CHAPTER – VII
SUMMARY AND CONCLUSIONS

The data collected in the present investigation have been analysed and findings presented in the preceding chapters. This chapter presents a brief summary of the investigations, the findings, discussion of the findings, conclusions that have been drawn from the findings, implications for education and suggestions for further research in the fields.

7.1 Re-statement of the Problem

The purpose of the study was “Development and Validation of Computer based Multimedia Packages for Teaching Biological Science and its Effect on Learning among Secondary School Students.”

7.2 General Objectives

The present study was designed with the following General Objectives in view:

i. To develop and validate computer based multimedia packages on Biological Science for Secondary School students

ii. To construct tools to find out the effectiveness of multimedia packages on learning Biological Science (Criterion Referenced Test)

iii. To study the relative effectiveness of computer
iv. To compare the effect of various elements of multimedia (text + still pictures, text + still pictures + audio, text + still pictures + animation, text + still pictures + animation + audio) on learning Biological Science.

v. To determine the influence of certain intervening variables, Intelligence, language aptitude, computer awareness, attitude towards science on learning outcome.

7.3 Specific Objectives

The present study was designed with the following specific objectives in view:

1. To study the significant mean difference between pre-test and post-test in Biological Science among the Control Group.

2. To study the significant mean difference between pre-test and post-test in Biological Science among the EG$_1$.

3. To study the significant mean difference between pre-test and post-test in Biological Science among the EG$_2$.

4. To study the significant mean difference between pre-test and post-test in Biological Science among the EG$_3$.

5. To study the significant mean difference between pre-test and
post-test in Biological Science among the EG₄

6. To study the significant mean difference in pre-test in Biological Science among Control Group and EG₁

7. To study the significant mean difference in pre-test in Biological Science among Control Group and EG₂

8. To study the significant mean difference in pre-test in Biological Science among Control Group and EG₃

9. To study the significant mean difference in pre-test in Biological Science among Control Group and EG₄

10. To study the significant mean difference in post-test in Biological Science among Control Group and EG₁

11. To study the significant mean difference in post-test in Biological Science among Control Group and EG₂

12. To study the significant mean difference in post-test in Biological Science among Control Group and EG₃

13. To study the significant mean difference in post-test in Biological Science among Control Group and EG₄

14. To study the significant mean difference in achievement gain in Biological Science among Control Group and EG₁

15. To study the significant mean difference in achievement gain in Biological Science among Control Group and EG₂
16. To study the significant mean difference in achievement gain in Biological Science among Control Group and EG$_3$

17. To study the significant mean difference in achievement gain in Biological Science among Control Group and EG$_4$

18. To study the significant mean difference in achievement gain in Biological Science between the Experimental Groups 1 & 2

19. To study the significant mean difference in achievement gain in Biological Science between the Experimental Groups 1 & 3

20. To study the significant mean difference in achievement gain in Biological Science between the Experimental Groups 1 & 4

21. To study the significant mean difference in achievement gain in Biological Science between the Experimental Groups 2 & 3

22. To study the significant mean difference in achievement gain in Biological Science between the Experimental Groups 2 & 4

23. To study the significant mean difference in achievement gain in Biological Science between the Experimental Groups 3 & 4

24. To study the significant relationship between the achievement gain and the intervening variables such as Intelligence, Language Aptitude, Computer-awareness, Attitude towards Science

25. To study the interaction effect between ‘EG$_1$ treatment’ X ‘levels’ of students with respect to achievement gain in Biological Science in the post-test

26. To study the interaction effect between ‘EG$_2$ treatment’ X
‘levels’ of students with respect to achievement gain in Biological Science in the post-test

27. To study the interaction effect between ‘EG₃ treatment’ X ‘levels’ of students with respect to achievement gain in Biological Science in the post-test

28. To study the interaction between ‘EG₄ treatment’ X ‘levels’ of students with respect to achievement gain in Biological Science in the post-test

7.4 Hypotheses

Keeping in view the above specific objectives, the following research hypotheses were framed.

i. **Hypotheses related to within Group Differences**

1. There is a significant mean difference between pre-test and post-test in Biological Science among the Control Group of the study

2. There is a significant mean difference between pre-test and post-test in Biological Science among the EG₁ of the study

3. There is a significant mean difference between pre-test and post-test in Biological Science among the EG₂ of the study

4. There is a significant mean difference between pre-test and post-test in Biological Science among the EG₃ of the study
5. There is a significant mean difference between pre-test and post-test in Biological Science among the EG_4 of the study

**ii. Hypotheses related to between Group Differences**

6. There is a significant mean difference in pre-test in Biological Science among Control Group and EG_1 of the study

7. There is a significant mean difference in pre-test in Biological Science among Control Group and EG_2 of the study

8. There is a significant mean difference in pre-test in Biological Science among Control Group and EG_3 of the study

9. There is a significant mean difference in pre-test in Biological Science among Control Group and EG_4 of the study

10. There is a significant mean difference in post-test in Biological Science among Control Group and EG_1 of the study

11. There is a significant mean difference in post-test in Biological Science among Control Group and EG_2 of the study

12. There is a significant mean difference in post-test in
Biological Science among Control Group and EG₃ of the study

13. There is a significant mean difference in post-test in Biological Science among Control Group and EG₄ of the study

14. There is a significant mean difference in achievement gain in Biological Science among Control Group and EG₁ of the study

15. There is a significant mean difference in achievement gain in Biological Science among Control Group and EG₂ of the study

16. There is a significant mean difference in achievement gain in Biological Science among Control Group and EG₃ of the study

17. There is a significant mean difference in achievement gain in Biological Science among Control Group and EG₄ of the study

18. There is a significant mean difference in achievement gain in Biological Science between the Experimental Groups 1 & 2

19. There is a significant mean difference in achievement gain in Biological Science between the Experimental Groups 1 & 3

20. There is a significant mean difference in
achievement gain in Biological Science between the Experimental Groups 1 & 4

21. There is a significant mean difference in achievement gain in Biological Science between the Experimental Groups 2 & 3

22. There is a significant mean difference in achievement gain in Biological Science between the Experimental Groups 2 & 4

23. There is a significant mean difference in achievement gain in Biological Science between the Experimental Groups 3 & 4

iii. Correlation: Hypothesis Related to the Influence of Intervening Variables

24. There is a significant relationship between the achievement gain and the intervening variables such as Intelligence, Language Aptitude, Computer-awareness, Attitude towards Science

iv. Hypotheses Related to within Group

25. There is a significant interaction effect between treatments (EG₁ / conventional) and Intelligence levels (high/low) of students with respect to achievement gain in Biological Science in post-test

26. There is a significant interaction effect between treatments (EG₂ / conventional) and Intelligence levels (high/low) of students with respect to
achievement gain in Biological Science in post-test

27. There is a significant interaction effect between treatments (EG\textsubscript{3} / conventional) and Intelligence levels (high/low) of students with respect to achievement gain in Biological Science in post-test

28. There is a significant interaction effect between treatments (EG\textsubscript{4} / conventional) and Intelligence levels (high/low) of students with respect to achievement gain in Biological Science in post-test

7.5 Variables Considered in the Study

7.5.1 Independent Variables

The method of Learning (Treatment Variables):

i. Control Group (Conventional Method)
ii. EG 1 (Text + Still Pictures)
iii. EG 2 (Text + Still Pictures + Audio)
iv. EG 3 (Text + Still Pictures + Animation)
v. EG 4 (Text + Still pictures + Animation + Audio)

7.5.2 Dependent Variable

Knowledge gain (variable i.e., seen as change)

7.5.3 Intervening Variables

i. Intelligence
ii. Language Aptitude
iii. Computer awareness
iv. Attitude towards Science

7.6 Methodology
7.7.1 Method of Research

The objective of the present study was to develop the multimedia packages and to study the effectiveness of the packages in learning. These objectives demand to design, develop and validate the computer based interactive multimedia packages and adoption of an experimental design, since systematic manipulation of treatment variables and observation of its effect on learning will be needed. Experimental designs are especially useful in addressing the questions about the effectiveness and impact of programs. Therefore, the investigator employed the “Pretest-Posttest Multi-Group Design” for the present study.

7.6.2 Data Gathering Tools

Review of related testing material revealed that, Suitable tool for the assessment of Intelligence, Language aptitude and Attitude towards science are readily available. Hence it was decided to use Non Verbal Group Intelligence test (NVGIT) (2002) developed by Imtisungba AO (Kohima); Language Aptitude Test (2004) developed and standardized by R. Ravi; Science Attitude Scale (SAS) (1990) Avinash Grewal, (ii) A test for the assessment of Knowledge gain in Biological Science based on Karnataka State Syllabus of IX Standard is conspicuous by its absence. Hence, it was decided to construct a suitable test (CRT) for the assessment of knowledge gain of student in Biological Science, (iii) Multimedia packages on content of
Biological Science subject was developed by the investigator.

7.6.3 Sample

One of the important steps in any research is to draw a sample which would truly represent the characteristics of the population in which the inferences are intended to be made. In this sense a sample is the population in a miniature form. Generally, the sample for a research is drawn by using either random sampling technique, stratified random sampling techniques and so on depending upon the purpose of the study.

The population for the present study was all those students who were studying Biological Science subject at the secondary schools in Dandeli city, Haliyal Taluk. 175 students with the breakup of 90 boys and 85 girls studying in IX standard were drawn using Random proportionate sampling technique among the secondary schools forms the sample.

7.6.4 Collection of Data

After completing the development of multimedia packages and adoption of tools for the study, the pre-study and post-study was conducted by the investigator. In order to collect the experimental data by manipulating the independent variable, the following experimentation was planned and
carried out. The phases of data collection are given below:

**Phase – I**

During the first day, the investigator started the process by assigning the students randomly from the list of all students. The number of students selected was pre-determined according to the proportion of 35%. After selecting the students, they were given a short briefing about the experimentation and what the investigator is going to do. Students who were selected randomly, but absent on the first day of data collection or having plan to take leave on the next day was replaced by other students.

After building rapport and giving instructions to them, the investigator distributed the Personal Information Proforma constructed by the investigator, Science Attitude Scale (1990) constructed by Avinash Grewal, Criterion Reference Test constructed by the investigator, Noverbal group intelligence test(2002) constructed by Imtisungba Ao (Kohima) were administered and collected data from 175 girls and boys groups of IX standard students selected at random. The time given for PIP and science attitude scale was 20minutes, CRT (Pre-test) 30 minutes and Non-verbal Group Intelligence Test was given for 30 minutes. In the whole, the first phase of data collection was completed in 80 minutes.

**Phase – II**
The phase II of data collection would be continued in the next day. The sampled students were randomly assigned to the control and Experimental Group of the study. One by one, all the Experimental Groups’ students were manipulated with the multimedia packages individually. To the Control Group, the content was taught by the school teacher through the conventional teaching method. There was no time restriction for learning the packages but the time taken by the students ranges from 20-30 minutes with the average of 26 minutes.

Schematic Flow of Data Collection
After learning the content, the students were engaged with the Language Aptitude Test (LAT)(2004) constructed by Ravi R and CRT (post-test) were administered and collected data from 175 girls and boys groups of control and experimental group of IX standard students. The time given for LAT was 25 minutes and for CRT (post-test) was given for 30 minutes. In the whole, the first phase of data collection was completed in 81 minutes. The reason for not giving the post-test immediately next to the learning of the content is to reduce the carry over effect. Special care was taken to prevent the students of different group to interact with each other till the end of the experimentation.

7.6.5 Statistical Techniques

In pursuance of the objectives of the study as well as the research hypotheses, the t-test, Product Moment Correlation and the ANOVA was used for testing the hypotheses.

7.7 Major Findings

i. Within Group Difference

There is a mean difference in knowledge in Biological Science between the pre-test and post-test in the control and all the
Experimental Groups. The mean score of post-test is higher than that of the pre-test in all the groups of the study.

**ii. Between Group Difference**

- There is a significant mean difference in knowledge of Biological Science among all the groups during post-test phase. All these groups do not significantly differ in pre-test mean scores. Hence, it can be concluded that the method of learning (lecture / multimedia) has caused the mean difference in knowledge of Biological Science in the post-test.

- There is a significant mean difference in gain in Biological Science among all the groups of the study (Control and all Experimental).

- There is a difference in mean achievement gain in Biological Science between the control and Experimental Group 1. It can be inferred that learning through Type-1 multimedia package is more effective than the conventional method (learning method of the Control Group) for learning Biological Science.

- The mean gain of the Experimental Group–2 is higher than the Control Group. Hence, the type-2 multimedia package is effective than the conventional method since the former promotes learning with text, still pictures and audio (voice over).

- There is a difference in mean gain between the Control Group and Experimental Group – 3. Type-3 multimedia package is more effective for learning Biological Science than the conventional method.
The mean difference in gain in Biological Science between the control and the Experimental Group-4. The Type-4 of the multimedia package is enriched with elements like text, visuals, animations and audio.

The mean difference in gain in Biological Science between the Experimental Group 1 and 2. The only difference between these two packages is the addition of audio. The element of audio is an additional feature in Type-2 package.

The mean difference in gain in Biological Science between the Experimental Group 1 and 3. The difference between these two packages is the feature of animation.

The mean difference in gain in Biological Science between the Experimental Groups 1 and 4. The Type-4 package is enriched with the combination of multimedia elements like audio, animation and motion pictures but Type-1 package has only still images with text.

There is very low mean difference in gain between the Experimental Groups 2 and 3, and it is not statistically significant. Type-2 package is combined with the elements viz., text with still pictures and audio whereas, Type-3 is also combined with the elements viz., text and animation. The mean gain score of the two groups are more or less same, it can be concluded that both packages are equally effective in learning Biological Science.

There is a difference in the mean achievement gain in Biological Science between the Experimental Groups 2 and 4. The only difference between these two packages is the feature of
animation. Since the mean gain score of Experimental Group 4 is higher than that of group 2, we can conclude that the element of animation contributes to learning and makes it more effective.

There is mean difference in achievement gain between the two Experimental Groups 3 and 4. These two packages differ in the element of audio. The mean gain score of the Experimental Group 4 is higher than group 3.

Influence of Intervening Variables

There exists a relationship between knowledge gain and the intervening variables viz., Intelligence, Language Aptitude, Computer Awareness and Attitude towards Science.

Related to within Group Interaction

There is difference in conventional method scores and EG-1 scores with respect to achievement in Biological Science – after treatment.

There is significant difference in high intelligence scores and low intelligence scores with respect to achievement in Biological Science – after treatment.

Secondary school students with conventional/EG-1 treatment and high/low intelligence differ significantly in respect of their achievement in Biological Science.

Secondary school students with EG-1 treatment and high Intelligence are high in achievement than the students with Conventional treatment and high intelligence.

Students with conventional treatment and low intelligence are high in achievement than the students with conventional treatment and high intelligence.
There is a significant difference between high intelligence scores and low intelligence scores with respect to achievement in Biological Science – after treatment.

Secondary school students with conventional/EG-2 treatment and high/low intelligence differ significantly in respect of their achievement in Biological Science.

Secondary school students with EG-2 treatment and high intelligence are high in achievement in Biological Science than the students with conventional treatment and high intelligence.

Secondary school students with EG-2 treatment and low intelligence are high in achievement in Biological Science than the students with conventional treatment and low intelligence.

Secondary school students with conventional treatment and high intelligence are high in achievement in Biological Science than the students with conventional treatment and low intelligence.

There is a significant difference between high intelligence scores and low intelligence scores with respect to achievement in Biological Science – after treatment.

Secondary school students with conventional/EG-3 treatment and high/low intelligence differ significantly in respect of their achievement in Biological Science.

Secondary school students with EG-3 treatment and high intelligence are high in achievement in Biological Science than
those with EG-3 and low intelligence.
Secondary school students with EG-3 treatment and low intelligence are high in achievement than the students with conventional treatment and high intelligence.

There is difference in conventional method scores and EG-4 scores with respect to achievement in Biological Science – after treatment.
There is a significant difference between high intelligence scores and low intelligence scores with respect to achievement in Biological Science – after treatment.
Secondary school students with conventional/EG-4 treatment and high/low intelligence differ significantly in respect of their achievement in Biological Science.
Secondary school students with EG-4 treatment and high intelligence are high in achievement in Biological Science than the students with EG-4 treatment and low intelligence.
Secondary school students with EG-4 treatment and high intelligence are high in achievement in Biological Science than with conventional treatment and high intelligence.

7.8 Delimitation of the Study

Keeping in view the objectives and hypotheses, the present study has been delimited as follows:

i. Due to lack of time, money and logistics the researcher considered only the IX standard students for the present study.

ii. The researcher has developed the Multimedia package on single topic Excretory system in man in Biological Science from the prescribed syllabus.
Many schools in the population do not have the laboratory facilities to conduct the experimentation. Hence the sample contains students from two schools of Dandeli city, Haliyal Taluk.

7.9 Discussion and Conclusions

From the result obtained in the present study clearly indicates that both conventional and multimedia methods helped the students to acquire knowledge in Biological Science. Multimedia method is more effective than the conventional teaching method. The study found that multimedia could scaffold learner to gain knowledge on Biological Science. The learning of Biological Science subject could be nurtured through computer based multimedia packages. Multimedia instruction draws more attention in learning the content and assists students to learn more effectively and above all to enjoy such a learning environment. Students learn because the instruction is presented to them in a meaningful way using sounds, pictures and animation. The manipulation of content on Biological Science i.e., Structure and function of Kidney unit through the conventional teaching method and multimedia methods helped the students to acquire knowledge. Further, we can observe that the knowledge acquired is not similar in all the groups. The highest gain score is obtained by the Experimental Group E-4, followed by E-3, E-2, E-1 and the Control Group in the descending order. Hence, the Type-4 multimedia package is most effective in learning Biological Science, whereas, conventional teaching is the least effective
Students under conventional method and EG-1, EG-2, EG-3, EG-4 methods differ in their achievement in Biological Science – after treatment. Also students under high and low intelligence differ in their achievement in Biological Science – after treatment.

When the content is presented with text, still pictures, animation and audio, the learning is most effective. This finding is in line with the findings of Nugen (1982), Palmiter and Elkerton (1991), Mayer and Anderson (1991) and Macaulay (2003)

The present study analyses the effectiveness of various presentation formats by combining the elements of multimedia in learning Biological Science. Four different types of multimedia packages and also the conventional method are effective in learning Biological Science among the students selected for the study. Type-4 multimedia package is most effective since it integrates the elements like text, still and motion pictures, animation and audio. Whereas, in the conventional method the learning occurs only through the lecture which is monotonous and lacks any visual aids. This might be the reasons for the least effectiveness of the conventional method in learning Biological Science.

The method of learning caused the mean score difference in
knowledge of Biological Science at the posttest phase. Comparing the pre and post test scores, it is explicit that all the groups acquired knowledge. Moreover, there is a significant difference in the knowledge gain scores. Hence it can be concluded that the influence of the learning method i.e., conventional or any type of multimedia varies in knowledge gain among the groups of the study. The computerized text accompanied with visual images (Type-1 package) attracted and made the students to learn more effectively than the conventional method. Computer based multimedia package on Biological Science which has text and still picture is more effective than conventional lecture method for learning.

Type-3 package combines the elements viz., text, visuals and animations which makes learning Biological Science more interesting and effective among the students. Type-4 provides the multi-sensory approach in learning and also increase the attention of the learners. Hence, it is the most effective method for learning Biological Science than the conventional method. When the poor readers listened to the same content, it helps them to understand the concept easily. Hence, we can infer that when audio is incorporated in the multimedia package, it is more effective in learning Biological Science. Further, it can be concluded that when both the receptive skills i.e., listening and reading are engaged, the learning is better than the engagement of reading skill alone.
The Experiment Groups 1 and 3 are manipulated with the Type-1 and Type-3 multimedia packages respectively. The difference between these two packages is the feature of animation. Animation is very effective in communicating complex ideas. The Type-3 package, with its added feature is more effective than Type-1 package in learning Biological Science. The Type-4 package is more effective than the Type-1 package in learning Biological Science. Because the Type-4 package is enriched with the combination of multimedia elements like audio, animation and motion pictures but Type-1 package has only still images with text. The Type-2 and 3 reveals that both animation and audio draw the attention of the students without much difference. Animation makes learning more effective when it is added in the multimedia package. The feature of audio contributes more in learning Biological Science. It can be concluded that the element of audio has a substantive effect on learning.

When the content is presented with text and still pictures alone, it provided better learning than conventional method. When an additional feature of (animation / audio) is added, learning is increased. This finding agrees with Mayer and Moreno (1999), Sujit Pal bandana and Asis Kumar Ghosh (2012). Animations are used in multimedia packages to attract attention, engage the learner, and sustain motivation. But in some cases animations may even prejudice learning (Lowe, 2001). Hence, animation needs to be well designed and supported by text to fulfill its undoubted
educational potential. Learning is equally effective in two presentation formats viz., animation or audio with the text and still pictures.

Among intervening variables intelligence, language aptitude, computer awareness attitude towards Biological Science are having positive correlation with the gain scores of the students. This is because when the students are having more intelligence, language skill and computer awareness and positive attitude towards the subject, it increases their learning.

Hence, it can be summarized that students learned better through multimedia. Since multimedia facilities students with interactivity, integration of multi-sensory information, individualization and immediate feedback to learner is deeply engaged and learning is more effective. At the same time, redundant multimedia does not always improve learning. Though the redundancy of multimedia is not seen in the present study, it is already proved by earlier research studies such as Holliday and Thursby (1977) and Najjar L. J. (1996). Hence, it is suggested from the findings that appropriate and well-designed computer based multimedia packages will improve learning even if the course is not useful in for immediate application i.e., Biological Science as a course of study.

7.10 Educational Implications
Many research studies have been conducted to study the impact of multimedia in learning, but discrepancy exists until now. Further, these studies are confined to the overall effectiveness of multimedia in learning. But the present investigation studied the impact of multimedia and the effectiveness of various presentation formats. Moreover there are very fewer research studies available in the area of using multimedia for teaching / learning the subject of Biological Science. These four multimedia packages on Biological Science will contribute to the learning of Biological Science at secondary level.

Computer based multimedia packages mediate in the flow of information in the teaching-learning process. This flow between the learner and the factual information that he/she has to absorb knowledge. Multimedia packages provides immediate feedback to the learner with regard to one’s progress, information about a model in which the learner is studying and rapport between the learner and instructor or experimenter.

The main strength of the computer as a learning medium is the ability to process information very quickly and accurately. Multimedia packages have an ability to adapt and respond to the learner’s needs, difficulties and progress. Multimedia packages use the computer to present the learner with a series of exercises which he/she must complete by giving some response – an answer. The computer processes that response to determine whether the
response is correct or incorrect. It may then provide a feedback on one's progress.

Multimedia packages offer a means of providing endless drill and practice without repetition, at a pace that can be controlled by the learner. It is possible to arrange the exercises on the learner’s progress. Multimedia packages proceed the ability to tailor a drill and practice session to the progress of each learner combined with helpful feedback, can lead to more effective learning. Its use with small groups offers many of the advantages of the classroom teaching and individualized methods while avoiding their disadvantages.

Multimedia package is much close to a real life teacher than to the audiovisual equipment previously found in the classroom. Its viewpoint is to provide a method of including very high resolution; animated color graphics in multimedia packages by substituting pictures of a real thing for simplifies diagrams. Multimedia packages with interactive video offers a range of new styles of learning. Learning through multimedia package makes students to progress through a logical sequence from some appropriate starting point to an expected finishing point.

Present study proves that the subject of Biological Science can be effectively taught by using the multimedia technology. It is wrongly believed that Biological Science subject is more text centered and dry. May students
perceive Biological Science as a boring subject and it could be learned only through rote methods. But the computer based multimedia packages developed for the present study, made the learning experience much more interesting.

There are numerous learning packages available for the subjects such as Mathematics, Languages. The present study suggests that computer based multimedia packages can be developed for the subject of Biological Science. It is subject of study that needs to be focused on a conceptual understanding rather than a lining up of facts to be memorized for examinations.

The present study proves that the multimedia technology is more accessible to school teachers and students. Further, these computer based multimedia packages can be designed and developed easily without spending much cost. Many of the available multimedia educational products are highly technical and comprised of complex animations and simulations. But, these packages lacks in sound theoretical background and educational value. Well-designed static graphics, simple animations and text with scholarly instructional design and strategy are more effective and much cheaper to produce and use. Development of multimedia products may take considerable time, but it is worth spending. Once developed, these packages can be used many number of times and individualized learning can
be catered.

Financial grants should be given for developing multimedia packages and more computers should be provided for students. It does not mean that technology should replace the human teacher but, technology can be used as a supportive methodology to enrich the teaching / learning process. A wide variety of computer supported multimedia can be used in an attempt to enhance traditional media.

The present investigation suggests that the teaching-learning time can be saved by the usage of multimedia technology. The conventional method of teaching takes more time to explain the content since it does not employ any audio visual aids. In the present study, the learning time is approximately 50% less in multimedia method when compared with lecturer method.

7.11 Suggestions for Further Research

An attempt is made in this study to investigate the effectiveness of multimedia packages on learning “Biological Science”. It is hoped that the present study will encourage, stimulate and provoke further researchers in the area of multimedia. Based on the present study, the researcher felt the need for undertaking the following studies in this field.

i. A study may be undertaken to prepare planned multimedia package for all the units of Biological Science.
ii. A study with the same design may be conducted to compare the effect of multimedia packages on learning Biological science of residential and non-residential schools.

iii. Similar studies can also be undertaken for other subjects like Languages, Mathematics, Social Science, General and Applied Sciences.

iv. A comparative study of multimedia packages with the self study through the text may be undertaken.

v. Similar studies can be taken as a programme for vivid and individualistic approach of teaching different subjects at secondary school level.

vi. A study may be undertaken to convert multimedia package into Data Based Programme in future.

vii. Multimedia package can be tested for its effectiveness with the other learning outcomes namely, verbal information, attitudes and psychomotor skills.

viii. Impact of multimedia on various instructional settings, namely, individualized and tutorial may be tested.

ix. Studies could be undertaken with larger samples involving both boys and girls of eighth, ninth and tenth classes for a longer period of treatment.

x. Studies could be undertaken to investigate the interaction effects of multimedia with the other variables, such as, study habits, gender, socio-economic background, locality, etc.
xi. Studies may be undertaken to investigate the effect of multimedia on retention.

xii. Furthermore, the recent proliferation of web-based and internet-based instruction suggests that studies could be conducted to examine the effect of objectives, examples, practice and review in these settings.

Thus, studies of this nature will continue to inform programme designers about the influence of multimedia on learning and performance.