CHAPTER –V

SUMMARY AND CONCLUSIONS

In the preceding chapters, introduction of the problem, development of the tools, method of the study and interpretation of the results, were discussed. The present chapter presents a brief summary of investigation and the conclusion of the study.

5.1 INTRODUCTION

There are massive facets accountable for building education system a success, but much depends upon the mode and media of instructions. Instruction is a plan of teaching and learning activities in which learning is organized. This instructional plan motivates students to learn. The aim of instruction is to make the learning process take place. In general, the evaluation of effectiveness of instructions can be divided by its emphasis on input (What do students and teachers bring to the classroom?), or process (what do teachers and students do in a course?), or product (what do students learn or accomplish in the course?)

The effectiveness of instruction and performance of the students is influenced by a large number of factors; the planning of instruction, the type of instructional system, the instructional media used for instruction, physical facilities of the school, attitudes of the students, and to a large extent, the intelligent level of the learners. For the present study, the factors namely, physical facilities of the school, level of intelligence and attitudes of the students toward instructional media, are considered as the variable for determining the potential of Information and communication technology as an instructional media, used in instructional system of teaching-learning process. Instructional System may be viewed as composed of various inter-related components functioning together to achieve a goal.

An effective instruction entails a careful planning. Instructional system may be viewed as a sequence and arrangement of external conditions of learning, in such a way that will optimally interact with the internal capacities of the learners, so as to bring about a chance in their capacities. There are different components of instructional system like task description, characteristics of learner, learning types, Instructional
strategy, Instructional media, supporting measures and devices, evaluation and feedback, instructional media selection and its interactivity and as a result of this Information and Communication technology is taking dramatic advances in the potential for learner-programme interaction. Information and communication technology (ICT) enabled teaching-learning encompasses array of techniques, tools, content and resources aimed at perking up the eminence 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 variety of choices accessible to the science teacher to employ assorted modes/ICT tools and resources for effective pedagogy. With the introduction of ICT in the science classroom, the confronts to science learning are larger especially to inculcate scientific skills, knowledge, and application as it can provide an environment for learning that is self-paced, learner controlled and oozes dynamism.

Information and communication technologies (ICTs) — which include radio and television, as well as newer digital technologies such as computers and the Internet — have been proven as potentially powerful tools for educational change and reform. When used appropriately, different ICTs can help expand access to education, strengthen the relevance of education to the increasingly digital workplace, and raise educational quality by helping make teaching and learning into an active process connected to real life.

When these technologies are applied in the field of education, it is termed as ICT in education. The term too can be used as the connotation to the term Educational technology because it also uses any hardware and software approaches that can enhance yield better learning outcomes. 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 utilise various modes/ICT tools for effective pedagogy. Each such device or strategy also involves changes in the classroom environment, understanding of which has a bearing on its effectiveness. Availability of
a wide range of such teaching learning materials will catalyse transformation of classrooms into smart classrooms.

Information and communication technology (ICT) enabled science teaching and learning encompasses array of techniques, tools, content and resources aimed at perking up the eminence and efficiency of the teaching learning process. There is variety of choices accessible to the science teacher to employ assorted modes of ICT tools for effective pedagogy. With the introduction of ICT in the science classroom, the techniques, procedures and approaches to science learning are copious especially to inculcate scientific skills, knowledge and application. Moreover with ICT that type of environment for learning is generated which is self paced, learner controlled and oozes dynamism.

5.2. USE OF ICT IN SCIENCE TEACHING

Why ICT is to be used for teaching of sciences? The answer is (i) to attract, arouse interest and motivate students. (ii) to increase effectiveness of work in science laboratory (iii) to encourage the answering of the question: “what will be”, if...? (iv) to enhance memorising and understanding of knowledge by assuring feedback (v) to facilitate realisation of the school curricula due to integration of ICT with the contents (vi) to provide application of multimedia methods (vii) to assure the use of simulations, modelling and investigations in real-time; to construct the knowledge of students by their creative individual work (viii) to cause association of computer-aided work with simplifying of science understanding, as computer helps to solve ordinary as well as complicated problems and finally allow students to extend their knowledge beyond the computer resources.

5.3.1 ICT-MEDIATED SCIENCE INSTRUCTIONS

ICT mediated instructions refer to instructions delivered via varied technological channels such as television, radio, or a computer and network. Such type of instructions can be synchronous, with both the instructor and the student participating simultaneously. For example, instruction may be delivered via desktop videoconferencing by a teacher located at a school to employees at widely separated institutions. ICT mediated instructions may also be delivered asynchronous, with the
instructor and student participating at different times. Instruction based on teaching materials placed on a website does not require simultaneous participation. The synchronicity may not matter, as and when self-contained instructional materials are packaged on a CD-ROM. In this case, the instructional designer may have developed the materials months or even years before the student uses them and communication between the two is possible.

Pedagogical Integration of ICT concept is not limited to the establishment of networks and/or the installation of equipments. It includes the use of technology in science to improve learning and to facilitate scientific development. Among other definitions, this concept implies a process of appropriate, regular, and regulated use of interactive technology with sustained beneficial changes in science practices and student learning. ICTs offer a range of different tools for use in school science activity, including:

- Tools for data capture, processing and interpretation data logging systems, databases and spreadsheets, graphing tools and modeling environments.
- Multimedia software for simulation of processes and carrying out ‘virtual experiments.’
- Information gathering tools (using Internet browsers and multimedia CD-ROMS).
- Simulations, (virtual experiments and visual aids, simulating and helping to explain phenomena) Publishing and presentation tools.
- Data handling tools (using spreadsheets and graphing software to analyse data digital recording equipments).
- Use of mathematical models (exploring relationships, predicting and testing theories Computer projection technology)
- Practical work via using sensors, interfaces and data-logging software, computer-controlled microscope etc.

Varied forms of ICT can enhance both the practical and theoretical aspects of science teaching and learning. The potential contribution of technology use can be conceptualized as follows:

- Expediting and enhancing work production; offering release from laborious manual processes and more time for thinking, discussion and interpretation.
• Increasing currency and scope of relevant phenomena by linking school science to contemporary science and providing access to experiences not otherwise feasible.
• Supporting exploration and experimentation by providing immediate, visual feedback.
• Focusing attention on over-arching issues, increasing salience of underlying abstract concepts.
• Fostering self-regulated and collaborative learning.
• Improving motivation and engagement.

ICT can provide access to a huge range of resources for example Social Networking, Wikis, Virtual Worlds, ICT Tutorial, Video Archives, Animations, etc.

5.3.2 PROCEDURE FOR INTEGRATION OF ICT TOOLS AND RESOURCES:

Step 1: Discovering ICT tools: This stage focuses on discovery of new ICT tools by teachers and students. This is linked with the emerging approach in ICT development.

Step 2: Learning how to use ICT tools: This stage emphasizes on learning the use of new ICT tools. It involves the use of general or particular applications of ICT.

Step 3: Understanding how and when to use ICT tools: It focuses on understanding how and when to use ICT tools to achieve a particular purpose, such as in completing a given project for imparting instructions. This stage indicates the ability to recognize situations where ICT will be helpful, choosing the most appropriate tools for a particular task, and using these tools in combination to solve real problems.

Step 4: Specializing in the use of ICT tools: The fourth and the last stage involve specializing in the use of ICT tools. This requires deep knowledge about using ICT tools. In this stage teachers become specialist in imparting instructions via ICT as well as students become specialists in using ICT for particular task, assignment or project taken in hand.

When ICT facilities are brought into the science teaching space, the teacher becomes the main user and driver of ICT. So the Information and Communication Technology (ICT), is used to help and create the learning and supportive environments that are known to be ideal, perfect, wonderful and amazing.
5.4 EFFECTIVENESS OF ICT MEDIATED SCIENCE INSTRUCTIONS

Effective instruction is instruction that enables students to acquire specified skills, knowledge and attitudes. During the effective instruction, students can be motivated well. To motivate students in the instruction process, all factors must be determined well.

Teaching via usage of varied ICT based tools and resources definitely enhance the academic achievement of students. Sindhi (1996) proved that the teaching through multimedia package is more effective than the traditional method in terms of achievement. An audio visual mediated instruction was found to be significantly more effective than the programmed learning method and the traditional method in terms of achievement (Thatte, 1998). Both the ETV and School Broadcast programmes have been found to have positive effect on achievement of pupils (Samal, 2000). Even the combination of text and pictures together can enhance comprehension and retention (Mayer, 2001).

Via increasing visual impact like simulations can improve scientific understanding (H uppert et al. and Trindade et al., 2002). Chalmers (2002) argued that ICT has a potential to support and nurture science education. It was avowed that Computer Assisted Learning Material was found effective in terms of achievement (Macwana, 2004). Further it was also revealed that ICT enhanced an increased sensitivity towards environmental concerns and a better understanding of the environment topics (Sharma, 2005). Modelling software helped in the development of valuable skills for scientific investigation (Rogers, 2006).

It was also examined that the students on whom CAI method was applied came out more successful than control group on whom traditional method was applied (Mustafa and Turgay, 2011).

Researches indicate that varied type of ICT mediated instructions with varied types of ICT can make a difference to pupils’ learning and achievement. The substantial gains in pupil attainment are achievable where the use of ICT is planned, structured and integrated effectively. Methods employed by teachers to teach Science subjects in secondary schools are to a very large extent influenced by the kind of resources and facilities available in the school. The teaching methods, in turn, influence the level and
quality of participation and performance by students. In general, where resources and facilities - teachers, textbooks, laboratories, chemicals, tools and equipment, teaching aids, stores, offices etc. - are inadequate, the teaching approach tends to be teacher-centered. This type of approach is heavily dominated by the teacher as he or she lectures on the subject, gives notes and demonstrates the practical aspects of the lesson. The students remain passive participants expected to listen and observe only. The teacher, therefore, is the sole source of knowledge for the pupils. This can be risky in the event that the teacher is inadequately informed on the subject or is not adequately trained in the art of communication. A teaching approach that centers on the teacher is bad for science teaching and learning and soon kills the interest of students in the subject.

But where facilities and resources are available, a qualified and motivated science teacher will deploy methods that center on the learner. Such an approach emphasizes practical activities and has the pupils experimenting, solving problems, discussing with each other and involved in practical hands-on-activities. This approach stimulates curiosity, imagination and critical thinking. It keeps the lessons exciting and captivating to the young people. Knowing therefore the critical role played by adequate resources and facilities in effective teaching and learning of Science. All facilities must be provided to the schools for the students’ better, concrete, and real experiences.

5.5. PHYSICAL FACILITIES

To ensure quality science education, the essential facilities like text book, teacher, teaching aids, library, laboratory, co-scholastic activities and above all Information and Communication Technologies (ICTs) are required. Effective science education is the need of the day. ICTs provide students and teachers with new tools that enable improved learning and teaching of science. In India, various ICTs have been employed over the years to promote primary and secondary education. These include radio, satellite based one-way and interactive television, and the Internet.

It was claimed that physical facilities help to enhance the learning of the students (Leeper et al., 1968). According to Balogun (1982) no effective science education programme can exist without equipment for teaching. Ogunniyi (1983)
divulged that there is a general consensus among science educators that the laboratory occupies a central position in science instruction.

It has been proved that schools with well-equipped laboratories have better results in the school certificate science examinations than those that are ill-equipped (Nyong, 1984). Fuller (1985) revealed that collection of books kept for reading in the library is related to performance. Positive relationship between the independent variables of laboratory facilities; recommended textbooks, number of science books in the library and teachers’ qualifications and the dependent variable, the academic achievement of students in physics, Chemistry and Biology was notified. (Arubayi, 1987).

It was also opined that a well-equipped library is a major facility which enhances good learning and achievement of high educational standard (Ola, 1990). Kovol (1991) examined the relationship of classroom physical features to the learning environment and found significance for every factor examined. Other scholars (Wilcockson, 1994, Lawal 1995, Ajayi 1996) have variously identified the significance of facilities in teaching learning spheres and concluded that absence or poor (and or deteriorating) quality of educational facilities can affect academic performance.

ICT usage have benefit for disadvantaged groups, the major gain regards to equity is that digital communication can engender the promotion of a more equitable participation (Hsi and Hoadly, 1997). Johnson (1998) found a significant relationship between instructional materials and students’ academic achievement. Becta (2001) resulted that consistent positive differences were found in science attainment between those schools with good levels of ICT resources and those with poor levels of ICT resources.

The study undertaken by Shami and Hussain (2005) revealed that the availability of physical facilities in a school had a significance impact on students’ performance. Dwyer, et al. (2005) divulged that the use of computers and Internet can deliberately provide learning outcomes to their students. Edyburn (2006) disclosed that the collaboration of technology and teaching among the schools can be a good start in academic performance.
The above studies have proven that facilities for teaching of science are the most potent determinant of academic achievement. Facilities in terms of pedagogy, laboratory, library, school buildings, chairs, tables, administrative blocks, chalk-board, school maps ICT and the likes are very crucial for high academic attainment. There is no doubt, that the function and availability of facilities to students is an important factor in achieving academic excellence. But intelligence of students also plays crucial role for academic achievement.

5.6. INTELLIGENCE

Intelligence is a trait of mind that encompasses numerous mental abilities, such as the capacities to reason, plan, solve problem, think abstractly, comprehend ideas and language and learn. According to John Kotter Intelligence is a “keen mind i.e., strong analytical ability, good judgment, and the capacity to think strategically and multi-dimensionally”.

“Intelligence is the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment (Wechsler, 1944).”

When instructions are imparted with diverse type of instructional media it transforms students and eventually resulting in the change in intelligence level of the students. Shute and Bonar (1986) also asserted that specialized computer programs are found to help in developing inquiry skills and increasing scientific knowledge. Students build connections between words and pictures in multimedia learning like narrated animations (Mayer and Anderson, 1992). It was also speculated that pupils who had used the computer database package were able to use more advanced data-analysis skills (Watson, 1993).

Boohan (1994) furnished that when ICT is used in science, pupils develop novel strategies for problem solving. Williamson and Abraham (1995) acquired support for their investigation that the simulations increase conceptual understanding by helping students from their own dynamic mental models. CAI increases learner knowledge when it involves the synergy of multiple senses (Cheney, 1996). In the early years of ICT use, science classes were the site of various innovations (Taylor et al. 1997).
The use of ICT changes the relative emphasis of scientific skills and thinking (Hennessy, 1999). Reviewed research concluded that the main contribution made by ICT to pupils’ understanding of science is through the acquisition of investigative skills and improved understanding of some scientific concepts and processes (Cox, 2000). Sanjna (2001) conducted a comparative study of the effectiveness of CAI and CMI on Pupil’s achievement in Science, Both CAI and CMI were found to be contributed significantly towards the achievement of pupils in science. Researchers have demonstrated that ICT can help to deepen students’ content knowledge, engage them in constructing their own knowledge and support the development of complex thinking skills (Kozma, 2005; Webb and Cox, 2004 and Kulik, 2003).

With ICT mediated teaching and learning environment there is increased student’s motivation and their understanding of the subject matter Barak and Dori (2005). Alev (2007) found that computer assisted instruction is more feasible than the traditional approach in terms of cognitive and affective behaviors Polman and Pea (2007) established that in the classroom, where learning objects are encountered in a social and discursive environment, digital resources can help teachers and students to slow down and focus on the intermediate cognitive processes of observing, predicting and explaining that are central for science inquiry and understanding. Kara (2008) study explored on retention effect with the ICT based instructions.

With the aid of different types of ICT mediated instructions, Dalacosta et. al. (2009) findings explored, increase in the young students' knowledge and understanding of specific science concepts with ICT. Korakakis et. al. (2009) inferred that students leave the time control of learning and decrease the cognitive load in computer assisted environment. Ferguson, Whitelock, and Littleton (2010) divulged that ICT is very helpful in communicating and representing ideas in science.

Above studies provide corroborating evidence about the effect of ICT on students' knowledge, understanding, learning, analysis and synthesizing of scientific concepts in an efficient way. Eventually ICT has effectiveness on the intelligence level of the students.
ICT based teaching environment effects drastically on student’s intelligence level, there is another imperative factors which is accountable for the achievement in science subject is interest of the students.

5.7 INTEREST

“No use to shout at them to pay attention. If the situations, the materials, the problems before the child do not interest him, his attention will slip off to what does interest him, and no amount of exhortation of threats will bring it back.” -John Holt

Much interest in science subject has been affected by ICT mediated instructional strategies. Cox (1997) listed a series of benefits of using ICT in lessons out of which one is enhanced enjoyment and interest in learning the subject. Newton and Rogers (2001) after reviewing varied researches inferred that there is considerable evidence that learners are highly motivated when their learning is supported by ICT.

ICT enhances the effectiveness of information presentation and also stimulates student’s interest (Osborne and Hennessy, 2001). Earl (2002) also established that using ICT in different activities that simulated the “real world” had given students opportunities to increase their motivation and improve their attitudes toward the subject and their interest in learning. The results from Bett’s study (2003) suggested that ICT can motivate students and enhance the quality of learning. Kajee (2004) found that researchers of ICT and ESL believe that ICT would harmonize the teaching and learning environment as well as promote equal participation among the students.

Trimmel and Bachman (2004) unveiled that “information technology has a positive impact on school attendance and learning interest”. Campbell (2005) recognized that with ICT students are more engaged in activities, they show increased interest and longer attention span.

It is apparent from the above that, several claims have been made in the literature about the effects of Information and Communication Technologies (ICT) on pupil’s interest, leading them to have a more interest in their work, spend longer time on tasks and have more commitment to their learning. As interest is an essential entity for attitude formation it becomes necessity, compulsion and binding to study the effect of ICT based teaching environment on the attitude of the students.
5.8 ATTITUDE TOWARDS INSTRUCTIONAL MEDIA

According to Freeman, dispositional readiness, to respond to certain situation, person, object or idea in a consistent manner, which has been learned and has one’s typical mode of response.

Attitude is a specific mental state of an individual towards something, according to which his behavior towards specific domain can be molded. It is a tendency to react in certain way towards a designated class of stimuli.

Pupils using computers had more positive attitude towards biology and natural sciences than pupils who were educated by traditional styles (Haunsel and Hill 1989). Price (1989) conducted an attitude survey and observed student progress in a middle school science project where CAI was used as a tutorial and research tool and found CAI group having positive attitude towards instructions. Winfred (1991) quotes in his study that initial computer experiences may play role in the formation of computer attitude.

One of the study established that the majority of the students in the university level class showed positive co-operation on group work and positive attitude toward using computers in the classroom (Park, 1993). Yu (1998) used computer assisted instruction and found that it increased students’ performance and attitudes towards science. Smith, Caputi and Rawstorne (2000) revealed that computer or ICT attitude has been defined as a person’s general evaluation or feeling of favor or antipathy toward computer technologies and specific computer related activities. Bozionelos (2001) exposed that there are many studies, where it is reported, that older students have more positive attitudes to computers than the younger.

Cooper and Brna (2002) reported evidence that pleasure and variety kept students engaged and motivated. Murphy and Beggs (2003) carried out an extensive survey of children’s attitudes to science and found that most of the older pupils (10-11 years) had significantly less positive attitudes than younger ones (8-9 years) towards science enjoyment, even though the older pupils were more confident about their ability to do science.

It was made public by Pandian (2004) that the CAI students demonstrated significantly higher achievement gains in biology. The variables self-esteem, attitude
towards Biology and computer were influenced by the CAI. The research findings of Girl and Tan (2005) and Chan (2002) in the meta-analytical research studies indicated that computer assisted lessons can improve students’ academic achievement and attitudes toward learning, and allow students to learn more in less time with more enthusiasm. Tekbiyik and Silk (2007) documented that CAI has varied effects on students such as academic achievement and attitudes toward course. Students’ attitudes are one of the key factors in learning science. Learning process is important in improving positive attitude. Charles and Crisp (2011) conducted a study and concluded that there was a significant relationship between attitude towards reading and reading achievement.

It is apparent from the above that, several claims have been made in the literature about the effects of Information and Communication Technologies (ICT) on pupil’s interest, leading them to have a more interest in their work, spend longer time on tasks and have more commitment to their learning. As interest is an essential entity for attitude formation it becomes necessity, compulsion and binding to study the effect of ICT based teaching environment on the attitude of the students.

5.9 EMERGENCE OF THE PROBLEM

Ideally a literature review compares findings from a number of different studies, which were perhaps conducted several years apart, or with different ages of pupils or in different educational settings. Although we did not have sufficient time to be able to do this with all the publications, the evidence researcher have compared provides very useful findings. Main findings from the studies are pertaining to:

i. Relationships between specific ICT use and the effects on attainment within a range of contexts.

ii. ICT has a positive effect on many areas of science attainment.

iii. Research in the area of science education has included studies of pupils’ misconceptions and alternative frameworks, so there is a large body of knowledge about what kinds of misconceptions learners have and what kinds of teaching methods and resources have been found to be helpful to address such
misconceptions. This has enabled developers and researchers to produce educational software which addresses these learning difficulties.

iv. Because of the content-and-process nature of many of the ICT environments, it is more straightforward to devise instruments to measure the effects on attainment. Many researchers have devised measures which relate to the specific learner interactions and tasks promoted by a simulation or a modelling environment, and are therefore able to measure more reliably the effects of ICT use.

v. There is evidence of a positive effect of specific ICT uses on pupils’ academic achievement at all key stages, which is related to their conceptual development in science and the types of learning environment available to them.

In today’s world, teachers need to be equipped not only with subject expertise and effective teaching methodologies but with the capacity to assist students to meet demand of the emerging knowledge based society with new forms of ICT and need to have the ability to use that technology to enhance the quality of learning. It is still the case that ICT is not used extensively in the science curriculum. It was also corroborated that very sparse studies are conducted on the effectiveness of ICT mediated instructions on the achievement of the students in science in relation to physical facilities, intelligence, interest and attitude of the students. Whether ICT also supports constructivist pedagogy, wherein students use technology to explore and reach an understanding of scientific concepts. Investigator developed ICT based lesson plans and intended to find its effectiveness of ICT mediated instructions in science at Secondary stage.

5.10 SIGNIFICANCE OF THE STUDY

Although, subject matter can be taught in infinite ways, the teacher because of their effectiveness is extensively using ICT based instructions. However, no mode of presentation can be stated as the best or the only means through which knowledge can be imparted for any subject. As the tremendous growth of ICT has given a new outlook to the modern world and this has, to some extent, influenced the way education is being imparted. There is an argument that enormous amount of money has been expended on ICTs in institutions. A more contentious issue is the educational effectiveness of its
integration into the normal classroom as a teaching learning tool. The effectiveness of Information and Communication Technology (ICT) based environment needs to be evaluated.

Unfortunately, there is no ‘magic bullet’, which will tell you simply and easily that a certain application of ICT has had an effect on student achievement. Indicators are needed to show the relationships between Information and Communication Technology (ICT) use, changes in teaching and learning processes and student achievement. There is also a need to show that education should be seen as using technology not only as an end in itself, but as a means to promote creativity, empowerment and equality and produce efficient learners and problem solvers. Moreover, parents and teachers, school boards and administrators, governors and state legislatures and Congress all want to know if the nation’s investment in technology is providing a return in student achievement. Indeed, if resources are to be expended on technology, it is becoming a political, economic, and public policy necessity to demonstrate its vital effectiveness. So realizing the tremendous importance of ICT in classroom processes, the investigator felt tempted to study the effectiveness of ICT mediated instructions in science at Secondary stage.

5.11 STATEMENT OF THE PROBLEM

The present study is stated as follows:

EFFECTS OF INFORMATION AND COMMUNICATION TECHNOLOGY MEDIATED INSTRUCTIONS ON ACHIEVEMENT IN SCIENCE SUBJECT AT SECONDARY STAGE

5.12 DELIMITATION OF THE PROBLEM

The study is delimited to secondary stage students of Gurdaspur district of Punjab. Information and Communication Technology based instructional plans were prepared out of four units from the N.C.E.R.T. science subject syllabus of 9th class chapter 2nd (Is Matter Around Us Pure?); 5th (The Fundamental Unit of Life); 12th (Sound) and 14th (Natural Resources) for the ninth standard students.
5.13 OBJECTIVES
The study was designed to achieve the following objectives:
1. To identify the ICT resources to be used by the teacher.
2. To develop instructional plans integrated with ICTs.
3. To study the effectiveness of treatment on the achievement of the students in science in relation to Physical facilities.
4. To study the effectiveness of treatment on the achievement of the students in science in relation to intelligence.
5. To study the effectiveness of treatment on the interest of the students in science in relation to Physical facilities and intelligence.
6. To study the attitude towards instructional media in relation to physical facilities and intelligence.

5.14 HYPOTHESES
The study was intended to test the following hypotheses:
1. There is no significant difference in the achievement of the students in science with ICT and without ICT mediated classroom instructional strategies.
2. There is no significant difference in the achievement of the students in science with high intelligence and low intelligence.
3. There is no significant difference in the achievement of the students in science with rich and poor physical facilities.
4. With ICT and without ICT mediated classroom instructions, achievement in science is equal in case of high intelligent and low intelligent groups.
5. With ICT and without ICT mediated classroom instructions, achievement in science is comparable at the two levels of physical facilities.
6. There is no significant difference in the achievement of high and low intelligent students at both the levels of physical facilities.
7. With ICT and without ICT mediated classroom instructions, achievement scores are equal for high intelligent and low intelligent students at both levels of physical facilities.
8. There is no significant difference in the interest in science with ICT and without ICT mediated classroom instructional strategies.
9. There is no significant difference in the interest in science among the students with rich physical facilities and poor physical facilities.

10. Difference in interest in science with ICT and without ICT mediated instruction is not qualified at the two levels of physical facilities.

11. There is no significant difference in the attitude towards instructional media of the students with ICT and without ICT mediated classroom instructional strategies.

12. There is no significant difference in the attitude towards instructional media of the students with rich physical facilities and poor physical facilities.

13. Difference in the attitude towards instructional media with ICT and without ICT mediated classroom instructions is not qualified by the levels of physical facilities.

5.15 TOOLS EMPLOYED

In the present study, the investigator used following tools for data collection:

(i) Rating scale for physical facilities (prepared by the investigator)

(ii) Standard Progressive Matrices (Raven, 1998) for testing intelligence

(iii) A Scale for Attitude towards Instructional Media (prepared by the investigator)

(iv) A Scale for Interest in the science subject (Dubey and Dubey, 2007).

(v) Achievement Test in Science (prepared by the investigator)

(vi) ICT based Instructional Plans (prepared by the investigator)

(vii) Without ICT based (Traditional) Instructional Plans (prepared by the investigator)

5.15 SAMPLE SELECTION

In order to conduct the experiment, six schools, three having rich physical facilities and three having poor physical facilities were selected. For their selection, a ‘Rating scale for physical facilities’, was administered to thirteen randomly selected secondary schools of Gurdaspur district, of which two were central government school and eleven were public or private schools.

Intelligence test of Standard Progressive Matrices set by Raven (1998) for testing intelligence was administered to 608 ninth class students of six selected schools. The obtained scores were arranged in descending order of their magnitude. On the basis
of intelligence scores, students were classified into high intelligent and low intelligent groups by taking 30% top and 30% bottom students. The middle scores were dropped.

Equal number of students was assigned to two groups viz., ICT mediated instructions and without ICT mediated instructions. Thus, the groups of subjects selected, represented the eight groups in each of the selected schools. High intelligent students comprising poor physical facilities, Low intelligent students comprising poor physical facilities, High intelligent students comprising rich physical facilities and the Low intelligent students comprising rich physical facilities were instructed with ICT mediated instructions in the same way high intelligent students comprising poor physical facilities, low intelligent students comprising poor physical facilities, high intelligent students comprising rich physical facilities and the low intelligent students comprising rich physical facilities were instructed without ICT mediated instructions. Each subgroup was consisting 45 students. In total the sample of the study comprised 360 students.

5.16 DESIGN OF THE STUDY

In the present investigation, 2 x 2 x 2 and 2 x 2 factorial design was employed. The variables studied were, Intelligence, Physical facilities, Instructional system, Interest gain score in Science and Attitude towards instructional media. The first two variables viz., Physical facilities and Intelligence, were used for classification purposes. Each one of the variables was studied at two levels. The variable of physical facilities was studied at two levels viz., Rich and Poor physical facilities. The variable of intelligence was studied at high and low intelligence levels and lastly the variable of instructional system was the treatment variable and also studied at two levels viz., the ICT assisted instructional system and without ICT assisted instructional system. The achievement gain scores were measured by applying the pre and post achievement test in Science.

Independent variables were manipulated in order to see the effect on the achievement gain scores of the students. In this study, ‘Treatment’ acted as an independent variable. The treatment involved the two approaches of teaching viz. ICT mediated instructions and without ICT mediated Instructions (traditional teaching). ICT mediated instructions were imparted to experimental group and the control group was taught through the traditional teaching. Thus, ICT mediated instructions and without
ICT mediated instructions (traditional teaching) were the two independent variables for the study. Achievement gain score in science, interest gain score and attitude towards instructional media were taken as dependent variable, which was measured twice during the course of the study. Once before beginning the experimental treatment that is at the pre-test stage and then second time after completing the experimental treatment that is at the post-test stage. The design of the study was split into three parts as given below:

1) $2 \times 2 \times 2$ factorial design was employed on the achievement gain scores in science with ICT and without ICT mediated classroom instruction in relation to intelligence and physical facilities. In the present design, gain in achievement was studied as dependent variable. Intelligence and physical facilities were studied as independent variables further studied at two levels viz. high and low; rich and poor. The layout of the design is presented below in the Fig. 5.1:

![Figure 5.1: Schematic Layout of 2 x 2 Factorial Design for Achievement Gain Scores in Science](image)

2) $2 \times 2$ factorial design was employed on the interest gain score in science with ICT and without ICT mediated classroom instruction in relation to rich and poor physical facilities. The interest gain scores were studied as dependent variable. Physical facilities and instructional system was studied as independent variables. The layout of the design is presented below in the Fig. 5.2:
2 x 2 factorial design was employed on the scores of various dimensions of attitude towards instructional media. The attitude towards instructional media was studied as dependent variable. Physical facilities and instructional system as independent variables. The layout of the design is presented below in the Fig.5.3:

**FIG.5.2: SCHEMATIC LAYOUT OF 2 X 2 FACTORIAL DESIGN FOR INTEREST GAIN SCORES IN SCIENCE**

**FIG.5.3: SCHEMATIC LAYOUT OF 2 X 2 FACTORIAL DESIGN FOR ATTITUDE GAIN SCORES IN SCIENCE**

### 5.17 PROCEDURE

After the selection of the sample, before starting the treatment pretest of achievement in science subject was administered to both the groups answer sheets were scored to obtain the information regarding their previous knowledge the means of pretest scores of both the groups
were equalized and after allocation of students to treatment groups, the experiment was started. The scale of attitude towards instructional media, the scale of interest in science subject was also administered to the students of both the treatment groups. One group was taught through ICT mediated Instructional System and the second group which was assigned to Teacher directed Instructional System, was taught by the investigator herself.

After the completion of the lessons, post test of achievement in science, the scale of attitude towards instructional media and the scale of interest in science subject and were administered to the students of both the groups and the answer sheets were scored. The procedure of experimentation is given in the figure 5.3:

**FIG. 5.3: PROCESS OF EXPERIMENTATION**

Time limit for attitude towards instructional media was an hour, for the scale of interest in science subject was half an hour and for post test of achievement in science was an hour. Time limit for attitude towards instructional media was an hour, for the scale of interest in science subject was half an hour and for post test of achievement in science was an hour.

5.18 **STATISTICAL TECHNIQUES EMPLOYED**

The following statistical techniques were employed to analyze the data obtained from the experiment:

1. Means and standard deviations of various groups was computed to understand the nature of data
2. $2 \times 2 \times 2$ analysis of variance was employed on the scores of achievement with ICT and without ICT mediated classroom instructional strategies in relation to intelligence and physical facilities.
3. $2 \times 2$ analysis of variance was employed on the scores of interest in science subject with ICT and without ICT mediated classroom instructional strategies in
relation to physical facilities.

4. 2 × 2 analysis of variance was employed on the sores of attitude towards instructional media of the students with ICT and without ICT mediated classroom instructional strategies in relation to physical facilities.

5.19. FINDINGS AND CONCLUSIONS

Underneath findings and conclusions were drawn from the study:

1. The achievement gain scores in science were higher of those students who were instructed via Information and Communication Technology than those who were taught without Information and Communication Technology.

This implies that the students who were taught using ICT method of teaching show significant improvement in their achievement in science than the students who received instruction through the traditional method. It suggests that ICT mediated instructions are found to contribute towards raising the achievement of students in Science.

The result is in agreement with the findings of Kulik, Bangert, and Williams (1983), Christmann et al. (1997) Huppert et al. (1998) Sanjna (2001) Kara (2008) and Muhlis (2009) who found that students who are instructed with different type of educational technologies scored more than traditionally instructed.

2. Achievement gain scores in science of low intelligent students were significantly higher than the high intelligent students. So it can also be concluded that low intelligent students’ are found to be influenced, attracted and interested towards ICT mediated instructions.

It was found that intelligence is a major factor in influencing the academic achievement (Briggs, 1962; Mitchell, 1963, Keller and Rawley 1964). More intelligent children with more capabilities are likely to accomplish more on academic tasks (Torrance, 1965). Academic achievement is significantly and positively related to intelligence, Exceptionally high achievement in final high school examinations correlated significantly with high I.Q (Berman, 1970). More
intelligent children tend to get better grades in school, remain in school longer and have more positive attitude towards instructional media (Tyler 1974).

All the exceeding studies are contradictory to the finding as with ICT mediated instructions the low intelligent group was found to be superior to high intelligent group with respect to achievement gain scores in science. Niedderer et al (1991), Webb (1992), Boohan (1994), Mellar et al. (1994), Worthen, Van Dusen, and Sailor (1994), Williamson and Abraham (1995) Berson(1996), Ferguson, Whitelock, and Littleton (2010) also corroborated the finding, that ICT plays imperative role on intelligence of the students.

3. It was found that students of schools possessing rich physical facilities exposed to ICT scored higher than the students of schools possessing poor physical facilities.

Students with rich physical facilities are already well versed with ICT considering ICT as its part so they performed better as compared to the students having poor physical facilities. Where as students with poor physical facilities achievement gain score was found to be less because they are not versed with the technology prone environment to learn in a better way.

This finding is in parallel with Adesina (1990), Kovol(1991) Wang, Haertel, and Walber, (1993) pointed out that the positive relationship exist between the learner and the facilities endowed to the students. Olubor (1998) revealed that lack of adequate facilities such as textbooks, ill-equipped classrooms, laboratories, workshops and library are among the probable causes of student's poor performance in examinations.

4. There was interaction effect of experimental and control group with different levels of intelligence namely high and low on the means of achievement gain scores in science.

When both high and low intelligent groups are exposed to ICT mediated instructions in science the achievement gain scores of low intelligent group is significantly higher than that of high intelligent group.

When high intelligent group is exposed to ICT mediated instructions in science their achievement gain score is significantly higher than those of high as well as low intelligent groups who are as not exposed to ICT mediated instructions in science.

Traditional method of teaching proves to be less effective as compared to the ICT mediated instructions because with ICT students have more participation and engagement in teaching learning process. Finding is also supported by Cox (2000), Linn and Hsi, (2000) that high intelligent students learn quickly with ICT mediated instruction.

When low intelligent group is exposed to ICT mediated instructions in science their achievement gain score is significantly higher than those high intelligent as well as low intelligent group groups who are not exposed to ICT mediated instructions in science.

Low intelligent students found that topic taught with ICT are easily and more understandable than the without ICT mediated instructions.

When both high and low intelligent groups are not exposed to ICT mediated instructions in science then there is no difference in the achievement gain score of both the low and high intelligent groups. Traditional or without ICT mediated instructions are found to be less effective on both the level of intelligence.

5. The results designate that there is interaction effect of treatment groups viz. experimental and control with different levels of physical facilities namely rich and poor on the means of achievement gain scores in science.

When both rich and poor physical facilities groups are exposed to ICT mediated instructions in science, the achievement gain scores
of rich physical facilities group is significantly higher than that of poor physical facilities group.

- When rich physical facilities group is exposed to ICT mediated instructions in science their achievement gain score is significantly higher than those of rich as well as poor physical facilities groups who are not exposed to ICT mediated instructions in science.

- When poor physical facilities group is exposed to ICT mediated instructions in science their achievement gain score is significantly higher than rich as well as poor physical facilities groups who are not exposed to ICT mediated instructions in science.

- When both rich and poor physical facilities groups are not exposed to ICT mediated instructions in science, the achievement gain scores of rich physical facilities group is significantly higher than that of poor physical facilities group.

The study revealing the same finding are of Becta (2001) Dwyer, et al. (2005) Edyburn (2006) and Kang (2007). It was unveiled that in addition to the educational investments provision of facilities can strongly contribute to increase the academic performance of the students.

6. The interaction effect of possession of physical facilities in a school and intelligence of the students suggest that intelligence level of the students is independent factor and do not matter with the existence and status of physical facilities in the schools.

Intelligence is inbuilt capacity in the individual, so the high intelligent students’ interaction with rich or poor physical facilities availability plays insignificant role in their achievement same is the case for low intelligent students.
7. The finding also advocate that the achievement gain scores in science is not effected when interaction between level of intelligence, level of physical facility and students’ exposer to either ICT mediated instructions or without ICT mediated instruction was seen. Achievement gain scores are equal for high intelligent and low intelligent students at both the levels of physical facilities.

Further it also suggests that the effect of teaching with ICT on the achievement gain scores in science is independent with respect to level of Intelligence at both the levels of physical facilities because intelligence is an independent variable and previous background of students in terms of their physical facilities also plays a vital role.

8. The interest gain scores in science were higher of those students who were instructed via Information and Communication Technology than those who were taught without Information and Communication Technology.

Much interest in science subject has been affected by ICT mediated instructional strategies. The finding also lends credence to Gay and Greschler (1994), Cox (1997), Osborne and Collins (2000) exposed that students may be motivated to learn science because using ICT may give them opportunities to have more control over their own learning by allowing them to study the topics they are interested in and that are relevant to their own lives.

Corroborating this Osborne and Hennessy (2001) reported that ICT enhances the effectiveness of information presentation and also stimulates student’s interest. Earl (2002), Betts’ study (2003) suggested that ICT can motivate students and enhance the quality of learning, McFarlane and Friedler’s study (2003) Dori, Barak and Adir (2003) found that ICT enhanced learning motivates and engage students for learning.

9. Finding also divulges that the interest gain in science is dependent on the level of physical facilities provided to the students. Physical facilities plays a crucial role in the generating the interest in science subject.

Newton and Rogers (2001) after reviewing varied researches inferred that there is considerable evidence that learners are highly motivated when their learning is supported by

10. The findings also substantiate that the interest gain scores through Information and Communication Technology based instructions, Teacher Directed Instructions and status of physical facilities is not effected.

Interest has no clear definition at one extreme it is the causal liking or disliking so the earlier experiences and judgment towards instructional media had played a crucial role so interest formation towards the instructional media was not observed in the students

11. The attitude gain scores towards instructional media were higher of those students who were instructed via Information and Communication Technology than those who were taught without Information and Communication Technology.

Effective efficient and selective usage of ICT to teach a particular topic plays a significant role as the topic taught with ICT made the students to learn in a better way in terms of their achievement gain score.


instructional media were higher of those students who were instructed via Information and Communication Technology

12. Finding also reveals that the change in attitude towards instructional media is not dependent on the level of physical facilities provided to the students.

The existence and status of physical facilities do not play any role in changing students’ attitude towards instructional media because the status and quality and its effective usage of physical facilities provided to the students also plays a significant role.

13. Finding substantiate that the attitude gain scores is not affected via Information and Communication Technology based instructions or Teacher Directed Instruction and status of physical facilities.

As attitude is a specific mental state of an individual and predisposition so the earlier experiences, believe, myths and judgment towards instructional media had played a crucial role so attitude formation towards the instructional media was not observed in the students.

5.20 EDUCATIONAL IMPLICATIONS OF THE FINDINGS

ICT used teaching methods not simply supplement class room teaching, it also extensively improve students’ achievement. It implies that ICT mediated teaching instructions prove to be more advantageous in its effectiveness on achievement than the traditional classroom approach. It appears more practical and is extensively acceptable to students. It also reduces individual differences and facilitates all variety of students to perform in a better way. The educational implications of the findings are:

1) ICT can be used as a surrogate for almost anything in the class e.g. pencil-stylus, book-e book, chalk board-interactive/smart board and many more.
2) It is easier to monitor students in ICT than in the traditional classroom setting.
3) ICT can be used individually, in small or large groups, or by the teachers with the whole class.
4) ICT suggests a new pose for the teacher.
5) The findings of the study also suggest that Instruction with Information and Communication Technology may be used to enhance the attainment of the students in science at the secondary school level.

6) The level of physical facilities in the schools may be raised for developing positive attitude towards instructional media.

7) The low intelligence may be compensated by enriching physical facilities and teaching through Information and Communication Technology.

5. 21 SUGGESTIONS FOR FURTHER STUDY

The studies can further be designed to find answers to the followings questions:

1. How effective can Information and Communication Technology based instructions be in providing individualized learning opportunities, separate from or integrated with conventional forms of instructions.

2. What is the best way to study a student’s involvement with Information and Communication Technology based instructions among remedial, review, drill and practice, tutorial and interactive learning experience?

3. To what extent can creative and original thinking be encouraged in Information and Communication Technology based instructions environment.

4. What will be the effect of ICT on special groups of children such as gifted, the learning disabled and other mildly handicapped students?

5. What are the psychological and physiological effects of the long term or intensive short term use of Information and Communication Technology based instructions on students.

6. What will be the effect of Information and Communication Technology based instructions on teacher training in schools.
7. What effects Information and Communication Technology based instructions will have on school systems design, allocation of resources, and administration.

8. Moreover in the present study, the effectiveness of instruction with Information and Communication Technology was studied only on a segment of science syllabus, more studies may be conducted on larger segments or on complete syllabus.