support the results of our study. Mtebe J and his colleagues carried out a study to determine the role of animations in teaching[13]. They employed a pragmatic approach to inquiry involving quantitative as well as qualitative methods. Their study reported that students who were taught with computer based animations performed better as compared to those who were taught without the animations. They further reported that 71% of their participants agreed that animations were useful

Table: Comparison of mean test scores between the two study groups.

Group I (n=30) (mean ± SD)	Group II (n=30) (mean ± SD)	*p*-value
Before teaching session		
31.62 ± 5.65	33.42 ± 4.13	0.19
Post-test I		
44.08 ± 3.37	41.15 ± 2.83	0.001*
Post-test II		
41.77 ± 3.80	38.54 ± 6.23	0.02*

p-value <0.05 hence significant

Comparison of test scores between the two groups is shown in table. The difference between the two means of pre-test scores is insignificant at *p*-value of 0.19. Comparison of post-test scores (post-test I) between group I (experimental

in enhancing student's understanding about the topics involving complex processes. Likewise, Printer R and his coworkers conducted a randomized control trial to find out the effect of animations on learning[14]. They divided the

students into experimental and control groups. The two groups underwent teaching sessions whereby the experimental group received 'teaching intervention' through animations. The pos-test given to the two groups showed that experimental group performed significantly better than the control group.

Barak M and his colleagues carried out a quantitative pre-test/post-test design study to evaluate the effect of animations on student's thinking and motivation[15]. Their findings showed that animations promoted student's explanation ability and their understanding of scientific concepts. They also reported that students who studied with animations developed higher motivation to learn in terms of self-efficacy,

tool depends upon multiple factors; some related to the animations whereas others related to the subject matter being taught[17]. Animations are most valuable as teaching/ learning tool for complex topics which involve deep understanding pertaining to three dimensional structures[18]. In current study, we selected such topics for which animations could be of maximum benefit for the students. For simple topics, there may not be much difference in learning with or without animations. Yue et al performed an analysis of medical animations by applying cognitive theory of multimedia learning[19]. They concluded that most of the medical animations did not follow recommended multimedia learning principles, particularly those that support the management of essential
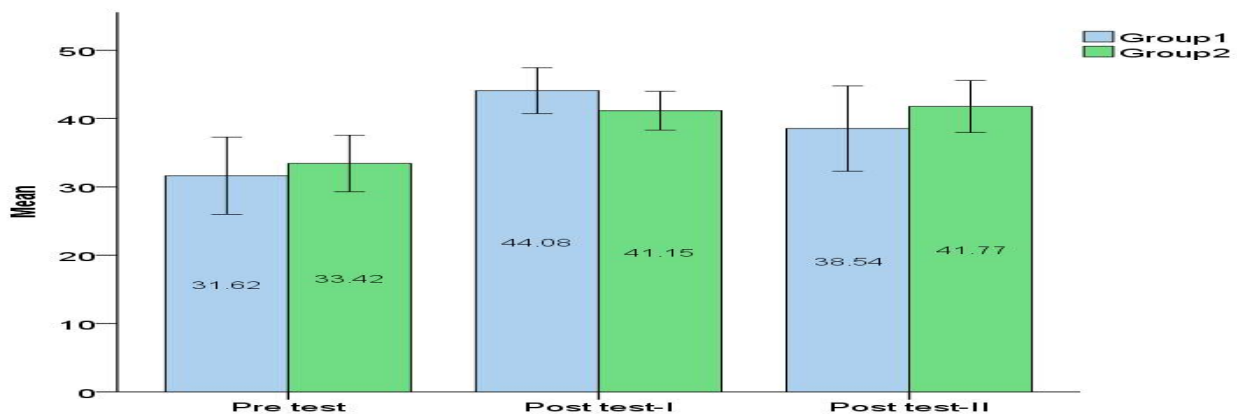

Figure: Bar charts showing comparison of test scores obtained between the two study groups.

interest and enjoyment, connection to daily life and importance to their future as compared to the control students. They also advocated that while learning from animations, students use all the three learning styles i.e. visual, auditory and kinesthetic which lead to better understanding of the subject matter.

Urooj et al carried out a study to compare animation based learning with chalk and board based learning[16]. Results of their study contrast with those of ours whereby she reported animation based learning as boring and not liked by students. The differing results may be due to the fact that use of animations in teaching is a tricky affair. Efficacy of animations as a learning

processing. They reported that in such conditions there is an excess of extraneous visual and auditory elements and a few opportunities for leaner interactivity. They recommended that medical animations should be developed in line with cognitive theory of multimedia learning. Findings of these studies are consistent with the results of our study showing importance of animations in learning. Sample size of our study was small hence it is not appropriate to generalize the results on to the general population, however the results prompt that a study with larger sample size covering wider subject area is required to be carried out to have higher internal and external validity. It is also recommended that such studies for other subjects

should also be carried out to see the effects of animations on learning of subjects other than Physiology.

CONCLUSION

Considering results of the present study, it is concluded that student's understanding of Physiology increases if they are shown computer based animations during the lectures. Hence, animations have positive effect on student's academic performance.

As the adage goes 'a picture is worth a thousand words' similarly it can be said that an animation is worth a thousand pictures'. However, there are multiple factors which can make their use in teaching and learning useful or useless. All the medical educationists need to be cognizant of these factors if they wish to include this modern teaching tool in their toolkit.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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