

Influence of Interactive Multimedia Courseware: a Case Study among the Students of Physical Science of Class VIII

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Abstract

The present Study deals with the influence of Interactive Multimedia Courseware on the achievement in Physical Science of Class-VIII Students. For this purpose a computer assisted multimedia courseware was developed with the help of Adobe Flash and Bangla Word on a single unit of Physical Science Curriculum of class-VIII under WBBSE (Bengali medium). Then we selected two equivalent groups of class-VIII students (experimental and control). One group was exposed to the multimedia courseware while the others are not. The performance of the both groups was then compared statistically (using t-test and ANOVA) after administering the self prepared standardized achievement test. The observed t value is 16.068 is higher than the critical value at 1% level of significance (df=49). ANOVA test also provide significant difference between experimental and control group. So statistically it can be concluded that computer assisted multimedia courseware facilitates students learning in Physical Science better than the traditional chalk and talk method.

[Keywords: Computer Assisted Instruction (CAI), Multimedia courseware, Computer Aided Learning (CAL), Achievement test]

Introduction

According to Information Technology Science, multimedia is technologically speaking an integration of the text, Picture, Sound and Speech within a surrounding – a Computer, which is extended in multimedia system. Croatian scientist Fjodor Ružić (2006) thinks that Multimedia '*is not just a sum of information via different media, but a logically shaped, organized and integrated group of mutually connected media which create a multimedia document*'. Multimedia technology is one of the most exciting innovations in the age of information. The rapid growth of multimedia technology over the last decade has brought about fundamental changes to

Use of multimedia vs. traditional instruction

Some researchers reported on their research-paper which compared the effects of computer assisted multimedia courseware alone with those produced by conventional instruction alone. Here, results are too mixed to permit any firm conclusion. Some inquires have

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found multimedia superior, some have found conventional instruction superior, and still others have found no difference between them. (Capper and Copple 1985; Edwards *et. al.* 1975; Rapaport and Savard 1980).

Using computer assisted multimedia courseware as a complete replacement for conventional teaching may seriously weaken its effectiveness (Kulik, Kulik & Bangert-Drowns, 1985), but Hartley managed to locate a few studies in which computer assisted multimedia courseware totally replaced conventional teaching and the results were considered to be unimpressive. Based on Hartley's results, Kulik, Kulik & and Bangert-Drowns (1985) warn that, "Total reliance on the computer as teacher therefore seems to be one thing that school systems should avoid".

The computer may provide a new form of presentation and allow for some learning without the presence of instructor; however, the computer alone may not be as effective as the computer with an instructor. The literature further suggests computer assisted multimedia courseware is best delivered as a supplement to conventional instruction and effective instruction appears to be more a matter of quality of design rather than a matter of medium (Lowe, 2001).

Effect of multimedia in achievement of students

The use of computer assisted multimedia courseware as a supplement to traditional, teacher directed instruction produces positive effects on the achievement of students. Throughout the 1980's and 90's computers have been generally heralded as being an effective teaching methodology (Christmann & Badgett, 2000). Kulik, Kulik & Shwalb, (1986) found that computer enriched instruction raised achievement by an average of 1.13 standard deviation.

In a report on the academic progress of mathematics and physics students taking CAI-based advanced placement courses (middle school through early high school), Ravaglia, Suppes, Stillinger and Alper (1995) argued that such courses were shown to be effective for the targeted students.

Springer (2002) studied academic performance improvements in delivering metric computer assisted tutorial to pre-service teachers and found that those individuals who received the special instruction performed significantly better on a metric posttest than those students who received no instruction.

Clark (as cited in Fletcher-Flinn and Gravatt, 1995) argued that much of the apparent success of CAI in the research literature may be related to the uncontrolled effects of instructional method and novelty of the medium. Clark further argued that when looking at studies that utilized the same teacher and a longer than typical study duration, the difference between computer assisted multimedia courseware and conventional method were minimized. In isolated studies of long duration and that utilized the same materials and teacher in the treatment and control conditions, they found no beneficial effect in favour of computer assisted multimedia courseware.

Learning and retention of learning

Computer assisted multimedia courseware enhances learning rate. Students learning rate is faster using computer assisted multimedia courseware than with conventional instruction. In some research studies, the students learned the same amount of materials in less time than

the traditionally instructed students; in others, they learned more material in the same time. (Batey 1986; Hasselbring 1984; Kulik, 1983; Kulik, Bangert and Williams 1983 etc.)

Students' scores on delayed tests indicate that the retention of content learned using computer assisted multimedia courseware is superior to retention following traditional instruction alone. (Capper and Copple 1985; Kulik *et.al.* 1985; Kulik, Bangert and Williams 1983; Rupe 1986; Woodward, Carnine and Gersten 1988). Patil, A.T. and Shivaji, 2006 found that there is significant difference between the performance of pupil-teachers from control and experimental groups in retention test.

Cost effectiveness of the method

Multimedia instructional strategy at secondary level is feasible because of its reproducibility and the cost management (Vardhini, V.P. 1983). Niemiec and Walberg, 1987 found multimedia instructional activities significantly most cost effective than tutoring and suggested that computers be used more extensively in schools. Krishna, S.S.(1983) stated the feasibility of the multimedia package was established in terms of cost involved in reproduction of the various resource materials and the time scheduling in an actual instructional set-up.

There has been a dramatic increase in the capabilities of computers, along with reduced cost, that has influenced an increase in the various forms of computer delivered instruction specially in education as well as other disciplines (Passerini, 2000; Brown, 2001).

Scope of the present study

The NCF 2005 suggests that 'Educational Technology should be viewed as a supplement rather than as a substitute for hands-on experience, both for classroom teaching and for teacher training.' The need to integrate Educational Technology with the larger goals and processes of education rather than viewing it in isolation or as an add-on has been emphasized. It has been suggested that any use of technology that turns teachers and children as mere consumers and technology operators need to be reviewed and discouraged.

It is therefore implied that, Computer Aided Learning (CAL) as a component of Educational Technology in School Education must be planned with the above noted guiding principles of the NCF 2005. The CAL is usually defined as a learning technique being employed in order to educate students via the use of computers. CAL may be used for teaching –learning of different subjects at various levels, utilizing computers in the explanation, tutoring and testing of subject matter. In almost all disciplines of study there is a large potential for the use of CAL, for instance in both the teaching and testing of mathematical material (usually called Computer Aided Assessments (CAA). Computerized diagnostic tests may be an integral part of teaching and testing, especially during the first few weeks when tutors want to understand the level of knowledge of students. Computer Aided Learning (CAL) is thus based on the integrative approach whereby a lecture or an instruction is not replaced by the computer programme but it is introduced during the course as a learning resource for engaging the learners as well as for their assessment.(De,2012).

On the basis of the above the present study deals with the selecting of a suitable methodology for developing the multimedia courseware. After proper development of the courseware there is a scope to study its effectiveness by implementing it on the target group i.e. the students of class VIII of WBBSE. Finally analyzing the collected data, a trend can be detected about the effectiveness of the multimedia courseware in class room situation. This is a

baseline study and result of it can be utilized by the future researchers for the improvement of the present teaching learning scenario.

Research trends

It has been found that in early 80' of last century a lot of efforts employed to include computer assisted instruction or more precisely multimedia instructional strategies to enhance the performance of school children as well as the achievement in the annual examination. Biolo, E. and Sivin, J. 1980, were first to report the effectiveness of microcomputer in schools. Burns, P.K. and Bozeman, W. C. 1981, presented the results of a meta-analysis of 40 studies to compare the effectiveness of traditional instruction alone with a combination of traditional instruction and computer assisted instruction on students' mathematics achievement. The combined traditional and computer assisted instruction approach was significantly more effective. In 1985 the researches carried out by Bangert-Drowns, R.L., Kulik, J.A. and Kulik, C.C. again supports the effectiveness of multimedia instructional strategies in school education, besides Capper, J. and Cople, C. presented information on costs and equity issues and also offered implications for curriculum, instruction and policy.

Bahr, C. M. and Rieth, H.J. 1989, compared the effects of conventional instruction, computerized drill and practice, and computer games on the mathematics achievement of learning disabled junior and senior high school students. Students in the drill and practice condition outperformed other students to a modest degree.

Robert Loss, Mario Zadnik and David Treagust, 1994, studied on teaching and learning 'abstract physical science concepts' in a computer based multimedia environment. To minimize hardware and software complications the authors initial developments were based around the Macintosh platform and Super Card software environment. A number of specific issues were also identified (Loss et al, 1992; Loss et al, 1993) including:

- text to screen conversion
- navigational issues
- effective screen design
- development time versus instruction time
- development of effective feedback and deep learning opportunities

After several interactions it was found that these could not be considered in isolation from the overall instructional design of the project. The presentation of complex and abstract concepts and the design of effective user interactions using Interactive multimedia (IMM) are still in its infancy. There are many different instructional design bases like- Tutorial base, Data base, Case study, Simulation, Visualization etc. and learning interactions being trialled and implemented in IMM instruction.

Du Plessis, J.P., Van Biljon, J.A., Tolmie, C.J. & Wollinger, T., 1995, presented the detail of a model for intelligent computer aided education(CAE) systems to provide methodologies, techniques and tools regarding the development of software. The system is based on the idea of cooperative learning, constructive problem solving by using expert techniques. The model shows how teaching and learning can be improved by the use of a suitable CAE system by providing to improve thinking skills while teaching content. The authors emphasis on that the use if CAE system by thinking pedagogical base can solve funding problem of CAE. The authors explain that for effective applications and also success of CAE

system, teacher must be more knowledgeable to modify the system according to different and specific needs of the students.

Ilango, V. and Doulai, P., 1996, introduced an interactive learning package which was developed for electrical engineering courses at the University of Wollongong, Australia. Computer assisted learning methods are increasingly used by educational institutions to support their conventional teaching methods, with the development of new information retrieval technologies and advancement in multimedia development tools these learning methods have become effective. The application author-ware in conjunction with on-line documentation and help files and other educational software is demonstrated for supporting laboratory and tutorial classes.

Gemmiti, F., 2003, reported the major findings of an investigation into a computer based learning system for students of human biology, a year long, first year unit at the University of Western Australia. The system was composed of practice quizzes and graded tests. Graded tests were randomly selected from the same bank of items as respective practice quizzes. The investigation was undertaken to assess-1) students' use and evaluation of the system and 2) the learning value of the system. A questionnaire was administered to students in semester two for information about use and evaluation of the system in semester one. Grades of semester one were used to assess learning. Most student attempted available practice quizzes (81% of 379 respondents) and graded tests (68% of 508 enrollees). Almost all respondents recommended the system to future students of the unit (94.5% of 380). General ability (as reflected in overall performance on other elements of assessment for the semester) varied with number of graded tests attempted, average performance on graded tests and total time spent on practice quizzes. Independently of general ability, average performance on graded tests varied with total time spent on practice quizzes, number of practice quizzes after which revision was done and number of graded tests attempted. Performance on each graded test varied with time spent on the respective quiz.

Yadav, K., 2004, set objectives to develop an IT-enable instructional package for teaching English Grammar, to implement it and to determine its effectiveness in terms of achievement of the students and opinion of students and English teacher. The investigator started with a null hypothesis that there will be no significant difference in the achievement scores of students in pre-test and post-test. A single group pre-test and post-test design was employed for the study. 20 students were randomly selected from Std. VIII of New Era Senior Secondary School, Baroda. Pre-test, post-test and opinionnaire were used for study. Data were analyzed through 't' test, % scores and content analysis. There was found a significant gain in terms students' achievement through IT-enable instructional package. It helped the students to learn kinds of sentences, namely-interrogative, assertive, affirmative, negative, imperative, orders or commands and exclamatory. The students and teacher were found to have favourable opinion towards the developed instructional package.

Desai, B.Y., 2004, also made a comparative study of the efficacy of teaching through the traditional method and the multimedia approach in the subject of home science. He found the mean achievement of the experimental group was significantly higher than that of the control group. From post-test to retention test almost equal reduction in performance was found in both the groups. The study has arrived at significant findings when caste, location, income, Std. XII examination marks and IQ of the students were considered as co-variables. The students were found to have favourable opinion towards the multimedia approach.

Pardeshi, R., 2005, set objectives to develop a computer assisted course materials and study in mono, diad triad settings and its relative effectiveness in the three settings and through reactions of the students. All the four hypotheses of study were formulated in the null form. The

study was conducted in the three sections of Std. IX of Zenith High School, Baroda, dividing each section into two groups- experimental and control. The CAI was developed using Flash-MS, Directors and Corel Draw 11.0 along with the internet. An achievement test was constructed for administering as pre-test and post-test. The data were analyzed through mean, SD, uncorrelated 't' and ANOVA. No significant difference has been found in mean achievement in scores of group in mono and diad. But significant difference has been found in the mean achievement scores of the experimental group in triad and that of control group. The students were also found to have positive reactions towards the developed software.

Patil, A.T. Shivaji, 2006, developed a multimedia instructional system on computer education for B.Ed. pupil-teachers and studied its effectiveness. The study has arrived at quite meaningful findings as follows:

- i) The present setting of teaching of computer education in B.Ed. colleges was found unsatisfactory.
- ii) It was found feasible to design, develop and implement a computer based multimedia instruction system for the computer education.
- iii) No significant difference was found between the performance of the pupil-teachers of control and experimental group on pre-test.
- iv) Significant difference was found between the performance of pupil-teachers of control and experimental group on post-test.
- v) Significant difference was found between the performances of pupil-teachers of control group from pre-test to post-test.
- vi) There is significant difference between the performances of pupil-teachers of experimental group from pre-test to post-test.
- vii) There is significant difference between the gains in achievement in terms of scores in pre-test and post-test of pupil-teachers from pre to post-test.
- viii) There is significant difference between the performance of pupil-teachers from control and experimental group in retention test.

Vesna Srnić, 2007, in his conference paper on New Communication Model: Multimedia Art made conclusion that, Multimedia Art, especially Multimedia Performance strengthens educational capacity of the Permanent Learning and enables the creative persons to integrate intensively their Cognitions and Existential Supportings, thus becomes favourable for Permanent Learning and Education in general.

Lindsey Conner and Dr Chris Astall presented a paper on 'Teaching science: Changes to teaching strategies through incorporating on-line resources' at the ESERA conference, Istanbul, 31st August- 4th Sept, 2009. They stated that there is growing evidence that human understanding can be enhanced through the use of multimedia. Instructional technology strategies to enhance learning may include computer simulations, models, video, interactive or digital objects and other multimedia materials. Studies have shown that when students are supported to learn through using websites and multiple digital media, they can increase their awareness of the relevance of science to daily life, learn enquiry skills and their attitudes towards learning science are more positive. Additionally students who have taken part in innovative web interventions have been shown to have a better understanding of the topics covered than students who had not used the web sources.

Louisa A. Stark, spring 2010, developed one multimedia teaching resource for life science to teach epigenetics. She used animation and sound effects to give a better understanding to the students. The study of effectiveness of the multimedia courseware is still awaited.

Finally the trends shows that most of the works in this field was developed in case of Science stream (Physics,Chemistry,Mathematics,Biology etc.) and very negligible amount of work performed in the area of Literature and Social science group. Again here all the multimedia courseware was developed in English. No such attempt was made to develop the multimedia courseware in Bengali language. So our present work was attempted to make up this gap.

Objective of the study

The specific objective of the study was to compare the achievement of students' taught Physical Science through computer assisted multimedia courseware with that of students taught through traditional teaching methods. This base line study may provide a programmatic framework which may guide the future researchers to making Computer Assisted Instruction more effective and productive.

Field of application

In recent years there has been a growing interest amongst modern English medium schools in computer assisted multimedia courseware. For this reason, a number of researchers and educationists tried to develop such computer assisted multimedia courseware and investigate its effectiveness under computer based environment. But there are very few such efforts to develop computer assisted multimedia courseware in local languages like Bengali. So the following parts of this report deals with the developing of computer assisted multimedia courseware in Bengali medium, its implementation and discussion of its effectiveness.

Materials and Methods

Research Design

It was decided that we will prepare a multimedia courseware (in Bengali) on a topic of Physical science for the students of class VIII of West Bengal Board of Secondary Education. Then It will be applied on one of the two pre-selected equivalent group (experimental and control group) of class-VIII. On completion a well structured achievement test on the same topic of physical science will be administered on both the group and their achievement on the test will be analyzed statistically.

Instrumentation or Process of Developing the Multimedia Courseware

Adobe Flash software has been selected to develop the multimedia courseware and windows based computer environment have been chosen for easy operating of the courseware. As the courseware has to be developed in Bengali medium the help of Bangla Word software have been taken. Some diagram has been drawn manually and incorporated in the courseware while some typical diagram and picture of scientists have been collected from different websites and included in the courseware.

Application

Sampling

A Bengali medium School, Patit High School (H.S.), Bankura, West Bengal has been chosen for sampling. In the school two sections of Class Eight (VIII A & VIII B) were selected for

this purpose which have almost same achievement level (equivalent group) according to their performance in the earlier unit test. Here section A was considered as the experimental group and the section B as the control group.

Sample size

Sample size has been taken as 50 students for each group to get comparable result and also for ease of calculation, which again recommended by Fraenkel and Wallen (2000) as at least 30 students per group.

Students' Interaction with the Multimedia Courseware

To both the groups, the unit 'Matter' and 'Atom' was discussed. In the control group, traditional lecture method was performed with the help of chalk and black board, whereas, the students of the experimental group interact with the courseware in a computer in the presence of their teacher, who will guide them how to interact with the multimedia courseware.

Data Collection

The achievement test was administered on both upon the control and experimental group. The test comprised of four sets of question papers each of which containing 20 multiple choice questions in different serials to avoid mutual copying. At the time of data collection, students' opinion, teachers' reaction, views of School Administration etc. were recorded.

During interaction with the multimedia courseware it was found that students were very much eager to learn in a computer based environment. They also enjoyed non-traditional multiple choice type of achievement test.

Most of the Teachers showed their interest to know the effect of multimedia courseware but at the same time they were also doubtful about the usability of the courseware.

School Authority opine about the necessity of the multimedia courseware in present day school system but they say about proper training of teachers should be required to carry out the course effectively.

Data Analysis

The scores of students of both the group in the achievement test were collected and analyzed statistically. With the collected data, first of all the item analysis (reliability, validity, difficulty value and discrimination value) was done to validate the structure of the achievement test. With the help of t-test and ANOVA the differences in achievement of students of both the group (the control and experimental groups) were analyzed.

Results

Reliability

The reliability of the achievement test was calculated with the help of Kuder-Richardson formula-20 and found to be 0.7, which is quite satisfactory for a achievement test.

Validity

The validity of the achievement test was qualitatively discussed with a number of experts related to this study and face validity of the test is quite high enough to accept.

Difficulty value

Difficulty value of each item was calculated by using the formula:

$$\phi = \frac{P_u - P_l}{T/2}$$

Where,

ϕ = Difficulty value

P_u = No. of upper 27% examinees who given correct answers.

P_l = No. of lower 27% examinees who given correct answers.

T = Total No. of examinees

It is found that 15 % items are highly difficult, 56% items are moderately difficult, 17% items are medium difficult and rest 12% items are moderately easy.

Discrimination value

Item discrimination determines whether those who did well on the entire test did well on a particular item. An item should in fact be able to discriminate between upper and lower scoring groups. The discriminatory power of item is determined by the index of discrimination. In case of our present study we first arrange the scores sequentially. From the arranged scores the top 27 percent and the bottom 27 percent are separately taken. The two groups are named as upper (U-group) and lower group (L-group) respectively.

The index of discrimination (D) is computed for each item as the difference between the percentages of pass of the two groups in that item.

$$D = \frac{\text{Success in the HSG}}{N \text{ in HSG}} - \frac{\text{Success in the LSG}}{N \text{ in LSG}}$$

(HSG = high scoring group, LSG = low scoring group, N= number students.)

Zero discriminating power (0.00) is obtained when an equal number of students in both groups gets the item right and negative discriminating power when more students in lower group than the upper groups get it right.

It may be concluded from the computed D scores that item no- 08 has the lowest discriminatory power (7.14) and item no 12 has the highest discriminatory power (78.58) whereas others items are in between.

t -test

The following null hypothesis was tested by t-test at 1% level of significance.

H_{01} : There exist no significant differences in achievement score in Physical Science between students who are exposed to computer assisted multimedia courseware and those who are not exposed to it.

The critical value of t-score at 1% level for the 49 degree of freedom is 2.67. The t- value calculated in case of our present study is 16.068 which is higher than the critical value. Therefore the null hypothesis may be rejected.

Hence, we may conclude that there lies statistically significant difference in achievement score in Physical Science between students who are exposed to computer assisted multimedia courseware and those who are not exposed to it. The mean value also determines a positive effect of the interactive computer assisted multimedia courseware on the achievement in the Physical Science of Class-VIII students.

ANOVA

The null hypothesis which was tested by t-test was also retested by ANOVA. The summary of the result of ANOVA test is given below.

Table: Result of ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	313.741	10	31.374	88.163	.000
Within Groups	13.879	39	.356		
Total	327.620	49			

ANOVA again supports the findings of t-test and reject the null hypothesis, which strengthen the views about the positive effect of the interactive computer assisted multimedia courseware on the achievement in the Physical Science of Class-VIII students.

Discussion

Based on the results of this study it can be concluded that computer assisted multimedia courseware facilitates students learning in Physical Science better as compared to chalk and talk method of teaching. Since achievement is important in the learning process, Physical Science teachers should be encouraged to use computer assisted multimedia courseware in order to improve performance in Physical Science. It is observed from the earlier records that the performance of the students of Patit High School (H.S.), Bankura in Physical Science examination was below average. But during our present study the achievement of students taught through computer assisted multimedia courseware were comparatively higher than their average academic scores. Therefore if computer assisted multimedia courseware is introduced in secondary schools of our State, there lies an ample opportunity for improving the performance of the students in Physical Science. The features of computer assisted multimedia courseware suggests that it can be easily implemented in most of our school as the several Govt. and Non-Govt. organization provides assistance for development of Computer Assisted Instruction(CAI) system.

The use of CAI as a supplement to conventional instruction produces higher achievement than the use of conventional instruction alone. Research is inconclusive regarding the comparative effectiveness of conventional instruction alone and CAI alone. A planned research programme in a programmatic framework should guide the future researchers so that it might contribute to making learning experience more interesting and effective.

Conclusion

Multimedia courseware is increasingly being used in computer-based learning, and the general indication is that this trend will persist for a while to come. One rationale for this trend is the assumption that multimedia has properties that can aid learning, particularly the learning of abstract subject matter. However, although the use of multimedia in this area is rapidly increasing, particularly in the form of numerous commercial applications, there still appears to be a lack of adequate research into the extent to which multimedia is effective in children's

abstract learning. We therefore need to study afresh the utility of current generation of hardware and software in teaching learning process and conduct research on what techniques are effective.

The inference can be drawn that teaching-learning process in schools should be transformed by making use of multimedia and animation to make lessons attractive, stimulating, and interactive. The ability to write scripts for such methodology should be made fully familiar with various multimedia and authoring tools.

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