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Effectiveness of multimedia-based program in developing experimental skills among prospective teachers in biological science

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Abstract
It is claimed that 21st Century belongs to "Biology". Therefore, biologists of this century are expected to contribute extensively to the generation and synthesis of new knowledges and innovations for the welfare of the society. Prerequisites for this are, with relevant teaching and laboratory works in biology, make a revolutionary change in the field of new innovations. Effective lab works will depend on how well school management motivates teachers to actively involved in lab works. Promoting pre-service science teachers' experimentation competency is required to provide a basis for meaningful learning through experiments in schools. The cognitive, affective and psychomotor function of doing experiments or practical work is to enable the Biology students learn the concepts and facts by hands- on experience, either by illustration or verification or observation. This study aims to find out the effectiveness of developed multimedia-based experiments in developing laboratory skills among prospective teachers. The findings revealed that the developed multimedia content is effective and can be applied as an alternative for wet laboratory experiments.
Index Terms—Biological science, Experimental skills, Multimedia, Prospective teachers

Keywords: prospective, Extensively, generation, synthesis, involved

1. Introduction
Science as a subject differs from all other subjects in that it cannot and should not be taught as facts. It should be taught through a process of experimentation and investigation wherein students are encouraged to do experiments and are guided in their investigations leading them to understand the facts. The learning process of science should be given more importance than the outcome. Theory and practical should not be mutually exclusive. Practical work gives students the opportunity to learn and practice the type of activities involved in working as scientists [11]. Laboratory exercises and experiments offer a sensory as well as an intellectual experience and students develop a sense of personal discovery which stimulates intellectual curiosity [8].

Role of Multimedia in Biology Experiments
Effectiveness of computer simulation in science education is getting more attention among the scientific community, since many laboratory experiments take time and cost. During experiments, students need to wait the results of experiment, but they seem to waste their time. Also, experimental equipment are highly expensive, that is problem for economically poor school, in developing and under developed countries. For instance, generally a computer-simulated experiment can take 40 minutes but hands-on experiment can be finished between 140 and 160 minutes. However, simulation provides students to understand lecture concepts and finish experiments in great speed and ease. Remaining time could be used to interpret data and draw graphs. While students do experiments with computer, they can receive immediate feedback. Also, students using computer simulations have opportunities for reinforce practice without having teacher spending extra time to prepare supportive materials.

B. Interactive Video disc in Biology Experiments
Video technology, as an offshoot of TV technology, found an important niche in the Experimental Biology work, because of the possibilities it offers with audio-visual stimulation it provides. Videodiscs are optical discs that store sound, motion pictures, and still pictures. With a videodisc, the information is not read by the computer. The computer functions only as a controller for the videodisc player, accessing and playing the required frames. "Interactive" refers to the user's ability to react to the computer or videodisc player through a command and have the system respond either negatively or positively. This may be as simple as a user striking the wrong key and having a computer correct the user, or a user telling a videodisc player to go in a certain direction in a simulation.

Review of Related studies
Dewhurst D. G, *et al*. (1994) carried a study entitled "Comparison of a Computer Simulation Program and a Traditional Laboratory Practical Class for Teaching the Principles of Intestinal Absorption". The study describe an evaluation of the effectiveness, compared with a traditional laboratory, of an interactive computer-assisted learning (CAL) program, which simulates a series of experiments performed using isolated, exerted sacs of rat small intestine. The program is aimed at undergraduate students of physiology and is designed to offer an alternative student-centered learning approach to the traditional laboratory-based practical class. It was found that the knowledge gain of both groups of students was the same, that students had a positive attitude toward using CAL programs of this type, and that the cost of the conventional laboratory-based approach was five times greater.
Harry R. Goldberg, Renee Dintzis (2007) carried a study

entitled "The positive impact of team-based virtual microscopy on student learning in physiology and histology". This study assessed the educational effectiveness of team-based learning, asynchronous content distribution, and virtual microscopy in the first-year Histology course at The Johns Hopkins School of Medicine. Many components of this study led to improved test scores: virtual slides, team-based learning environments, increased faculty/student contact time, standardization of content, and increased student participation in class
and at home. Virtual microscopy was the learning component that made the other phases of the course possible.

Need and Significance of the Study

Laboratory-based learning allows students to experience bioscience principles first hand. Prospective science teachers in general showed deficiencies in scientific inquiry [1]. This gap between lack of scientific inquiries on one hand and pre-service science teachers' deficiencies on the other must be bridged by science teacher preparation by promoting experimentation competency. Scientific experiments in school, however, frequently tends to resemble more like a "cookbook" comprising simply of "hands-on" activities rather than inquiry-based, "mind-on" activities [5]. Minner *et al*., [10] established that inquiry instruction emphasizing students' own active thinking during scientific investigation are more likely to increase students' understanding of science concepts.

One of the most effective ways of persuading prospective biology teachers of the value of alternatives is to demonstrate how they can be used and to present evidence in a form relevant to them of their educational effectiveness. The key is the closeness of relation between the educational requirements, the context in which the alternative is to be used, and the choice of the medium such as computer or video. A number of studies have been conducted to measure the educational effectiveness of computer-based alternatives by comparing learning outcomes of those with traditional animal labs.

So, the teachers of Biology should think of the Paradigm shift in the Biology experiments and laboratory works. Dissection experiments based on computer simulations are gradually popular in all Biology lab works. The technological advancement in the field of computer and allied areas yielded multimedia computer program which gradually replacing the laboratory experiments. Computer simulation and virtual laboratory practical provide the real-world experimental feeling to the Biology learners.

Objectives of the Study

1. To develop an interactive multimedia based biology experiments in the respective subject.
2. To find out the impact of developed multimedia based experiments among prospective biology teachers.
3. To find out the difference between male and female biology prospective teachers in developing the Experimental skills using the developed multimedia based program.
4. To find out the difference between undergraduate and post graduate biology prospective teachers in developing the Experimental skills using the developed multimedia based program

Hypotheses of the Study

1. There exists a significant difference between the pre-test and posttest mean scores of the prospective biology teachers in developing the experimental skills through multimedia based biology experimental program.
2. There exists a significant difference between the male and female prospective biology teachers in developing the experimental skills through multimedia based biology experimental program.
3. There exists a significant difference between the Undergraduates and post graduate prospective biology teachers in developing the experimental skills through multimedia based biology experimental program.

Methodology Adopted for the Study

Parallel Group Experimental Research Design

The sample of the study is divided into two groups, viz, Experimental Group and Control Group. Both the groups were equal for the variables under study. The groupings were done based on their age and thus formed a homogenous group. The experimental group was taught with an interactive multimedia-based biology experiments and the control group by the conventional method. After the treatment period, effect of the program was analysed.

Sample used for the study

Sample consists of 50 B.Ed students (Prospective Biology Teachers), of which 22 are males and 28 are females

V. Tools used for the Study

Development of the Multimedia Programs for Physiology Experiments

The multimedia program was developed based on physiology experiments, that were conducted in the laboratory and have been recorded with the help of experts. The multimedia experiments presented in the study were created by the researcher himself. The video tapes were cut, edited, spliced and prepared for presentation using the Windows Movie Maker program.

Administration of Experimental Procedure

PRE-TEST

Pretest was administered to the experimental group and control group consisting of basic Physiology Experiments to assess the entry level behavior of the learners. The pretest was conducted in the laboratory by performing the physiology experiments by the students through traditional method. The performance was evaluated using the developed experimental skill assessment scale in the form of five-point likert scale.

Treatment of The Experimental Group

Administration of Multimedia Program

The students were taught through multimedia-based program for a period of five working days, at the rate of one hour per day. The students were asked to self-study with the help of computer-based multimedia courseware. The students were not allowed to use any handbook regarding the experiments. For conducting the experiments, the computer laboratory in Government College of Education, Pudukottai was used. Since, multimedia courseware had a motivating quality of its own, due to the provisions for interaction by students; the learners were very much attracted to it. The provision to obtain result, immediate

feedback and reinforcement in the program made their learning exciting and pleasant. At the end of the treatment posttest was administered.

POST TEST

Post-test was administered to the experimental group and control group. After exposure to the multimedia-based program to the experimental group, the performance was assessed.

Likewise, the control group performance was also assessed through traditional laboratory work. The assessment was made using the five-point scale developed by the researcher to evaluate the performance of the experimental skills in Biology.

Evaluation format for Pretest Tool

The pretest tool consists of statements regarding the Physiology experimental skills which depict the required area of experimental procedures, ability to perform the experiments etc., in the form of 5 point scale.

Evaluation format for Post-test Tool

The same pre-test tool was used to find out the acquired experimental skills by the students

Statistical Techniques Adopted for the Study

The differential analysis techniques were used for analyzing the data as per the objectives of the study.

Analysis and Interpretation of Results

Table 1: Mean scores of control group compared with that of Experimental group in the pre-test in developing experimental skill among prospective teachers in Biological science through Traditional method

Group	N	Mean	SD	t	Level of significance
Control	25	32.28	1.90	0.14	NS (2.01)
Experimental	25	32.2	1.97		

Statistically it is clear that there is no significant difference between the mean scores of pre-test and post-test. This proves that both experimental and control group students are identical in nature.

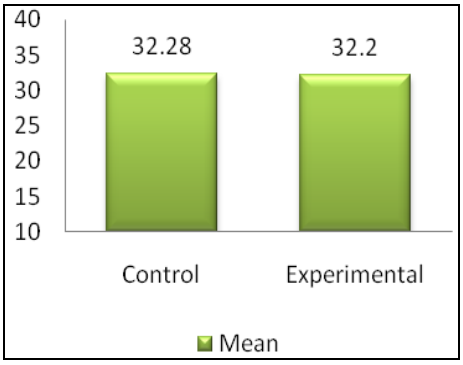

Fig 2: shows Mean scores of control group compared with that of Experimental group in the pre-test in developing experimental skill among prospective teachers in Biological science through Traditional method

Table 2: Mean scores of control group compared with that of Experimental group in the post test in developing experimental skill among prospective teachers in Biological science through Multimedia based program

Group	N	Mean	SD	t	Level of significance
Control	25	36.92	1.86	6.87	S (2.01)
Experimental	25	42.6	3.68		

It is very clear from the table –2 that there is a significant difference between control group and experimental group in developing experimental skills in Biology through multimedia-based program with regard to their post-test. This shows that the developed multimedia based experimental program has an impact on developing experimental skills among prospective teachers in experimental group.

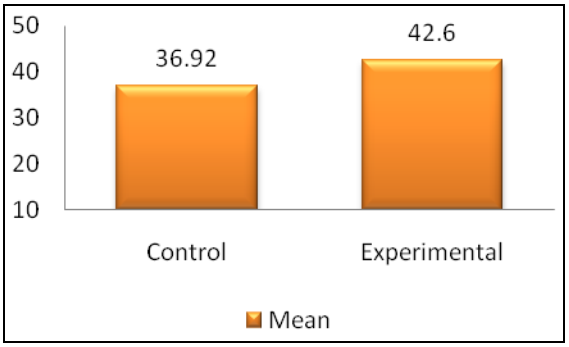

Fig 3: shows Mean scores of control group compared with that of Experimental group in the post test in developing experimental skill among prospective teachers in Biological science through Multimedia based program

Table 3: Showing the gender wise comparison of the post-test mean scores of the effectiveness of multimedia program in developing experimental skill among prospective teachers in Biological science

Gender	N	Mean	SD	t	Level of significance
Male	11	43.36	3.50	0.91	NS (2.06)
Female	14	42	3.84		

It is inferred from the above table that there is no significant difference between the male and female prospective teachers in developing experimental skills in biology through multimedia-based program with regard to their post-test.

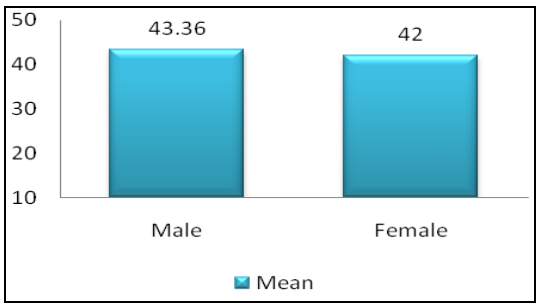

Fig 4: Showing the gender wise comparison of the post-test mean scores of the effectiveness of multimedia program in developing experimental skill among prospective teachers in Biological science

Table 4: Showing the qualification wise comparison of the post-test mean scores of the effectiveness of multimedia program in developing experimental skill among prospective teachers

Qualification	N	Mean	SD	t	Level of significance
UG	10	39	2.58	6.72	2.06
PG	15	45	1.88		

It is inferred from the above table that there is significant difference between the undergraduate and postgraduate prospective teachers in developing experimental skills in biology through multimedia-based program with regard to their post-test.

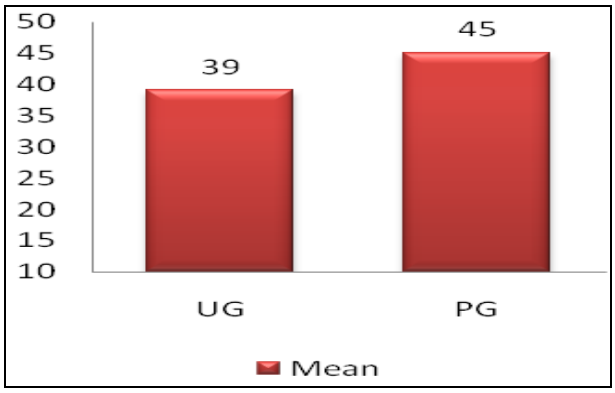

Fig 5: Showing the qualification wise comparison of the post-test mean scores of the effectiveness of multimedia program in developing experimental skill among prospective teachers

Discussion

The present study found out that the developed multimedia-based program was highly effective in developing the laboratory experimental skills in Biology. This was supported by many research studies conducted in Multimedia based program by researchers, such as. Tatli, & Ayas [13], revealed through their study that virtual chemistry laboratory software is effective as the real laboratory, both in terms of student achievement in the unit and students' ability to recognize laboratory equipment. Akpan, and Strayer [2] in their study indicated that students receiving Simulation before Dissection, the simulated dissection group significantly outperformed the conventional dissection group on the posttest. Cengiz Tuysuz [3] identified that the use of virtual lab increased students' achievement levels and made a positive impact on students' attitudes towards chemistry.

The paper in Karen Croker *et al*., [8] found that Digital video guides enhanced the students' learning experience, enabled students to become more autonomous and efficient learners in the laboratory. Mukesh *et al*., [12] emphasizes the value of CAL in development of experimental skills and understanding of theoretical concepts and thinks that computer simulation is the best alternative to laboratory practical in pharmacology Experiments. Vinayak *et al*., [14] concluded that Video demonstration can be a useful alternative to live experimentation for learning experimental physiology in M.B.B.S. students. Sasikala. M (2014) in her study revealed that use of multimedia package enhance student's achievement. The paper in Ravichandran *et al*. (2014) found that the developed video programme has made positive impact in developing Biology experimental skills among prospective Teachers.

The paper from James et.al., [7] showed that students completed virtual dissections had higher learning (posttest) scores, indicating that they learned more than those performed physical dissections. The paper in Dewhurst et.al., [4] suggest that the benefits of computer-based simulation materials are that they offer a large amount of supporting and reinforcing information, and that students are able to work at their own pace.

Conclusion

This study helps the Biology teachers to understand the effectiveness of multimedia based instructional program and the necessity of multimedia application in Biology experiments as an alternative and cost-effective method. The findings of the study are useful for educational planning and could be helpful for educators and curriculum framers to develop and utilize this type of packages for other areas. In addition, the skills required for various competencies in Biology can be easily developed and retained for longer time through this developed multimedia-based Biology experimental program among students and teachers.

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