CHAPTER – III
REVIEW OF RELATED LITERATURE

A research work is not meaningful without a thorough analysis of the related work. The search of related literature should be completed before proceeding with the actual conduct of the study. Survey of related literature serves the following purposes as;

i. It shows whether the evidence already available solves the problem adequately without further investigation. In such a case the review helps to avoid unnecessary duplication. However, if the researcher is not satisfied with the procedures followed by the previous researchers in solving the problem, researcher can conduct the study using innovative, alternative or refined procedures. Further, in educational research it should not be assumed or generalized that when a problem has been studied under one set of the conditions the issue is settled for all other circumstances. Secondly, normative type of studies which deal with current conditions need to be repeated at fairly regular time of interval in order to cope up with the latest trends and developments. Thirdly, studies in educational research need to be repeated under similar conditions, in order to confirm the results of the previous investigation.
ii. Review also tells the researcher about what has been done, found and accepted, further helping in what is to be done. Thus it will be of immense help at the stage of ‘finalizing the selection of the problem for research’.

iii. It provides new ideas, concepts, theories, explanations or hypotheses valuable in formulating the problem. It is useful in defining and delimiting the problem in terms of objectives questions and hypotheses. Thus, it is quite useful at the stage of ‘formulating the problem’.

iv. Review suggests the research methodology appropriate to the selected problem. Through the review, the researcher will come to know the methodology used by the previous researchers. This helps the researcher to select method(s) of research appropriate for his study. He may imitate, improvise, modify, refine, integrate, enrich or innovate suitable methods. Thus review is found to be useful at the stage of ‘planning of research’.

v. It suggests data gathering tools and techniques appropriate for the study. The review helps the researcher in knowing about data gathering devices used by the previous researcher and for similar related studies in the field. This knowledge helps him to select or construct appropriate data gathering devices and tools for his study. Thus review is found to be quite useful at the stage of ‘selection and construction of tools for the collection of data’.
vi. Review of related literature suggests the statistical techniques appropriate for the analysis of data since the researcher will be acquainted with the statistical techniques used by the previous researchers in their studies.

vii. It also helps the researcher in the formulation of conclusions and generalizations.

viii. Review of related literature helps in knowing about the recommendations of previous researchers for further research which they will have listed in their studies. It contributes towards the general research competency of the researcher. The researcher who makes a thorough review of literature develops confidence in planning and conducting research.

According to Gay (1998), “the review of literature involves the systematic identification, location and analysis of documents containing information related to the research problem. The review tells the researcher what has been done and need to be done”.

According to J.W. Best (1977), “Familiarity with the literature in any problem area helps the students to discover what is already known, what others have attempted to find out, what methods of attacks have been promising and what problems remains to be solved”

Practically all human knowledge can be found in books and
libraries. So, extensive use of the library and thorough investigation of related literature are essential in planning and carrying out the kind of searching involved.

Hence review of related literature is a valuable guide to define the problem, recognizing its significance, suggesting promising data, gathering tools and devices appropriate to the study design and also sources of data. In the present study the method of Learning (Treatment Variable Conventional and Experimental) are independent variables and the Knowledge gain is a dependent variable. The studies related to independent and dependent variable are reviewed in this chapter.

3.1 Studies Related to Learning through Visuals

Samuel (1967) attempted to study the effect of related picture accompanying a simple short story. Pictures interfered with the ability of poor first grade readers who learned to read the 50 words in the story. Here, the addition of the non-verbal medium (pictures) actually decreases learning. Poor first grade readers appeared to be distracted by the supporting illustrations that were added to the text. Hence, the usage of multimedia has not always given good results.

Shepard (1967) had conducted a study in which he made people to look at 600 pictures, sentences, or words. On an immediate test, recognition
accuracy was 98% for pictures, 90% for sentences, and 88% for words.

**Nickerson (1968)** found that people had 63% recognition accuracy for a group of 200 black and white photographs on year after initial viewing. These studies proved that to communicate information, pictures are extremely effective.

**Dwyer (1967, 1978)** conducted a series of research studies and found that illustrated text was better than text alone when students were tested on spatial information using a drawing test.

**Sherman and Turvey (1969)** had undertaken a study by presenting 9-digit sequences in the visual mode and auditory mode for immediate recall under comparable conditions to 90 undergraduates. The number of correct items recalled in the correct order, prior to an error omission, was significantly greater for the presentation in the visual mode. This superiority of the visual mode over the auditory mode of presentation was interpreted as evidence for the presence of a more flexible rehearsal strategy in the visual mode.

**Standing et al., (1970)** carried out a study to measure the retention ability of pictures. They showed people 2,560 photographs for 10 seconds each. After three days, the study participants recorded recognition accuracy of over 90%.
**Bransford and Johnson (1972)** conducted a study to see the impact of pictures. They presented a short, ambiguous text passages to high school students. Before seeing each passage, one group of students saw a picture that explained the ambiguous text. The students who saw the picture recalled more ideas from the text than the students who did not see the picture. It appears that the picture helped the students to interpret the meaning of the text.

**Peek (1974)** carried out a study in which he asked fourth grade children to read a story with supportive pictorial illustrations or without illustrations, measured learning with help of multiple choices, verbal recognition tests, and found that retention was better when the text was accompanied by supportive illustrations.

**Bahrick and Gharrity (1976)** attempted a study using verbal captions. They found that pictures helped people recall captions that were related to the pictures, but not captions that were unrelated.

**Holliday and Thursby (1977)** carried out a study and suggested that there is also the danger that complicated realistic images may distract the student and impede learning.

**Read and Barnsley (1977)** had undertaken a study which compares the effectiveness of addition of picture with text. They showed adults,
pictures and text from the elementary school books they used 20 to 30 years ago. Recognition accuracy rates for pictures and text were better than chance, with pictures alone being recognized more accurately than text alone.

Blake (1977) carried out a study, in which college students with low or high aptitude in spatial and mental abilities learned the pattern of movement of five chess pieces via moving pictures (film), static pictures, or static pictures with arrows indicating motion. The students with low aptitude performed better in the conditions with moving pictures or static pictures with motion arrows than the condition with static pictures alone. However, the students with high aptitude performed similarly on all three kinds of pictures.

Wardle (1977) conducted a study on the impact of picture illustrations. He gave 800-word textual passages on various science topics to seventh grade students. Some of the passages included supporting pictorial illustrations. During a comprehension test, the students were allowed to look at the materials. Poor readers performed better when the passages included illustrations. For good readers, the illustrations had no effect. The studies by Blake (1977) and Wardle (1977) found that multimedia is more effective for students who are low in aptitude. The findings of these studies suggest that multimedia is most effective for people with low prior knowledge or aptitude in the domain being learned. This may be because experts already have a cognitive model and large amounts of information for new knowledge to
connect to, but novices do not. Alternatively, novices may not know which information is important and on which information they should focus their attention.

**Garrison (1978)** carried out a study, which supports the effect of pictures that spatial relations are recalled and recognized better by children when the spatial relations are presented via story text and pictorial illustrations rather than story text alone.

**Evans and Denney (1978)** found that the short phrases in picture-phrase combinations were recalled better since the pictures and phrases became more related.

**Levin and Lesgold (1978)** reviewed a dozen studies that examined the effect of pictures on children’s ability to learn auditory, oral, fictional, stories. The pictures reflected the contents of the stories and learning was measured by short answers to factual questions. The reviewers found that related pictures improved learning of the oral prose. Hence, static pictures also appear to help children learn auditory, oral prose.

**Sewell and Moore (1980)** conducted a study to see the impact of irrelevant pictures in learning. They added small cartoons to textual material that did not support the textual information. Although the students enjoyed the cartoons, the cartoons did not affect learning. This is because mere
inclusion of picture will not improve learning, whereas the picture/visuals should be related and be supported to the textual information.

Bartram (1980) conducted a study for college students to learn how to get from a starting point to a destination using a minimum number of buses. The researcher presented the bus route information via maps or lists and asked the students to provide as quickly as possible the correct list of bus numbers in the correct order. Bartram measured the time it took to correctly complete each bus route task. The study found that the students learned the bus route information more quickly when they used a map (pictures) than when they used lists (text). Bartram believed that the students performed a spatial task, and the maps were superior to lists because the map presentation of information is consistent with people’s preferred internal representation of spatial information.

Stone and Glock (1981) had undertaken a study and found that college students who used text with pictures made fewer errors on an assembly task than college students who used text alone. Apparently the best way to learn an assembly task is to acquire both spatial and verbal knowledge about the task steps.

Levie and Lentz (1982) conducted a study on text and illustrations. They found that learning is higher when text was accompanied by picture illustrations than text that was not accompanied by illustrations. Levy and
Lentz estimated that children reading illustrated text learned one-third more than children reading non-illustrated text, especially when the illustrations supported information presented in the text. These results are consistent with the dual coding theory. They also found that illustrations that did not show what was described in the text did not improve learning.

Beagles-Roos and Gat (1983) conducted a study and found that children recalled more details about the story when the story was presented via television with a narrated soundtrack than radio (soundtrack alone).

Stoneman and Brody (1983) found that children in visual or audiovisual conditions recognized more products in commercials than children in an auditory only condition. Pictures seem to allow very rich cognitive encoding that allows surprisingly high recognition rates, even years after the initial encoding took place.

Moyer et al., (1984) found that children in grades 3 to 11 solved mathematical word problems better with text and picture illustrations of the problem elements than text alone.

Threadgill-Sowder, et al., (1985) found that the school students who scored in the lowest quartile on a cognitive restructuring test were able to improve their scores when the story problems in the test were presented using drawing that organized the problem data.
Beiger and Glock (1986) found that people assembled with fewer errors when they received spatial information via text, but they performed the assembly task more quickly when they received spatial information via pictures.

Goia and Bass (1986) carried out a study and observed that students had grown up in an intensive environment of television, movies and video games, have developed learning styles where comprehension occurs through visual images.

Kunz et al., (1989) found that for college students with low prior meteorology knowledge, use of pictures in text correlated positively with comprehension. But, for college students with high prior meteorology knowledge, use of pictures in text did not correlate with comprehension.

Mayer and Gallini (1990) in their study made college students to read with and without picture illustrations that explained the operation of automobile drum brakes. For college students with low prior knowledge of automobile drum brake operation, the illustrations improved their recall of explanatory information and their ability to solve problems related to the explanations. For college students with high prior knowledge, the explanatory illustrations did not affect their performance.

Bernard (1990) considered two strategies for increasing the
effectiveness of illustrations in text, two types of caption were used: (i) descriptive – the caption repeated the contents of the picture; (ii) instructive – the caption included key features of the picture.

Results from experiments employing these strategies show that both caption types produced better results than when the illustration alone was used. Little difference between types was shown and there was no additive effect when both types were combined. He stresses the importance of placing the image near the text that it supports or making obvious the links between image and text. Often this is difficult if the size of the computer image is full screen. Therefore, use quarter screen images when available. Images related to text should not be put on a second “page” of the module. That is, the text and associated image must appear together. If necessary place a “button” on the screen that when pressed causes the appropriate image to appear.

Bell and Johnson (1992) conducted an exploratory study, in which they allowed four people to select pictures or text for communicating instructions for loading a battery into a camera. Qualitative results showed a strong preference for pictures rather than text. The researchers believed that the information to be communicated was spatial, and that the results supported the hypothesis that spatial information should be presented
Dewhurst et al., (1994) found that the knowledge gained from a physiology simulation of experimental work was the same as that gained in conventional lab classes.

Sharma and Sansanwal (2001) studied to Compare video based instructional strategies for teaching science at IX level in terms of achievement. ANOVA was used for analysis of data based on post-test only control group design. The data were further analyzed through Duncan’s Multiple range test in order to know which group mean of achievement in science is significantly higher than other.

3.2 Studies Related to Learning through Animations

Spangenberg (1973) compared motion and still pictures and found that motion pictures sometimes help people learn procedures better than still pictures.

Palmiter and Elkerton (1991) had undertaken a study to see the impact of animation on learning. People were made to learn some
procedural information through animation and text alone format. People who saw animated demonstrations learned faster and accurate and performed well on an immediate test than people who saw only text. However, seven days later the people who saw only text were faster than and as accurate as the people who saw animated demonstrations.

**Mayer and Anderson (1991)** carried out a study, in which the students who heard a verbal description simultaneously with the animation performed better on a problem-solving test than the students who heard the description only, saw the animation only.

**Mayer and Anderson (1992)** again performed a series of studies in which an auditory explanation of bicycle pump or automobile brake operation was presented before or during an explanation showing the same information. The students who heard the explanation with the animation (combined verbal and non-verbal channels) performed better on a creative problem-solving test than the students who heard the verbal explanation before the animation (separate verbal and non-verbal channels).

**Mayer and Moreno (1998)** asked seventy-eight college students to view an animation depicting the process of lighting either along with concurrent narration or along with concurrent on-screen text, results showed that students who learn with concurrent narration and animations outperformed those who learn with concurrent on-screen text and
animations.

**Moreno and Mayer (1999)** conducted a study (Experiment – 1) where the physical proximity of the on-screen text and the animation was manipulated. One hundred and thirty-two college students participated in this study. One group of students had on-screen text that the integrated or physically close to the animation (IT group) while a second group of students had on-screen text that was separated or physically far from the animation (ST group). A third group of students saw a presentation with concurrent animation and narration (N group). The results indicated that the N group scored significantly higher than the IT and ST groups in the transfer test, with the IT group scoring significantly higher than the ST group.

**Moreno and Mayer (1999)** conducted another study (Experiment – 2). In this study, one hundred and thirty-seven college students viewed the animation in one of the following six conditions: one group of students viewed concurrently on-screen text while viewing the animation (TT), a second group of students listened concurrently to a narration while viewing the animation (NN), a third group of students listed to a narration preceding the corresponding portion of the animation (NA), a fourth group listened to the narration following the animation (AN), a fifth group read the on-screen text preceding the animation (TA), and the sixth group read the on-screen text following the animation (AT). The text groups (TT, AT, and TA) scored significantly lower than the narration group (NN, AN, and NA).
Moreno and Mayer (1999) (Experiment – 3) compared the learning outcomes of four groups of sixty nine college students to answer the question, would the presentation of redundant verbal information enhance learning when students need to simultaneously process an animation? Two groups were presented with an animation and concurrent explanation about the formation of lightning via narration (Group AN) or via narration and on-screen text (Group ANT) and two groups received an animation preceding the explanation via narration (Group A-N) or via narration and on-screen text (Group A-NT). A two-way analysis of variance with the between subjects factors being redundant or non-redundant verbal information (A-NT and ANT versus A-N and AN, respectively) and simultaneous or sequential presentation order (AN and ANT versus A-N and A-NT, respectively) failed to reveal that students generated significantly more conceptual creative solutions when the verbal material was redundant than when it was not. However, students who received sequential presentations generated more conceptual creative solutions on the transfer test than those who received simultaneous presentations (p<0.0005) most importantly, a significant interaction between redundancy and presentation order for the transfer score was found.

Mayer et al., (1999) conducted a study with 60 college students. One group of students saw a presentation with concurrent animation and
narration (concurrent group), a second group of students either viewed the whole animation followed or preceded by the whole explanatory narration (large bites group) and a third group of students either viewed small chunks of animation followed or preceded by small chunks of explanatory narration (small bites group). The large bites group scored significantly lower than the concurrent and small bites groups in the transfer test. The concurrent and small bites groups did not differ from each other.

**Moreno and Mayer (2000)** asked students to view an animation depicting the process of lightning either with concurrent narration (Group N), with concurrent narration and environmental sounds (Group NE), with concurrent narration and music (Group NM), or with concurrent narration, environmental sounds and music (Group NEM). The findings suggest that auditory overload can be created by adding auditory material that does not contribute to making the lesson intelligible.

### 3.3 Studies Related to Learning through Audio

**Barrow and Westley (1959)** found that in an immediate test of factual recall, children who saw a movie with an audio narration did better than children who heard a similar narration through radio.

**Severin (1967)** found that animal name recognition accuracy was highest when children were presented the names through simultaneous
audio and pictures (verbal and non-verbal channels). However, children who received the same information via audio and print (two verbal channels) did not outperform students who received the information via print alone (verbal channel).

Murdock (1968) carried out an experimental study and found that recognition for items in a nine item verbal list was better with an auditory presentation than with a visual presentation. Sound appears to be an effective way to communicate a small amount of verbal information for a short period of time.

Penney (1975) conducted a study of review of related literature and concluded that for tasks involving short-term memory, auditory presentation was better than visual presentation. This conclusion appears to be appropriate for about six verbal items.

Baggett (1979) found that, after a seven-day delay, college students who saw a dialogue-less movie made fewer errors when recalling the story structure than college students who heard only equivalent text. This shows the effectiveness of motion picture over audio.

Watkins and Watkins (1980) carried out a study and found that, short-term memory is better for a few verbal items when the items were presented via the auditory mode rather than the visual mode.
Meringoff (1980) found that children remembered more story action when they saw a televised film with story narration than when they were read a very similar illustrated story.

3.4 Studies Related to Learning through Multimedia

Kulik et al., (1980) conducted a comparative study involving eight studies. They found that computer-based multimedia instruction took about 2.25 hours per week while traditional classroom instruction took about 3.5 hours, a 36% savings in learning time.

Nugent (1982) studied the effectiveness of multimedia by combining the elements. The highest learning levels were found when students were presented information via combined text and pictures or combined audio and pictures compared to the same content presented via text alone, audio alone or pictures alone.

Kulik et al., (1983) conducted a study that recorded an 88% savings in learning time with computerized multimedia instruction (90 minutes) versus classroom instruction (745 minutes) and another study that recorded 39% savings in learning time.

Kulik et al., (1986) identified 13 studies in which students using computers for tutoring learned in 71% less time than students in traditional classroom instruction.
Najjar (1996) reviewed studies from a wide variety of fields related to learning and multimedia. This examination shows that multimedia information helps people learn, but not always. Redundant (more than needed or required) multimedia does not always improve learning compared to “mono-media”. Specific situations in which multimedia information may help people to learn include (i) when the media encourage dual coding of information, (ii) when the media support one another, and (iii) when the media are presented to learners with low prior knowledge or aptitude in the domain being learned. There is empirical support for concluding that specific multimedia can be used to help people learn specific kinds of information.

Meskill (1996) examined multi-modal processing and its implications for listening skills development in a foreign or second language. He found that listening skills development can be supported by multimedia technology.

Gunn and Maxwell (1996) carried out a study to find the effectiveness of multimedia. In this study, first year human anatomy course students were engaged. Student who learned through computer based multimedia performed better.

Hasebrook and Gremm (1999) found multimedia could potentially facilitate learning processes. Seventy-five subjects participated in two concurrent experiments. They were tested the influence of video and
photography. Video has no measurable influence in both experiments. Photography supports recall of all facts. Data analyses reveal that the students enjoyed using electronic media, but they rely on printed matter.

Boeglin et al., (1999) developed and studied the outcomes of an alternative teaching learning method which could also be defined as multimedia method. The alternative method was implemented in the first-year university-level introductory psychology course. They found that the multimedia environment fostered the development of a number of personal skills including communication, critical thinking, adaptability, and working with others.

Kachala and Bialo (2000) reviewed 311 research studies on the effectiveness of technology on student achievement. Their findings revealed positive and consistent patterns when students were engaged in technology-rich environments, including significant gains and achievement in all subject areas, increased achievement in preschool through high school for both regular and special needs students, and improve attitude toward learning and increased self-esteem.

Schoenfeld-Tacher, et al., (2001) mentioned that technology and multimedia facilitates the knowledge-construction process for students by allowing learners to construct links among their prior knowledge and the new concepts. This assertion supports research suggesting that science
education should include both constructivist methodologies and technology integration as a natural part of its ideology. Computerized magnification systems and video-based virtual experiences have been studied in the attempt to improve areas such as the ease of viewing, interactivity, and improvement of group learning activities within the context of science education. Downing (1995) noted the size of the ocular as an inhibitor to communication and other dynamics within group learning situations and suggested the use of magnified images on video screens.

In the Harris et al., (2001) study of the replacement of light and stereo microscopes with a virtual imaging system, digital virtual experiences largely occurred in science coursework at the university level, with emphasis on potential in the medical and biomedical fields.

Wilson and Mires (2001) studied the effectiveness of computer assisted multimedia learning programme. Audio and Graphics were included in the material. Teaching session was run in which both medical and midwifery students (N=178) were with the computer in four two-hour sessions. Students were tested before and after using the programme. The average knowledge gain score increased by more than 100%. The enjoyment rating was > 90%. Gain score improvement did not correlate with computer expertise, attitude toward computers, age or enjoyment of the programme.
Werner (2001) examined the usefulness of multimedia applications in art education with 64 participants and by constructing four different presentations of 12 representational paintings. Various visual effects, such as motion, fading, zooming, and dissolving, as well as spoken text were used to modify the viewers’ mode of understanding. The experimental conditions were varied on two dimensions: (i) the adequacy of the visual effects and (ii) the additional presentation of verbal information. The findings support the notion that sophisticated multimedia applications assist the viewer in adopting a more elaborate mode of understanding. Few effects on viewers’ aesthetic interest in art or quality of aesthetic experience were found. In contrast to the sophisticated use of multimedia, the use of “flashy” multimedia elements did not have any instructional value.

Whatannarang (2002) investigated and compared the effects of Internet-based teaching and learning systems and traditional instruction on learners in the areas of quality of students’ term papers, homework, reference sources, analytical ability, synthesis and summarization of information, and time used for study. The samples were 80 graduate students randomly selected from the class of 4 subjects registered from the second semester of academic year 2000 to the first semester of academic year 2002. They were divided into 4 control groups and 4 experimental groups. The control groups studied with traditional instruction. The
experimental groups studied with teacher-prepared instruction programs on the Internet-based system. Data were analyzed by using a one-way t-test for independent samples. The Pre-test and Post-test results indicated that there was no negative effect on the learners. The scores of experimental groups were not significantly higher than the scores of the control groups in the area of quality of students’ term papers, homework, reference sources, and analytical ability, synthesis and summarization of information. However, the experimental groups spent significantly less time.

Dee et al., (2003) stated that a comparison of virtual slides to traditional microscopy demonstrated that information technologies improved the identification of cellular structures by learners. Further information from the study indicates that the quality of the digital images is often superior to other formats.

Macaulay (2003) investigated the effectiveness of multimedia on the learning. Performance of non-English-speaking third world children. The performance scores of two groups of 18 children were recorded immediately before and after using either multimedia or no multimedia to learn mathematics. The children that used multimedia scored significantly higher than those who did not.

Susanne et al., (2002) has studied cancer cell Biology and has experienced that a student-centered instructional module exploring the use of
multimedia to enrich interactive, constructivist learning of science. Multimedia has the potential of providing bioscience education, novel learning environments and pedagogy applications to foster student interest, involve students in the research process, advance critical thinking/problem-solving skills, and develop conceptual understanding of biological topics. *Cancer cell Biology*, an interactive, multimedia, problem-based module, focuses on how mutations in proto-oncogene and tumor suppressor genes can lead to uncontrolled cell proliferation by engaging students as research scientists/physicians with the task of diagnosing the molecular basis of tumor growth for a group of patients. The process of constructing the module, which was guided by scientist and student feedback/responses, is described. The completed module and insights gained from its development are presented as a potential “multimedia pedagogy” for the development of other multimedia science learning environments.

According to Ali (2004) the significant role of technology in teaching and learning is limited as an instructional delivery medium and not a key determinant of learning. It can only Support the classroom learning.

Thus there is empirical evidence to suggest both the positive and negative effects of multimedia. The key is to analyze these findings and find out the precise reasons and the situations in which multimedia is useful and in which it is not. While Multimedia seems to be improving the learning rate, it
is not a universal fact. In the next section contains discussion on the main conditions in which multimedia would be useful.

Today’s teachers are concerned with how to use technology to enhance and enrich their learning environment. The role of technology in the classroom is not to replace traditional educational methods, it does act as an enhancement for teaching students to think critically, communicate creatively and solve problems in analytical way. Students can learn “from” computers – where technology is used essentially as tutors and serves to increase students basic skills and knowledge; and can learn “with” computers- where technology is used as a tool that can be applied to a variety of goals in the learning process and can serve as a resource to help, develop higher order thinking, creativity and research skills.

**Bhutak (2004)** This study developed a Multimedia Package for subject science of standard IX. The Multi-media Package was in three parts, (i) Learning by PowerPoint Slide Show, (ii) Self study material and (iii) Learning by transparencies through Over Head Projector and the effectiveness of Multimedia Package with reference to achievement test in science and retention of the material of science. The results showed that (i) Multimedia package was more effective in terms of achievement and retention of science for both the groups of girls and the boys separately and jointly. (ii) Self-study material was more effective than slide show for girls,
while slide show proved more effective than self-study material for boys. (iii) Slide show and self-study material were almost equally effective for girls and boys jointly.

**Klein and Koroghlanian (2004)** have investigated the effects of audio, animation, and spatial ability in a multimedia computer program for high school Biology. The study examined the effects of instructional mode (text vs. audio), illustration mode (static illustration vs. animation) and spatial ability (low vs. high) on practice and post-test achievement, attitude and time. Results indicated that spatial ability was significantly related to practice achievement and attitude. Participants with high spatial ability performed better on the practice items than those with low spatial ability. Participants with low spatial ability responded more positively than those with high spatial ability to attitude items concerning concentration, interest and amount of invested mental effort. Findings also revealed that participants who received animation spent significantly more time on the program than those who received static illustrations.

**Paris (2004)** stated that e-Learning can improve school results. Furthermore, a simple multimedia presentation helped the students to better understand a subject without the help of a teacher particularly for shy and weak students.

**Yan and Treagust (2004)** suggested that Biology educators are
increasingly using technology to supplement their teaching. A variety of computer technologies have been used over the past two decades to enhance student learning of many of the biological sciences in colleges and universities. Computer technology and educational software has provided new learning opportunities that can change the look and feel of traditional science classrooms. This does not necessarily imply that learning in traditional education is ineffective. However, traditional methods sometimes fail to reflect skills and interests of students who have grown up in the digital age. Technology can enhance learning environments and increase opportunities for authentic hands-on experiences (Zumbach et al, 2006). Computer technologies support the development and implementation of teaching and learning strategies that support many important science skills (Maor and Fraser, 1996).

Koehler et al., (2005) carried out an experimental study. In the study, the investigator sought to understand some of these interactions by studying the impact of two different media (video and text) on learners. They studied how equivalent text and video versions of four different stories impacted participants' learning. Results indicate that while video does not provide an advantage over text on measures of immediate information recall. There is a more complex interaction between media format, story type, video style.
Singh (2005) This study compared the effectiveness of Computer Assisted Instruction (CAI) as compared to lecture method on the topics ‘Tissues and cell’ and found that (i) Both the methods were effective in enhancing the learning about cell and tissues; (ii) While lecture method was more effective than CAI for the teaching cell, CAI was more effective then lecture method for teaching tissues.

Dange and Wahb (2006) This study investigated the Effectiveness of Computer Assisted Instruction on the Academic achievement of Class IX Student’s Physical Science and found that (i) There were no significant difference between mean gain scores of experimental and Control Group of pre post. (ii) There was no significant difference between mean gain scores of pre test and post test of Control Group. (iii) There was significant difference between mean gain scores of pre test and post test of Experimental Group. (iv) There was significant difference between mean gain scores of post test of control and Experimental Group.

Hennessy et al., (2006) discussed ways teachers make use of computer-based technologies to support the learning of science, and suggested that technology supports stepwise knowledge building and application. Such applications have implications for both curriculum-related science activities and emerging computer-based learning technologies. Technology helps students construct links between theories and phenomena.
by extending the human capacity.

**Bridget and Danner (2007)** study was to investigate student perceptions of Virtual Biology labs used in two online introductory Biology courses. Students completed an online survey, containing Likert type and open ended items, about perceptions of the CDROM based Virtual Biology laboratories and face to face (F2F) laboratories they completed during the courses. Findings indicated that though most students (86.9%) perceived the F2F laboratories as more effective than the virtual laboratories across several criteria, many of them (60.8% on one criterion) perceived the virtual laboratories as effective as well. The authors discuss how student identified issues related to interactivity and feedback could be influenced by the design of the learning experience, virtual laboratory tool, and/or the use of synchronous collaboration tools. Additionally, the authors include suggestions for future research on the use of virtual Biology laboratories in the online setting.

**Hirani (2007)** Development and Try-out of Computer Based Multimedia Package for Instruction in Gujarati. This study developed a Computer Aided Multimedia Package for teaching a unit ‘Light: Reflection and Refraction’ of the subject Science and Technology for standard 10th in secondary school in Gujarati Language and to try out effectiveness of the package in the context of the academic achievement of the students. Among
the other things, the study reveals that; (i) The students of Computer Aided Multimedia Package group scored significantly higher on posttest than the students of traditional method group. (ii) Students opined favourably for learning through Computer Aided Multimedia Package.

McLaughlin and Arbeider (2008) have studied evaluating multimedia-learning tools based on authentic research data that teach Biology concepts and environmental stewardship. High school science teachers and students need interactive, multimedia research-based learning objects that (i) support standards-based teaching, (ii) enforce complex thinking and problem solving, (iii) embrace research skills, (iv) include appropriate assessments to measure student performance, and (v) show real-world uses. To meet these five criteria, the CHANCE modules have been purposefully designed to allow students to “learn how things work” using real-world research data. These modules pace students through images and text that help them to interpret biological and ecological principles. Indeed, each module has been carefully field tested with practicing in-service and pre-service science teachers and real students to assure its effectiveness. Notably, the integration of authentic scientific research with sequenced, interactive computer simulations create a solid curriculum base of national interest that has laid the groundwork for additional materials collections that capitalize on the resources of communities that surround schools in particular regions of the country.

Among the other things; the study reveals that; (i) The study has resulted in the development of a CAI program on ‘motion in one dimension and two dimensions’ and ‘Laws of Motion’ for teaching Physics to the students of Class XI. (ii) The package was found significantly effective for the students of class XI of both the groups. (iii) Comparative effectiveness of the CAI method and the traditional method was measured by the experiment and CAI method was found more effective in terms of achievement scores. (iv) In relative effectiveness of the package was equally effective in teaching boys and girls. (v) Students and teachers both revealed a favorable opinion towards CAI program.

Sangodoyin (2010) studied computer animation and the academic achievement of Nigerian senior secondary school students in Biology. This study investigated the effects of computer animation on the academic achievement of Nigerian senior secondary school students in Biology. The moderating effects of mental ability and gender were also investigated. The pre-test and post-test, control group, quasi-experimental design with a 2x2x2 factorial matrix was adopted for the study. One hundred and eighty-nine senior secondary school Year II Biology students from two randomly selected
Federal Government Colleges in two states in Southwestern Nigeria were the participants. Findings show that there is a significant main effect of treatment on students’ achievement in Biology. The computer animation was effective in improving students’ achievement therefore, computer animation is recommended as a means of teaching Biology to students in Nigerian secondary schools.

Ahmad (2010) in his study the effectiveness of innovative and traditional methods of teaching Biology, and has experienced that multimedia, is the combination of various digital media types such as text, images, audio and video, into an integrated multi-sensory interactive application or presentation to convey information to an audience. The teacher uses multimedia to modify the contents of the material. It will help the teacher to represent in a more meaningful way, using different media elements. These media elements can be converted into digital form, modified and customized for the final presentation. By using multimedia or digital media in teaching Biology the students are able to learn better since they use multiple sensory modalities, which would make them more motivated to pay more attention to the information presented and retain the information better. There are many multimedia technologies that are available for developers to create these innovative and interactive multimedia applications. On the basis of the results and personal discussion in the group meeting of Biology teachers, it is concluded that Multimedia teaching is most effective in
teaching Biology, as new software and high technologies like Animation software and Photoshop are available in market easily, which can also help students in understanding various aspects of Biology. The study recommended that there are many innovative teaching methods introduced to teach Biological Sciences and every method has its advantages and disadvantages. Therefore teacher should select methodology of teaching that suits the students for their effective learning. For effective teaching, the teacher should acquire mastery on the content as well as expertise and adaptability on methods. Optimum opportunity should be provided to the students to actively participate in the teaching-learning process. Efforts should be made to make teaching-learning process to be learner centered. Appropriate software, new technologies and modern Audio-Visual aids like multimedia should be used to make the learning process effective as well as interesting.

Anboucarassy (2010) This study deals with effectiveness of multimedia in teaching Biological Science to IX standard students. The objectives of the study were (i) To study the effectiveness of multimedia approach over the conventional method in teaching Biology to IX standards students (ii) To develop a multimedia package to teach Biology for IX standard students. Mean of the experimental group is higher than the mean of the controlled group. Thus, the experimental study reveals that there is a significant difference in the achievement of the experimental group over the
control group.

Sujit Pal Bananda Sana et al., (2012) This study deals with the influence of Interactive Multimedia Courseware on the achievement in Physical Science of Class-VIII Students. For this purpose a computer assisted multimedia courseware was developed with the help of Adobe Flash and Bangla Word on a single unit of Physical Science Curriculum of class-VIII under WBBSE (Bengali medium). Then selected two equivalent groups of class-VIII students (experimental and control). One group was exposed to the multimedia courseware while the others are not. The performance of the both groups was then compared statistically (using t-test and ANOVA) after administering the self-prepared standardized achievement test. The observed t value is 16.068 is higher than the critical value at 1 percent level of significance (df=49). ANOVA test also provide significant difference between experimental and Control Group. So statistically it can be concluded that computer assisted multimedia courseware facilitates students learning in Physical Science better than the traditional chalk and talk method

3.5 Conclusion

The studies cited above leads to the following conclusions:

The studies by Barrow and Westly (1959), Mudlock(1968), Penny (1975), Meringoff (1980), Watkins and Watkins (1980) revealed that audio narration for text/pictures/images is more significant and Severin (1967), Baggett (1979) found that pictures/motion with audio was more effective.
The studies by Nickerson (1968), Sherman and Turvey (1969), Bransford and Johnson (1972), Bahrick and Gharrity (1976), Mayer and Gallini (1990), Bell and Johnson (1992) revealed that visuals help in communicating the information better.

The studies by Mayer and Anderson (1991), Moreno and Mayer (1999), revealed that animation with audio has significant effect on learning and Moreno and Mayer (2000) found that auditory over load does not contribute to making the lesson intelligible.

The studies by Gunn and Maxwell (1996), Harris et.al.,(2001), Bhutak (2004), Singh (2005), Hirani (2007),Ahmad (2010), Anboucarassy (2010), Sujit Pal Bandanna Sana and Asis Kumar (2012) revealed that use of Multimedia packages is effective in context to academic achievement of the students.

A critical appraisal of both Indian and foreign studies revealed that there are some gaps on the relationship of different multimedia packages with academic achievement of students.

Among the studies reviewed no study has investigated different elements of multimedia package on academic achievement of students in Biological Science. Therefore present research is off great significance.

Hence the present study is an attempt to investigate the effect of
multimedia packages on academic achievement in Biological Science.