Chapter-V

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5.1 Introduction

The present study was conducted to develop and validate a multimedia package and to assess the effectiveness of developed multimedia package instruction as compared with the conventional method of instruction in the subject of science part-2 (Biology) for high school classes. The purpose of the study were two fold, firstly the development of a multimedia package (software) and secondly to validation of multimedia package (software). Comparison of multimedia method instruction and conventional method of instruction is not only a comparison of two modes of instruction but of two theoretical paradigms. Conventional method represents a paradigm whereby knowledge is transmitted from teacher to student. Something is poured in learners mind and the learner is a passive recipient of knowledge. Teacher plays an active part in this mode of instruction. Multimedia method of instruction represents a paradigm where knowledge is constructed and sought by the learner. Learner
plays an active role in learning process. Learning is individualized, self paced and hands on.

This study was completed in two phases; during the first phase multimedia method instruction software was developed by the investigator. The second phase of the study was experimentation with multimedia method instruction software to determine its effectiveness in terms of student learning or gain. Investigator also constructed three instruments to be used in the study. These instruments included an observation schedule for teachers has been used to evaluate the quality of multimedia package, achievement test was used as pre-test and post-test performance measurement and opinionnaire was used to collect learners’ opinion towards multimedia package, support for learning Biology.

5.2 Statement of the Study

The present study is an attempt to development of a multimedia package for the teaching of Biology to high school students and its validation in academic achievements. And to find out its effectiveness in learning Biology. The investigator had to prepare multimedia packages on two topics: The Living World and The Study of Cells, which gives emphasis on computer assisted
instruction. Hence, the study is entitled “Development and Validation of Multimedia Package in Biology”.

5.3 Objectives of the Study

1. To develop and validate a multimedia package on the topics: The Living World and The Study of Cells, in IX Standard Biology (science part-2) of the Karnataka State Board Text Book.

2. To find out the significant difference between post-test mean scores of students under multimedia method of instruction and conventional method of instruction in Biology.

3. To find out the significant difference between post-test mean scores of boys under multimedia of instruction and conventional method of instruction in Biology.

4. To find out the significant difference between post-test mean scores of girls under multimedia of instruction and conventional method of instruction in Biology.

5. To find out the significant difference between post-test mean scores of boys and girls students under conventional method of instruction and multimedia method of instruction in Biology.
6. To find out the significant difference between pre-test and post-test mean scores of students under conventional method of instruction and multimedia method of instruction in Biology.

7. To find out the significant difference between pre-test and post-test mean scores of boys students under conventional method of instruction and multimedia method of instruction in Biology.

8. To find out the significant difference between pre-test and post-test mean scores of girls students under conventional method of instruction and multimedia method of instruction in Biology.

9. To find out the significant difference between pre-test and post-test mean scores of boys and girls students under conventional method of instruction and multimedia method of instruction in Biology.

10. To find out the significant difference between post-test mean scores of conventional method of instruction of the boys and girls students on the topic of The Living World.

11. To find out the significant difference between post-test mean scores of multimedia method of instruction of the boys and girls students on the topic The Living World.

12. To find out the significant difference between post-test mean scores of conventional method of instruction of the boys and girls students on the topic of The Study of Cells.
13. To find out the significant difference between post-test mean scores of multimedia method of instruction of the boys and girls students on the topic The of Study of Cells.

14. To find out the significant difference between pre-test and post-test mean scores of conventional method of instruction of the boys students on the topic of The Living World.

15. To find out the significant difference between pre-test and post-test mean scores of multimedia method of instruction of the boys students on the topic of The Living World.

16. To find out the significant difference between pre-test and post-test mean scores conventional method of instruction of the girls' students on the topic The of Living World.

17. To find out the significant difference between pre-test and post-test mean scores of multimedia method of instruction of the girls students on the topic of The Living World.

18. To find out the significant difference between pre-test and post-test mean scores of conventional method of instruction of the boys students on the topic of The Study of Cells.

19. To find out the significant difference between pre-test and post-test mean scores of multimedia method of instruction of the boys students on the topic of The Study of Cells.
20. To find out the significant difference between pre-test and post-test mean scores conventional method of instruction of the girls' students on the topic of The Study of Cells.

21. To find out the significant difference between pre-test and post-test mean scores of multimedia method of instruction of the girls students on the topic of The Study of Cells.

22. To find out the significant difference between pre-test and post-test mean scores of students under conventional method of instruction on the topic of The Living World.

23. To find out the significant difference between pre-test and post-test mean scores of students under multimedia method of instruction on the topic of The Living World.

24. To find out the significant difference between pre-test and post-test mean scores of students under conventional method of instruction on the topic of The Study of Cells.

25. To find out the significant difference between pre-test and post-test mean scores of students under multimedia method of instruction on the topic of The Study of Cells.

26. To know students' opinions towards multimedia method of instruction (multimedia package software).

27. To know teachers' observation towards multimedia package.
5.4 Hypotheses

1. There is no significant difference between post-test mean scores of students under multimedia method of instruction and conventional method of teaching in Biology.

2. There is no significant difference between post-test mean scores boy students under multimedia method of instruction and conventional method of instruction in Biology.

3. There is no significant difference between post-test mean scores of girl students under multimedia method of instruction and conventional method of instruction in Biology.

4. There is no significant difference between post-test mean scores of boy and girl students under multimedia method of instruction and conventional method of instruction in Biology.

5. There is no significant difference between pre-test and post-test mean scores of students under conventional method of instruction and multimedia method of instruction in Biology.

6. There is no significant difference between pre-test and post-test mean scores of boy students under conventional method of instruction and multimedia method of instruction in Biology.
7. There is no significant difference between pre-test and post-test mean scores of girl students under conventional method of instruction and multimedia method of instruction in Biology.

8. There is no significant difference between pre-test and post-test mean scores of boy and girl students under conventional method of instruction and multimedia method of instruction in Biology.

9. There is no significant difference between post-test mean scores of boy and girl students under conventional method of instruction in the topic The Living World.

10. There is no significant difference between post-test mean scores of boy and girl students under multimedia method of instruction in the topic The Living World.

11. There is no significant difference between post-test mean scores of boy and girl students under conventional method of instruction in the topic The Study of Cells.

12. There is no significant difference between post-test mean scores of boy and girl students under multimedia method of instruction in the topic The Study of Cells.

13. There is no significant difference between pre and post-test mean scores of boy students under conventional method of instruction in the topic The Living World.
14. There is no significant difference between pre and post-test mean scores of boy students under multimedia method of instruction in the topic The Living World.

15. There is no significant difference between pre and post-test mean scores of girl students under conventional method of instruction in the topic The Living World.

16. There is no significant difference between pre and post-test mean scores of girl students under multimedia method of instruction in the topic The Living World.

17. There is no significant difference between pre and post-test mean scores of boy students under conventional method of instruction in the topic The Study of Cells.

18. There is no significant difference between pre and post-test mean scores of boy students under multimedia method of instruction in the topic The Study of Cells.

19. There is no significant difference between pre and post-test mean scores of girl students under conventional method of instruction in the topic The Study of Cells.

20. There is no significant difference between pre and post-test mean scores of girl students under multimedia method of instruction in the topic The Study of Cells.
21. There is no significant difference between pre and post-test mean scores of students under conventional method of instruction in the topic The Living World.

22. There is no significant difference between pre and post-test mean scores of students under multimedia method of instruction in the topic The Living World.

23. There is no significant difference between pre and post-test mean scores of students under conventional method of instruction in the topic The Study of Cells.

24. There is no significant difference between pre and post-test mean scores of students under multimedia method of instruction in the topic The Study of Cells.

5.5 Design of the Study

The design found to be most useful for the purpose of this study was the pre-test and post-test experimental and control groups design. These groups were obtained through paired matching on the basis of intellectual capacity of the students. Raven’s Progressive Matrices were used to measure the intellectual capacity of the students. Forty pairs matched on intellectual capacity were selected and assigned randomly to the experimental and control groups.
5.5.1 Sample of the Study

Sample of the study was 80 students (40-boys and 40-girls) out of total 117 students in the age group 13.5 to 14.5 who are studying in IX standard, in PDJ high school Bijapur city, Karnataka. Sample of the study was selected on the basis of intellectual capacity measured on Raven's Standard Progressive Matrices (Raven's SPM), the instrument to measure intellectual capacity. Raven's SPM was administered to all 117 students in the IX standard, those all are present on the day of administration of the instrument.

Forty pairs of equal intellectual capacity were to be taken as a sample of the study. It could be done in three ways that is proportionately, randomly and selectively. Scores on SPM revealed that six percent students were intellectually superior, eight percent students were above the average in intellectual capacity, thirty two students were intellectually average and fifty one percent students were found to be below average in intellectual capacity. In case of proportionate selection twenty eight pairs out of forty would have been selected from below average intellectual capacity students, eight from average and two pair from above average students, and only two pairs from students were intellectually superior. Similarly random selection also might have increased the number of below average
students. Excessive number of similar category that is below average intellectual capacity students could cause decreased variability in achievement scores. Therefore, keeping in view the composition of the group, all possible pairs form superior, above average and average students were selected to maximize their representation. In spite of that selected forty pairs included forty five percent superior, above average and average students and fifty five percent below average students.

5.5.2 Development of Multimedia Package (Software)

As no multimedia package (software) covering the topics of high school level Biology was available, multimedia package (software) to be used in the experiment was developed by the researcher. It was decided to develop the multimedia package (software) in English medium IX standard Biology of Karnataka state board syllabus.

The investigator:

a. Identified a list of instructional objectives for the content of the units 'The Living World' and 'The Study of Cells'.

b. Prepared the multimedia (text, animated pictures and back-voice) scripts, based on the instructional objectives. The script for the multimedia instruction was produced in two stages. The
draft script and the final script. The draft script was scrutinizes and the final script was produces by incorporating the changes perceived as necessary in the draft script.

c. Developed the multimedia package with the assistance of expertise in the field of computer multimedia animation.

**Medium of Presentation**

Medium as a means physical formats and media relationship with time, and different criteria like perception, distribution and presentation of information, representation, and storage. There are two classes of media: static and dynamic (or time continuous). Static media do not have a time dimension, and their contents and meanings do not depend on the presentation time. Dynamic media have a time dimension, and their meanings and correctness depend on the rate at which they are presented. Dynamic media include animation, audio, and video. These media have their intrinsic unit interval or rate. For example, to have a perceptually smooth movement, video must be played back at 25 frames per second, sometimes 30 frames per second. Similarly, where the playback a recorded voice message and music, playback at a slower or faster rate distorts the meaning or the quality of the sound. Because these
media must be played back continuously at a fixed rate, they are often called continuous media.

The final multimedia presentation package (text, animated-picture with voice-over the topic for better understanding and retention of the content) had objectives of the topic, a beginning (introduction), a middle (presentation of the content), end (summary of the content), and at last assessment (multiple choice items). The objectives of the topic related to learning of the content. The beginning was attractive and attention catching and interesting to the learners. The middle part of the presentation was instructional in nature. Thus, a rich variety of stimuli were presented to the learners in the form of icons such as home, menu, print, search, glossary, notes, exit, back-next, pause, reply and sound off/on. The material was presented in an academic style rather than an entertaining one. There was a wealth of audio-visual interactive material occurring on the screen, along with voice / commentary over the presentation. When the presentation moved from page to page the learners were given linking information about the thread of continuity underlying the progressive sequence of the pages.
5.5.3 Materials and Tools Used for Experiment and Data Collection

Instruments were developed to measure the dependent variables and to record perception, personal, and situational data.

Data was collected by using:

- Raven's Standard Progressive Matrices (Raven's-SPM) were used to measure the intellectual capacity of the students for the purpose of paired matching.
- Achievement test has used as pre-test and post-test.
- Multimedia package used to teach the experimental group.
- Observation schedule for teachers has used to evaluate the quality of multimedia package.
- Opinionnaire to collect learners' opinion towards multimedia package.

5.5.4 Variables involved in the Study

Controlled variables: Age of the students, Intelligence and Treatment (Conventional Method of Instruction and Multimedia Method of Instruction)

Dependent variable: Achievement mean scores

Independent variables: Sex of the students
5.5.5 Experiment Conducted

To compare multimedia method of instruction with conventional method of instruction on students achievement in Biology, an experiment was conducted at BDE Society's PDJ high school 'A' Raven's Standard Progressive Matrices (Raven's-SPM) was administered to 117 students of IX standard students who were present on the day of test administration. Two matched groups of 40 (20 boys + 20 girls) students each were taken to conduct the experiment. Experimental group students received treatment in the form of multimedia method of instruction in the computer laboratory of the school while the control group students received instruction as usual from the investigators everyday second period of school time, this arrangement was made by the Head mistress of the school, on investigator request. Investigator himself supervised the students of experimental group while receiving multimedia method of instruction in the laboratory everyday evening. Investigator remained present in the computer laboratory all the time during treatment sessions.

5.5.6 Data Collection

The experimental group students received treatment in the form of multimedia method of instruction in the computer laboratory
of the school while the control group students received instruction as usual from the investigator everyday second period of school time. Investigator himself supervised the students of experimental group while receiving multimedia method of instruction in the laboratory everyday evening. Investigator remained present in the computer laboratory all the time during treatment sessions.

The pre-test was administered to both the group just before the beginning of treatment. Both groups were equated on the basis of Raven's SPM test scores. After the completion of treatment (teaching), the post-test was administered immediately.

Data were collected from 80 students, 40-(20 boys + 20 girls) from each group. The purpose of this test was to measure the achievement of students constituting the sample of the study.

Opinionnaire was administered to the students of the experimental group after immediate completion of the treatment (multimedia method instruction), to collect their opinion towards the multimedia method of instruction, this data were collected from 40 students of experimental group (20 boys + 20 girls).

The structured observation schedule for teachers has used by the investigator to evaluate the quality of multimedia package.
Observation schedule was given to 10 teachers and asked to mark (√) on three point scale. Investigator aim was to evaluate technical adequacy to the learning objectives of the multimedia package.

5.5.7 Analyses of Data

Data were analyzed through Microsoft excel program. To compare the achievement test scores of the experimental group with the control group students on achievement test paired ‘t’ test was employed. Comparison was done on the basis of total achievement score and sub totals of achievement with respect to two topics: The Living World and The Study of Cells and boys and girls students' achievement scores. Significance of difference between the expected scores and observed mean achievement scores was determined by applying paired ‘t’ test.

Data were collected on structured observation schedule to evaluate the quality of multimedia package by the teachers. Its purpose was to evaluate its technical adequacy to the learning objectives of the program. The teacher observations on three point scale it was analyzed by percentage technique.
Data collected on opinionnaire to elicit student opinion towards multimedia package were analyzed by computing statement-wise response and over all mean response.

5.6 Findings of the Study

The findings of the study are the following:

1. The post-test mean scores of students on multimedia method of instruction were high as compared with the conventional method of instruction. It was concluded that students who received multimedia method of instruction showed significantly better achievement than the students who received instructions in conventional manner. This finding depicts the effectiveness of the multimedia method of instruction as compared with the conventional method of instruction in Biology.

2. The post-test mean scores of boys under multimedia method of instruction are significantly different from conventional method of instruction. Therefore, there is significant difference between post-test mean scores of boy students under multimedia method of instruction and conventional method of instruction in Biology. It can be concluded that the said significant
difference was due to the treatment in the form of multimedia method of instruction received by the experimental group boys than the conventional group.

3. The post-test mean scores of the two paired groups are significantly different. It means that the girl students of the experimental group who received multimedia method of instruction performed better achievement in Biology than the girl students who received conventional method of instruction in Biology.

4. The mean value in the post-test of multimedia method of instruction for boys were high and girls were very high and in conventional method of instruction for boys were high and girls were very high in both the method of instruction girls shows better achievement than the boy students.

5. The mean score of multimedia method of instruction in post-test was very high, and in the conventional method of instruction in post-test was high. But in multimedia method of instruction post-test performance was effectively better than the post-test performance of conventional method of
instruction. The finding depicts the effectiveness of the multimedia method of instruction is more in Biology learning.

6. The mean score in the pretest of multimedia method of instruction for boys were very low and in the post-test of multimedia method of instruction for boys was very high and in conventional method of instruction for boys in pretest were very low and in the post-test of conventional method of instruction for boys was very high in both the method of instruction boys shows better achievement in the post-test, and it is compared with the conventional method of instruction the multimedia method of instruction is more effective.

7. The mean score in the pretest of multimedia method of instruction for girls were very low and in the post-test of multimedia method of instruction for girls were very high and in conventional method of instruction for girls in pretest were low and in the post-test of conventional method of instruction for girls was high in both the method of instruction girls showed better achievement in the post-test, and it was concluded that girl students who received multimedia method of instruction shows significantly better achievement than the students who received instructions in conventional method.
8. The mean score in the pretest of multimedia method of instruction for boys and girls were low and in the post-test of multimedia method of instruction for boys and girls was high and in conventional method of instruction for boys and girls in the pretest were low and in the post-test of conventional method of instruction for boys and girls showed better performance, and in both the method of instruction girls shows better achievement in the post-test, and it is compared with the conventional method of instruction the multimedia method of instruction is more effective for both boys and girls, but it is more effective for girls students who received multimedia method of instruction showed significantly better achievement than the students who received in conventional manner.

9. The post-test mean scores of the boys in conventional method of instruction was high as compared to the girls, so difference between the two means was not statistically significant.

10. The post-test mean scores of the boys under multimedia method of instruction was high as compared to the girls, therefore, difference between the two means was not statistically significant.
11. The mean scores for the boy students in the conventional method of instruction were low as compared to the girls. These two scores are not significantly different.

12. The calculated mean score for the boy students in the multimedia method of instruction were low as compared to the girls. It shows that the girl students performance is better than the boy students under multimedia method of instruction in the topic The Study of Cells. The above two mean scores are not significantly different.

13. The mean score for boy students under the conventional method of instruction in pre-test was very low as compared to the post-test mean score; these two mean scores are not significantly different.

14. The mean scores for boy students under the multimedia method of instruction in the topic The Living World in pre-test was low as compared to the post-test scores, these two mean scores are significantly different. This finding reveals that the effectiveness of the multimedia method of instruction in the topic The Living World is good.
15. The mean scores for girl students under the conventional method of instruction in pre-test was low as compared to the post-test scores, these two mean scores are not significantly different.

16. The mean scores for girl students under the multimedia method of instruction in the topic The Living World in pre-test was low as compared to the post-test scores, these two mean scores are not significantly different. This finding shows that the effectiveness of the multimedia method of instruction in the topic The Living World is good.

17. The obtained mean scores for boy students under the conventional method of instruction in pre was low as compared to the post-test scores, these two mean scores are significantly different.

18. The mean scores for boy students under the multimedia method of instruction in the topic The Study of Cells in pre-test was low as compared to the post-test scores, these two mean scores are significantly different. This finding reveals that the effectiveness of the multimedia method of instruction in the topic The Study of Cells is good.
19. The obtained mean scores for girl students under the conventional method of instruction in the topic The Study of Cells in was low as compared to the post-test scores, these two mean scores are significantly different.

20. The obtained mean scores for girl students under the multimedia method of instruction in the topic The Study of Cells in pre-test was low as compared to the post-test scores, these two mean scores are not significantly. This finding shows that the effectiveness of the multimedia method of instruction in the topic The Study of Cells is good.

21. The mean scores of students under the conventional method of instruction in the topic The Living World in the pre-test was low as compared to the post-test scores, these two mean scores are significantly different.

22. The obtained mean scores of students under the multimedia method of instruction in the topic The Living World in the pre-test was low as compared to the post-test scores, the achievement mean scores of post-test is significant. The finding showed that the effectiveness of the multimedia method of instruction was effective in the topic The Living World. The
students showed that better performance in their post-test score.

23. The mean scores of students under the conventional method of instruction in the topic The Study of Cells in pre-test was low as compared to the post-test scores, these two mean scores are not significant. It can be concluded that the said difference was not significant.

24. The obtained mean scores of students under the multimedia method of instruction in the topic The Study of Cells in the pre-test was low as compared to the post-test scores, The achievement mean scores of students under the multimedia method of instruction in the topic The Study of Cells was not significantly different. But finding shows that the effectiveness of the multimedia method of instruction was effective in the topic The Study of Cells The students showed that better performance in their post-test score.

5.7 Analysis of Multimedia Package Observed by the Teachers

Overall observation

The observation schedule designed to elicit teachers' observation about multimedia package, comprised three main areas
of statements, these aspects included technical-instructive adaptation: interface design (screen design), didactic or curricular adaptation and usefulness.

The overall average scores for the first cluster show that screen design was quite appropriate and teachers were fully satisfied with it.

The overall average scores for the second cluster revealed the style of curricular adoption in multimedia software was systematic as felt by the observers.

Learning contents: The overall average scores for this cluster were also high, which indicates that learning content was clearly presented in the multimedia package.

Learning activities: The four statements pertaining to learning activities gained the good opinion, which reflects the learning activities are emphasized in multimedia package.

Evaluation: This sub cluster having eight statements average scores depicts that comprehensive evaluation takes place throughout the multimedia package.
Motivation: Two statements in this sub cluster the average score shows that the students have motivation to learn the content properly.

Usefulness: The average scores for the third cluster revealed that the multimedia package was useful for high school students for their individual learning and at their own pace.

5.8 Experimental Group Students' Opinion about Multimedia Package

Students in the experimental group responded on an opinionnaire to rate the multimedia method of instruction software. The findings of the students' opinions are summarized as under:

i) The multimedia method of instruction package imparts instruction according to the material given in the textbook.

ii) The multimedia package content presented here is relevant to the objectives of the secondary school Biology.

iii) The subject matter was logically sequenced and language also simple readable and understandable.

iv) Voice, text and images are adequately presented in the multimedia package.
v) The navigating nature of the multimedia presentation was more effective and it is user friendly package. Students can easily operate and proceed through it.

vi) It is an instructional package enriched with thought provoking multiple choice items along with feedback to guide and foster learning.

vii) This multimedia package constantly evaluates the learning progress of the student.

viii) This package provides the student with a facility to proceed at with ones own pace.

ix) This package brings clarity to the concepts of the students.

x) Students like this package than conventional method and learn more through this package than the other method of instruction.

xi) Students opined that the multimedia package is an individualized instructional package as it provides the students with multiple choice paths to proceed on according to their own ability and choice.

xii) Study through multimedia package is more interesting than the conventional method of instruction.

xiii) This multimedia package has to be used as complementary material to the conventional class room learning.
5.9 Discussion and Conclusion

The basic purpose of the present study was to development and validation of multimedia package that is two fold purposes, firstly the development of a multimedia package (software) and secondly validation of the multimedia package by comparison of multimedia method instruction and conventional method of instruction. It is not only a comparison of two modes of instruction but of two theoretical paradigms. Conventional method represents a paradigm whereby knowledge is transmitted from teacher to student. Something is poured in learners mind and the learner is a passive recipient of knowledge. Teacher plays an active part in this mode of instruction. Multimedia method of instruction represents a paradigm where knowledge is constructed and sought by the learner. Learner plays an active role in learning process. Learning is individualized, self paced and hands on.

These two groups, experimental and control group matched by intellectual capacity were randomly assigned to the experimental group and control group to receive multimedia package instruction and conventional instruction, respectively. Students' learning was measured in terms of scores on pre and post achievement test. Findings of the experiment revealed that students of the multimedia
method of instruction group outperformed the matched students of the conventional method of instruction group. Students who encountered multimedia package (software) learned more than those who encountered conventional method of instruction.

Results of the present study demonstrated that multimedia method of instruction was an effective for knowledge, understanding, application and skill domains of learning as well as for learning in all content areas of Biology. Mean achievement scores of the students in their post-test in both the topics are equal in experimental group, but in conventional it is different.

The results of the present study was in consonance with the results of many of the experimental studies demonstrating preparation and validation of computer software and effectiveness of effectiveness of computer assisted instruction for better student achievement in Biology.

Thus, to ascertain the effectiveness of multimedia it would be reasonable to compare it with classroom instruction. A number of studies (Najjar, 1996) have been conducted in the area to ascertain the effectiveness of multimedia instruction. Analysis has been done by Bosco, 1986; Fletcher, 1989, 1990; Khalili and Shashaani, 1994;
Kulik, et al. 1983; Kulik, Kulik, and Bangert-Drowns, 1985; Kulik, et al. 1980; Kulik, et al. 1986; Schmidt, et al. 1985 by examining 200 over studies. The information included general science and biosciences. The control group normally learnt the information via classroom or lecture combined with hands-on experiments. The comparison group learnt information via interactive video discs or computer based instruction. The achievement of learning was measured via tests taken at the end of the lessons. Over this wide range of students, meta-analysis found that learning was higher when computer-based education was used. Learning also appeared to take less time when multimedia instruction was used.

Computer multimedia are highly promising educational tools but it is the way computers are used rather than the actual machines themselves that contribute to learning. Investigator is of the opinion that effectiveness of multimedia package instruction for improved student learning as demonstrated by the present study may be attributed to the multimedia software used in the experiment and the way it was used.

The multimedia package software used in the study was developed by the investigator as no software was available to serve the purpose effectively. Educational multimedia package software
development is not the task of an individual. It requires a team effort and host of resources. In spite of these limitations software used in the experiment proved effective for student learning as compared to conventional classroom instruction. The salient features of the multimedia package software that might have caused better student learning are discussed in the preceding part.

a. **Mode of Presentation:** Tutorial mode of presentation was employed in the multimedia package as it was to be used to deliver the entire instructional sequence similar to the teachers' classroom instruction on the topics. To enrich learning the unfamiliar terms and concepts were explained through in glossary by hyperlinks. Multiple choice questions along with their feedback followed each text segment so that students may keep track of their own learning. These questions also provided the students with a facility of drill and practice.

b. **Underlying Learning Theory:** Some theorists like Melinda (1991) and Bereuter (1990) believe that approaches from various learning theories can be combined in a particular instructional program for the purpose to enhance and improve student learning. Tutorial programs are generally classified into two categories that is linear based on behaviorist approach and branching based on cognitive approach (Allies and Trollip, 1991).
A simple linear tutorial gives the same instructional sequence of explanation, practice and feedback to all the learners regardless their individual differences. A branching tutorial directs learning along alternative paths depending on learners’ performance and ability. Although the tutorial software mainly adopts cognitive approach to learning but behaviorist and constructivist approaches can also be incorporated in it. The software used in the present study employs cognitive approach to learning. A large number of multiple choice items not only provoke thought processes of the student but also provide them with a facility to drill and practice. Drill and practice facility employs behaviorist approach in the package. Incorporation of hyperlinks made the software interactive that is an exclusive characteristic of constructivist approach.

**c. Multiple choice items:** A distinguishing characteristic of the software is multiple choice items incorporated in it. A conscious effort was made to make the items explore knowledge, understanding, application and skill of the learners. Students utilizing the multimedia package encounter these items; this experience certainly provokes their thought process and hence improves the quality of their learning.
Like any other tool multimedia package can be used beautifully, efficiently and effectively. Worth of any tool depends upon its utilization. Worth of multimedia package to enhance student learning is not unprecedented but it depends upon the way it is used to support and enhance learning. Fortunately the potential of multimedia package in teaching-learning process is under utilized in India; moreover, there is consistency in education policies. National Curriculum Framework 2005 has emphasized the use of computers and ICT to improve the quality of instruction and aimed at providing the schools with necessary facilities to use computers for instructional purposes.

The National Policy on Education 1986, as modified in 1992, stressed upon employing educational technology to improve the quality of education. The policy statement led to two major centrally sponsored schemes, namely, Educational Technology (ET) and Computer Literacy and Studies in Schools (CLASS) paving the way for a more comprehensive centrally sponsored scheme – Information and Communication Technology @ Schools in 2004.

Educational technology also found a significant place in another scheme on up-gradation of science education. The significant role of ICT in school education been highlighted in the National

With the convergence of technologies it has become imperative to take a comprehensive look at all possible information and communication technologies for improving school education in the country. The comprehensive choice of ICT for holistic development of education can be built only on a sound policy. The initiative of ICT Policy in School Education is inspired by the tremendous potential of ICT for enhancing outreach and improving quality of education. This policy endeavours to provide guidelines to assist the States in optimizing the use of ICT in school education within a national policy framework.

The National Task Force on Information Technology and Software Development (IT Task Force, 1998), made specific recommendations on introduction of IT in the education sector including schools for making computers accessible through the Vidyarthi Computer Scheme, Shikshak Computer Scheme and
School Computer Schemes. Smart Schools were recommended on a pilot basis in each State for demonstration purposes. It was also stipulated that 1 to three percent of the total budget was to be spent on provision of computers to all educational Institutions upto Secondary and Higher Secondary level during the next five years. Based on the experience gained so far, a need for a revision of the scheme of ICT @ Schools was felt on the following grounds.

- **Expansion with emphasis on quality and equity:** A need was felt to expand the outreach of the scheme to cover all Government and Government aided secondary and higher secondary schools in the country with emphasis on educationally backward blocks and areas with concentration of SC, ST, minority and weaker sections. Along with that, there is a need for ensuring dependable power supply where the electricity supply is erratic and internet connectivity, including broadband connection.

- **Demonstration effect:** There is a need to set up smart schools at the district level to serve as demonstration models for neighboring schools.

- **Teacher engagement and better in-service and pre-service training:** Since ICT education will be imparted to all secondary and higher secondary students, an exclusive ICT teacher is
required for each school. Similarly, there is a need for pre service as well as in service training of all teachers in effective use of ICT in teaching and learning process.

- **Development of e-content**: There is also a need to develop and use appropriate e-content to enhance the comprehension levels of children in various subjects.

- A strong mechanism for monitoring and management needs to be set in place at all levels for ensuring optimal delivery of set targets.

- The Scheme envisages that the School Management Committee, Parents Teachers Association and local bodies would be involved in the programme management along with the setting up of an online web-based portal for real-time monitoring and transparency. In addition, independent monitoring and evaluation is envisaged.

Indian experiments in taking computers to schools involved the participation of a large number of institutions for tasks such as the supply of hardware and software, the development of Computer Assisted Learning (CAL) packages, and the training of teachers. A project called Computer Literacy and Studies (CLASS) launched in 1984 was a joint initiative of MHRD, Department of Electronics, and
NCERT. It covered 42 Resource Centres and 2,582 schools. It made use of microcomputers provided by the BBC. The evaluation of the project by SAC revealed the need for greater interaction between resource centers and project schools, the need to reduce the time gap between the training of teachers, the installation of systems, and the initiation of activities in schools, the imparting of adequate hands-on experience to teachers and students, and the provision of computer literacy programmes in the timetable. The project had only a limited success, and has been described at best as a “spectator sport”.

A revised CLASS project during 1993–2004 saw the introduction of PC machines in keeping with broad global trends. Subsequently, the government initiated the CLASS 2000 programme with the aim of providing computer literacy in 10,000 schools, computer-assisted learning in 1,000 schools, and computer-based learning in 100 schools. These 100 schools were called smart schools, and were designed to be agents of change seeking to promote the extensive use of computers in the teaching-learning process. This, too, has not yielded the expected results. In the words of (Mallik, 1993), “Ambiguity of purpose, tentative policies and faltering practices marked the major computing initiatives in India during the
last two decades... Schools are using IT as an add-on, not as an integral part of a new pedagogy."

Though all these interventions did make some impact, where the schools and teachers went the extra mile to avail of the facilities provided using their own ingenuity, many of these schemes have been half-hearted attempts even at the conceptual level. Computer literacy is not so much about knowing the technical jargon, but rather learning to use computers in a meaningful way, that is, meaningful to children.

Biology occupies a unique position in the school curriculum. Biology is central to many science related courses such as medicine, pharmacy, agriculture, nursing, biochemistry and genetics so on. It is obvious that no student intending to study these disciplines can do without Biology. These factors, among others, have drawn attention of researchers and curriculum planners towards Biology as a subject in the school curriculum (Kareem, 2003). In spite of the importance and popularity of Biology among students, performance at senior secondary school level had been poor (Ahmed, 2008). The desire to know the causes of the poor performance in Biology has been the focus of researchers for some time now. It has been observed that poor performance in the sciences is caused by the poor quality of
teaching strategies and science teachers, overcrowded classrooms, and lack of suitable and adequate science equipment, among others (Abdullahi, 1982; Bajah, 1979; Kareem, 2003; Ogunniyi, 1979). Students perform poorly in Biology because the Biology classes are usually too large and heterogeneous in terms of ability level. In addition, the laboratories are ill-equipped and the Biology syllabus is over loaded (Ahmed, 2008; Ajayi, 1998).

As multimedia teaching technologies become more widely advocated and employed in education, researchers strive to understand the influence of such technologies on student learning. Advances in technology enable pedagogical enhancements that some believe can revolutionize traditional methods of teaching and learning. Advanced technologies, especially multimedia instruction, which often involves introducing or enhancing the visual aspects of the presentation of course contents, created an active learning environment, improved students' performance, fostered positive attitudes toward learning complex concepts, increased communication, and could be adapted to all learning styles and levels of instruction (Harris, 2002). Researchers suggest that, compared to classes with a traditional teacher-leading approach, those using multimedia are better liked by students and yield slight but
statistically significant improvements in student learning as measured by both student self-report and objective outcome testing. Such encouraging findings have precipitated the adoption of these technologies on a widespread basis. Despite many studies suggesting that multimedia instruction benefits students, there are also some that found no significant differences between multimedia classes and traditional classes.

Thus, to ascertain the effectiveness of multimedia it would be reasonable to compare it with classroom instruction. The achievement of learning was measured via tests taken at the end of the lessons. Over this wide range of students, meta-analysis found that learning was higher when computer-based education was used. Learning also appeared to take less time when multimedia instruction was used.

Findings of this experimental study lead to the following conclusions:

a. Multimedia method of instruction is a better method of instruction for high school level students as compared with the conventional method of instruction.
b. Multimedia method of instruction proved as more effective method as compared with conventional method of instruction to enhance student learning in Biology at secondary school.

c. Multimedia method of instruction proved to be a better mode of instruction than the conventional method of instruction in both the topic of Biology.

d. While developing multimedia software it was assumed that hyperlinks and questions in multimedia software will enhance learning. Students supported the assumptions that hyperlinks and questions in multimedia software direct and foster learning.

e. Students benefited from the individualization, self pacing and interactive nature of the multimedia software.

f. Interactive self paced and individualized mode of presentation as used in the present study is better strategies to enhance student learning than the conventional method of instruction.

g. Incorporation of questions and feedback in instructional process has a better impact on student learning.

h. Girls’ student shows their better performance in multimedia method of instruction as well as conventional method of instruction.

i. Learners’ active participation in instructional process results for better student achievement.
Multimedia method of instruction is a powerful, useful and interesting mode of instruction.

5.10 Educational Implications of the Study

Combining research and theory with practical and useful ideas to our students learning is a challenge to many teachers with mission and vision. Teachers can help the learners to learn by discovering the key to their individual learning styles. Still, teachers seem to be reluctant to switch over to new instructional strategies, because of their ignorance about the comparative effectiveness of these strategies even in the context of an ICT era.

The findings of the present study are related to the effectiveness of multimedia package (software) based on individualized instructional strategies. It also gives a view on the performance of the students in their achievement. Teachers are therefore able to select the most appropriate method for classroom teaching in accordance with the needs and caliber of the students.

The scope of the present study was extended to comparison of multimedia method of instruction and conventional method of instruction by total achievement in Biology and sub total in two topics and gender wise achievement. It shows that multimedia
method of instruction was more effective than conventional method of instruction in learning of Biology.

5.11 Possibilities of Multimedia Method of Instruction in Indian Schools

Government of India has decided in its revised scheme of information and communication technology in schools (ICT in schools) during the 11th Five Year Plan:

The scheme of educational technology (ET) was started in 1972 during the 4th Five Year Plan. Under the scheme 100% assistance was given to 6 state institutes of educational technology (SIET) and the states/ UTs were assisted for procurement of radio cum cassette players and colour TVs. Further, in recognition of the importance of role of ICT in education, the computer literacy and studies in schools (CLASS) project was introduced as a pilot project in 1984-85 with the use of BBC micros. The project was adopted as a centrally sponsored scheme during the 8th Five Year Plan (1993-98) and its scope was widened to provide financial grants to educational institutions and also to cover new Government and government aided secondary and higher secondary schools. The use and supply of software was limited with coverage confined only to higher secondary Schools.
The national task force on information technology and software development (IT Task Force, 1998), made specific recommendations on introduction of IT in the education sector including schools for making computers accessible through the vidyarthi computer scheme, Shikshak computer scheme and school Computer schemes. Smart schools were recommended on a pilot basis in each state for demonstration purposes. It was also stipulated that 1 to three percent of the total budget was to be spent on provision of computers to all educational institutions upto secondary and higher secondary level during the next five years. Based on the experience gained so far, a need for a revision of the scheme of ICT @ schools was felt on the following grounds.

- **Expansion with emphasis on quality and equity:** A need was felt to expand the outreach of the scheme to cover all Government and Government aided secondary and higher secondary schools in the country with emphasis on educationally backward blocks and areas with concentration of SC, ST, minority and weaker sections. Along-with that, there is a need for ensuring dependable power supply where the electricity supply is erratic and internet connectivity, including broadband connection.
• **Demonstration effect:** There is a need to set up smart schools at the district level to serve as demonstration models for neighboring schools.

• Regarding teacher engagement and better in-service and pre-service training, ICT education will be imparted to all secondary and higher secondary students, an exclusive ICT teacher is required for each school. Similarly, there is a need for pre-service as well as in-service training of all teachers in effective use of ICT in teaching and learning process.

• **Development of e-content:** There is also a need to develop and use appropriate e-content to enhance the comprehension levels of children in various subjects.

• A strong mechanism for monitoring and management needs to be set in place at all levels for ensuring optimal delivery of set targets.

• The scheme envisages that the School Management Committee, Parents Teachers Association and local bodies would be involved in the programme management along-with the setting up of an online web-based portal for real-time monitoring and transparency. In addition, independent monitoring and evaluation is envisaged.
5.12 Suggestions for Further Research

The present study brings to light a number of new areas to be covered by future researchers. The following problems, if studied would help to broaden the perspective of the present study.

1. The present study is limited to development and validation of multimedia package in Biology of IX standard Karnataka State Board Syllabus. Hence, different types of packages can be developed and validated on different subjects, which are helpful to different stages of students.

2. Interactive multimedia instructional tool can be developed to evaluate its effectiveness in learning Biology at secondary level.

3. The study could be replicated on a large sample giving adequate coverage to different variables like gender, locality, management, socio economic status and personality variables, on a state wide or a nation wide basis.

4. The study can be repeated at primary, higher secondary and college level of education.

5. This study was tested for teaching of only two topics in Biology for IX standard students. This can be extended to whole subject and different subjects and at different levels of education.
6. Further research is needed to investigate use of other types of multimedia instead of solely using different colors, and sound or combination of visual and audible media.

7. To study the effects of visual and verbal prompts in multimedia instruction at secondary level teaching Biology.

8. Multimedia packages on practical oriented content can be developed at different level of learning.

9. The effects of multimedia technologies to improve student knowledge and understanding of Biology concepts can be studied.

10. Effectiveness of multimedia packages in virtual practical can be studied.

11. To study the effectiveness of innovative method of instruction and traditional method of instruction.

12. Comparative study can be conducted to evaluate the effectiveness between multimedia method of instruction versus conventional method of instruction for Biology teaching at high school level.

13. Surveys can be conducted to identify the learning difficulties of traditional method of instruction, effectiveness of present system of education and difficulties faced by the teachers who teach different subjects in different levels.
14. Studies are required to know technological competency of teachers who handle different apparatus OHP, Slide projectors, Film projectors and Computers etc., and how the teachers teach with the amount and specification of technologies available in different schools.

The researcher wishes to put on record the humble efforts and the scholarly guidance which converted itself in present form, which, it is hoped, may be useful for one and all.