CHAPTER-I

INTRODUCTION

1.1 INTRODUCTION

The advancement in the field of Science and Technology has influenced each and every sphere of life. The impact of technology in human lives is unmeasurable. There are many examples of using technology to accomplish many tasks of day to day life with ease. So, many educationists call this present world a ‘digital-world’, in which each and every person is surrounded by various modern digital gadgets. Even a small child in this digital world is capable of accomplishing multiple tasks using modern gadgets. Such children are called as ‘Digital-natives’ of 21st century.

This influence of Science and technology is very well visible in the field of education too. It has revolutionized the education world at each and every level. The digital natives are more adaptable towards technology supported or technology mediated instructions, as they have opened eyes in the world of highly sophisticated digital world. So, technology is being integrated in the classroom for better learning outcomes and it is a growing phenomenon worldwide. Countries are devoting a considerable amount of time and money for making technology available to the students for better learning and better achievement of the students. Especially computers are being used as teaching tools with better outcomes as compared to traditional teaching.

Thus, with the advent of computers, when the 21st century was approaching, a new term has been evolved, i.e. Information and Communication Technology (ICT). This information age has promoted use of ICT in instructional process and it has gradually become a global phenomenon. Educational reforms included successful integration of ICT in teaching learning process for improving learning outcomes.
What is Information and Communication Technology (ICT)?

Tella et.al. (2007) suggest that “ICTs are information handling tools that are used to produce, store, process, distribute and exchange information”.

World Bank (2007) defines ICT “as a form of technology comprising the use of the following: hardware, software, networks and media for the collection, storage, processing in transmission, as well as presentation of information”.

According to Olufunke et.al. (2010): “ICT is a computer based tool used for transformation of information, along with organizational communication needs”.

UNDP explains that “ICT refers to both the latest computer and internet based technologies, and also to simple audio-visual aids such as transparencies and slides; tape and cassette recorders; and radio, video cassette, television and film. These older and more familiar technologies are referred under the collective heading of ‘analogue’ media, while the newer and internet – based technologies are called the ‘digital media’”.

So, in school reference ICT can be defined as a collection of technological tools with vast diversity which are used for creating, communicating, disseminating, storing and managing information.

Schools, powerful agencies of social development are greatly influenced by rapid developments in ICT. Computers laboratories have become now essential features of school infrastructure and study of computers has emerged as a compulsory component of school curriculum.

1.2 COMPUTERS AS LEARNING TOOLS IN EDUCATIONAL ARENA

Use of technology in education has tremendously changed and it has taken many dimensions. Taylor and Chonack (1982) mentioned that computer can serve three different roles as an educational tool: As an instructor, a tool, and a pupil. However, ongoing advancements in the field of computer technology and innovations in the field of education suggest that more roles can be added to this framework. Understanding these three periods sheds light for predicting possible future trends in computer use in education.
The beginning of 21st century has seen an explosive growth of variety of computer applications which are relevant for classroom usages. Use of computers in classrooms resulted in improved teaching-learning and supported technology related educational reforms. It has also helped in improving school management and enhanced school-community partnership. In table-1.1. detail of different periods of computers, predominant computer technologies belonging to periods and functions of computers is given.

Table: 1.1
Different periods of Computers, predominant technologies and functions

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<th>Periods</th>
<th>Predominant Computer Technology</th>
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<td>➢ Computer-managed instruction</td>
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<td>Microcomputer Period</td>
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<td>➢ Drawing tools</td>
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<td>Internet Period</td>
<td>➢ Networked personal computers, ➢ Portable computers (laptops and handhelds)</td>
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1.2.1 Government’s initiatives to promote computer as an educational tool in India

Government of India has taken major initiatives to promote technology supported instructions in classrooms for enhancing the quality of education at all levels i.e. school as well as higher university level. Some of the programs are as follows:

1. **Computer Literacy and Studies in Schools (CLASS) project**: By recognizing the importance of ICT in India, the Government of India, during the year 1984-85 came up with a new initiative in form of **Computer Literacy and Studies in Schools (CLASS) project**. This project was initiated as a pilot project and BBC microcomputers were introduced. Under this project a total of
12,000 micro-computers were distributed by state governments to secondary and senior secondary schools. Keeping in view the educational benefits of computers, in revised NPE (1992) inclusion of computers in education was emphasized. As a result, during the 8th plan (1993-98) the CLASS project was adopted as a Centrally Sponsored Scheme. In this new plan Government Aided Secondary and Sr. Secondary schools were also included and financial grant was given to many institutions which were previously provided with BBC microcomputers. 2598 schools were covered during the 8th plan; instructors, consumables and textbooks for students were provided, maintenance of hardware was taken care, and training of teachers in schools was organized. NIC was entrusted with a work of nodal agency for finalizing the contract for the supply of hardware. The use and supply of software was not widespread, as the coverage was confined to only Sr. Secondary Schools. Moreover, it was necessary for the students of class XI and XII to undergo a Computer Course Module.

2. **IT Task Force:** In July 1998 Prime minister constituted an IT Task Force with School Computer Scheme, Shikshak Computer Scheme and Vidyarthi Computer Scheme with attractive packages. The CLASS project was modified during 2001-02. Prof. M. Mukhopadhyay has appositely observed that in the class project computers were provided with a few CAI softwares while colleges were provided with computers without any software. Lack of provision of suitable educational software has led to under or no utilization of computers which turned them into mere a display item.

Emphasis on information technology and use of skills and values have supported the concept of SMART schools. The Task Force recommended that the development of smart schools in the next millennium should be given momentum, so that it could be started as demonstrative pilot project in each state. It should have a provision of Computer Systems to be installed in upto Higher Secondary or Secondary Schools by suitable investments (about 1-3%) of the total budget during the next five years.

The emphasis is also being laid on self-learning aspect through initiatives like Gyan Darshan launched in January, 2000. It has three digital TV
channels completely dedicated to education running round the clock. Gyan Vani which is an FM radio channel was launched in November 2001, with different FM stations in the country.

3. **Vidya Vahini Project:** The Indian Government launched a project called Vidya Vahini in 2002, to provide IT and IT enabled education in 60,000 schools in India over three years, as a part of Rs. 6,000 crore project. Initially it was started with a pilot project covering 150 schools, later the Government proposed that each school should have a computer lab well equipped with internet, intranet and television so that video-conferencing, web-broadcasting and e-learning can be supported.

4. **World Links India:** Initiated with Intel Corporation this program was launched in January 2002. It was focused to provide connectivity to schools and basic computer literacy. Various teacher professional development programs related to ICT were also organized under this initiative.

5. **Information and Communication Technology in Schools (ICT) Scheme:** Another initiative taken by government of India is the Information and Communication Technology (ICT) in Schools Scheme, which was launched in December, 2004. This scheme aims at to provide opportunities to secondary stage students so that they can build their capacities on ICT skills. With developed skills they can be made to learn through computer aided learning process. The digital divide amongst students of various socio economic and other geographical barriers was bridged through this scheme up to a large extent because it acted as a catalyst in the process. Government and Government aided secondary and higher secondary schools were benefitted by this scheme and they were provided with sanction to establish necessary infrastructure for ICT based teaching learning processes.

On September 30, 2008 under the **ICT in Schools** scheme, a round table discussions and consultation was organized to promote, reenergize the existing scheme and to bridge the digital divide. In this it was also discussed that additional educational content on CDs for embellishing classroom teaching will also be made available.
Due to the felt need of expansion and outreaching of the scheme, in July 2010 revised ICT at School Scheme was introduced which focused to cover more schools under its umbrella, to develop and share appropriate e-content and to develop the capacity of teachers in this information age.

6. **National Repository of Open Educational Resources (NROER):** National Repository of Open Educational Resources (NROER) was launched on 13th August 2013 as a result of efforts of the Ministry of Human Resource Development (MHRD), Government of India. The development of NROER has been a combined effort of the Ministry of Human Resource Development, Government of India, National Council of Educational Research and Training, the Central Institute of Educational Technology, Department of School Education and Literacy, and Meta-studio (Repository hosting platform).

   NROER is a comprehensive digital repository of all digital resources of school education from primary to higher secondary level, in multiple languages. These resources are divided into five categories: Science, Math, Languages, Social Science, and Art Education. These resources are useful for the teachers as well as for learners in developing better understanding of the subject and aiding the teacher for effective teaching. It has been conceptualized as a collaborative workspace, which provides a common and centralized platform to create and share various resources. The purpose of the development of this repository was to equip teachers with diversified resources which can be chosen according to the suitability of the teaching style of the teachers and needs of the learners. NROER not only allows to access and upload resources but also support teachers in downloading, commenting, sharing and rating media resources for quality improvement.

7. **National Mission on Education through Information and Communication Technology (NME-ICT):** The report of Knowledge Commission of India (2006) Chaired by Mr. Sam Pitroda in the support of importance of integration of ICT in education mentions that, “higher education has made a significant contribution to economic development, social progress and political democracy
in Independent India. .....Large segments of our population just do not have access to higher education. .... There must be a focusing on upgrading infrastructure, improving the training of teachers and continuous assessment of the syllabi. It is particularly important to enhance the ICT infrastructure. Websites and web based services would improve transparency and accountability. A portal on higher education and research would increase interaction and accessibility. A knowledge network would connect all universities and colleges for online open resources”.

Indian Government has shown keen interest to use the technological resources and make nationwide accessibility of technology supported Higher Education to all worthy students. It has taken various steps to improve the quality and quantity of Higher Education Institutions (HEIs). In February 2009 during 11th Five Year Plan one such prime step was taken by the Union Ministry of Human Resource Development (MHRD) and launched a Mission entitled National Mission on Education through Information and Communication Technology (NMEICT) having a fair budgetary allocation of Rs. 4612 crores. It is an endeavor of MHRD through which it is collaborating with different educational institutions like UGC, IGNOU, IITs, NITs, CEC, and other higher education quality institutions of the nation which are putting up efforts making ICT enabled learning a dream come true for the students. The mission aimed at providing opportunities to all educators and education experts in the country to bring their collective knowledge and wisdom together for benefitting every learner of the nation and in turn reducing the digital divide. One of the most important aspects of this mission is that it was supposed to supervise a balance among content generation according to the need of the learners, researches which are related to the methodology of imparting education and integrating our knowledge with the knowledge and developments in various different countries. This major task could not be achieved without an adept and critical mass of professionals from every field of knowledge working cohesively with utmost zeal and commitment. Although there are many examples of collaborative efforts by various institutions of higher repute and many individual stories are
also available with huge success, but a holistic approach is needed for the better outcomes. It is quite obvious that promotion and focus on ICT is the need of the hour as it is supporting to the exponential growth of the capacity building endeavors of the educational institutes. It is obvious that emphasis on ICT is a crying need as it acts as a multiplier for capacity building efforts of educational institutions without undermining the quality. Following are the projects initiated under NMEICT:

i. **SAKSHAT Portal:** “One Stop Education Portal” SAKSHAT, is equipped with intelligent navigation techniques to take care of diverse needs of entire learning community by extensively utilizing e-learning concepts and ICT based technology without any cost. INFLIBNET has taken up the initiative to create integrated e-content portal for easy access to all the contents developed under the Mission.

ii. **Broadband Connectivity to Colleges and Universities:** A key component of the NMEICT is to provide connectivity to the Institutes of Higher Education at highly subsidized rates. 50% of the cost of hardware and 25% of the cost of bandwidth charges are expected to be borne by the State Government educational institutions and private educational institutions. Around 400 Universities and 26000 colleges have been connected.

iii. **Low Cost Access Device (Aakash Tablets):** NMEICT has funded the development of Ultra Low Cost Devices – Aakash tablets so that the vast majority of the learners will be able to access the best e-content with ease. On 11th Nov 2012 the advanced version of Aakash- 2 was launched, with three times faster processor, doubled memory and capacitive touch compared to first version. Various useful educational applications and content on Aakash-2 has been built by IIT Bombay.

iv. **National Program on Technology Enhance Learning (NPTEL) (E-content Development):** IITs and IISCs have taken a joint initiative in form of NPTEL which has a major focus on online strengthening of distance education, and it is funded by the Mission (NMEICT). Through this programme various free e-learning courses are being developed in Science, Engineering and Humanities
which are integrating technologies like web and video to support distance education. One more objective of this programme is to digitalize the already available content to strengthen the resources for the students. The digitalize content is also being indexed, for the convenience of the learner according to disciplines and subjects.

More than 329 courses are completed and nearly 990 courses are getting generated in phase II of NPTEL. Nearly 5000 hours of lectures have been recorded by the IITs. Through Doordarshan’s Eklavya channel many video courses have been telecasted. Within two years of its launch NPTEL website http://nptel.ac.in has been accessed by working professionals, students and instructors from 140 different nations. It gives vast opportunities for skill development and enhancing knowledge.

v. The Virtual Labs Project: This project has been launched on 23rd February, 2012 to complement the NPTEL, to plan and develop Virtual labs concerning with diversified areas of Science and Engineering for the utmost welfare of the students. Virtual labs are beneficial for graduate and undergraduate college and university students, as because of scarcity of resources and good quality labs they are not able to perform experiments which are the backbone of any Science and engineering course. These labs provide support to students by which they are able to perform their essential laboratory experiments using only a computer, and an internet connection. The students practice and learn better by the support of these Virtual Labs which allow students to experiment by their own pace and convenience. It’s a kind of fully equipped laboratory at learners’ door steps. Virtual Labs are also boon for the rural areas as they are also able to perform experiments which they would not otherwise be able to access as non-affordability of costly equipment at their college. In that way these labs also allow the sharing of costly equipment among various institutes across the country. Seven IIT’s ; Delhi, Bombay, Kanpur, Kharagpur, Madras, Roorkee and Guwahati), IIIT Hydrabad, Amrita University, Dayalbagh University, NIT Karnataka, and College of Engineering, Pune, are the institutions participating in the project.
vi. **Consortium of Educational Communication (CEC):** CEC was established with the main objective to use effective modern media television and ICT for university UG and PG courses. It is one of the Inter University Centers set up by UGC. The CEC along with its 21 media center is developing E-content for nearly 87 subjects of UG and 71 subjects of PG. The Digital Media Library housed at CEC has a total collection of about 20000 Educational video Programmes on various formats like Cassettes, CD’s, DVD’s, PD’s/OD’s. Every year it adds more than 2000 video programmes and E-Content in Hindi and English on various subjects.

vii. **Free and Open Source Software for Education (FOSSE):** This project is based at IIT Bombay, a part of NMEICT with focus on “Adaptation and deployment of open source simulation packages equivalent to proprietary software”. It is funded by MHRD and is providing free support to eliminate the use of commercial software in education. The major objectives of this project are; to promote use of open source or free softwares in education and public sector, to create educational content, books, courses and virtual labs.

viii. **E-Yantra (Robotics in Higher Education):** This is another project under NMEICT, sponsored by MHRD and initiated by IIT Bombay, launched in the year 2012. This project is helping those students who have less availability of labs and mentors with hands on experience. To create the next generation of engineers with innovative minds having specialization of Robotics education is the main goal of e-yantra.

ix. **Online Labs for School Lab Experiments:** Amrita-CREATE (Center for Research in Advanced Technologies for Education), a part of Amrita University had taken an initiative in collaboration with Center of Development of Advances Computing (CDAC), Mumbai to develop virtual online labs (O-Labs) for students of 9th and 10th class in accordance with CBSE curriculum. This project was developed under the research grants of Department of Information Technology, Government of India. The basic thought behind the lab was that Science can be learned better through experiments, so if we do not have lab facilities in schools then online labs can be created to give students proper
understanding of the experiment and the concept behind it. This online lab contains experiments in Physical, Chemical and Biological Sciences. Recently O-Labs have also included Mathematics and English lessons (for 9th and 10th standard). In Feb 2012, CBSE chairman has recommended use of O-Labs in schools in a circular to all CBSE schools. These online labs can be accessed anytime and anywhere thus support the students to learn and experiment at their ease.

All the above schemes and earnest efforts of the Central Government, State Government, MHRD and NGO almost at all the school levels bring forth the fruitful results. With the use of Computers as personal productive tools, the learners have started to bring a new way of knowing, researching the vast knowledge. With further advancements in the field of computer technology and educational applications of computers has widened the scope of researches and gradually we come across various innovative terms like Computer Assisted Instructions (CAI), Computer Managed Instructions (CMI), Computer Based Instructions (CBI) and the latest are the Multimedia and Interactive Multimedia Packages.

1.3 EVOLUTION OF MULTIMEDIA AND MULTIMEDIA INSTRUCTIONAL PACKAGES IN EDUCATION

Over the years Multimedia instruction has been evolved as a strong means of delivery of instructions in various subjects at various levels. In the 1950s, Skinner’s “teaching machine” started a new era of using mechanical devices as educational tools. These teaching machines were being used extensively in schools by students to respond to questions as Skinner (1960) mentioned it. Later Suppes (1972) also accepted that “the notion of computers as educational tools became established”. Later the desk-top computers were being affordable and available to common masses and it accelerated the growth in progress and development of electronic educational resources, commonly known as Computer Assisted Learning or Instruction (CAL/CAI). Later, in the year 1990s the term multimedia appeared and was used to describe any combination of media such as a slide-tape program or a kit containing a videotape, transparencies, and an instructor’s guide. With advancements in computer systems, video, networking, and
related technologies, computer-based multimedia came on the scene and introduced more complex systems that could access, manage, combine, and control multiple media. So, there was evolution and establishment of multimedia as a strongest tool as an integrated combination of text (words & numbers), aural (sound effects, music, & speech), and visual (still images, movies, & animation) elements as part of the teaching/learning process. Multimedia combines, synthesizes, and synchronizes various media components into a single, integrated presentation of information which are controlled by a computer system. As the multimedia popularized and established as an educational tool, an increasing number of researches were directed towards the exploration of diverse potentialities of multimedia in the field of education. Then a large pool of learning packages using multimedia were being developed. Multimedia Learning Packages are "those that integrate essential elements or objects of multimedia such as text, graphics, video, animation, and sound to represent and convey information according to the learning objectives. Multimedia Learning Packages can be used as effective aids for complex topics where there is a need of visual explanation.

1.3.1 Science Education

Science occupies a unique position in the school curriculum and it has been given due place in our school education programme by being made as a compulsory subject. Now more and more emphasis is being given to scientific and technical education. By doing so a right step has been taken to push our country forward and to enable us to compete with other progressive nations. It has necessitated laying emphasis on teaching of Science right from the primary stage. Realizing such need, Kothari commission (1964-66) has rightly remarked in their recommendations: “Science and mathematics should be taught on a compulsory basis to all pupils as a part of general education during first ten years of schooling”. In our schools till secondary level Science is being taught as an integrated subject, including Physical Sciences (Physics and Chemistry) and Life Sciences/ Biology (Zoology and Botany), whereas at Higher secondary stage Life Science has been given a separate place and being taught as a subject Life Science / Biology.

The importance and significance of Life Sciences in our daily life is enough to justify providing its due place in the school curriculum. That is why it has been given a
compulsory status for being studied up to secondary school level as a part of general Science curriculum. It helps our future citizens to have adequate background of knowledge, skills and applications of the subject life Science for making them adjusted on one hand in this progressive world of developed biotechnological advancements and on the other hand to have wide opportunities for entering into many professions and vocations.

The Position Paper National Focus Group of NCERT (2006) directs curriculum of Science at different stages with respect to the objectives, content, pedagogy and assessment. In this the focus group has made every effort to address various issues related to Science curriculum and problems in its implementation. It has been mentioned that “Information and Communication Technology (ICT) is also an important tool for bridging the social divides. ICT should be used in such a way that it becomes an opportunity equalizer, by providing information, communication and computing resources in remote areas”.

The focus group has clearly shown a belief that for a qualitative change it is necessary that the Science education in India must undergo a radical change. It has been emphasized on development of inquiry skills of students supported and strengthened by appropriate language, suitable design and quantitative skills. Rote learning has been criticized and it was suggested that it should be discouraged in Science classrooms.

1.3.1.1 Introduction of multimedia in Science education

One of the uses of computers in school is in the teaching and learning of Science subjects. Computer technology has revolutionized the scope of Science instructions tremendously. Started with the simple Teaching Machines of Skinner it has taken its most modern form as multimedia. In the contemporary Science education the term Multimedia is becoming more and more popular term. Multimedia supported instruction have enhanced the scope and impact of Science teaching and it has been proved as a replacement of conventional method in various schools across the globe. The journey of computers as an educational tool has gained its supremacy with the advent of multimedia. Through their studies various researchers have suggested that multimedia technology has manifold advantages over conventional instruction in
Science subjects as pictures, sound and animations all collectively stimulate the learners’ senses and it is easy to comprehend the concept.

1.3.1.2 Scope of Multimedia Resources and Instructional Packages in Science Education

Science is a very important part of school curriculum. Hardly can, some of complex content in Science be effectively taught to learners theoretically. Science concepts being dry and abstract always need relevant visual aids or support material so that the learners can understand it. Students’ poor academic performance can be attributed to a large extent to the method of teaching that teacher is using. In this information age still some teachers prefer using the ‘chalk and talk’ method in Science teaching as they can cover more and more syllabus in less time. The result is that the expected learning outcomes are not at par in our secondary and senior secondary schools. Two more causes can be associated with the low achievement in Science subjects that the appropriate instructional material is not available or the available instructional material is not being properly utilized. New interesting and innovative methods should be followed for effective teaching. In using technology to mediate the learning experience, multimedia instructional packages offer tremendous potential. These packages are based on the fact that using audio, video, animation and text technologies collectively provide extremely rich experience to the learners. Moreover, the learning of complex concepts of Science becomes fun filled activity for the learners rather than being dull or monotonous learning. For qualitative improvement in the instructional process, multimedia packages can prove as big breather as it is capable of sustaining the interest of students, through visuals and audio inputs. It can also help students in understanding the complex concepts in a very simple way. In Science subjects the theory is supported by experiments for concept clarity or to prove what has been said. So, it is necessary that students should be able to perform experiments or at least they should be able to see the experiments which are not possible to conduct in laboratories. This problem can be overcome by the use multimedia packages which can be exclusively designed to meet the requirement of the learners according to their mental level.
As the document of National Policy on ICT 2012 mentions: “ICT enabled teaching-learning encompasses a variety of techniques, tools, content and resources aimed at improving the quality and efficiency of the teaching-learning process. Ranging from projecting media to support a lesson, to multimedia self-learning modules, to simulations to virtual learning environments, there are a variety of options available to the teacher to utilize various ICT tools for effective pedagogy. Each such device or strategy also involves changes in the classroom environment, and its bearing on effectiveness. Availability of a wide range of such teaching-learning materials will catalyze transformation of classrooms into ICT Enabled classrooms.”

As this new policy pointing towards digital education clearly indicates the importance and utility of Multimedia Modules for self-learning of the learners and as an aid for the teacher to make his lessons more effective. Keeping in view the enormous potential of computer technology Government of India has initiated various projects, which have been mentioned earlier, for school as well as for higher education level. So it is well understood that in the present age where Science and technology has shown its influence in every sphere of classroom instruction, conventional method is not enough to induce interest among the learners. Also it is not able to cater the psychological, emotional and intellectual needs of the students in the new millennium. One or more hour lecture, which consists purely of a verbal presentation, is seldom effective in holding attention, stimulating interest or encouraging students to analyze, evaluate and think critically. The traditional method of teaching is based on giving information as bits. It includes rote memorization of concepts facts and principles, which do not realize objective of teaching Life Sciences. Teaching strategies play an important role in enhancing the learning abilities of the students. So in this world of Science and technology, it is not possible for a single method, technique or medium to make teaching learning process effective and to fulfill the needs of pupils and society. The involvement of more than two media of communication in instructional procedure can bring fruitful results.

Hands-on learning can never be replaced by multimedia, despite of its major advantages over other supporting aids as it can simulate, amplify and strengthen the learning in Science classrooms. Various researchers have conducted experimental
studies related to the effectiveness or impact of multimedia learning packages on students achievement like; Sindhi (1996) prepared a multimedia package for the students of XI class in Physics and found that teaching through multimedia package is more effective and resulted in better retention of learning in comparison to conventional method of instruction; Jayaraman (2006) studied the impact of Multimedia Learning Packages on performance and behavioural outcomes of students of different age groups and found them effective; Singh (2010) found that irrespective of sex students’ achievement receives a significant effect of multimedia program; Pal, Sana and Ghosh (2012) established the supremacy of multimedia courseware in Physical Science over traditional chalk and talk method in learning outcomes of students; Rani (2012) showed that using E-Content in Science instructions have given a significantly higher achievement by the students as compared to conventional strategy; Suman (2014) found a significant effect of multimedia package on cognitive and affective outcomes of elementary students in environmental Science etc. Findings of all these empirical researches clearly show that multimedia technology and multimedia packages have a tremendous scope in the field of Science education. Various dry and uninteresting concepts of any branch of Science can be well explained with a correct mixture of pictures, graphics, animation, sound and text; here the technology what we called the multimedia, a combination of multiple media. Life processes can be very well explained with the help of animated pictures. In this the students feel more engaged and engrossed and the learning is long lasting as the students are using all of his/her senses.

1.3.2 Characteristics of effective multimedia packages

Multimedia package development is not an easy task for a program developer because multimedia is not just a combination of multiple media but all these media elements should be combined logically and in accordance with the multimedia principles given by Mayer. So, an effective multimedia has following characteristics:

1. It recognizes that working memory has limited space or capacity for processing information.
2. It takes benefit of both the channels i.e., auditory and visual in working memory to deliver content. By the use of multiple channels we can increase the overall amount of information that the brain can process.

3. It recognizes that long term memory organizes information into meaningful parts called schemas. When information is presented in a way, which makes use of existing organizing structures (schema), or that supports the learners to organize the information can up to a great level assist the learner in incorporating information into long term memory.

1.3.3 Functions of multimedia packages

Multimedia instructions execute various functions. Some of them are as follows:

1. Development of Mastery Learning: Multimedia packages are used for developing active and mastery learning. A multimedia instruction ensures active participation of the learners contrary to the passive learning in boring lectures and demonstrations.

2. Activates Learner’s Mind: Multimedia packages also trigger the learners’ mind and promotes learning through all senses as it is a combination of multiple media.

3. Promotes Self-Learning: Multimedia packages being nonlinear and interactive in nature encourage self-learning. Interactivity is the most important feature of multimedia which makes it a tool having enormous potential from the point of view of self-learning.

4. Encourages Flexible Learning: Multimedia learning promotes flexible learning based on the mental level and pace of the learner. Flexibility is recognized at various levels like; level of access to content, entry and exit from the content, pattern of interaction, type and resources for supporting study and communication, evaluation methods. Because of all these flexibilities multimedia packages are gaining popularity among students these days.

5. Improvement in Quality of Education: Multimedia packages are enhancing learning as well as improving the quality of education.
1.3.4 Advantages of using multimedia packages in classrooms

1. **Learner Centered**: As Cognitive theory of Multimedia Learning (CTML) strongly recommends that multimedia learning is a learner centered learning.

2. **Captures Attention of Learners**: It captures attention of the learner. Multimedia makes the content very entertaining.

3. **Motivation**: It motivates the learners, as they become curious knowing that they are going to study in a novel way.

4. **Learning Styles Addressed**: It allows teacher to address variety of learning styles in the class room. It provides multiple ways to present the content, thus helps in addressing the needs of diverse learners in a classroom.

5. **Technology Needs Addressed**: A learner in today’s world is a ‘digital learner’, who does not want to learn through traditional method. Learning through technology supported instructions is more engaging for him/her rather than traditional methods. So, through multimedia package the technology need of the learners is very well addressed.

6. **Develops HOTS**: Higher Order Thinking Skills can be developed by the use of these packages in the classrooms. It raises the level of understanding and application of the learner. With the complete understanding of the topic the learner creates a greater comprehension.

7. **Drill and Practice**: Learners prefer practicing and studying through multimedia. It gives them inner motivation for practice resulting in good achievement.

8. **Expansion of Learning**: It helps learners to expand and retain their learning because they are engaged, using multiple senses resulting in fun filled learning.

9. **Organization of Teaching**: These packages helps a teacher to organize his/her teaching and in that way saves time and energy with better learning outcomes of learners. It helps the teacher to prepare well for the class in advance for effective delivery of technology supported instructions.

10. **Classroom Management**: Learners’ get engaged and participate actively while learning through multimedia package leaving no space for indiscipline in the
classroom. So, using multimedia package in classroom for teaching helps the teacher in classroom management.

1.4 CONCEPT OF MULTIMEDIA

The term Multimedia can be broken down its constituent elements like: multi, which means more than one and media, a plural form refers to the means for conveying information. So, multimedia can be seen as a collection of various media formats like text, images, audio, video, animation and graphics blend together to give rise to an effective unified whole, which is capable of holding the attention, and enriching the user or the learner.

Thus, we can say that, the media in which various formats of information content and information processing (e.g. text, audio, graphics, animation, video, and interactivity) are being utilized for the information or entertainment of the user or learner is known as Multimedia.

1.4.1 Definitions of multimedia

Multimedia, a boon for the modern pedagogical systems has been defined by various educationists and researchers in multiple ways, based on the different prospective. Some of the definitions are as follows:

- According to Schwartz & Beichner (1999), “Multimedia is the use of multiple forms of media in a presentation”.
- Brooks (1997) explains that, “Multimedia is the combined use of several media, such as movies, slides, music, and lighting especially for the purpose of education or entertainment”.

Fig. 1.1 Meaning of Multimedia

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Thus, we can say that, the media in which various formats of information content and information processing (e.g. text, audio, graphics, animation, video, and interactivity) are being utilized for the information or entertainment of the user or learner is known as Multimedia.
Greenlaw & Hepp (1999) says that, “Multimedia is information in form of graphics, audio, video, or movies. A multimedia document contains a media element other than plain text”.

Maddux, Johnson & Willis (2001) asserts that, “Multimedia comprises a program that includes text along with at least one of these: audio or sophisticated sound, music, video, photographs, 3-D graphics, animation, or high resolution graphics”.

Jonassen (2000) strongly puts forward that, “the commonality among these definitions, involves the integration of more than one medium into some form of communication….Most commonly, though, this term now refers to the integration of media such as text, sound, graphics, animation, video, imaging, and spatial modeling into a computer system”.

While defining multimedia Mayer (2001) emphasized on the auditory/verbal channel and visual pictorial channel, asserting, “I define multimedia as the presentation of material using both words and picture. By words, I mean that the material is presented in verbal form, such as using printed or spoken text. By pictures, I mean that the material is presented in pictorial form such as using static graphics, including illustrations, graphs, photos, or maps, or using dynamic graphics, including animations or video. The definition of multimedia I use is narrower than some other definitions….I have opted to limit the definition to just two forms – verbal and pictorial – because the research base in cognitive psychology is most relevant to this distinction”.

1.4.2 Component/ elements of multimedia

Multimedia is essentially use of multiple media in a single presentation. Text, audio, video, graphics and animation are the five components of any multimedia presentation (Fig. 1.2).
1. **Text**: Text is the basic element of multimedia which has most impact on quality of multimedia programme. Text provides information to the viewer and a well written text makes the communication clear. Though text alone provides the simplest form of information, yet most often it is the most effective format of conveying information. Text can be made attractive by enhancing it with background colour scheme; font: colour, type, style and size; and text effects. For development of effective multimedia three important points should be taken care related to text; message length, text position on the screen and legibility of text. In multimedia, hypertext is a facility by which the text on one screen can be linked to another text or another screen. This is a very useful technique of navigation in any multimedia package.

2. **Audio/ Sound**: Audio or sound is another important element of multimedia programme. A multimedia module requires use of narration, music and sound effect to enhance the quality and effectiveness of the programme. There are two types of sounds: Analog and Digital (fig. 1.3).
3. **Video:** Videos are key elements of multimedia and provide joyful learning experience to the learners with increased learning outcomes as suggested by various studies. It gives strong impact to any multimedia programme making it more effective when presented to the learner. In this way video has been evolved as a powerful format of presenting information or content to the learner for better achievement and greater retention.

   Video is “the technology of capturing, recording, processing, transmitting and reconstructing moving pictures, electronic signals, or digital media, primarily for viewing on television or computer monitors”.

Video can be generated using various devices like; video cameras, mobile phones, web cam etc. These days video is capturing the attention of various designers to be included in multimedia instructional packages or programmes because of its following characteristics:

- Easy editing of video clips.
- Video files can be stored in computer easily without compromising with the quality.
- Video files can easily be transferred in a computer network.
- Non-linear editing of any part of video file is possible.

4. **Graphics:** A digital representation of non-text information such as chart, drawing or a photograph etc. are called graphic images. These graphics play a significant role in learning as a picture worth a thousand words. Graphics are used in multimedia to enhance its overall look and give it captivating effect. The utility of graphics is in illustrating some phenomena or in comparing several information. The idea can also be illustrated by using still
pictures. Two types of graphics are used: Bitmaps (Paint graphics) and Vector (Draw graphics). Table-1.2 depicts different types of images.

Table: 1.2
Types of Images

<table>
<thead>
<tr>
<th>Graphic Type</th>
<th>Device Used</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitmap Images</td>
<td>Real images can be captured from devices such as cameras or scanners.</td>
<td><img src="bitmap.png" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td>Digital Camera</td>
<td><img src="bitmap.png" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td>Scanner</td>
<td><img src="bitmap.png" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vector Graphics</th>
<th>Drawn on computer.</th>
<th><img src="vector.png" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Computer</td>
<td><img src="vector.png" alt="Image" /></td>
</tr>
</tbody>
</table>

5. **Animation**: When still images are displayed or projected in a rapid sequence an illusion of motion or movement is created, this is known as animation. So, animation is a process of creating an illusion of movement in a static image (fig.1.4).

We can define animation as “the optical illusion of motion created by the consecutive display of images of static elements”.
Animation enhances the multimedia presentation as difficult processes and concepts can be presented through animation, which give a natural enjoyment to the learner as he/she experiences the complex content in very entertaining ways. Thus, it also supports greater learning and achievement. Also, the learners are happily engaged in the program resulting better participation. Multimedia utilizes digital animation. Digital animation can be classified into two categories (fig. 1.5): 2D (2 Dimensional) and 3D (3 Dimensional) animation.

![Fig. 1.4 Animation: A static image looks like as it is moving](image)

![Fig. 1.5 Categories of Animation](image)

1.4.3 Categories of multimedia

Multimedia may be broadly divided into two categories: Linear and Non-Linear

1. **Linear Multimedia**: In this category the active content can be forwarded one screen ahead or one screen previous. In this way users have limited
control over access to information. There is only one linear fixed path that the presentation can follow. This is also known as passive multimedia.

2. **Non-linear Multimedia/ Hypermedia:** It is the advance form of multimedia in which user is supported with interactivity to control progress. The user can click to the desired content to know more information regarding that. It promotes self-paced learning as the user has full control over the presentation.

### 1.4.4 Multimedia Learning (Mayer’s Cognitive Theory of Multimedia Learning-CTML)

Rechard E. Mayer and others have popularized the term Multimedia Learning which is a Cognitive Theory of Learning. It is also known as Cognitive Theory of Multimedia Learning (CTML). Mayer asserts that better learning occurs when the information is presented as a combination of words and pictures rather than words alone. The theoretical foundation for the CTML is based on several cognitive theories like; Baddeley’s theory of working memory (1986), Paivio’s dual coding theory (1986) and Sweller’s cognitive load theory (1988,1994).

According to Mayer (2001) “The process of multimedia learning can be viewed as information acquisition (in which multimedia messages are information delivery vehicles) or as knowledge construction (in which multimedia messages are aids to sense making)”.

### 1.4.4.1 Process of Multimedia Learning

1. **Three Principles from the Learning Sciences**

Mayer and Moreno (1998) and Mayer (2003), express that CTML is based on three major assumptions:

i. **Dual-Channel Assumption:** On the basis of Baddeley’s theory of working memory and Paivio’s dual coding theory, CTML assumes that working memory has dual channels viz., auditory and visual.

ii. **Limited Capacity Assumption:** Sweller’s cognitive load theory is the base of second assumption which asserts that each subsystem of working memory possesses a limited capacity.
iii. **Active Processing Assumption:** This is based on Mayer’s assertion that, “people construct knowledge in meaningful ways when they pay attention to the relevant material, organize it into a coherent mental structure, and integrate it with their prior knowledge”.

2. **Three Store Structure of Memory**

CTML favors that there are three memory stores known as sensory memory, working memory, and long-term memory.

According to Sweller (2005) “Sensory memory is the cognitive structure that permits us to perceive new information, working memory as the cognitive structure in which we consciously process information, and long term memory as the cognitive structure that stores our knowledge base”.

i. **Sensory Memory:** It is made up of two sections: Visual memory which holds printed text and pictures as visual images for a short time; and Auditory memory which bears different sounds as auditory images.

ii. **Working Memory:** The information from the sensory memory is selected by the working memory for further processing and integration. Mayer (2010) declares that “Sensory memory holds an exact sensory copy of what was presented for less than 0.25 of a second, while working memory holds a processed version of what was presented for generally less than thirty seconds and can process only of a few pieces of material at any one time”.

iii. **Long Term Memory:** The entire store of a person’s knowledge is held by long term memory for an indefinite period of time.
Mayer puts forward that words and pictures can be represented in five forms that occur as information and processed by memory. Each form represents a particular stage of processing in the three memory stores models of multimedia learning.

i. **First Form:** It includes words and pictures in the multimedia presentation itself.

ii. **Second Form:** It represents acoustic representation (sounds) and iconic representation (images) in sensory memory.

iii. **Third Form:** It represents the sounds and images in working memory.

iv. **Fourth Form:** Verbal and pictorial models, are represented by this form, which are also present in working memory.

v. **Fifth Form:** It is prior knowledge, or schemas, which is stored in long-term memory. CTML proposes that, content knowledge is accommodated in schemas which are cognitive constructs. These constructs organize information for storing in long term memory. Simpler elements are organized by schemas, these later act as elements of higher order schemas. With the progress in learning, more and more advanced schemas are developed and learned procedures are transferred from controlled to
automatic processing. By the process of automation the capacity of working memory sets free, that can be used for other functions.

3. **Five Cognitive Processes Required For Meaningful Learning:**

Mayer further explains that the learner has to be engaged in five cognitive processes for a meaningful learning from the words and pictures. A short pictorial description is given in table-1.3. These cognitive processes in working memory decide about the information which has to be attended to or selected from the pool of information presented to the learner, which knowledge has to be retrieved from long term memory and merged with newly selected information so as new knowledge can be constructed. These finally, also decide that which bit of new knowledge are transferred to long-term memory. The new knowledge that is constructed in working memory is transferred through the process of encoding to long-term memory.

<table>
<thead>
<tr>
<th>COGNITIVE PROCESSES</th>
<th>DESCRIPTION</th>
<th>ACTION &amp; LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELECTING</td>
<td>i. Selecting relevant words</td>
<td>Transfer information from sensory memory to working memory</td>
</tr>
<tr>
<td></td>
<td>ii. Selecting relevant images</td>
<td></td>
</tr>
<tr>
<td>ORGANIZING</td>
<td>iii. Organizing selected words</td>
<td>Manipulate information in working memory</td>
</tr>
<tr>
<td></td>
<td>iv. Organizing selected images</td>
<td></td>
</tr>
<tr>
<td>INTEGRATING</td>
<td>v. Integrating</td>
<td>Transfer knowledge from long term memory to working memory</td>
</tr>
</tbody>
</table>

| Description of Five Cognitive Processes |

**Table: 1.3**

However, Dwyer & Dwyer (2006) warn that, “proper coding requires rehearsal and since rehearsal takes time, the multimedia lesson must allow an adequate period for incubation or it can be ineffective”. Hasler, Kersten and Sweller (2007) advocate the importance and necessity of learners’ control while using animation in multimedia learning.
1.4.4.2 Principles of multimedia instruction

Mayer (2009) indicates the Science of instruction as “creation of evidence based principles for helping people learn” or simplifies it as the “scientific study of how to help people learn” (Mayer, 2010). There are various researches related to multimedia instruction. In this regard Mayer strongly asserts that the research must be theory-grounded and evidence-based. Here, “theory grounded means that each principle, method and concept is derived from a theory of multimedia learning. Evidence-based means that each principle, method and concept is supported by an empirical base of replicated findings from rigorous and appropriate research.”

After analyzing more than hundred empirical studies Mayer (2009) recognized and proposed following twelve multimedia instructional principles:

i. **Principle of Coherence**: It states that better learning happens when extraneous or irrelevant material is excluded from the information to be given to the learner rather than included.

ii. **Principle of Signaling**: This principle advocates the addition of cues, highlighting the organization of the essential material

iii. **Principle of Redundancy**: According to this principle, a combination of (graphic + narration) supports better learning rather than a combination of (graphic + narration + printed text).

iv. **Principle of Spatial Contiguity (adjacency)**: By placing corresponding words and pictures near to each other we can expect better learning as compared to by placing them far from each other on the page or screen.

v. **Principle of Temporal Contiguity (Time related closeness)**: Corresponding pictures and words should be presented at the same time rather than one after another for greater learning.

vi. **Principle of Segmenting**: The multimedia lesson should be presented as an organized whole of small bits of information, promoting user-paced learning rather as a continuous unit of heavy information.

vii. **Principle of Pre-training**: If the learner is given pre-training related to the key components included in the multimedia programme then they learn more deeply so the impact of multimedia is effective.
viii. **Principle of Modality:** The mode of presentation of information plays an important role in the learning. This principle states that better learning occurs when the content is in form of graphics and narration rather than graphics and printed text.

ix. **Principle of Multimedia:** Multiple media supports the learning rather than single medium like words alone.

x. **Principle of Personalization:** The style of narration in a multimedia presentation also affects the learning as conversational style rather than formal style supports rich learning of the content.

xi. **Principle of Voice:** A friendly human voice multiplies the learning whereas the machine voice does not.

xii. **Principle of Image:** Learning do not necessarily depend upon whether the speaker’s image on the screen is present or not in a multimedia presentation. (Mayer 2009) further asserts that these twelve principles can be categorized in a framework which is based on three types of cognitive load:

![Categorization of principles of CTML](image)

**Fig: 1.7 Categorization of principles of CTML**
1.4.4.3 Applying the cognitive theory of multimedia instruction

CTML is essentially a learner-centered theory which actually advocates the central place of the learner at any learning endeavor. These principles of multimedia learning, should be considered as instructional strategies whose primary goal is to foster greater and meaningful learning among the learners. These principles should be seen as guidelines that can be adjusted according to the intended audience, the objectives and goals of the instruction, and competency level of the learner.

While applying CTML in instruction due care should be taken as carefully designed multimedia instructional material may lead to a better learning whereas a faulty material would definitely result into wastage of time and energy with no or poor learning outcome. So, instructional designer should be very cautious as well as conversant with twelve principles of multimedia learning as suggested by Mayer.

While planning a multimedia instructional module some important points to be taken care are as follows:

1. **Focus is Learner not Technology:** As discussed earlier that multimedia learning methods are child or learner centered. CTML does not support the technology centered approach. A still image with words is a simplest example of Multimedia. So, it is the method of instruction that matters not the technology used to create the instructional module. So, the format of the multimedia programme can be kept as simple as possible depending on the mental level of the learners and nature of the content to be taught.

2. **Managing Cognitive Load:** Mayer, Fennell, Farmer, and Campbell (2004) based on research evidence strongly put forward that, “two important ways to promote meaningful learning are to design activities that reduce cognitive load, which frees working memory capacity for deep cognitive processing during learning, and to increase the learner’s interest, which encourages the learner to use this freed capacity for deep processing during learning”. CTML recommends that for an effective instruction utmost care should be taken while designing it. The instruction should be designed in such a way that it should not overburden the capacity of brain for information processing, an overburdened brain hampers the learning process. The layout of multimedia instructional
design should be visually alluring and intuitive, but focus should be on the learning rather than too much entertaining the learner. Too much entertainment will be time consuming and it may divert the learner from his/her actual goal, i.e. learning. Moreover, the entertainment activities may overload the learner’s working memory before he/she even reaches to the concept to be learned. Mayer (2009) asserts that “effective instructional design depends on techniques for reducing extraneous processing, managing essential processing, and fostering generative processing”. So, extraneous processing should be reduced as far as possible in multimedia instructional design for meaningful learning.

3. **Task Analysis is Necessary:** While designing a multimedia lesson a proper scrutiny of necessary information and skills needed to perform the task for learning should be done so that it can be matched with the capacity of the learner. This scrutiny is termed as task analysis. If the task and skills required are beyond the capacity of the learner then it will surely develop a frustration and probably even cause the loss of interest of the learner. The learner may even drop out the activity. A proper task analysis will surely help the learner to learn with his /her pace without having any kind of displeasure.

4. **Guided Instructions are Favored:** CTML supports guided instruction and prefers them over discovery learning, despite of the fact that many learning theories support it as an important part of multimedia instruction.

For supporting guided instructions Mayer has given four principles, these are spacing, feedback, worked examples, and guided discovery.

5. **Interactivity is Significant:** Results of various studies recommend that when interactivity is added to the multimedia lesson in form of feedback, learner control and guidance it will improve transfer of learning and performance of the learner. Interactivity can be defined as “reciprocal activity between a learner and a multimedia learning system, in which the (re)action of the learner is dependent on the (re)-action of the system and vice versa”. Domagak, Schwartz and Plass (2010). Domagak suggested an interactivity model known as Integrated Model of Multimedia Interactivity (INTERACT) which includes six major components of an integrated learning system viz. The learning Environment, Behavioural activities, Cognitive and meta-cognitive activities,
motivation and emotion, learner variable and learner’s mental model (learning outcomes). So, we can say that interactivity added in a multimedia instruction supports learning.

6. **Viability of Animations and Screencasts:** As recommended by Hasler, Kersten and Sweller (2007), when learner is active and allowed to operate the animated multimedia content the impact of this program is increased rather than when it is played through one go. When the learner gets the control of the multimedia program he/she becomes active, can play and pause the program at his/her will. Various researchers argue and question the viability of animations as instructional tool in improving learners’ achievement. But CTML strongly recommends use of animation and screen cast improve learning outcomes as simple graphical images proves highly effective when used in collaboration with words.

So, the principles of CTML can be applied in development of effective multimedia instructional packages based on the needs and mental level of the intended learners. These principles help us in deciding the components of multimedia which have to be included necessarily for a desired result in form of learning outcome, and which components have to be excluded to lower the cognitive load.

**1.5 NEED AND SIGNIFICANCE OF THE STUDY**

The Life Science/ Biology curriculum over the years is being delivered through lecture method which introduces a sense of boredom in the classrooms. Lecture, being teacher centred instructional method is not suitable for Science subjects in the present age. One or more hour lecture, which consists purely of a verbal presentation, is seldom effective in holding attention, stimulating interest or encouraging student to analyze, evaluate and think critically. This traditional method of teaching is based on giving information as bits. It includes rote memorization of concepts facts and principles, which do not realize objective of teaching Life Science at secondary level. Teacher and teaching methods have a major influence on students’ academic achievement. Poor instructional methods used by the teacher in the classroom lead to students’ poor
academic growth. It was discovered that, despite of governments numerous initiatives to promote Science education in the secondary schools of our country the learning outcomes of the students are not up to the mark. Reason may be attributed to the poor and traditional instructional methods employed by the teachers with no or poor quality instructional material for teaching Science. It is an alarming fact that in the present scientific and technological age traditional instructional method is not sufficient to arouse interest of the students for learning difficult concepts of Science. The teachers should be provided with modern instructional tools to aid them in classroom teaching.

So, new interesting and innovative instructional methods should be devised and adopted for effective teaching because teaching strategies play an important role in enhancing the learning abilities of the students. Findings of various research studies revealed that out of many reasons behind the poor academic performance of students in Life Science one distinguished reason is that in some cases our teachers are not equipped with good quality instructional material, whereas in some other cases the instructional material is there but is not being effectively utilized. So, there is a dire need of directing researches not only towards finding out the suitable and effective instructional method, according to learners’ interest and mental level but also developing innovative instructional material to aid teaching of Science. In this world of Science and technology, it is not possible for a single method, technique or medium to make teaching learning process effective and to fulfill the needs of the students and society. The involvement of more than two media of communication in instructional procedure can bring fruitful results. For qualitative improvement in teaching learning process, Multimedia instructional method may prove as big breather as it is capable of sustaining the interest of students, through visuals and audio inputs. It also brings the element of outer world into the classroom. It can also help students in understanding the complex concepts in a very simple way.

So, keeping this in view, the investigator decided to develop a multimedia instructional package in Life Science for class X students and check its validity.
1.6 STATEMENT OF THE PROBLEM

Development and Validation of Multimedia Instructional Package in Life Science for Students of X Standard.

1.7 OPERATIONAL DEFINITIONS OF THE TERMS USED

Development:

According to Cambridge Advanced Learner’s Dictionary & Thesaurus (Cambridge University Press); development (noun) means process of developing something new.

Validation:


Here by validation the investigator means, establishing the efficacy of the procedures on the basis of empirical testing.

Multimedia:

Integrated use of the different instructional media including film, slides, computer, tape, picture, text, graphics etc.

The term multimedia appeared in the 1990s and was defined by Reddi and Mishra (2003) as:

“an integration of multiple media elements (audio, video, graphics, text, animation etc.) into one synergetic and symbiotic whole that results in more benefits for the end user than any one of the media element can provide individually”.

Mayer (2005) extended the definition:

“a multimedia instructional message is a presentation consisting of words and pictures that is designed to foster meaningful learning”.

Instructional Package:

It is a set of strategies used in the instructional process so as to make teaching learning process more easy and simple.

Multimedia Instructional Package (MMIP):

Multimedia Instructional package means “an instructional material prepared using multiple media elements viz, text, audio, video, sound and animation; including set of strategies”.

1.8 OBJECTIVES

For the present study following objectives were framed:

1. To develop Multimedia Instructional Package in Life Science for X standard students.
2. To validate the developed Multimedia Instructional Package in Life Science for X standard students.
3. To conduct descriptive analysis of data with respect to various variables viz, Socioeconomic status (SES), Intelligence, Science achievement and Science attitude of the present study.
4. To compare the mean scores of control and experimental groups with respect to various variables viz, Socioeconomic status (SES), Intelligence, Science achievement and Science attitude of the present study at pre-test stage (before the experiment).
5. To compare the mean scores of control and experimental groups on Science achievement and Science attitude at post-test stage (after the experiment).
6. To compare the mean gain scores of control and experimental groups on Science achievement.
7. To compare the mean gain scores of control and experimental groups on Science achievement with respect to gender of the students.
8. To compare the mean gain scores of control and experimental groups on Science achievement with respect to intelligence of the students.
9. To compare the mean gain scores of control and experimental groups on Science attitude.
10. To compare the mean gain scores of control and experimental groups on Science attitude with respect to gender of the students.
11. To compare the mean gain scores of control and experimental groups on Science attitude with respect to intelligence of the students.

12. To study the effect of treatment, gender and their interaction on post-test Science achievement scores of students by considering pre-test Science achievement scores as covariate.

13. To study the effect of treatment, intelligence and their interaction on post-test Science achievement scores of students by considering pre-test Science achievement scores as covariate.

14. To study the effect of treatment, gender and their interaction on post-test Science attitude scores of students by considering pre-test Science attitude scores as covariate.

15. To study the effect of treatment, intelligence and their interaction on post-test Science attitude scores of students by considering pre-test Science attitude scores as covariate.

16. To study the opinion of students of experimental group towards Multimedia Instructional Package.

17. To compare the opinion of male and female students of experimental group towards Multimedia Instructional Package.

1.9 HYPOTHESES

A hypothesis is a shrewd guess of inference or superposition or tentative generalization as to the existence of some facts, condition or relationship relative to some phenomenon which serve to explain such facts as already are known to exist in a given area of study and to guide the search for new truth. In words of Good and Hatt, "A hypothesis states what we are looking for. A hypothesis looks forward. It is a proposition which can be put to test to determine its validity. It may prove to be correct or incorrect."

In the present study, following null hypotheses were formulated:

**H₀ 1(a)** There is no significant difference between mean Science achievement scores of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.

**H₀ 1(b)₁** There is no significant difference between mean Science achievement scores of male students of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.

**H₀ 1(b)₂** There is no significant difference between mean Science achievement scores of female students of control group (to be taught through TTM) and
experimental group (to be taught through MMIM) before the experimental treatment.

\text{H}_0 \ 1(b)_3 \text{ There is no significant difference between mean Science achievement scores of male and female students of control group (to be taught through TTM) before the experimental treatment.}

\text{H}_0 \ 1(b)_4 \text{ There is no significant difference between mean Science achievement scores of male and female students of experimental group (to be taught through MMIM) before the experimental treatment.}

\text{H}_0 \ 1(c)_1 \text{ There is no significant difference between mean Science achievement scores of low intelligence category students of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.}

\text{H}_0 \ 1(c)_2 \text{ There is no significant difference between mean Science achievement scores of average intelligence category students of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.}

\text{H}_0 \ 1(c)_3 \text{ There is no significant difference between mean Science achievement scores of high intelligence category students of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.}

\text{H}_0 \ 1(c)_4 \text{ There is no significant difference between mean Science achievement scores of control group (taught through TTM) with respect to intelligence of students before the experimental treatment.}

\text{H}_0 \ 1(c)_5 \text{ There is no significant difference between mean Science achievement scores of experimental group (taught through MMIM) with respect to intelligence of students before the experimental treatment.}

\text{H}_0 \ 2(a) \text{ There is no significant difference between mean Science attitude scores of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.}

\text{H}_0 \ 2(b)_1 \text{ There is no significant difference between mean Science attitude scores of male students of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.}

\text{H}_0 \ 2(b)_2 \text{ There is no significant difference between mean Science attitude scores of female students of control group (to be taught through TTM) and}
experimental group (to be taught through MMIM) before the experimental treatment.

\( H_0 \ 2(b)_3 \) There is no significant difference between mean Science attitude scores of male and female students of control group (to be taught through TTM) before the experimental treatment.

\( H_0 \ 2(b)_4 \) There is no significant difference between mean Science attitude scores of male and female students of experimental group (to be taught through MMIM) before the experimental treatment.

\( H_0 \ 2(c)_1 \) There is no significant difference between mean Science attitude scores of low intelligence category students of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.

\( H_0 \ 2(c)_2 \) There is no significant difference between mean Science attitude scores of average intelligence category students of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.

\( H_0 \ 2(c)_3 \) There is no significant difference between mean Science attitude scores of high intelligence category students of control group (to be taught through TTM) and experimental group (to be taught through MMIM) before the experimental treatment.

\( H_0 \ 2(c)_4 \) There is no significant difference between mean Science attitude scores of control group (taught through TTM) with respect to intelligence of students before the experimental treatment.

\( H_0 \ 2(c)_5 \) There is no significant difference between mean Science attitude scores of experimental group (taught through MMIM) with respect to intelligence of students before the experimental treatment.

\( H_0 \ 3 \) There is no significant difference between mean Science achievement scores of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

\( H_0 \ 4 \) There is no significant difference between mean Science attitude scores of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

\( H_0 \ 5(a) \) There is no significant difference between mean gain Science achievement scores of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.
\( H_0 \ 5(b)_1 \) There is no significant difference between mean gain Science achievement scores of male students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

\( H_0 \ 5(b)_2 \) There is no significant difference between mean gain Science achievement scores of female students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

\( H_0 \ 5(b)_3 \) There is no significant difference between mean gain Science achievement scores of male and female students of control group (taught through TTM) after the experimental treatment.

\( H_0 \ 5(b)_4 \) There is no significant difference between mean gain Science achievement scores of male and female students of experimental group (taught through MMIM) after the experimental treatment.

\( H_0 \ 5(c)_1 \) There is no significant difference between mean gain Science achievement scores of low intelligence category students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

\( H_0 \ 5(c)_2 \) There is no significant difference between mean gain Science achievement scores of average intelligence category students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

\( H_0 \ 5(c)_3 \) There is no significant difference between mean gain Science achievement scores of high intelligence category students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

\( H_0 \ 5(c)_4 \) There is no significant difference between mean gain Science achievement scores of control group (taught through TTM) with respect to intelligence of students after the experiment.

\( H_0 \ 5(c)_5 \) There is no significant difference between mean gain Science achievement scores of experimental group (taught through MMIM) with respect to intelligence of students after the experimental treatment.

\( H_0 \ 6(a) \) There is no significant difference between mean gain Science attitude scores of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.
**H₀ 6(b)₁** There is no significant difference between mean gain Science attitude scores of male students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

**H₀ 6(b)₂** There is no significant difference between mean gain Science attitude scores of female students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

**H₀ 6(b)₃** There is no significant difference between mean gain Science attitude scores of male and female students of control group (taught through TTM) after the experimental treatment.

**H₀ 6(b)₄** There is no significant difference between mean gain Science attitude scores of male and female students of experimental group (taught through MMIM) after the experimental treatment.

**H₀ 6(c)₁** There is no significant difference between mean gain Science attitude scores of low intelligence category students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

**H₀ 6(c)₂** There is no significant difference between mean gain Science attitude scores of average intelligence category students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

**H₀ 6(c)₃** There is no significant difference between mean gain Science attitude scores of high intelligence category students of control group (taught through TTM) and experimental group (taught through MMIM) after the experimental treatment.

**H₀ 6(c)₄** There is no significant difference between mean gain Science attitude scores of control group (taught through TTM) with respect to intelligence of students after the experimental treatment.

**H₀ 6(c)₅** There is no significant difference between mean gain Science attitude scores of experimental group (taught through MMIM) with respect to intelligence of students after the experimental treatment.

**H₀ 7(a)** There is no significant effect of treatment on adjusted means of post-test Science achievement scores by considering pre-test Science achievement scores as covariate.
\(H_0\ 7(b)\) There is no significant effect of gender on adjusted means of post-test Science achievement scores by considering pre-test Science achievement scores as covariate.

\(H_0\ 7(c)\) There is no significant interaction effect of treatment and gender on adjusted means of post-test Science achievement scores by considering pre-test Science achievement scores as covariate.

\(H_0\ 8(a)\) There is no significant effect of treatment on adjusted means of post-test Science achievement scores by considering pre-test Science achievement scores as covariate.

\(H_0\ 8(b)\) There is no significant effect of intelligence on adjusted means of post-test Science achievement scores by considering pre-test Science achievement scores as covariate.

\(H_0\ 8(c)\) There is no significant interaction effect of Treatment and Intelligence on adjusted means of post-test Science achievement scores by considering pre-test Science achievement scores as covariate.

\(H_0\ 9(a)\) There is no significant effect of Treatment on adjusted means of scores of Science Attitude by considering pre-test scores of Science Attitude as covariate.

\(H_0\ 9(b)\) There is no significant effect of gender on adjusted means of post-test Science attitude scores by considering pre-test Science attitude scores as covariate.

\(H_0\ 9(c)\) There is no significant interaction effect of treatment and gender on adjusted means of post-test Science attitude scores by considering pre-test Science attitude scores as covariate.

\(H_0\ 10(a)\) There is no significant effect of treatment on adjusted means of post-test Science attitude scores by considering pre-test Science attitude scores as covariate.

\(H_0\ 10\ (b)\) There is no significant effect of intelligence on adjusted means of post-test Science attitude scores by considering pre-test Science attitude scores as covariate.

\(H_0\ 10(c)\) There is no significant interaction effect of Treatment and Intelligence on adjusted means of post-test Science attitude scores by considering pre-test Science attitude scores as covariate.

\(H_0\ 11\) There is no significant difference between the opinions of male and female students of experimental group regarding the effectiveness of MMIP.
1.10 DELIMITATIONS OF THE STUDY

The study has a number of ramifications but due to constraints of time and resources it had to be delimited as it is not humanly possible to study each and every aspect of a problem. Therefore, in this study delimitations have been observed in the following aspects:

1. The study was delimited to one English medium school, affiliated to CBSE, Delhi only.
2. The study was delimited to X standard students only.
3. The study was delimited to a sample size of 80 students of class X only.
4. The study was delimited Science subject only.
5. The study was delimited to only two topics of Life Science.