RESEARCH PAPER | Geography | Volume : 2 | Issue : 1 | October 2012 | ISSN - 2249-555X

The Effect of Computer Animation in the Teaching of Chemistry at Higher Secondary level: An Experimental Study

KEYWORDS: Computer Animation, SPSS, Chemical Bonding, CAI, Chemistry Teaching

Dr. Bhim Chandra Mondal

Assistant Professor, Sponsored Teachers' Training College, Deshbandhu Road, Purulia-723101, West Bengaal, India

ABSTRACT *A study was conducted to measure the effect of computer animation on 10 + 2 level in relation to student's understanding for the unit chemical bonding. One experimental group and one control group were used for the study. While the control group was taught with traditional instruction, the experimental group received computer animated instruction. At first, entry level test was administered as pretest, then post-test and retention test were used to collect data. The results of the study indicated that while there is no statistically significant difference between groups in pre-test, but a significant difference in performance scores was observed in case of post-test and retention test, confirmed by paired group 't' value. The data was analyzed by using SPSS (Statistical Package for Social Science) -16 software.*

Introduction

With the ever advancing technology and the constant need to improve teaching practices, a course that could successfully put the two together efficiently would be very advantageous to not only the students but also the teacher. Most students today are more proficient with computers than their parents, but the computer is very seldom used in their studies. These computers are used not only as a means of helping them in analyze data, computers have become a pervasive tool toward optimizing their learning. Now-a-day computer programmers have been able to create some programs that have served to increase student learning by affecting cognitive processes and increasing motivation. Current research shows the mechanisms by which computer programs facilitate this learning are (1) personalizing information, (2) animating objects on the screen, (3) providing practice activities that incorporate challenges and curiosity, (4) providing a fantasy context and (5) providing learner with choice over his/her own learning.

Animations of molecular structure and dynamics are often used to help in understanding the abstract ideas of chemistry. It has various advantages like simplification, unlimited resolution and magnification, ability to highlight certain symbols within a complex background, control of motion, shape , or color change, and the stepwise fading in and out of symbols. With the help of this techniques student acquired the ability of explaining the particular concept, for example, Motion of electron around the nucleus. The animation of the objects increases learning by decreasing the cognitive load on the learner's memory thereby allowing the learner to perform search and recognition processes and to make more informational relationships (Reiber, 1991).

Nishino (1993) conducted a doctoral investigation which has special relevance to the present problem. In his experiment the control group received instruction based upon traditional science teaching while the experimental group received instruction using a multimedia computer-based science learning environment. It was found that students in the experimental group had a significantly higher post test mean score than the students in the control group.

Williamson, V. M, Abraham, M.R., (1995) conducted a study to explore the effect of computer animations depicting the particulate nature of matter on (n=400) college students' mental models and comprehension of chemical phenomena. They found that treatment groups received significantly higher conceptual understanding scores than did the control group.

Yang, E., Andre, T., Greenbowe, T. J. (2003) examined the impact of computer animations that illustrate chemical reactions occurring inside a battery on students, enrolled in a college introductory chemistry course. This study implied that instructor-guided animations may helped the student in understanding the targeted chemistry concepts.

Kelly, R. M.; Jones, L. L (2007) investigated how the features of two different styles of molecular-level animation affected students' explanations of sodium chloride dissolution in water. In small group sessions 18 college-level general chemistry students dissolved table salt in water, after which they individually viewed two animations of salt dissolution. Before and after viewing each animation the participants provided pictorial, written, and oral explanations of the process at the macroscopic and molecular levels. An analysis of the data showed that students incorporated some of the microscopic structural and functional features from the animations into their explanations. However, oral explanations revealed that in many cases, participants who drew or wrote correct explanations did not comprehend their meanings.

Chang, H.Y et al (2010) have investigated whether the understanding of the particulate nature of matter by students was improved by allowing them to design and evaluate molecular animations of chemical phenomena. They developed Chemation, a learner-centered animation tool, to allow seventh-grade students to construct flipbook-like simple animations to show molecular models and dynamic processes. The results indicate that designing animations coupled with peer evaluation is effective at improving student learning with instructional animation. On the other hand, the efficacy of allowing students to only design animations without peer evaluation is questionable compared with allowing students to view animations.

According to Fensman (1975) Concepts like bonding, structure, rate of reaction, and internal energy has implications regarding understanding the whole chemical process, mainly chemical reactions and chemical properties of substances. On the other hand, chemical reactions involve the breaking and forming of chemical bonds (Taber & Coll, 2002). Therefore, chemical bonding is a key concept in chemistry.

However, most of the researcher focused their study towards the teaching of chemistry at college level but it is very important to build their concepts of chemistry at 10+2 level. That is why investigators made a study at 10+2 level by using computer animation as research tool to ensure whether this tool is effective or not.

Objectives of the study

The purpose of the study can be stated in terms of some specific objectives, which are:

Volume : 2 | Issue : 1 | October 2012 | ISSN - 2249-555X

1. To develop an Entry Level Test to measure the prerequisites of learners for learning the unit 'Chemical Bonding' in Chemistry for class XI.
2. To develop the computer animation program with the help of expert persons for the unit 'Chemical Bonding' in Chemistry for class XI.
3. To develop and standardized Criterion Reference Tests for measuring immediate learning and retention on the unit Chemical Bonding'.
4. To perform the experiment in classroom and compare the effectiveness of the two instructional treatments on the criterion of immediate learning and retention.

Hypothesis
To facilitate the study, the following null hypothesis has been framed:
0H1: There is no significant difference between the means of criterion test scores from the two instructional treatment groups on the criterion of immediate learning.
0H2: There is no significant difference between the means of criterion test scores from the two instructional treatment groups on the criterion of retention.

Design of the study
Methodology:
Experimentation is an attempt to control all essential factors except a single variable which is manipulated in order to determine the effect of its manipulation.

Population:
Learners of class XI under West Bengal Council of Higher Secondary Education (WBCHSE) having Bengali as medium of instruction and possessing adequate understanding of English language, of the district of Birbhum in the state of West Bengal, India formed the population for the present study.

Sample:
As the experiment involving different instructional strategies are to be performed in school under controlled condition, the researcher preferred to treat the schools as the sampling unit and obtained a random sample of two boys' schools in the district of Birbhum, West Bengal India. The sample consists of 80 learners from class XI.

Instructional instruments:
(a) Computer software: In this study the investigators developed the computer animation programme with the help of an expert person on the unit 'chemical bonding' for class XI.

Identification of Variables:
(1) Independent variable: Instructional treatments
(2) Dependent variables: Tests scores obtained from entry level test (CRT 1), immediate learning (CRT 2) and retention (CRT 3).
(3) Intervening variables: (a) Socio-economic status, (b) Grade level, (c) Familiarity with content presented in the unit, (d) Teacher variable, (e) School variable, (f) Scholastic achievement in chemistry, (g) Learner variable , (h) Physical environment of the classroom, (i) Contamination effect. These variables are controlled following standard procedure.

Experimental design:
In this study 'randomized control group pre test post test design was selected for carrying the experiment. In this design, subjects are assigned to the experimental and control group by random procedures and administered a entry level test (CRT 1). The investigators introduce the treatment only to the experimental group for a specific period of time. At the end of the experiment, the experimental and control groups are administered the post test (CRT 2) as the measure of dependent variable. After the interval of 15 days another test (CRT 3) was administer to know about the retention of the content. The difference between means of scores of CRT 1, CRT 2 and CRT 3 are compared with the help of suitable statistical test in order to ascertain whether the experimental treatment produced a significant effect than the control condition.

Result and discussions
Analysis by descriptive statistics:
Within the framework of the problem concerning the relative effectiveness of the two instructional treatment, it is observed from Table 1 that the mean achievement scores of experimental group, designated as A1, (M=68.62, SD = 9.71) is slightly higher than that of mean scores of control group, designated as A2, (M = 66.60, SD=7.32) on the same criterion measure i.e. entry level test. It is also observed from the same table that mean scores are higher for experimental group than that of control group for the rest two criterions i.e. immediate learning and retention respectively. So, it is now necessary to examine whether this difference is real or apparent, for which inferential statistics has used.

Table 1 Mean and SD for achievement scores

	Experimental Group (A1)		Control Group (A2)	
	Mean	SD	Mean	SD
Entry level test (CRT 1)	68.62	9.71	66.30	7.32
CRT 2	74.22	9.90	66.60	8.51
CRT 3	63.45	8.90	45.67	6.23

Analysis by inferential statistics:
One important aspect of the analysis was to find out if there was any significant difference between strategy 1 and strategy 2 i.e. computer animated instruction and conventional method of instruction respectively. The pupil of class XI was also selected through randomization from each of school selected. It is expected that as the groups were formed randomly, so the two groups are accepted as equivalent to each other. In order to test this equivalency the investigators try to determine the significance difference between the mean scores of the two groups by means of t-test (Table 2) using SPSS -16 software.

Table 2 Determination of 't' value for entry level test

Group compared	Mean (M)	SD	Mean difference	SED	df	t
Experimental (A1)	68.62	9.71				
Controlled (A2)	66.30	7.32	2.32	1.99	78	1.167*

* Not significant at 0.05 level

The t-value was found to be equal to 1.167 for df = 78 which was not significant at 0.05 and 0.01 level. Hence there is no significant difference between two group A 1 and A2 prior to commencement to the experiment. It is thus interpreted that both the groups i.e. experimental and control are equivalent in all respect.

Testing of null hypothesis ($^{\circ}H_1$)
It was hypothesized that there would be no significant difference between the two treatment group on the criterion of immediate achievement. In order to test this hypothesis t- value is essential for which Table 3 is constructed.

Table 3 Determination of 't' value for the criterion of immediate learning

Group compared	Mean (M)	SD	Mean difference	SED	df	t
A1	74.22	9.90				
A2	66.60	8.51	7.62	2.13	78	3.58**

** Significant at both the level

It is observed that t value (t = 3.58) which for df = 78 was found to be significant (P <0.01). The null hypothesis 0H1 was thus rejected. It is thus interpreted that there is some difference between two strategies of instruction. It is observed from Table 1 that mean achievement scores of A1 (M = 74.22) is higher than the mean scores of A2 (M=66.60). So learner under A1 i.e learning through computer animation has achieved more than 74% of immediate learning where as through under conventional instruction performed the extent of 67 % of the same learning.

Volume : 2 | Issue : 1 | October 2012 | ISSN - 2249-555X

Testing of null hypothesis ($^{o}H_2$)
It was hypothesized earlier that there would be no significant difference between the two treatment groups on the criterion of retention. To test this hypothesis t- value is essential and this value is calculation from Table 4.

Table 3 Determination of 't' value for the criterion of retention

Group compared	Mean (M)	SD	Mean difference	SED	df	t
A1	63.45	8.90				
A2	45.67	6.30	17.77	1.84	78	9.63***

*** Significant at 0.05 and 0.01 level

It is observed that t value (t = 9.63) which for df = 78 was found to be significant (P <0.01). Thus the null hypothesis is not accepted. In other words there is a real difference between the two treatment groups. It is observed that mean score of A1 (M = 63.45) is higher than the mean scores of A2 (M=45.67). It implies that rate of retention (85.4%) is higher in case of computer animated instruction than that traditional teaching (68.5%). As far as retention is concerned, better performance of learning under A1 may be attributed to the fact that concept taught through animated have impressed the pupil more firmly and facilitated their learning and retention as well. The results was supported by the work done by Ozmen et al (2009).

As far as the immediate achievement and retention of the unit 'chemical bonding' in chemistry is concerned, there is some difference between the two treatments. Thus the two treatments are not equally effective in enabling the learners to achieve the required standard of performance. One significant aspect of this investigation is that attainment of such a standard of performance is possible when the media of instruction are highly structured and learners are able to get continuous feedback in terms of 'knowledge of results' in computer assisted instruction. This may be justified by the fact that the components of computer asssited instruction are highly structured. Moreover, the animation, graphics, sound, etc attracts the attention of the learner towards learning. Since the experiment has been performed under highly controlled condition and the treatments were of considerable length involving a time period of four week which was sufficient to pick up the effect of the experimental treatments it can safely be stated that the finding can be generalized over a larger population.

Conclusion
It is a common expectation that multimodal presentation is always superior to the unimodal one. The findings of experimental work on the role of sensory cues lead one to this inevitable conclusion. Thus there seem to be fairly strong evidence that supports the superiority of visual presentation over the auditory one in verbal learning. Hence it can be concluded that since visual mode of presentation of learning materials has some significance in learning, it must also be contributing significantly to make the strategy of computer animated instruction more effective so far as the immediate learning as well as retention is concerned.

REFERENCES

1. Reiber, L. P. (1991). Animation, incidental learning and continuing motivation. J. Edu. Psy. vol 83, 318-328. | 2. Chang, H.Y., Quintana, C. ,Krajcik, J.S. (2010), The Impact of Designing and Evaluating Molecular Animations on How Well Middle School Students Understand the Particulate Nature of Matter, Sc. Edu., 9 pp 73-94. | 3. Kelly, R. M.; Jones, L. L (2007). Exploring How Different Features of Animations of Sodium Chloride Dissolution Affect Students' Explanations, J. Sc. Edu. Technol, vol 16 413-429. | 4. Ozmen, H., Demircioglu, H., Demircioglu, G.(2009) The Effects of Conceptual Change Texts Accompanied with Animations on Overcoming 11th Grade Students' Alternative Conceptions of Chemical Bonding, Compu & Edu. Vol 52, pp 681-695. | 5. Yang, E., Andre, T., Greenbowe, T. J. (2003) Spatial Ability and the Impact of Visualization/Animation on Learning Electrochemistry, Int. J. Sc. Edu., vol25,pp 329-49. | 6. Williamson, V. M, Abraham, M.R., (1995) The Effects of Computer Animation on the Particulate Mental Models of College Chemistry Students, J. Res. In Sc. Teaching, vol 32, pp 521-534. | 7. Fensham, P. (1975). Concept formation. In D. J. Daniels (ed.), New movements in the study and teaching of chemistry, pp. 199-217. London: Temple Smith. | 8. Taber, K. & Coll, R. (2002). Bonding. In J. K. Gilbert, O. D. Jong, R. Justy, D. F., Treagust, & J. H. Van Driel (eds.), Chemical education: Towards research-based practice, pp. 213-234. | 9. Nishino, A.K. (1993), An Exploratory Investigation to Determine the Effect of a Multi media Computer –Based Science Learning Environment and Gender Difference, on Achievement, and Attitude and Interest of Students in an Eight-Grade science Classroom. Ed. D. University of Southern California, DAI v 54, No. 12 pp 4414-A.