

CHAPTER 5

SUMMARY, DISCUSSION AND SUGGESTIONS

5.0 INTRODUCTION

There have been many calls for reforming Science Education in India. If these are to be attended to, attention needs to be directed towards the Life Sciences, including Biology Education Research. The basis for this claim is found in elementary, middle, and high school classrooms throughout the country. Life Science content is commonly taught at all levels. One reason is that elementary teachers tend to be most comfortable teaching Life Science topics. In addition, for students at both the elementary and secondary levels, learning about living things, including themselves, is a dire necessity. Thus, research that enlightens on teaching and learning Biological Concepts has the potential to improve the Biology Education that students receive. This may be particularly important because today we are in the midst of a Biological Revolution -- one that will continue to present significant political, economic, ethical, and educational issues for our society to grapple with.

Properly designed Educational Multimedia on Multimedia Computers supports active participation and puts the students in control. Such multimedia demands the right teaching architecture, as explained here. Learning about people and the various ways in which they interact with each other and with the various environments in which they find themselves is very essential. The way to make people aware about themselves and their environment is through education. The subject of Biology which directly deals with every form of life and the environment in which they live, carries a special responsibility of preparing young children to become well informed, constructive participants in society and capable of developing healthy and harmonious relationships. The aim of providing education to the children is the all round development of their personality. The scope of Biology is very vast and in fact as wide as the world itself and as lengthy as the history of life on the earth. Modern Technologies can make learning Biology an engaging affair. It allows students to find information which they construct into their own knowledge using

computer production software. In the proposed research, the investigator is taking an effort to use modern technologies in the form of Multimedia Instructional Software Package to teach some important components or concepts of Biology to standard XII students of (GSHSEB) Gujarat Secondary and Higher Secondary Education Board.

5.1 REVIEW OF RELATED LITERATURE

The investigator has reviewed a total of 63 studies keeping the present study in view to develop a complete and holistic perspective of these studies and to arrive at the implications to support the present study.

The investigator has first reviewed 56 studies related to innovative methods of teaching science and other subjects other than Biology conducted by Shah (1966), Sharma (1966), Patel (1975), Jones (1980), Kolz (1980), Adeshera (1981), Tauro (1981), Golani (1982), Krishnan (1983), Rao (1983), Vardhini (1983), McDonald (1984), Menon (1984), Desai (1985), Joseph (1985), Parry, et al (1985), Johnson and Stanne (1986), Meyer (1986), James (1987), Joshi (1987), Cutlet (1990), Slick (1990), Srivastava (1990), Jeyamani (1991), Mahapatra (1991), Raghavan and Dharmaraja (1991), Bhatia (1992), Douglas (1992), Stella (1992), Williamson (1992), Agarwal (1994), Waddick (1994), Agarwal (1995), Wilson (1995), Karandikar (1996), Rangaraj (1997), Das (1998), Khirwadker (1998), Zyoud (1999), Yadav (2000), Dalwadi (2001), Zschoke (2002), Crews (2003), Sharma (2003), Casanova (2004), Helaiya (2004), McLaughlin Daniel (2004), Barot (2005), Hung (2005), Rosales (2005), Gilbert (2006), Parikh (2006), Thakkar (2006), Ford (2007), Galvis (2007), Ratwa (2007) and Karnati (2008). They have found in their studies that teaching through computers and multimedia is effective in terms of students' academic achievement and it helps in increasing conceptual understanding of the subject matter.

The investigator has also reviewed 7 studies related specifically to teaching of Biology conducted by Hopper (1982), Ravindranath (1982), Waugh (1984), Dighal (1985),

Leila (1987), Bhardwaj (1990) and Adhikari (1992). They have found that teaching Biology through computers and other innovative methods is effective in terms of students' academic achievement and they could learn at their own pace.

5.2 IMPLICATIONS OF THE REVIEWED STUDIES FOR THE PRESENT STUDY

On the whole, from the review of the related literature it can be inferred that majority of the studies indicated that teaching through computers and multimedia is effective in terms of students' academic achievement. Teaching through computers or multimedia has been found effective, not only for academic achievement but for developing interest and attitude towards Biological Sciences.

From the review of related literature, the investigator further infers the following:

- ✚ The nature and the type of methodology adopted for the teaching of Science determines the effectiveness of the method.
- ✚ In many of the studies it was seen that innovative methods were more effective than traditional methods.
- ✚ Audio-visual methods also promoted the understanding of the subject well.
- ✚ Learning capacity of the students was more when Multimedia Instructional Packages were used along with traditional methods of teaching.
- ✚ The methodology used is largely based upon the pre-test – intervention - post-test design. The tools used are Questionnaires and Reaction Scales. The data have been analyzed using the appropriate statistical tools, such as, t-test, correlated t-test, Chi-square ANOVA and ANCOVA.
- ✚ The studies have been carried out for the teaching of mainly Science. The sample group, in these studies, consisted mainly of school children of urban areas.
- ✚ There is no one single method of teaching Science. The teacher should be experimental-minded and should use different approaches in the light of different objectives.

On the basis of review presented above, the researcher has observed that the scope of studies was quite diverse. The available studies clearly indicate that not many studies on teaching of Biology have been conducted in India.

From the review of the related literature, it can be inferred that the methodology of teaching Science has an impact in the learning process. Most of the studies mentioned above concluded in favour of innovative methods in comparison with traditional methods of teaching.

The pressing need of the hour therefore, is to impart Education (Biological sciences) effectively. This has been the immediate inspiration behind the researcher taking up the present investigation. The investigator has been very keenly interested as to whether imparting knowledge through a new and non-traditional, multimedia instructional package would make it easier for the children to understand the different Biological Concepts in an efficient and effective manner.

As not many studies on Biological Sciences have been conducted at the higher secondary level, the researcher sought to explore the effectiveness of an innovative Multimedia Instructional Software Package in the teaching of Biology at the higher secondary level.

It is in this background that the present study seeks to improve upon the existing methods adopted for the education of the students. The present study seeks to study the impact of the Multimedia Instructional Software Package in increasing the knowledge, interest, and scientific attitude of the students regarding Biological Sciences.

5.3 RATIONALE FOR THE PRESENT STUDY

Biology as a discipline, by its very nature is media-genic. Biology is a study of life which is broadly classified into two parts, namely **Botany**, the study of the life of Plants and **Zoology**, the study of the life of Animals. Subdivisions of each of these branch include **Cytology**, that is the study of Cell and Cell structure, **Histology**, that is the study

of Tissues, **Anatomy** or **Morphology**, that is the study of internal and external features of living organisms, **Physiology**, that is the study of various functions of the living organisms and **Embryology**, that is the study of the embryonic development of an individual animal or plant.

The various features of the biological contents are height, weight, length, breadth, depth, shape, size, colours, textures and sounds, pictures, diagrams, landscapes, lab experiments, field trips, educational tours and so on. The time for the coverage of the content is limited whereas the volume is very large. Properly developed multimedia may very well facilitate coverage of the content more efficiently and intelligibly. It may not be feasible to take the students on to the field trips for each and every bit of content coverage or to dissect in the laboratory each and every animal or plant, they study in their syllabus. Moreover, today the dissection of animals in the labs is prohibited. Thus, the reality may be captured and mediated through a well developed Instructional Multimedia Package. Particularly in life-sciences, multimedia has shown to be beneficial because it provides visualization of concepts that are difficult to envision. Today, we are in an age of computers, ICT and digital technologies. Media are said to be the extension of human beings which are expected to facilitate educational instruction cost effectively. In today's society, students are constantly surrounded by many aspects of technology. Allowing the use of technology in the classroom, can make learning more meaningful, exciting and enjoyable too. Once students have discovered a purpose and passion for learning, the drive for solving problems increases. Biology is a subject that contains an inordinate amount of abstract concepts. So, using the multimedia can aid in clarifying matters for students.

A successful student in biology should have exposure to hands-on laboratories, but when the situation does not always warrant the means for accomplishing this task, it is important to look for alternatives. As a means of enhancing the curriculum, the technology is priceless. The students can actually “see” concepts via virtual laboratories, they have the most current research/findings available, and they are taking a direct part in their learning. Due to the fact that Biology, and most other science disciplines have very

broad, abstract topics, it became apparent that the traditional way of delivering instruction could be revised. Implementing technology into the classroom seemed a likely solution. Biology is a subject that involves many processes such as mitosis and meiosis. These topics can be unusually difficult for students to grasp when taught with chalk and talk method, so when a visual presentation can be used, it goes a long way as for as comprehension is concerned.

As teachers, we must present as many ways of learning to our students as possible. Lectures, laboratories, field trips, and computers are all helping our students succeed in school and in life. We must understand that technology is here to stay and it is involved in every aspect of our lives. If we allow our students to become familiar with the software available for biology (and other subjects), we can assist in opening their minds and increasing their critical thinking skills. The learning styles of students in any given classroom vary greatly. Therefore, if we include computers, we are helping to bridge the gap for those students who may otherwise tune out the subject matter.

The investigator after having graduated in Biology at Masters Level and having more than 15 years of experience in teaching Biology subject is very much keen on realizing quality Biology Education. Also, the investigator has specialized in the area of Computer Education. And therefore, the investigator has decided to develop a Multimedia Instructional Software Package to teach Biology. The investigator has not come across any study at Standard XII level on Biology teaching through multimedia.

The investigator envisaged to try his level best to make the Multimedia Instructional Software Package as comprehensive, interesting and enriching as possible, directing the concepts to the various senses of the learners optimally for their maximum involvement. Most of the students find it difficult to understand biological concepts on Animal Physiology and Reproduction as compared to other units in Biology. And therefore, the investigator thought of developing Multimedia Instructional Software Package on Animal Physiology and Reproduction for better understanding of the seemingly difficult biological concepts.

The investigator has attempted to improve the understanding of the students in Biological Sciences, using various media, such as, Power Point Presentation, Charts, Video-clips, accompanied by appropriate music, flash, animations, virtual laboratories and movie clips in the Multimedia Instructional Software Package. Students enjoy learning through various differential modes. Therefore, this study was undertaken to improve the quality of teaching and learning Biology in the classroom.

5.4 STATEMENT OF THE PROBLEM

Development and Implementation of a Multimedia Package to Teach Biology to Std. XII Students

5.5 OBJECTIVES OF THE STUDY

1. To develop a Computer Based Multimedia Instructional Software Package to teach Biology to the students of Standard XII.
2. To study the effectiveness of the Multimedia Instructional Software Package in terms of mean achievement of the students in the subject of Biology.
3. To study the effectiveness of the Multimedia Instructional Software Package in terms of reactions of the students towards Biological Sciences through multimedia package.
4. To study the effectiveness of the Multimedia Instructional Software Package in terms of reaction of Biology teachers towards teaching of Biology through multimedia Software Package.

5.6 OPERATIONALIZATION OF TERMS

Multimedia Instructional Software Package: In this study, **Multimedia Instructional Software Package** consists of Power Point Presentation, accompanied by appropriate music, video clips, charts, movie clips, flash, animations and graphics.

Effectiveness: Effectiveness of the programme was studied in terms of the difference in the mean gain score of the experimental group and the mean gain score of the control group and the reactions of students and Biology teachers towards teaching of Biology through Multimedia Instructional Software Package.

5.7 HYPOTHESES

1. There will be no significant difference between the mean gain scores of the experimental group and control group from pre-test to post-test.
2. There will be no significant difference between the observed frequencies and the expected frequencies against equal probability on various points of the reaction scale of the students.
3. There will be no significant difference between the observed frequencies and the expected frequencies against equal probability on various points of the reaction scale of the Biology teachers.

5.8 DELIMITATION OF THE STUDY

The study is delimited to Biology textbook (2010-11) prescribed for Standard XII by GSHSEB. The research has been further delimited to 8 chapters covered in the syllabus of the Gujarat Secondary and Higher Secondary Education Board as mentioned below.

Chapter 05: Nutrition in Animals

Chapter 06: Digestive system of Cockroach & Human beings

Chapter 07: Respiration in Animals

Chapter 08: Circulation in Animals

Chapter 09: Excretion and Osmoregulation in Animals

Chapter 10: Movement and Locomotion in Animals

Chapter 11: Nervous System of Cockroach and human

Chapter 12: Reproduction and Development in Animals

5.9 POPULATION OF THE STUDY

All the students of Standard XII studying in English Medium opting Biology in the schools of Baroda, following the syllabus of Gujarat Secondary and Higher Secondary Education Board (GSHSEB).

5.10 SAMPLE OF THE STUDY

The sample for the present study was selected purposively. For this the researcher selected standard XII students studying in two schools of Baroda city. The investigator judged the availability of Computer and Multimedia LCD Projector, speakers etc, for implementing the Multimedia Instructional Software Package while deciding on the school. The willingness of the Principal and of the teaching staff was also taken into account while deciding the school. Other factors like convenience of approach and availability of time were also taken into account while deciding upon the school.

All the 30 students of Biology Group of (2010-11) of Standard XII B of Covent of Jesus and Mary School, Fatehgunj, were taken as experimental group, whereas all the 31 students of Biology Group of (2010-11) Standard XII B of Rosary High School, Pratapgunj, were taken as control group for the present study. All the 35 Biology teachers of Bio-teachers' Club, Baroda (2010-11) comprised the sample of Biology teachers.

5.11 METHODOLOGY OF THE STUDY

5.11.1. DESIGN OF THE STUDY

The present study is experimental in nature where Quasi-experimental design was employed. The Pretest-Posttest-Experimental and Control Group Design was employed for the study. The design of the study is presented as follows.

O₁ X O₂

O₃ C O₄

Where, O_1 and O_3 are pretests

O_2 and O_4 are posttests

X stands for Experimental group and




C stands for Control group.

For the purpose of studying the effectiveness of Multimedia Instructional Software Package in Biology, the achievement of students in Biology of experimental group and control group was considered.

5.11.2 PROCEDURE OF THE STUDY

The entire procedure consisted of four phases for the present study.

5.11.2.1 Phase I: Development of Multimedia Instructional Software Package and Tools

-  All the eight chapters of animal physiology and reproduction were selected from the English Medium Biology textbook of Standard XII prescribed by the Gujarat Secondary and Higher Secondary Education Board (GSHSEB) for the preparation and implementation of the Multimedia Instructional Software Package.
-  Content analysis of all the eight chapters was done. Thereafter, the Multimedia Software Instructional Package was developed with the help of Power Point Presentation, video clips, charts, movies, graphics, flash, and animations, accompanied by appropriate music.
-  The Multimedia Instructional Software Package was developed over a period of three months. The developed Multimedia Instructional Package was shown to two experts in the field of Biology and two experts in the field of Education to ascertain its content validity, clarity, mode of presentation and comprehensiveness. Changes were made as per the suggestions of the experts.

- ✚ A pre-test, post-test, reaction scale for students and reaction scale for teachers were constructed by the investigator and validated by the experts mentioned above. Changes were made as per the suggestions of the experts.

5.11.2.2 Phase II: Administration of the Pre-test.

- ✚ Before the implementation of the Multimedia Instructional Software Package, both the groups, viz., control as well as experimental were administered pretest on achievement in Biology to check the level of knowledge in Biology.

5.11.2.3 Phase III: Implementation of the developed Multimedia Instructional Package for Experimental Group.

- ✚ The developed Multimedia Instructional Software Package was administered on the experimental group for 5 months, 35-minutes each day, during the Biology period.

5.11.2.4 Phase IV: Administration of the Post-test and Reaction Scale.

- ✚ After the completion of the treatment with the Multimedia Instructional Software Package, the Post-test was administered on the students.

5.12. TOOLS FOR DATA COLLECTION

5.12.1 A Pre-test and a Post-test

A Pre-test and a Post-test were constructed on the selected chapters of Biology to study the achievement of the students. After constructing the tests, they were shown to the experts in the field for determining their correctness, language, comprehension and validity. Changes were made as per the suggestions of the experts. Answer keys, for both, the Pre-test and Post-Test were prepared to maintain the objectivity of scoring. The answer keys were given to the experts for validation. Each test consisted of forty items, to be answered in forty minutes. All the items were of multiple choice types. Each item was having four alternative answers (A, B, C and D) and the students were expected to

encircle the correct answer. In every question there was only one correct answer. Each question carried one mark. All the questions were to be answered.

5.12.2 Reaction Scale for Students

The reaction scale for students was constructed by the investigator comprising the areas concerned with the Multimedia Instructional Software Package for teaching Biology. It is a five point scale. The initial draft was given to the experts for correction and suggestions and also to point out language clarity, inconsistency in the presentation and direction (positive and negative) of the statements. After receiving the feedback some of the items were modified and some eliminated. Thus the final and modified scale was having 50 items.

5.12.3 Reaction Scale for Biology Teachers

The reaction scale for Biology teachers was constructed by the investigator comprising the areas concerned with the Multimedia Instructional Software Package for teaching Biology. It is a five point scale. The initial draft was given to the experts for correction and suggestions and also to point out language clarity, inconsistency in the presentation and direction (positive and negative) of the statements. After receiving the feedback some of the items will be modified and some eliminated. Thus the final and modified scale was having 50 items.

5.13 DATA COLLECTION

The data collection was personally done by the investigator from the students. The investigator prepared a time schedule for data collection. The investigator personally administered the tests mentioned above. The first step involved administering the Pretest to the students. The second step was to implement the intervention programme. This was followed by administration of the Post-test and the Reaction Scale for students and the Reaction scale for Biology teachers. Thus the required data for the study were collected.

5.14 DATA ANALYSIS

Data analysis was done quantitatively by employing the t-test to find out the significance of difference between the mean gain scores of the Experimental and Control Groups. The data on the reactions of the students towards Biology through Multimedia Instructional Software Package and the reaction of teachers on Multimedia Instructional Software Package to teach Biology were analyzed through Chi-square.

5.15 FINDINGS

The findings of the study are as follows:

5.15 .1 The Multimedia Instructional Software Package was found to be effective in teaching Biological Sciences.

This could be said on the basis of the statistical tool adopted for data analysis: The t-test. The computed t-value of 2.46 is lesser than the table t-value of 2.66 at 0.01 level against 57 degrees of freedom. So, the null hypothesis that there will be no significant difference between the mean gain scores of the experimental group and the control group is not rejected at 0.01 level.

The computed value of 2.46 is greater than the table t-value of 2.00 at 0.05 level against 57 degrees of freedom. So, the null hypothesis that there will be no significant difference between the mean gain scores of the experimental group and the control group is rejected at 0.05 level. The mean gain score of the experimental group has been found to be significantly greater than the mean gain score of the control group. Hence, the Multimedia Instructional Software Package treatment has been found to be effective at 0.05 level.

It is evident from the above analysis that the treatment through Multimedia Software Instructional Package in teaching Biological Sciences has been found to be effective.

5.15.2 Reaction of Students towards Biology through Multimedia Software Instructional Package in terms of expected frequencies and observed frequencies against equal probability has been found to be effective

This could be said on the basis of the tool adopted for data analysis, that is, Reaction of Students on Multimedia Instructional Software Package for teaching Biological Sciences in terms of expected frequencies and observed frequencies against equal probability on various points of the reaction scale of the students.

The computed values of Chi-square are greater than the table value of Chi-square of 13.277 at 0.01 level against 4 degrees of freedom. So the null hypothesis that there will be no significant difference between the observed frequencies and the frequencies expected against equal probability is rejected against all the 50 statements. The frequency loading is greater on the higher points of the rating scale that is Strongly Agreed (SA) and Agreed (A) against the statements 1, 3, 7, 8, 10, 12, 13, 15, 17, 18, 20, 22, 24, 25, 26, 27, 29, 30, 32, 34, 36, 38, 40, 42, 44, 45, 46, 47, 48 and 50, having positive polarity. Whereas, greater on the lower points of the rating scale that is Strongly Disagreed (SD) and Disagreed (DA) against the statements 2, 4, 6, 9, 11, 14, 16, 19, 21, 23, 28, 31, 33, 35, 37, 39, 41, 43 and 49 having negative polarity. So, the students have been found to have favourable reactions towards Biology through Multimedia Instructional Software Package.

So, the treatment through Multimedia Software Instructional Package in terms of reactions of the students towards teaching Biological Sciences through Multimedia Instructional Software Package has been found to be effective.

5.15.3 Reaction of Biology teachers on Multimedia Software Instructional Package in teaching of Biological Sciences in terms of expected frequencies and observed frequencies against equal probability has been found to be effective.

This could be said on the basis of the tool adopted for data analysis, that is, Reaction of Biology teachers on Multimedia Package for teaching Biological Sciences in terms of expected frequencies and observed frequencies against equal probability on various points of the reaction scale of the biology teachers.

The computed values of Chi-square are greater than the table value of Chi-square of 13.277 at 0.01 level against 4 degrees of freedom. So the null hypothesis that there will be no significant difference between the observed frequencies and the frequencies expected against equal probability is rejected against all the 50 statements. The frequency loading is greater on the higher points of the rating scale that is Strongly Agreed (SA) and Agreed (A) against the statements 1, 2, 4, 5, 6, 8, 9, 11, 13, 15, 17, 19, 20, 21, 23, 24, 26, 27, 29, 31, 33, 35, 37, 39, 40, 42, 43, 45, 47, 48 and 49, having positive polarity. Whereas, greater on the lower points of the rating scale that is Strongly Disagreed (SD) and Disagreed (DA) against the statements 3, 7, 10, 12, 14, 16, 18, 22, 25, 28, 30, 32, 34, 36, 38, 41, 44, 46 and 50 having negative polarity. So, the Biology teachers have been found to have favourable reactions towards Multimedia Instructional Software Package to teach Biological Sciences.

So, the treatment through Multimedia Software Instructional Package in terms of reactions of Biology teachers towards teaching Biological Sciences through Multimedia Instructional Software Package has been found to be effective.

5.16 DISCUSSION




5.16.1 Psychological Foundations and Importance of Multimedia Package in teaching and learning process

It is accepted in psychological and sociological circles that very young children imitate the behaviours of important people in their environment such as parents, teachers and peers. Children older than about two years of age engage in much more complex learning processes. Still older children need to pay attention to behaviour, remember the behaviour and be motivated to reproduce it in one form or another. This process is called 'modeling'

(as distinct from imitation) and shows that children often produce behaviours that are novel variations on what they have observed. This understanding has clear implications for the ways in which we understand the effects of multimedia on children. It also highlights the importance multimedia can play in the learning processes of children. Multimedia, if used appropriately in the classroom, provides opportunities for children to work together and hence learn co-operative and communication skills as they each contribute to a combined project. Children can also create their own games and books and use the material they access from multimedia sources creatively. This way of using the multimedia resources available is already working well in many classrooms across the globe. However it must not replace the face to face interaction of the parents or the teachers with the children.

We are very well aware of the increasing use of multimedia technology, both in educational forums and to promote learning in general. The widespread availability of multimedia technology means that people have greater access to the broadest range of information ever available. Its importance in the education of young people is now being realized. As a result, the introduction of multimedia technology into the way school curricula are developed is now gaining credence within the general education system. Accordingly, school students are relying less on the traditional blackboard and textbook methods of learning and are instead emphasizing computer-generated technology as the most significant learning tool.

However, the largely unregulated nature of many resources such as the Internet, video and computer games give rise to concerns over content, manipulation and exploitation. Educators are recognizing the potential use of multimedia to enhance learning outcomes. The National Council for Educational Technology (NCET) in identifying potential outcomes, states that the effective use of multimedia can:

-  provide the flexibility to meet the individual needs and abilities of each student
-  reduce the risk of failure at school
-  provide students with immediate access to richer source materials

- ✚ present information in new, relevant ways which help students to understand, assimilate and use it more readily
- ✚ motivate and stimulate learning
- ✚ enhance learning for students with special needs
- ✚ motivate students to try out new ideas and take risks
- ✚ encourage analytical and divergent thinking
- ✚ encourage teachers to take a fresh look at how they teach and ways in which students learn
- ✚ help students learn when used in well-designed, meaningful tasks and activities
- ✚ offer potential for effective group work

This optimism was supported by The Effectiveness of Technology in Schools Report (1996) based on 176 research reviews and reports – 70 of which were published in professional journals, 33 were doctoral dissertations. Other studies are based on interviews and surveys of classroom teachers. The three parts of the report address

- ✚ the effect of technology on student achievement
- ✚ the effect of technology on student attitudes to learning and self image
- ✚ the effect of technology on student and teacher communication

5.16.2 Critical review of Multimedia Package

In view of psychological foundations and importance of Multimedia Package in teaching and learning process mentioned above and their role in guiding the design and development of the Multimedia Instructional Package, it would be useful to analyze the design of the package itself. The package is basically a Power Point presentation which is accompanied by appropriate music. The package also has video clips, charts, movies, flash, graphics and animations. The Multimedia Package was developed for about three months, 2010. However, the collection of materials for the development of multimedia package spanned about five months prior to this period. The Multimedia Instructional

Package was shown to two experts in the field of Biological science and two experts in the field of education to ascertain its content validity, clarity, mode of presentation and general comprehensiveness. Changes were made accordingly to the suggestions given by the experts. The salient features of this Multimedia Instructional Package are as follows:

- ✚ Logical and sequential order of the subject matter to be taught.
- ✚ Judicious use of pictures, photographs and animations.
- ✚ Good and sober design to give aesthetic effect.
- ✚ Use of appropriate music to trigger the feelings of the students.
- ✚ Use of appropriate sound effects.
- ✚ Use of movies to capture the students imagination and also for conceptual clarity.
- ✚ Use of animations for providing conceptual clarity.
- ✚ Judicious use of colours for the texts and captions.
- ✚ Judicious use of sound effects and animated slide transitions.

Thus Multimedia Package can be analyzed in the light of the psychological foundations and the importance of Multimedia in teaching and learning processes discussed briefly above. The Package takes into consideration the cognitive, affective and psychomotor domains of the children. The investigator was conscious of the cosmetic effects of the package as well as its ability to motivate the students intrinsically towards learning about Biology by its novelty. Gaining the attention of the students was of prime importance and the instructional package, with its share of video clips, movies, flash, animations, sound effects and appropriate music has made all efforts towards that purpose.

5.17. SUGGESTIONS FOR FURTHER RESEARCH

- Multimedia package on other units of Biological Sciences may be designed, developed and implemented in the schools.
- Multimedia Instructional Software Package may be designed on other branches of Science such as, Mathematics, Physics and Chemistry.
- Multimedia Instructional Software programmes may be prepared for all levels of education, that is, schools, colleges and universities.

- Proper evaluation of already available Multimedia Instructional Packages on science studies can be done to put Multimedia Instructional Software Package on a sound footing.
- A survey can be done to ascertain the prevalence of such non-traditional Instructional Packages in the teaching and learning processes.
- The efforts of present study can be extended to a wider spectrum of schools to ascertain its impact on the learning abilities of children at different levels.
- Studies with a large sample can be done to arrive at more generalized findings.
- Case studies can also be conducted on Technology Integrated Biology Education and problems faced in imparting Science Education.

5.18 CONCLUSION

The investigator in this study has made a genuine attempt to design, develop and implement Multimedia Instructional Software Package to teach Biological Sciences to the Students of Standard XII. The investigation revealed that the Multimedia Instructional Software Package was effective in understanding various Biological concepts. It has enhanced the understanding of the students towards Multimedia Instructional Software Package to learn Biology in a joyful way. It has also brought tremendous awareness among the Biology teachers on how effectively Biological Sciences can be taught through Multimedia Software Instructional Package.

The Multimedia Software Instructional Package was developed taking into consideration the psychological needs of the children. The Package very well captured the attention of the students. The Software Instructional Package was very interesting and facilitated joyful learning in the students. It motivated the students to learn the Biological concepts with much interest. The inclusion of pictures, video clips, movies, flash, animations, sound effects and appropriate music made the subject of Biological Sciences more realistic and comprehensible. The Multimedia Package resulted in saving of instructional and learning time. The presentation of the Package was found to be very appealing to the students.