SUMMARY

BACKGROUND OF THE STUDY

Education is an engine for the growth and progress of any society. It not only imparts knowledge, skills and inculcates values, but is also responsible for building human capital. The purpose of education is not just making a student literate but to add rationale thinking, knowledge ability and self-sufficiency.

In the traditional method of teaching, the teacher is the sender or the source, the educational material is the information or message, and the student is the receiver of the information. In terms of the delivery medium, the educator can deliver the message via the “chalk-and-talk” method and overhead projector (OHP) transparencies. The teacher controls the instructional process, the content is delivered to the entire class and the teacher tends to emphasize factual knowledge. In other words, the teacher delivers the lecture content and the students listen to the lecture. Thus, the learning mode tends to be passive and the learners play little part in their learning process.

Modern age is the age of science and technology. Science and technology have always been instrumental in bringing efficiency and perfection. As the world is becoming more and more civilized brutal animal energy is receding into background, giving place to science, which is increasingly felt as a powerful force in the lives of human beings. On one hand it has empowered the values, attitudes and conventions, trying to modify, change, alter or replace those, which are traditional and old. On the other hand, it has supported the pedagogical practices in the classroom situations.

With the introduction of multimedia into various industries, many educators began to see computers as part of a combination of technology resources, which included media elements such as text, graphics, sound, video and animations, instructional systems, and computer based support systems.

Science is an important part of school curriculum. The term science has been defined differently by different philosophers and scientists. The comprehensive
definition of Science can be stated as ‘A body of knowledge, a way of thinking, a way of investigation and a way of experimentation in the pursuit of exploring the nature’. The task of the teacher in the present times has become complicated, challenging and more professional than a decade ago. The curriculum demands more thinking by the teachers and students and is no more just a routine task of teaching and learning. According, to Jean Piaget the Swiss psychologist that, ‘the more the child has seen and heard the more he wants to see and hear’.

Today though there are a variety of instructional material available, offering a wide range of choice for the teachers to choose, the teacher must learn how to use new media as a part of modern learning system not merely to enrich but also supplement present methods of instruction. These new emerging media can transform classroom instruction into a series of rich memorable experiences. Most of the teachers teaching Science still follow the traditional lecture method giving the students little chance of participation. Teachers are not even acquainted with the new instructional materials that results in failing to use modern media technology while teaching. Consequently students fail to achieve the objectives which are kept in mind while framing the curriculum and textbooks.

General Science is a compulsory subject up to secondary school level. Therefore to improve the science teaching in order to inculcate scientific attitude among students the advanced methods of teaching needs to be used. Research findings reveal that with the proper use of science and technology in the field of education, desirable results can be achieved in teaching and learning processes. The answer to the ever increasing demand and problems related to present challenges of science education (acc. to UNESCO) lies in the integration of multimedia technologies.

Multimedia can contribute to psychosocial development if it is used meticulously. One can dialogue with the distant people through networks within no time as per needs. So there is a shift from local society to global society. It is a well-known fact that very often team mind is better than the individual mind. Countrywide classroom programs and World Wide Web are contributing to the enhancement of human psyche. Students will use their visual senses after going through sites. Their
concepts will be cleared which will help in enhancing the learning ability. They will become more creative and can grasp the new technologies in easier way.

Thus the present study was carried out by the investigator to compare the effectiveness of the multimedia approach and the traditional method of teaching. Multimedia is one of the most important tools of ICT, which will provide a theoretical background to the student, enhanced by the use of different media such as sound, video, text and hypertext, pictures and animations. These multimedia presentations aim at providing the students with a realistic description of the topic and enhance greatly their interest. Researcher developed the multimedia packages based on science related unit of IX class general science. The General Science text book of class IX was analyzed and multimedia approach based packages were developed, and their effectiveness software was studied.

JUSTIFICATION OF THE STUDY

The traditional view of the learning process is typically teacher centered, with teachers doing most of the talking and intellectual work, while students are passive receptacles of the information provided. This is not to indicate that the traditional lecture method is without value, as it allows the teachers to quickly convey lot of information to students and is a useful strategy for recall or rote learning. However, it is not the most effective way to help students develop and use higher order cognitive skills to solve complex real world problems. As noted by Driscoll (1994), “We no longer can view learners as empty vessels waiting to be filled, but rather as active organisms seeking meaning.”

Today’s students no longer want to be passive recipients in the information transfer model of learning rather they want to be active participants in the learning process. Students in their new role become empowered as creators of things they could not create before or as researchers with technology providing access to information from all over the world. It introduces students to a real world enquiry approach, rather than relying solely on textbooks and the teachers for information to learn.

Technology acts as a catalyst to support change in teacher’s pedagogy. With new multimedia technologies a teacher is no longer the sole source of knowledge but
instead a guide or facilitator who supports students learning. More recently, the advent of the World Wide Web (WWW) and associated information and communications technologies (ICT) has opened a vast array of possibilities for the use of multimedia technologies to enrich the learning environment. Computers are now able to provide students with rich learning experiences and enabling them to have more depth and direction in their learning processes. In terms of functionality, the computer has gone beyond processing only text and data. It can now process various media elements such as high-resolution graphics, animation, sounds and video. Today the use of computers and multimedia technology in the classroom has greatly increased. An area of education in which the use of multimedia technology is becoming more apparent is classroom teaching.

In the light of above said role of multimedia approach and its utility in effective classroom teaching the investigator got inspired to undertake the present study. The present study was conducted to assess the effectiveness of multimedia approach as compared with the traditional method of teaching in the subject area of general science at secondary school level. The purposes of the study were two fold, firstly the development of multimedia instructional packages and secondly to assess the effectiveness of such a program. Comparison of multimedia approach and traditional method of instruction is not only a comparison of two modes of instruction but of two theoretical paradigms. Traditional method represents a paradigm whereby knowledge is transmitted from teacher to student. Something is poured in learner’s brain and the learner is a passive recipient of knowledge. Teacher plays an active part in this mode of instruction. Multimedia approach 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, interactive, flexible, interesting and hands on.

This study was completed in two phases, during the first phase a multimedia approach based multimedia packages were developed by the researcher. The second phase of the study was experimentation with the multimedia packages to determine its effectiveness in terms of academic achievement and retention. The researcher also constructed other tools achievement tests (pre-test, post-test and retention test) and an
opinionnaire, to evaluate the effectiveness of the multimedia approach in comparison to the traditional method.

STATEMENT OF THE PROBLEM

“Effect of Multimedia Approach and Traditional Method on Retention and Academic Achievement of Science Students at Secondary School Level – A Comparative Study”

OPERATIONAL DEFINITIONS OF THE TERMS USED

1. **MULTIMEDIA APPROACH**: In the present study the term multimedia approach means the use of different media (i.e. audio, video, audio video, print text, graphics, etc) in combination for the effective teaching and learning.

2. **TRADITIONAL METHOD**: In the present study the term traditional method means the usually followed conventional method also called the chalk and talk method, lecture method. It is the teacher centered approach.

3. **RETENTION**: In the present study retention means memorization of the concepts (which will be clearly understood and learnt by the students) for a longer time.

4. **ACHIEVEMENT**: In the present study achievement means the measuring tool used for ascertaining the quantity of learning attained in the subject after a period of instruction.

5. **SCIENCE**: In the present study the term science means the subject taught, also called as General Science.

6. **SECONDARY**: In the present study the term secondary means post elementary education i.e. from class IX-XII.

OBJECTIVES

1. To develop two multimedia instructional packages as a part of multimedia approach for the teaching of science to the students at secondary school level, in order to:
   
i. Prepare the multimedia package-I which contains the lessons in the form of computer assisted PowerPoint presentations and a comprehensive booklet.
ii. Prepare the multimedia package-II which contained the lessons in the form of interactive multimedia software, computer assisted PowerPoint presentations and a comprehensive booklet.

2. To compare the relative effect of multimedia approach (multimedia package-I and multimedia package-II) and traditional method on total academic achievement and retention of secondary school science students.

3. To compare the relative effect of multimedia approach (multimedia package-I and multimedia package-II) and traditional method on academic achievement and retention of secondary school science students according to the different instructional objectives.

4. To compare the relative effect of multimedia approach (multimedia package-I and multimedia package-II) and traditional method on academic achievement and retention of secondary school science students at varying levels of intelligence.

5. To study the opinion of students regarding learning through multimedia approach.

**HYPOTHESES**

1. Traditional method has significant effect on academic achievement and retention of secondary school science students.

2. Multimedia approach (Multimedia Package-I and Multimedia Package-II) has significant effect on retention and academic achievement of secondary school science students.

3. Multimedia approach (Multimedia Package-I and Multimedia Package-II) has significantly higher effect on total academic achievement and retention of secondary school science students as compared to traditional method.

4. Multimedia approach (Multimedia Package-I and Multimedia Package-II) has significantly higher effect on academic achievement and retention of secondary school science students as compared to traditional method according to the different instructional objectives.

5. Multimedia approach (Multimedia Package-I and Multimedia Package-II) has better significant effect on academic achievement and retention of secondary
school science students as compared to traditional method at varying levels of intelligence.

6. There will be a favourable opinion of students about learning through multimedia approach.

DELIMITATIONS OF THE STUDY

1. The study was delimited to one English medium Secondary School (Ramjas Senior Secondary School) of Sonepat district.

2. The study was confined to one unit of General Science ‘Fundamental Unit of Life’.

3. The study was confined to only two methods of teaching i.e. traditional and multimedia.

4. The study was confined to the students of class IX.

RESEARCH DESIGN

An experimental design to the researcher is what a blueprint is to an architect. The design found to be most useful for the purpose of this study was “The pre-test-post test Equivalent Groups Design.” In this design, subjects were randomly assigned to experimental and control groups.

This design is one of the most effective in minimizing the threats to experimental validity. In this design the groups are randomly selected from the total available group. One of the groups was treated as experimental group. This design has an advantage of the pre-test, which affords an opportunity to check on the initial equivalence of the groups. Many other factors jeopardizing internal and external validity are easy to control.

Although there are three groups in the present study (one control and two experimental groups), but comparisons at a time are made between two groups only. The groups were compared in the following sequence to compare the performance of each group in achievement and retention tests on the basis of teaching through multimedia approach and traditional method

1. Experimental Group-I and Control Group

2. Experimental Group-II and Control Group

3. Experimental Group-I and Experimental Group-II

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Population of 186 students of class IX

Population was categorized into three categories of Low, Average and High Intelligence groups on the basis of their intelligence score in the Non Verbal Intelligence Test (Raven’s Standard Progressive Matrices Test)

Sample of 90 students was randomly selected. The students were distributed into 3 groups

Each group has equal number of students from the low, average and high intelligence categories. Each group has 6 students of low intelligence, 18 students from average intelligence and 6 students of high intelligence level.

Control Group

Experimental Group-I (30 students)

Experimental Group-II

Pre Achievement Test

Control Group taught with the Traditional Method of Instruction

Experimental Group-I taught with the Multimedia Approach (Multimedia Package-I)

Experimental Group-I taught with the Multimedia Approach (Multimedia Package-II)

Post Achievement Test administered to all the three groups

Delayed Post Achievement Test administered to all the three

Administration of Opinionnaire

Flow chart showing the steps involved in the conduct of the study
POPULATION AND THE SAMPLE

Out of the different English medium Secondary schools of the Sonepat District of Haryana, one school namely Ramjas Senior Secondary School was purposively selected keeping in view of the availability of the sufficient infrastructural facilities mainly a well equipped computer laboratory and other audio visual aids like LCD projector and a power backup system. Out of the total 186 students of IX class, 90 students were selected for the sample on the basis of their performance in a non-verbal intelligence test (Raven’s Standard Progressive Matrices Test). The criterion to select the sample subjects was based on varying intelligence level of the students i.e. Higher Intelligence Level, Average Intelligence Level and Low Intelligence Level. This test was administered to the students for the two reasons. Firstly, this helped in the formation of equated groups, as intellectual capacity of a student is a major contributor towards student learning and it would be a strong mediator if not controlled. Secondly, to form groups on the basis of the varying level of intelligence so that the objective to compare the relative effectiveness of the different instructional strategies in terms of academic achievement and retention of the students could be studied.

Out of the total 186 students those who were given the intelligence test, the different categories of intelligence i.e. High, Average and Low had 30, 116 and 44 students respectively. Further out of these 30, 116 and 44 students of high, average and low intellectual ability, 18 (high intelligence), 54 (average intelligence) and 18 (low intelligence) students respectively were selected randomly, thus making the total sample of 90 students. These 90 students were equally distributed among the three groups i.e. two experimental groups and one control group. Thus, each group had total 30 students. The sample of 30 students in each of the three groups had students of three categories of high intelligence group (6 students in each group), average intelligence group (18 students in each group) and low intelligence group (6 students in each group) as given in the table below.
SAMPLE OF THE STUDY

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Students</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Intelligence</td>
<td>Average Intelligence</td>
</tr>
<tr>
<td>Experimental Group-I</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Experimental Group-II</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Control Group</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18</strong></td>
<td><strong>54</strong></td>
</tr>
</tbody>
</table>

TOOLS AND MATERIALS USED

Keeping in view of the objectives of the study, the following tools and materials were developed and used:

- Standardized Raven’s Standard Progressive Matrices Test.
- Self developed Multimedia Instructional Packages (MMIPs) were used. The experimental group-I was taught with Multimedia Package-I whereas the experimental group-II was taught with Multimedia Package-II.
- Achievement tests.
  - A self constructed Pre-test was used.
  - A self constructed Post-test was used.
  - A self constructed Retention test was used.
- A self-developed Opinionnaire was used.

PROCEDURE FOR DATA COLLECTION

Following major steps were used in the data collection:

- Administration of the non-verbal intelligence test (Raven’s Standard Progressive Matrices Test).
- Administration of the pre-test to all the three groups.
- Conducting classes for control group with the help of the traditional method.
• Conducting classes for the experimental group-I with the help of the multimedia approach based multimedia package-I.

• Conducting classes for the experimental group-II with the help of the multimedia approach based multimedia package-II

• Administration of the post-test to all the three groups after experimental treatment.

• Administration of the retention test after three weeks for all the three groups.

• Administration of the opinionnaire to the experimental groups-I and II for eliciting the opinion regarding the effectiveness of the self developed multimedia instructional packages.

**STATISTICAL TECHNIQUES USED**

Data were analyzed through computer program SPSS (Statistical Package for Social Sciences). The main objective of the study was to assess the effectiveness of the multimedia approach and traditional method on academic achievement and retention. For this the scores obtained through all the tools were consolidated and analyzed statistically. The mean and standard deviations of items in the pre-test, post-test and retention test were used. The opinionnaire was analyzed with the percentage score. The ‘t’ test and ANOVA were used for comparison.

In order to test the performance regarding the use of multimedia approach, paired ‘t’ test was done using the pre-test, post test scores. Analysis of Covariance was applied for overcoming the slight difference in the pre-test scores. The pre-test scores and post-test scores of the two experimental groups and the control group (total and objective wise scores) were compared using the statistical technique of Analysis of Covariance.

Comparison of performance of students in experimental group-I and control group was done in terms of pre-test, post-test and retention test scores. Similarly performance of students in experimental group-II and control group was done. Likewise the comparison of performance of experimental group-I and experimental group-II was also carried out.

Comparison of effectiveness of multimedia package-I and multimedia package-II with traditional method for secondary school science students using
ANCOVA with regard to total achievement and retention scores was also carried out.

Multimedia packages and performance of the students according to the objective wise achievement and retention was also compared. A similar comparison among the three groups at varying level of intelligence was also carried out to find out effectiveness of the developed packages for the students of differential intellectual abilities.

Lastly the opinionnaire was analyzed with the percentage score. The percentage of positive responses for all the items in the opinionnaire was calculated.

MAIN FINDINGS

A. MULTIMEDIA APPROACH and TOTAL ACADEMIC ACHIEVEMENT OF STUDENTS


   a. Comparison of Pre-Test Scores of Experimental Group-I and Control Group.

      Since the table value for df 58 is 2.00 at 0.05 level of significance, the obtained critical ratio ‘t’ 0.192 is not significant at 0.05 level for df 58. It means that the difference between the means of the pre-test scores of the pupils in experimental group-I and control group did not differ significantly in their initial academic achievement. So, it is concluded that before experiment, the two groups were of the same academic ability with reference to the knowledge of the concepts of science.

   b. Comparison of Post-Test Scores of Experimental Group-I and Control Group.

      Since the table value for df 58 is 2.00 at 0.05 level of significance, the obtained critical ratio 2.277 is significant at 0.05 level. It means that there is significant difference between the means of the post-test scores of the pupils in experimental group-I and control group in the subject of Science. Also, the mean of the post-test scores of experimental group-I is greater than that of control group, pupils in the experimental group-I have performed better than the pupils in the control group in their academic achievement. Hence, it is inferred that teaching with the help
of multimedia approach (using multimedia package-I) has a higher effect on the student’s academic achievement than the traditional method of teaching science to secondary school students.

c. **Comparison of Retention Test Scores of Experimental Group-I and Control Group.**

The table value for df 58 is 2.66 at 0.01 level of significance, the obtained critical ratio 2.52 is significant at 0.05 level. It means that there is significant difference between the means of the delayed post-test (i.e. retention test) scores of the pupils in experimental group-I and control group. Since the mean of the retention test scores of experimental group-I is greater than that of control group, pupils in the experimental group-I (using multimedia package -I) have performed better than the pupils in the control group in terms of their retention scores.

Hence, it is concluded that teaching with the help of multimedia approach (using multimedia package-I) had a higher effect on the student’s retention than the traditional method of teaching science to secondary school students.

2. **Comparison of Achievement and Retention Scores of Experimental Group-II and Control Group.**

a. **Comparison of Pre-Test Scores of Experimental Group -II and Control Group.**

Since the table value for df 58 is 2.00 at 0.05 level of significance, the obtained critical ratio 0.454 is not significant. It means that the difference between the means of the pre-test scores of the pupils in experimental group-II and control group in the subject of Science did not differ significantly in their initial academic achievements. So, it is concluded that before the experiment, the two groups were more or less of the same academic ability.

b. **Comparison of Post-Test Scores of Experimental Group -II and Control Group.**

The obtained critical ratio 5.066 is significant at 0.01 level and indicates that pupils of the two groups differ significantly in their academic achievement, after the experiment in the subject of Science. Since the mean post-test scores of experimental
group-II is much greater than that of control group, the pupils in the experimental group-II are superior to the pupils in the control group in terms of their academic achievement. Hence, it is concluded that teaching methodology with the help of multimedia approach (using multimedia package-II) had a higher effect on the student’s academic achievement as compared to the traditional method of teaching science to secondary school students.

c. **Comparison of Retention Test Scores Experimental Group -II and Control Group.**

Since the table value for df 58 is 2.00 at 0.05 level of significance and the obtained critical ratio is 6.03 which is significant. Therefore it implies that that the difference between the means of the delayed post-test scores of the pupils in experimental group-II and control group differ significantly in their retention scores. It means that there is significant difference between the means of the delayed post-test (i.e. retention test) scores of the pupils in experimental group-II and control group in the subject of Science. Since the mean of the retention test scores of experimental group-II is greater than that of control group, it is inferred that pupils in the experimental group-II (using multimedia package-II) have performed better than the pupils in the control group in terms of their retention scores.

Therefore, it is concluded that teaching with the help of multimedia approach (using multimedia package-II) had a higher effect on the student’s retention than the traditional method of teaching science to secondary school students.

3. **Comparison of Achievement and Retention Scores of Experimental Group-I and Experimental Group-II.**

a. **Comparison of Pre-Test Scores of Experimental Group-II and Experimental Group-I.**

Since the table value for df 58 is 2.00 at 0.05 level of significance, therefore the obtained critical ratio 0.208 is not significant. It means that the difference between the means of the pre-test scores of the pupils in experimental group-I and experimental group-II in the subject of science did not differ significantly in their initial academic achievement. So, it is concluded that before the experiment, the two groups were of the same academic ability.
b. Comparison of Post-Test Scores of Experimental Group-I and Experimental Group-II.

Since the table value for df 58 is 3.102 at 0.01 level of significance, the obtained critical ratio 3.102 is significant at 0.01 level. It means that there is significant difference between the means of the post-test scores of the pupils in experimental group-II and experimental group-I in the subject of Science. Since the mean of the post-test scores of experimental group-II is greater than that of experimental group-I, pupils in the experimental group-II have performed better than the pupils in the Experimental group-I in their academic achievement. Hence, it can be tentatively concluded that teaching with the help of multimedia approach (using multimedia package-II) has a higher effect on the student’s academic achievement than the multimedia approach (using multimedia package-I) of teaching science to secondary school students.

c. Comparison of Retention Test Scores of Experimental Group-I and Experimental Group-II.

Since the table value for df 58 is 3.776 at 0.01 level of significance and the obtained critical ratio is 2.234 which is significant. Therefore it implies that the difference between the means of the delayed post-test scores of the pupils in experimental group-I and experimental group-II differ significantly in their retention scores. It means that there is significant difference between the means of the delayed post-test (i.e. retention test) scores of the pupils in experimental group-I and experimental group-II in the subject of Science. Hence, it is concluded that teaching with the help of multimedia approach (using multimedia package-II) has a higher effect on the student’s retention than the multimedia approach (using multimedia package-I) of teaching science to secondary school students.

4. Comparison of Gain in Performance of Experimental Groups over Control Groups

The difference in the pre-test and post-test scores of pupils in the experimental and control groups were calculated and tested for significance after computing critical ratio. The obtained values are given below.
a. Comparison of Gain in Performance of Experimental Group-I over Control group.

The values of significance for df 58 at 0.05 level = 2.00 and at 0.01 level = 2.66. The calculated value of ‘t’ is 2.707. So the difference between the mean gain scores is significant (t=2.707; p <0.05/0.01). The significantly higher mean value indicates that the pupils in the experimental group-I are better than that of pupils in the control group in their academic achievement. Since the mean gain scores of the control group is less than that of experimental group-I, this difference is in favour of experimental group-I. Consequently it is inferred that learning through multimedia approach is more effective in the subjects of science than learning through traditional method.

b. Comparison of Gain in Performance of Experimental Group-II over Control group.

The calculated ‘t’ value as 7.420 for df 58. The critical value of the ‘t’ for df 58 at 0.05 level = 2.00 and at 0.01 level = 2.66. So the difference between the mean gain scores is significant (t=7.420; p <0.05/0.01). The significantly higher mean value indicates that the pupils in the experimental group-II (using multimedia package-II) are better than that of pupils in the control group in their academic achievement. Since the mean scores of the control group is less than that of experimental group-II, this difference is in favour of experimental group. So it is concluded that learning through multimedia approach (using multimedia package-II) is more effective in the subject of Science than learning through traditional method.

c. Comparison of Gain in Performance of Experimental Group-II over Experimental group-I.

The values of significance for df 58 at 0.05 level = 2.00 and at 0.01 level = 2.66. From the table it is clear that the calculated critical ratio is 4.509 of the mean gain scores of the pupils in the experimental group-II and experimental group-I. So the difference between the mean gain scores is significant (t=4.509; p <0.05/0.01). The significantly higher mean value indicates that the pupils in the experimental group are better than that of pupils in the control group in their academic achievement. Since the mean gain scores of the control group is less than that of
experimental group, therefore this difference is in favour of experimental group. Therefore it is concluded that learning through multimedia package-II is more effective in the subject of Science than learning through multimedia package-I.

5. Comparison of Effect of Multimedia Package-I and Multimedia Package-II with Traditional Method for Secondary School Science Students Using ANCOVA with regard to Total Achievement Scores

a. Effect of Multimedia Package-I over Traditional method for Secondary school science students with regard to total achievement (Experimental Group-I x Control Group)

For group I and control group, the post ANCOVA calculated value of \( t = 3.0163 \) whereas, the table value of \( t \) for \( df = 58 \) at 0.05 level is 2.00 and at 0.01 level is 2.66. So the value is significant at 0.01 level (\( t = 3.0163; p<0.01 \)). The significant ‘t’ value indicates that the two means differ significantly. The difference in adjusted means for post-test scores of experimental group I and control group were tested for significance separately for df 58.

The difference between the adjusted post-test means of the experimental group I and control group in the achievement test is found to be significant at 0.01 level (\( t=3.0163 \) \( p<0.01 \)). This shows that experimental group I where the mean post-test score is higher (\( My.x=56.79 \)) is better than the control group in their achievement. It can be therefore concluded that the students who learned with the help of multimedia package I have achieved better achievement test scores than those taught through traditional method.

The above analysis leads to the conclusion that learning with the help of multimedia package-I is more effective than the traditional method of teaching science to secondary school students.

b. Effect of Multimedia Package-II over Traditional method for Secondary school science students with regard to total achievement (Experimental Group-II x Control Group)

For group II and control group, the post ANCOVA calculated value of \( t = 7.345 \) whereas, the table value of \( t \) for \( df =58 \) at 0.05 level is 2.00 and at 0.01 level
is 2.66. So the value is significant at 0.01 level \( t = 7.345; p<0.01 \). The significant \( t \) value indicates that the two means differ significantly. The difference in adjusted means for post-test scores of experimental group II and control group were tested for significance separately for df 58. The difference between the adjusted post-test means of the experimental group II and control group in the achievement test is found to be significant at 0.01 level \( t = 7.345; p<0.01 \). This shows that experimental group II where the mean post-test score is higher (My.x=66.67) is better than the control group in their academic achievement. Therefore, it can be concluded that the students who learned with the help of multimedia package II have achieved better achievement test scores than those taught through traditional method.

The above analysis leads to the major conclusion that learning with the help of multimedia package II is more effective than the traditional method of teaching science to secondary school students.

c. Effect of Multimedia Package II over Multimedia Package-I for Secondary school science students with regard to total achievement. (Experimental Group-II x Experimental Group-I)

For experimental group-I and experimental group-II, the post ANCOVA calculated value of \( t = 4.518 \) whereas, the table value of \( t \) for df = 58. at 0.05 level is 2.00 and at 0.01 level is 2.66. So the value is significant at 0.01 level The difference between the adjusted post-test means of the experimental group II and experimental group I in the achievement test is found to be significant at 0.01 level \( t = 4.518; p<0.01 \). This shows that experimental group II having higher mean post-test score (My.x=.66.97) is better in achievement than the experimental group I.

It is therefore inferred that students who learned with the help of multimedia package II have surpassed the students who learned with the help of multimedia package I in achievement.

The above analysis leads to the conclusion that

- Learning with the help of multimedia package-I and multimedia package -II is more effective than the traditional method of teaching science to secondary school students.
• It is also concluded that among the two packages used in the present study, multimedia package- II based on interactive multimedia software was more effective than multimedia package-I which is merely based on computer assisted power point presentation of the content.

6. Comparison of Effectiveness of Multimedia Package I and Multimedia Package II with Traditional method for Secondary school science students using ANCOVA (Retention Test Scores)

   a. Effect of Multimedia Package I over Traditional method for Secondary school science students with regard to total achievement in retention test (Experimental Group-I x Control Group)

      The post ANCOVA ‘t’ value obtained was 6.42. The table value for significance for df = 58 is 2.00 at 0.05 level and 2.66 at 0.01 level (t=6.42; p< 0.01). The significant’ value points to a significant difference between the two groups, i.e., the Experimental Group I and the control group differ significantly in their retention capacity. The adjusted mean of retention test scores of Exp. Gp-I is greater than that of control group. So it is apparent that the students taught by the multimedia package- I have better retention capacity than the students taught by conventional traditional method of teaching science to secondary school students.

   b. Effect of Multimedia Package II over Traditional method for Secondary school science students with regard to total achievement in retention test (Experimental Group-II x Control Group)

      The post ANCOVA ‘t’ value obtained was 4.835. The table value for significance for df = 58 is 2.00 at 0.05 level and 2.66 at 0.01 level (t= 4.835; p< 0.01).The significant t value points to a significant difference between the two groups, i.e., the Experimental Group II and the control group differ significantly in their retention capacity. The adjusted mean of retention test scores of Exp. Gp-II is greater than that of control group. So it is evident that the students taught by the multimedia package- II have better retention capacity than the students taught by conventional traditional method of teaching science to secondary school students.
c. Effect of Multimedia Package II over Multimedia Package I with regard to total achievement in retention test (Experimental Group-II x Experimental Group-I)

The t value obtained was 2.166. The table value for significance for df = 58 is 2.00 at 0.05 level and 2.66 at 0.01 level (t= 2.166 p< 0.05). The significant ‘t’ value points to a significant difference between the two groups, i.e., Experimental Group-II and Experimental Group-I differ slightly in their retention capacity.

The above analysis leads to the conclusion that

- The significant ‘t’ value points to a significant difference between the two groups, i.e., the Experimental Group II and the experimental group I differ significantly in their retention capacity.

- The adjusted mean of retention test scores of Exp. Gp-II is greater than that of experimental group I. So it is evident that the students taught by the multimedia package- II have better retention capacity than the students taught by multimedia package- I of teaching science to secondary school students.

B. MULTIMEDIA APPROACH and ‘ACADEMIC ACHIEVEMENT and RETENTION’ according to DIFFERENT INSTRUCTIONAL OBJECTIVES

7. Comparison of Effect of Multimedia Approach (using Multimedia Package-I and Multimedia Package-II) with Traditional Method on Academic Achievement and Retention according to Different Instructional Objectives


i. The difference between the post-test means of the experimental group-I and control group in the achievement test under the category of objective knowledge is found to be significant at 0.01 level. This shows that experimental group-I performed well than control group in their achievement. It may be concluded that students who learned with the help
of Multimedia Package-I showed better achievement test scores under the category of instructional objective—‘Knowledge’ as compared to the students who learned with the traditional method.

ii. The difference between the post-test mean scores of the experimental group-II and control group in the achievement test is found to be significant at 0.01 level. This shows that experimental group-II where the mean post-test score is higher (Mean= 18.76) is better than the control group in their academic achievement. It may be therefore concluded that students who learned with the help of multimedia package II have accomplished enhanced achievement test scores than those taught through traditional method under the category of instructional objective—‘Knowledge’.

iii. There is no significant difference between the pre-test mean scores of the experimental group I, experimental group-II and control group in the achievement test even at 0.05 level of significance. This shows that the three groups do not differ significantly in their pre achievement level and indicates that groups are equally good in the performance irrespective of the multimedia packages under the category of instructional objective—‘Knowledge’.

iv. The difference between retention test mean scores of the experimental group I and control group under the category of objective creativity is found significant as the calculated ‘t’ value (t =2.084) is greater than the critical value of ‘t’ at 0.05 level of significance. This shows that these two groups differ significantly in their retention level. It can thus be concluded that students who learned with the help of Multimedia Package –I showed better retention test scores under the category of instructional objective knowledge as compared to the students who learned with the traditional method.

v. The difference between the retention test mean scores of the experimental group-II and control group is found to be significant at 0.01 level (t= 6.929). This shows that experimental group-II where the mean retention
test score is higher is good in performance than the control group in their retention level. Hence, it may be concluded that students who learned with the help of multimedia package-II show a clear advantage in retention scores than those taught through traditional method under the category of instructional objective-‘Knowledge’.

The analysis leads to the conclusion that multimedia package-I and multimedia package-II are more effective than traditional method in the teaching of science to the secondary school science students under the category of objective knowledge. It is also concluded that among the two packages, the multimedia package-II had a higher effect than the multimedia package-I on academic achievement and retention.

b. Comparison of the effectiveness of Multimedia Package-I and Multimedia Package-II with Traditional Method for Teaching Science to Secondary School Students under the category of Instructional Objective-‘Understanding’.

i. The difference between the post-test means of the experimental group I and control group under the category of objective understanding is significant as the ‘t’ value is greater than the values (t=2.3; p<0.01). This shows that these two groups differ significantly in their achievement. It can be therefore concluded that the students who learned with the help of Multimedia Package –I showed better achievement test scores under the category of instructional objective-‘Understanding’ as compared to the students who learned with the traditional method

ii. The difference between the post-test means of the experimental group-II and control group in the achievement test is found to be significant at 0.01 level (t=5.109; p<0.01). This shows that experimental group-II where the mean post-test score is higher (Mean= 22.10) under the category of the instructional objective-‘Understanding’ is better than the control group in their achievement. It is therefore concluded that the students who learned with the help of multimedia package-II have accomplished enhanced achievement test scores than those taught through traditional method under
the category of instructional objective- ‘Understanding’.

iii. There is no significant difference between the pre-test mean scores of the experimental group-I, experimental group-II and control group in the achievement test even at 0.05 level of significance under the category of the instructional objective-‘Understanding’. This shows that the three groups do not differ significantly in their pre-achievement level and indicates that groups are equally good in the performance irrespective of the multimedia packages under the category of instructional objective – ‘Understanding’.

iv. The difference between retention test mean scores of the experimental group-I and control group under the category of instructional objective – ‘Understanding’ is found to be significant as the calculated ‘t’ value ($t = 2.12$) is greater than the critical value of ‘t’ at 0.05 level of significance. This shows that these two groups differ significantly in their retention level. It is thus concluded that the students who learned with the help of Multimedia Package-I showed better retention test scores under the category of instructional objective-‘Understanding’ as compared to the students who learned with the traditional method.

v. The difference between the retention test mean scores of the experimental group-II and control group is found to be significant at 0.01 level ($t = 4.65$). This shows that experimental group-II where the mean retention test score is higher is good in performance than the control group in their retention level. Hence, it is concluded that the students who learned with the help of multimedia package-II show a clear advantage in retention scores than those taught through traditional method under the category of instructional objective- ‘Understanding’.

The analysis leads to the conclusion that multimedia package-I and multimedia package-II are more effective than traditional method in the teaching of science to the secondary school science students under the category of instructional objective-‘Understanding’. It is also concluded that among the two packages, the multimedia package-II is better than the multimedia package-I in its
iii. There is no significant difference between the pre-test mean scores of the experimental group-I, experimental group-II and control group in the achievement test even at 0.05 level of significance under the category of instructional objective-Application. This shows that the three groups do not differ significantly in their pre-achievement level and indicates that the groups are equally good in the performance irrespective of the multimedia packages under the category of instructional objective-Application.

ii. The difference between the post-test means of the experimental group-I and control group in the achievement test is found to be significant at 0.01 level (t=2.13, p<0.01). This shows that experimental group-I students who learned with the help of Multimedia Package-I accomplished enhanced achievement test scores than those taught through traditional method under the category of instructional objective-Application as compared to the students who learned with the traditional method.

i. The difference between the post-test means of the experimental group-II and control group under the category of objective understanding is significant as the 't' value is greater than the values (t=2.35, p<0.01). This shows that these two groups differ significantly in their achievement. It is therefore concluded that the students who learned with the help of Multimedia Package-II showed better achievement test scores under the category of instructional objective-Application as compared to the control group.
group-I and control group under the category of instructional objective-
‘Application’ is found to be significant as the calculated ‘t’ value (t = 2.10)
is greater than the critical value of ‘t’ at 0.05 level of significance. This
shows that these two groups differ significantly in their retention level.
Hence, it is concluded that students who learned with the help of
Multimedia Package –I showed better retention test scores under the
category of instructional objective -‘Application’ as compared to the
students who learned with the traditional method.

v. The difference between the retention test mean scores of the experimental
group-II and control group is found to be significant at 0.01 level (t = 3.46).
This shows that experimental group-II where the mean retention test score
is higher, is good in performance than the control group in their retention
level. Therefore, it is concluded that the students who learned with the help
of multimedia package-II show a clear advantage in retention scores than
those taught through traditional method under the category of instructional
objective -‘Application’.

The analysis leads to the conclusion that the multimedia approach
(including either multimedia package-I or multimedia package-II) is more
effective than traditional method in the teaching of science to the secondary
school science students under the category of instructional objective-
‘Application’. It is therefore, concluded that among the two packages, the
multimedia package-II has a higher potential than the multimedia package-I in
enhancing the academic achievement and retention among the learners.

d. **Comparison of the effectiveness of Multimedia Package-I and Multimedia
Package-II with Traditional Method for Teaching Science to Secondary
School Students under the category of Instructional Objective-‘Creativity’**.

i. There is no significant difference between the pre-test mean scores of the
experimental group I, experimental group-II and control group in the
achievement test even at 0.05 level of significance under the category of the
instructional objective-‘Creativity’. This shows that the three groups do not
differ significantly in their pre-achievement level and indicates that groups
are equally good in the performance irrespective of the multimedia packages

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under the category of instructional objective-‘Creativity’.

ii. The difference between the post-test means of the experimental group-I and control group under the category of instructional objective-‘Understanding is significant as the ‘t’ value is greater than the table value \( t = 2.05; p < 0.05 \). This shows that these two groups differ significantly in their achievement. It can be therefore concluded that the students who learned with the help of Multimedia Package –I showed better achievement test scores under the category of instructional objective-‘Creativity’ as compared to the students who learned with the traditional method.

iii. The difference between the post-test means of the experimental group-II and control group in the achievement test is found to be significant at 0.01 level \( t = 6.554; p < 0.01 \). This shows that experimental group-II under the category of the instructional objective-‘Creativity’ is better than the control group in their academic achievement. It is therefore concluded that the students who learned with the help of multimedia package-II have accomplished enhanced achievement test scores than those taught through traditional method under the category of instructional objective-‘Creativity’.

iv. The difference between retention test mean scores of the experimental group-I and control group under the category of instructional objective-‘Creativity’ is found to be significant as the calculated ‘t’ value \( t = 4.565 \) is greater than the critical value of ‘t’ at 0.05 level of significance. This shows that these two groups differ significantly in their retention level. Hence it is concluded that the students who learned with the help of Multimedia Package-I showed better retention test scores under the category of instructional objective-‘Creativity’ as compared to the students who learned with the traditional method.

v. The difference between the retention test mean scores of the experimental group-II and control group is found to be significant at 0.01 level \( t = 8.264 \). This shows that experimental group-II where the mean retention test score is higher, is good in performance than the control group in their retention level. Hence, it is empirically concluded that the students who learned with the
help of multimedia package-II show a clear advantage in retention scores than those taught through traditional method under the category of instructional objective-‘Creativity’.

The analysis leads to the conclusion that the multimedia approach (including either multimedia package-I or multimedia package-II) is more effective than traditional method in the teaching of science to the secondary school students under the category of instructional objective-‘Creativity’. It is concluded that among the two packages, the multimedia package-II has a higher potential than the multimedia package-I in enhancing the academic achievement and retention among the learners.

C. MULTIMEDIA PACKAGES and ‘ACADEMIC ACHIEVEMENT and RETENTION’ at VARYING LEVELS of INTELLIGENCE

8. Comparison of Effect of Multimedia Package-I and Multimedia Package-II with Traditional Method on Academic Achievement and Retention of Secondary School Science Students at Varying Levels of Intelligence

a. Comparison of the effectiveness of Multimedia Package-I and Multimedia Package-II with Traditional Method for Teaching Science to Secondary School Students with respect to Academic Achievement and Retention of High Intelligence Group

i. The difference between the post-test means of the experimental group-I and control group in the achievement test under the category of high intelligence is found to be significant at 0.01 level. This shows that experimental group-I performed well than the control group in their academic achievement. Thus we can say that the students who learned with the help of Multimedia Package-I showed better achievement test scores at high intelligence level as compared to the students who learned with the traditional method.

ii. The difference between the post-test mean scores of the experimental group-II and control group in the achievement test is found to be significant at 0.01 level. This shows that experimental group-II where the mean post-test score
is higher (Mean= 88) is better than the control group in their academic achievement. Consequently, it is concluded that students who learned with the help of multimedia package-II have accomplished enhanced achievement test scores than those taught through traditional method under the category of high intelligence group.

iii. There is no significant difference between the pre-test mean scores of the experimental group-I, experimental group-II and control group in the achievement test even at 0.05 level of significance. This shows that the three groups do not differ significantly in their mean pre achievement scores and indicates that the groups are equally good in the performance irrespective of the multimedia packages at high intelligence level.

iv. The difference between retention test mean scores of the experimental group -I and control group under the category of high intelligence level, is found to be significant as the calculated ‘t’ value (t=3.581) is greater than the critical value of ‘t’ at 0.01 level of significance. This shows that these two groups differ significantly in their retention level. Evidently, therefore it is concluded that the students who learned with the help of Multimedia Package –I showed better retention test scores under the category of high intelligence level as compared to the students who learned with the traditional method.

v. The difference between the retention test mean scores of the experimental group-II and control group is found to be significant at 0.01 level (t= 10.554). This shows that experimental group-II where the mean retention test score is higher is good in performance than the control group in their retention level. Hence, it is concluded that students who learned with the help of multimedia package II show a clear advantage in retention scores than those taught through traditional method at high intelligence level.

The analysis leads to the conclusion that multimedia package-I and multimedia package-II are more effective than traditional method in the teaching of science to the secondary school students under the category of high intelligence
level. Hence, among the two packages, the multimedia package-II is much better than the multimedia package-I in its effectiveness.

b. Comparison of the effectiveness of Multimedia Package-I and Multimedia Package-II with Traditional Method for Teaching Science to Secondary School Students with respect to Academic Achievement and Retention of Average Intelligence Group.

i. There is no significant difference between the pre-test mean scores of the experimental group I, experimental group-II and control group in the achievement test even at 0.05 level of significance under the category of the average intelligence. This shows that the three groups do not differ significantly in their pre-achievement level and indicates that groups are equally good in the performance irrespective of the multimedia packages under the category of average intelligence.

ii. The difference between the post-test means of the experimental group-I and control group under the category of average intelligence is significant as the ‘t’ value is greater than the values (t=3.960; p<0.01). This shows that these two groups differ significantly in their achievement. It is therefore concluded that the average intelligence students who learned with the help of Multimedia Package –I showed better achievement test scores as compared to the students who learned with the traditional method.

iii. The difference between the post-test means of the experimental group-II and control group in the achievement test is found to be significant at 0.01 level (t=7.208; p<0.01). This shows that experimental group-II where the mean post-test score is higher (Mean= 66.83) at average intelligence level, is better than the control group in their achievement. Therefore is concluded that the students who learned with the help of multimedia package-II have accomplished enhanced achievement test scores than those taught through traditional method at average intelligence level.

iv. The difference between retention test mean scores of the experimental group-I and control group under the category of average intelligence is
found to be significant as the calculated ‘t’ value (t = 3.463) is greater than the critical value of ‘t’ at 0.01 level of significance. This shows that these two groups differ significantly in their retention level. Hence, it is concluded that students who learned with the help of Multimedia Package – I showed better retention test scores at average intelligence level as compared to the students who learned with the traditional method.

v. The difference between the retention test mean scores of the experimental group-II and control group is found to be significant at 0.01 level (t = 8.666). This shows that experimental group-II where the mean retention test score is higher (Mean = 60.22) has performed better than the control group in their retention scores. Hence, it proves that average intelligence students who learned with the help of multimedia package-II show a clear advantage in retention scores than those taught through traditional method.

The analysis leads to the conclusion that multimedia package-I and multimedia package-II are more effective than traditional method in the teaching of science to the secondary school average intelligence students. So, it is concluded that among the two packages, the multimedia package-II is much better than the multimedia package-I in its effectiveness for the average intelligence students also.


i. There is no significant difference between the pre-test mean scores of the experimental group I, experimental group-II and control group in the achievement test even at 0.05 level of significance under the category of the low intelligence level. This shows that the three groups do not differ significantly in their pre achievement level and indicates that groups are equally good in the performance irrespective of the multimedia packages under the category of objective knowledge.

ii. The difference between the post-test means of the experimental group I
and control group under the category of objective understanding is not significant as the calculated ‘t’ value 1.031 is less than the table value of ‘t’ at 0.05 level of significance. This shows that these two groups do not differ significantly in their achievement. It is therefore concluded that the low average students who learned with the help of Multimedia Package –I did not show better achievement test scores when compared to the students who learned with the traditional method.

iii. The difference between the post-test means of the experimental group II and control group in the achievement test is found to be significant at 0.01 level (t=2.781; p<0.01). This shows that experimental group II under the category of low intelligence level is better than the control group in their academic achievement. It may be therefore concluded that the students who learned with the help of multimedia package-II have accomplished improved achievement test scores than those taught through traditional method under the category of low intelligence level.

iv. The difference between retention test mean scores of the experimental group-I and control group under the category of objective application is found to be significant as the calculated ‘t’ value (t =2.619) is slightly greater than the critical value of ‘t’ at 0.05 level of significance. This shows that these two groups differ significantly in their retention level. It thus proves that students who learned with the help of Multimedia Package –I showed better retention test scores under the category of low intelligence level as compared to the students who learned with the traditional method.

v. The difference between the retention test mean scores of the experimental group-II and control group is found to be significant at 0.01 level (t= 4.068). This shows that experimental group-II where the mean retention test score is higher is good in performance than the control group in their retention level. Hence, it may be concluded that the students who learned with the help of multimedia package-II show a clear advantage in retention scores than those taught through traditional method under the category of low intelligence level.

The analysis leads to the conclusion that the multimedia approach (including
either multimedia package-I or multimedia package-II) is more effective than traditional method in the teaching of science to the secondary school science students even for the students of low intelligence levels. Further, it is also concluded that among the two packages, the multimedia package-II has a higher potential than the multimedia package-I in enhancing the academic achievement and retention among the learners of low intelligence level. Thus, it is concluded that Multimedia Approach with Multimedia Package-II can help the students of low intelligence level to perform better in their academic achievement and retention.

D. MULTIMEDIA APPROACH AND OPINION OF THE STUDENTS

9. Opinion of the Students towards the Effect of Multimedia Approach

a. Opinion of the students regarding the impact of multimedia approach on the Quality of Learning.
   
i. The use of multimedia approach was found to be interesting by 91.7 percent of the students (i.e. 75 percent strongly agree and 16.7 percent).
   
ii. The multimedia approach has a positive effect on the experimental/practical work of the subject is supported by almost 93.4 percent of the students.
   
iii. 83.4 percent students agree with the fact that with the help of multimedia approach learning is more convenient and easy.

iv. The major impact of the multimedia approach in comparison with the traditional approach was on the academic performance. The academic achievement of 88.3 percent students was improved because of the use of multimedia approach.

v. The major impact of the multimedia approach in comparison with the traditional approach was on the academic performance. The academic achievement of 88.3 percent students was improved because of the use of multimedia approach.

vi. Almost 85 percent students do not agree with the statement that multimedia approach is not capable to satisfy the individual needs of the learners. Thus, we can say that it is a useful tool which satisfies the individual needs of the majority of the learners

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vii. 86.7 percent of the students disagree with the statement that self paced learning is not possible via multimedia approach. Thus, with the help of this software majority of the students can learn according to their own pace of learning.

viii. Similarly 79 percent students disagree with the statement that multimedia approach makes it difficult for them to retain their concepts. This clearly shows that multimedia approach has a positive impact on the retention of the subject matter among the learners.

ix. Multimedia instructional technology has helped the learners learn newer technology is supported by positive opinion of almost 85 percent of the students.

b. Opinion of the students about the impact of multimedia approach on the Quality of Teaching.

i. More than 90 percent students are of the opinion that multimedia approach strengthens the interaction between the student and teacher. Thus, the teaching learning environment is made more effective with the use of the multimedia approach in the classroom.

ii. The instructions are systematically designed and implemented in the classroom with the help of the multimedia approach. 88.3 percent students found that continuity is thus maintained throughout the teaching.

iii. Multimedia presentations have been found to have a greater impact on the teaching-learning than the normal conventional teaching strategy as 85 percent students have found these multimedia presentations easier to see and read and were also found to be sufficient by more than 70 percent of the students.

iv. Almost 84 percent students disagree with the statement that multimedia approach does not have sufficient written instructions and simulations. Thus, it is clear that multimedia approach is a complete package in itself.

c. Opinion of the students about the New Instructional Settings/Materials.

i. Instructional material used in multimedia approach is easy to understand and convenient to comprehend is supported by almost 88.3 percent of students.

ii. Since the software is easy to comprehend therefore, almost 78.3 percent of the
students disagree with the statement that the style of the questioning is not appropriate.

iii. The language used in the multimedia software is not easy to understand is disapproved by 85 percent majority of the students.

iv. The usefulness of the software in the science experiments is appreciated by almost 90 percent of the students.

v. The various elements of the multimedia approach like text, graphics, and animations were widely acceptable by almost 85 percent of the students which have ultimately aroused their interest in the subject of the science and motivated them to learn this subject.

vi. The multimedia content in terms of question bank, glossary and solved exercises in the software are very helpful in quick revision of the concepts is clearly evident with almost 95 percent of the favourable opinion and merely 5 percent of the students were in unfavourable opinion.

vii. Another better outcome of the software was that a majority of the students i.e. 83.4 percent students were in favourable opinion of having no further tuitions requirement.

viii. Only 16.7 percent of the students prefer the traditional approach in comparison with the 83.3 percent of the students liking the multimedia approach.

ix. Only few students i.e. 13.4 percent of the students were of the view that the images used in the software were not appropriate whereas majority of the students were fascinated by the colorful images and drawings.

x. Similarly, only 11.7 percent of the students found the size of the text not readable.

d. Opinion of the students about the impact of multimedia approach on learners with respect to the Socialization.

i. Only 11.6 percent of the students are of the opinion that multimedia approach does not promote socialization while 80 percent of the students do not agree with this opinion.

ii. Whereas on the other hand 85 percent of the students support the fact that since there is an active participation of the students while using multimedia
approach therefore it helps in developing cooperation and group feeling among the students.

e. **Opinion of the students about the Change in Teacher’s Role/ Attitude due to the use of multimedia approach.**

i. The role of the teacher in the multimedia approach is equally important. Teacher rendering help to the student has been found to be important with favourable opinion by majority 90.7 percent of the students whereas the percentage of the students those who disagree and strongly disagree with the opinion are 4 percent and 2 percent respectively.

ii. A mere 6.0 percent of the students believe that the importance of the teacher is diminished while using the multimedia approach. In contrast to this almost 55 percent and 36 percent of the students disagree and strongly disagree respectively with the diminishing importance of the teacher while using multimedia approach.

iii. 86.6 percent of the students are of the opinion that majority of the school teachers do not have the required expertise in handling the multimedia approach, thus necessitate the training of the teachers in handling the newer technology and newer approach equally important for doing justice with the use of this technology for achieving the desired educational objectives.

iv. Teachers can bring a lot of attitudinal changes and evoke emotions as evident from the positive perception of almost 90 percent of the students whereas only few students were not in favour of the same.

f. **Opinion towards the Development of Students Abilities by using multimedia approach.**

i. Only 3.4 percent of the students think that the student's participation is more in conventional method whereas 91.6 percent of the students disagree with the same fact.

ii. By adopting multimedia approach almost 85 percent of the students think that multimedia approach helps in improving the creativity among the students whereas in contrast to this merely 8.3 percent of the students were against this opinion.
iii. A mere 6.7 percent of the students are of the opinion that multimedia approach increases anxiety and frustration among the learners, whereas a majority of 86.7 percent students did not agree with the opinion.

iv. Almost 88.4 percent of the students are of the opinion that multimedia approach has enhanced their confidence level.


i. Multimedia approach has been found to be student centric and diagnostic in nature by almost 93.3 percent of the students. Similarly, almost more than 80 percent of the students feel that this approach provides specific help for the student’s error.

ii. 88.3 percent of the students do not agree with the opinion that feedback provided by the multimedia approach is not clear and complete. Thus, highlighting the importance of the multimedia approach in providing immediate feedback.

h. Opinion of the students regarding the Effect of Multimedia Approach on the Education System

i. Almost 85 percent of the students agree with the opinion that multimedia approach is an effective technique and therefore the students will prefer to study other science subjects also with the help of the multimedia approach, whereas a mere 9.7 percent of the students disagree from the same opinion. 5.3 percent of the students were in a state of flux and remained undecided about the opinion.

ii. Merely 11.7 percent of the students are of favourable opinion that multimedia approach cannot be useful in improving the standard of education, whereas contrary to it, 85 percent of the students are against the opinion and strongly rejected the view.

i. Opinion of students about the Change in Student’s Role/ Attitude due to the use of multimedia approach.

i. Out of the 90 percent of the students 50.7 percent students strongly agree where as 39.3 percent of the students agree with the opinion that with the help
of multimedia approach their power of reasoning has increased. A mere 6.7 percent of the students are not in favour of the said opinion.

ii. Likewise, a mere 11.7 percent of the students are of the view that they didn’t like the multimedia approach. On the contrary this methodology was liked and appreciated by almost 85 percent of the students.

iii. Only few 5 percent of the students opined that multimedia approach has no effect on their retention power, whereas almost 88 percent of the students are not in the favour of this opinion. Thus, they contented for the positive effect of the multimedia approach on retaining the concepts in science for a longer time.

iv. Similarly, a majority of the students i.e. almost 91.7 percent of the students supported the statement with a favourable response that a lively environment is created with the help of the multimedia approach.

j. General/Other opinion of students towards multimedia approach.

i. Multimedia approach can easily correlate with the day today life experiences of the learner are favoured by 86.7 percent of the students.

ii. Like science multimedia approach can also be used in the other subjects also is favourably opined by 90 percent of the students.

iii. Only 10 percent of the students believe that the multimedia approach destroys the imagination of the students whereas 83.3 percent of the students disagree with the same opinion.

iv. Similarly, only 8 percent of the students are of the favourable opinion that it is difficult to take notes while using the multimedia approach, whereas, 88.3 percent of the students disagree with the same.

k. Opinion of the students towards the overall effectiveness of the multimedia approach.

In order to rate the overall effectiveness of the multimedia approach used in the subject of the science for the secondary school student’s majority of the students favoured this approach. 36.7 percent of the students rated this approach ‘outstanding’ whereas majorities i.e. 43.3 percent of the students have rated this approach as
‘excellent’. There were only 1.7 percent students who have rated this approach as ‘poor’. A mere 6.7 percent of the students have rated this approach as ‘fair’ whereas 13.3 percent of the students have rated it as ‘about average’.

1. Opinion of the students towards the open ended question “Give further suggestion (s) for improving the multimedia software.

In order to give further suggestions to modify or improve this multimedia software, some useful suggestions were given by the students. The suggestions like additional information for competitive exams should be included, more animations and videos should be included, mobile applications of the software should also be developed, software should be multilingual are given by 28.33 percent, 25 percent, 33 percent and 20 percent respectively.

Conclusion

The analysis of opinionnaire with regard to the use of multimedia packages revealed that the students have favourable opinion towards the use of multimedia approach in the subject of science.

DISCUSSION OF THE RESULTS

While reviewing all the analysed data, the investigator found that new strategies are more effective than the conventional method of teaching in formal educational system. The results of the present study are related to the comparative effectiveness of multimedia packages in the teaching of science to the secondary school students with respect to academic achievement and retention and also attainment according to the varying levels of intelligence.

The results clearly show that multimedia approach using the packages, multimedia package-I and multimedia package-II are more effective than traditional method in teaching science to secondary school students in relation to their academic achievement and retention.

Another important result of the present study is related to the attainment of different categories of instructional objectives in education. Though both packages are effective, Multimedia package-II is more effective than multimedia package-I in according to different instructional objectives, i.e., Knowledge, Understanding, Application and Creativity. The present study also indicates the impact of multimedia
approach on the students at varying levels of intelligence. The high and average intelligence groups were found equally good in their effectiveness with regard to the low intelligence group.

**EDUCATIONAL IMPLICATIONS**

The scope of the study indicates that this study is a “drop in an ocean”. But as “drops make the ocean”, this study has educational implications especially for science teaching at school level. Implications for the teachers

Multimedia based technology acts as catalyst to support change in teachers’ pedagogy. With new technologies a teacher is no longer the sole source of knowledge but instead is a guide or facilitator who supports students learning.

**Implications for students**

The individualized instruction of this multimedia approach based education will allow students to advance at precisely the rate that will be advantageous for them.

Multimedia based tools will be able to break problems into small segments and to formulate questions. They will take students through each level, repeatedly and with many problems if necessary, until pupils begin to understand better. A human teacher could do the same if he or she had only one child in class.

**Implications for Teacher Education (TE)**

1. In the light of multimedia based approach in TE, changing roles of learners and teachers, high-tech classrooms, etc., it may be said that integration of multimedia based approach in TE will make TE highly interactive, individualized, flexible, accessible, more relevant and affordable and computer mediated.

2. A model of teacher training on use of multimedia technology need to be developed for effective instruction of science and other subjects at the secondary school level.

3. Human resources with proficiency in pedagogy and multimedia technology are needed to benefit from multimedia approach. Hence teacher training institutions are required to introduce courses to prepare teachers equipped with pedagogy
and multimedia based skills.

4. Teacher education institutions may start new programs to produce multimedia programmers proficient to develop and implement effectively the multimedia based software in the classroom settings.

5. In-service teachers should be given multimedia literacy training through refresher courses. It is necessary to develop a culture for better utilization of multimedia in teaching learning process.

SUGGESTIONS FOR FURTHER STUDIES

1. A research study can also be undertaken to determine the effectiveness of various types of multimedia based instructions for various subject areas.

2. A study can be conducted to develop multimedia software on various topics of science according to science curriculum as prescribed by CBSE.

3. The study can be replicated on a large sample with special reference to different variables like gender, locality, management, socio-economic status and personality.

4. The study can be conducted at primary, higher secondary and college level for different subjects.

5. Further studies can also be conducted by dividing various types of multimedia elements (individually or in combinations) to see the best type of combination(s) higher achievement and retention capacity of students belonging to different age groups.