

Effectiveness of Multimedia Presentations in Acquisition of Biological Concepts

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Abstract

The study was undertaken to investigate the effectiveness of Multimedia Presentations as a teaching strategy in acquisition of concepts in Biology. A sample of 120 class IX students (60 Girls and 60 Boys) was randomly selected from two secondary schools purposively situated in the Union Territory of Chandigarh where computer facilities were available. Multimedia Presentations in selected topics of Biology were developed by the investigators. The experimental study was based on pre-test/post-test design. The students were divided into two groups randomly: experimental group taught with the use of Multimedia Presentations (MMP) and control group taught through Lecture Method (LM); each group consisting 60 students (30 Girls and 30 Boys). An achievement test, to measure the acquisition of Biological concepts was constructed by the investigators. The results revealed that the achievement of MMP group was significantly higher than the group taught through Lecture Method ($F= 105.994$, $p= .0001$). Both girls and boys taught through MMP achieved significantly higher than those taught with LM. Girls and boys were not found to differ significantly in acquisition of biological concepts. However, interaction between Instructional Strategies and gender was found to be significant $F=5.586$, $p =.020$). It was found that in MMP group, boys outperformed girls (Mean Scores Boys=35.47; Girls=30.5, t -ratio=3.258) whereas in LM group, girls achieved higher than boys (Mean Scores Girls=26.33; Boys=22.43, t -ratio=2.819).

Key Words: Achievement, Acquisition, Biological Concepts, Multimedia Presentations, Lecture Method

1.1 Introduction

Fast pace of advancements in technology have also brought dynamic changes in classroom interactions all over the world. With the integration of multimedia technology, old and conventional teacher centred or subject centred methods are rapidly being replaced by student centred instructional designs and practices that can cater to new emerging needs of learners thus providing facilitative classroom environment for effective learning.

Instruction through Multimedia is finding a prominent place in the classrooms world over. Multimedia, as defined by Neo and Neo (2001), is the combination of various digital media types, such as text, images, sound, and video, into an integrated multisensory interactive application or presentation to convey a message or information to an audience.



Conventional methods of classroom teaching are found to be generally monotonous, abstruse and less participative thus are often unable to arouse curiosity and interest of learners especially in Science subjects like Biology. Mayer (2001) suggested that students learn at a higher level from well-designed multimedia presentations than from traditional verbal or text only presentations. Imparting instruction through Multimedia Presentations offers remarkable opportunities in acquisition of biological concepts as it allows the educator to present more information, examples, illustrations, and problems for students to solve than the conventional instructional method. It also facilitates a user to seek information and construct knowledge in a variety of ways, and it frequently relies on problem solving as a basis for understanding—using images and video of real world experiences to help illustrate abstract principles and concepts.

Multimedia is becoming an important tool for faculty in the biological sciences as it has the potential of providing novel learning environments and pedagogy applications to foster student interest, involved students in the research process, advance critical thinking/problem-solving skills, and developed conceptual understanding of biological topics (Bockholt et al. 2003); provides meaningful connections between text and graphics that potentially allow for deeper understanding and better mental models than from either alone. (Mayer,2003); can incorporate 3-D visualization of many biological and biochemical structures as well as more interactive animations of the processes, which can substantially enhance the understanding of learners of biological concepts (Stith, 2004). Well-designed multimedia helps learners build more accurate and effective mental models than they do from text alone (Shank 2005).

Research findings of many recent studies have indicated that the use of Multimedia in classroom teaching improved learning and retention of material presented and students performed better than the ones taught through conventional method in many subjects including English (Sharma, 2013), Biology (Satyaprakasha & Sudhanshu, 2014; Singh, 2010 & Udayakumar 2013), Science (Krishnakumar 2013; Owolabi & Oginni,2014) and Physics (Erdemir 2011).

Research studies conducted to investigate the effect of gender difference on acquisition of Biological concepts have shown mixed results: in life science, girls perform better than boys (TIMSS, 1994-1995); girls perform significantly better than boys on a test of errors in biological labelling (Soyibo, 1999); both boys and girls are found to be equal with respect to achievement and attitude toward Biology (Sungur & Tekkaya, 2003). Though there are ample research studies to acknowledge the effectiveness of instructing various subjects through multimedia presentation, its effectiveness in the acquisition of Biological concepts especially in relation to gender needs further examination Also the studies about the interaction among teaching strategies and gender are found to be inconclusive which persuaded the investigators to take up this study.

1.2 Statement of the Problem



EFFECTIVENESS OF MULTIMEDIA PRESENTATIONS IN ACQUISITION OF BIOLOGICAL CONCEPTS: AN EXPERIMENTAL STUDY

1.3 Objectives of the Study

The study was undertaken keeping in view the following objectives:

1. To develop Multimedia Presentations on various biological concepts.
2. To compare the effects of Multimedia Presentations and Lecture Method in acquisition of biological concepts.
3. To study whether gender accounts for differential achievement in acquisition of biological concepts.
4. To study whether there is a significant interaction between gender and two instructional strategies.

1.4 Hypotheses

The study was conducted to test the following hypotheses:

1. There is no significant difference between mean achievement scores of students exposed to two instructional strategies: Multimedia presentations and Lecture method
2. Gender does not account for differential achievement in learning of Biological Concepts, irrespective of instructional strategies.
3. There is no significant interaction between instructional strategies and gender.

1.5 Delimitation

1. The study was delimited to 120 class IX science students of CBSE affiliated English medium schools of Chandigarh.
2. The study was also delimited to selected topics of Biology.

1.6 Research Method:

a) Method

The experiment was based on pre-test, post-test 2x2 factorial design and was conducted on two groups of students, the one imparted instruction with Multimedia Presentations (MMP) formed the experimental group whereas the other taught with traditional Lecture Method (LM) was taken as control group. The classifying variable taken was gender. The post-test achievement scores of both the groups were subjected to statistical treatment and conclusions were drawn on the basis of descriptive and inferential statistics.

b) Sample

A sample of 120 students (boys and girls 60 each) of 13-15 years of age studying in class IX at two secondary schools situated in the Union Territory of Chandigarh was selected by employing randomized sampling technique. The students were divided into two groups randomly: each group consisting 60 students (30 boys and 30 girls). The experimental group was imparted instruction with the use of MMP while the other group was taught through Lecture Method. A sample of 10 Biology teachers/experts was also chosen for validation of MMP package. Another sample of 10 students studying in different schools



of Chandigarh was also given MMP package on individual basis for validation. An additional sample of 120 students was chosen for validation of Achievement Test (50 students for item analysis and 70 students for test re-test reliability).

c) Tools Used

The following techniques and tests were used for collecting data during the study.

1. An Achievement test in selected topics of Biology was developed and standardized by the investigators to measure the performance of students before and after the treatment.
2. MMP package in selected topics in Biology topics was developed by the investigators.
3. Lesson plans of the same topics for lecture method teaching strategy were also prepared by the investigators.

d) Procedure

The study was conducted in four phases:

- In phase I, MMP package and lesson plans for lecture presentation and Achievement test to were developed.
- In phase II, Achievement pre-test based on selected topics in biology of class IX was administered.
- In phase III, both groups were given instruction. Students of experimental group were taught through MMP whereas the students of control group were taught by Lecture Method. The contact period was one month in each case.
- In phase IV, the Achievement post-test (the same one used as pre-test) in selected topics of Biology was administered to the students of both groups.

1.7 Statistical Analysis of Data

Descriptive statistics such as Mean and Standard deviation were computed to know the normal distribution. Analysis of Variance (ANOVA) and t-test were computed to test the hypotheses by finding out the main effects and interaction between the independent variables.

Before Experiment

Table 1 Comparison of pre-test scores of Experimental and Control groups

Group	N	Pre-Test Scores			Level of Significance
		Mean	SD	t-Value	
Control (LM)	60	7.35	1.830	0.5907	NS
Experimental (MMP)	60	7.60	2.720		

Table 1 reveals that there are no statistically-significant differences between the experimental and control groups in the pre test which indicates the equivalence of the two groups (calculated t value is less than table value **1.658** at the significance level of 0.05).

Table 2: Summary of Descriptive Statistics

Gender	Instructional	N	Pre-Test Scores	Post-Test Scores
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	Method		Mean	S.D.	Mean	S.D.
Girls	MMP	30	7.80	2.894	34.50	6.569
	LM	30	7.77	1.888	26.33	5.738
	Total	60	7.78	2.894	30.42	7.372
Boys	MMP	30	7.40	2.568	35.47	5.164
	LM	30	6.93	1.701	22.43	4.946
	Total	60	7.17	2.172	28.95	8.266
Total	MMP	60	7.60	2.720	34.98	5.879
	LM	60	7.35	1.830	24.38	5.663
	Total	120	7.48	2.312	29.68	7.833

MMP=Multimedia Presentations LM=Lecture Method

Interpretation: The mean scores of MMP group (34.98) were found to be higher than LM group (24.38). The mean scores of girls (30.42) were found to be higher than boys (28.95). To determine whether the differences in the mean scores were significant or not, data were subjected to inferential statistics. F-values and t-ratios were calculated in respect of achievement scores by applying two way ANOVA and t-test respectively by using SPSS software.

Table 2: Summary of Analysis of Variance (2x2) on Post-Test Achievement Scores

Source of Variance	Df	Sum of Squares	Mean Squares	F-ratios	Significance
Instructional Method (A)	1	3370.800	3370.800	105.994	S**(p value=.0001)
Gender (B)	1	64.533	64.533	2.029	NS (p value=.157)
A x B	1	177.633	177.633	5.586	S* (p value=.020)
Total Error With Treatment	116	3689.000	31.802		
Total	119	7301.967	3644.768		

S**-Significant at 0.01; S*-Significant at 0.05; NS-Not Significant

Interpretation & Discussion

• Main Effect of Instructional strategies

The main effect of instructional strategies viz. Multimedia Presentations (MMP) and Lecture Method (LM) based on ANOVA was found to be significant. The F-ratio of 105.994 (Table 2) was found to be significant at 0.01 level (1/1119 df). Consequently the difference among mean of two groups (MMP=34.98 and LM=24.38) could not be attributed to sampling error or chance factor. The p value 0.001 (Table 2) which is less than 0.05 further strengthens the evidence in favour of the same result. Thus, the null hypothesis that there is no significant difference between mean Post-test achievement scores of students taught through two instructional strategies i.e., Multimedia Presentations and Lecture Method is not retained, thus accepting the alternative hypothesis.



The difference between the achievement post-test scores of students taught through two teaching strategies was also tested for significance within pairs of groups through t-test. The results are shown in Table 3.

Table 3: t-Ratio between Instructional Strategies with regard to Achievement Post-Test Scores

Groups	N	Mean	SD	t-ratio	
MMP	60	34.98	5.879	10.0586	Significant at .01 level
LM	60	24.38	5.663		

The t- ratio 10.0586 (Table 3) between groups taught through MMP and Lecture Method for Achievement Post-test Scores were found to be significant at .01 level (Table value 2.358). Thus, it is concluded that students taught through MMP achieved significantly higher than the students taught Lecture Method. These findings are in agreement with findings of Satyaprakasha & Sudhanshu, 2014; Singh (2010) & Udayakumar (2013) in Biology, Krishnakumar (2013) & Owolabi & Oginni (2014) in Science and Erdemir (2011) in Physics.

These findings can be attributed to the reason that the combined use of various tools in MMP stimulates multiple sensory organs of learners simultaneously resulting into enhanced comprehension especially of dynamic processes of Biology.

- **Main Effect of Gender**

The F value of 2.209 (Table 2) was not found to be significant at 0.05 level (1/119 df). Though girls (mean achievement score=30.42) outscored boys (mean achievement score=28.95), the p value 0.157 (Table 2) which is more than 0.05 depicts no significant difference in their performance. So, the null hypothesis that there is no significant difference between the mean achievement of girls and boys, irrespective of instructional strategies, is accepted.

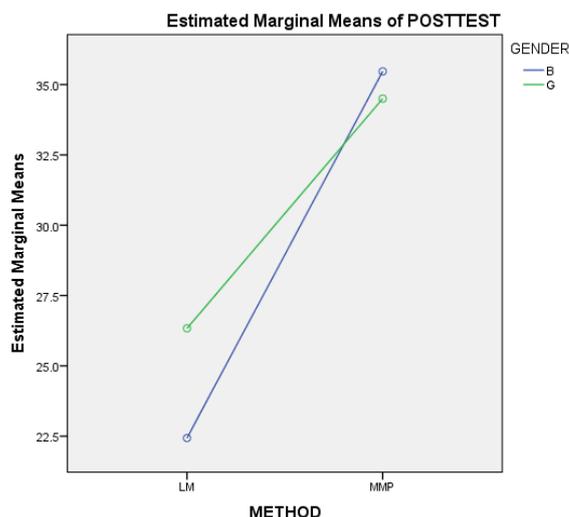
Similarity in the achievement scores of girls and boys may be attributed to the changing socio-cultural environment which has widened the scope for equal educational opportunities for them. Education systems have made significant strides towards closing the gender gap in educational attainment in recent decades (OECD, 2001a). Findings of the present study are supported by many other studies which revealed no statistically significant mean difference between boys and girls with respect to achievement and attitude toward biology (Soyibo, 1999; Sungur and Tekkaya, 2003).

- **Interaction between Instructional Strategies and Gender (AXB)**

The F value of 5.586 (Table 2), for the interaction between instructional strategies and gender, was found to be significant at 0.05 level (1/119df). This implied that girls and boys when exposed to different instructional strategies differed significantly in their mean

achievement. The difference between the means of various combinations cannot be attributed to sampling error or chance factor. The p value 0.02 (Table 2) which is less than 0.05 further strengthens the evidence in favour of the same result. Thus, the null hypothesis, “There will not be significant interaction between Instructional Strategies and Gender” is not retained. Interaction graph given in Figure 1 depict the same result.

Figure 1: Graph showing Interaction between Instructional Strategies and Gender



To further investigate the interaction between instructional strategies and gender within the groups, significance of difference between means of Post-test achievement scores was tested using t-test.

Table 4: t-Ratio between Instructional Strategies with regard to Post-test achievement score of Girls and Boys

Gender	Groups	N	Mean	SD	t-ratio	
Girls	MMP	30	30.50	6.569	2.556	Significant at .01 level
	LM	30	26.33	5.738		
Boys	MMP	30	35.47	5.164	9.989	Significant at .01 level
	LM	30	22.43	4.946		

t ratios of 2.556 and 9.989 (Table 4) between Post-test achievement scores of girls taught through MMP and LM and between Post-test achievement scores of boys taught through MMP and LM respectively were found to be significant at .01 level (Table value= 2.392; df=58). Both girls and boys taught through MMP achieved significantly higher than those taught with LM which is evident from mean scores shown in Table 4.

Table 5: t-Ratio between achievement score of Girls and Boys with regard to Instructional Strategies

Groups	Gender	N	Mean	SD	t-ratio	
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MMP	Girls	30	30.50	6.569	3.258	Significant at .01 level
	Boys	30	35.47	5.164		
LM	Girls	30	26.33	5.738	2.8198	Significant at .01 level
	Boys	30	22.43	4.946		

t ratios of 3.258 and 2.8198 (Table 5) between Post-test achievement scores of girls and boys taught through MMP and LM respectively were found to be significant at .01 level (Table value= 2.392; df=58). It is evident from mean scores that in MMP group boys outperformed girls (Boys=35.47; Girls=30.5) whereas in LM group, girls achieved higher than boys (Girls=26.33; Boys=22.43). Thus the null hypothesis that there is no significant interaction between instructional strategies and gender is not retained.

Higher performance of boys in MMP group and that of girls in LM group can be attributed to factors like differences of boys' and girls' attitude towards computer technology, their learning styles etc. Males generally have a more positive attitude toward computers, the primary medium for digital images, than females (Butler, 2000). Males are generally more sensitive to visual stimuli (i.e., graphics, images, charts, etc.) than females (Chanlin, & Chuang, 2001). Males showed a preference for applied learning styles whereas females opted for copious reading assignments, organised learning materials and instructors' knowledge, for learning (Keri, 2002). Males were found to be significantly more inclined to replace traditional teaching activities with ICT resources (Dorup, 2004). Male students prefer multimodal instruction whereas most female students prefer single mode instruction (Wehrwein, Lujan and DiCarlo 2007). However the higher performance of girls of MMP group over their counterparts in LM group can be credited to the combined use of various tools in MMP including those that are used in LM thus facilitating all students for enhanced acquisition of biological concepts by catering to their needs with varied attitudes and learning styles.

1.8 Findings and Conclusions

The following conclusions are drawn from the results of the present study:

- Students taught through Multimedia Presentations (MMP) were found to have achieved significantly higher in acquisition of Biological Concepts than through traditional Lecture Method (LM). Thus MMP proved to be superior instructional strategy over Lecture Method (LM) in the acquisition of biological concepts.
- Gender proved redundant in the acquisition of biological concepts.
- Interaction between Instructional Strategies and Gender on the achievement of students in the acquisition of biological concepts was found to be significant. Though both girls and boys taught with MMP were found to perform significantly better than Lecture Method, boys achieved significantly higher than girls in the group taught with MMP and girls outscored boys in the control group taught with Lecture Method.

1.9 Educational Implications



Findings of this study have wide implications in enhancing the effectiveness of instruction in Indian classrooms. Thoughtfully designed MMPs have immense potential of motivating learners by gaining their attention, increasing their perception, enhancing their comprehension skills as their use allows the educators to present more information, more examples, illustrations, and problems for students to solve than the conventional instructional method, thus facilitating their conceptual understanding of biological and other scientific concepts leading to greater achievement as compared to traditional methods of teaching not only in Biology but also in other Science subjects viz. Physics, Chemistry, General Science etc. The results of the study also point towards the prospective benefits of incorporating MMP in school curricula at all levels for which government should fund research projects to develop MMP packages in all school subjects, ensuring their distribution to all rural and urban schools of the country. Such projects can also be undertaken for higher levels of education with an aim to improve overall quality of education in our country.

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