CHAPTER IV

ANALYSIS OF DATA AND DISCUSSION OF RESULTS

Data once collected should be analyzed with the help of statistical techniques which yield certain results. This process leads researcher to draw a rational conclusion on the research problem. Therefore, the attempt has been made in the present chapter to deal with the results and their corresponding interpretation in accordance to the hypotheses. Tabulated data is analyzed through statistical techniques to yield certain results. The depiction of results and their interpretations is considered to be the most important part of research work as it verifies the hypotheses and eventually leads to final conclusions of study. The data, as such, has no meaning unless analyzed and interpreted by some dependable techniques. Analysis of data means studying the tabulated material in order to determine inherent facts or meanings. It involves in breaking up of the complex factors into simpler parts and putting them in new arrangements for purpose of interpretation. The whole scheme of research methodology revolves around the analytical interpretation of the reality of the methodological approach to deal with the situation is meaningless, unless it moves in the path of allotment of mathematical digits for the purpose of analysis and interpretation. The data was studied from as many angles as possible as to explore the new facts, and findings where analysis requires an alert, flexible and open mind.

Analysis is of bare necessity for the purpose of thinking in terms of significant tables that the data permits, to examine carefully the statement of the problem and earlier analysis and to study the original records of the data, to get away from the data by making various statistical techniques. So, the inherent problem for, statistical calculation is necessary for interpretation purpose which facilitates the stream of analysis of collected raw data and to formulate them in orderly manner and to put them in such a way that on the bases of analysis of data, it reflects a vast area of knowledge. The aim of the present study was to study the Effectiveness of Instructions With and Without Information and Communication Technology in Science Subject at Secondary Stage. Data was collected according to method and procedures mentioned in previous
chapter. After collecting data from 360 students of IX grade, it was analyzed keeping in view the objectives and hypotheses of study.

In the preceding chapters, theoretical rationale of the problem, objectives, hypotheses, description of the tools employed, sample, design of the study and procedure of the experiment etc. were discussed.

The present chapter deals with the statistical analysis of the data, interpretation and discussion of the results. The results of the study have been discussed in the light of the hypotheses and place of findings in the body of the knowledge in the subject concerned.

The following acronyms have been used throughout the chapter.

- **ICT**: Information and Communication Technology
- **PPF**: Poor Physical Facilities
- **RPF**: Rich Physical Facilities
- **PF**: Physical Facilities
- **LI**: Low Intelligent group
- **HI**: High Intelligent group
- **E**: Experimental Group
- **C**: Control Group
- **N**: Number of Students
- **M**: Mean Value
- **D**: Difference of means
- **SE**: Standard Error
- **SD**: Standard Deviation
- **ANOVA**: Analysis of Variance
The data obtained have been analyzed under the following headings:

4.1 2×2×2 ANALYSIS OF VARIANCE ON THE ACHIEVEMENT GAIN SCORES WITH ICT AND WITHOUT ICT MEDIATED CLASSROOM INSTRUCTIONAL STRATEGIES IN RELATION TO INTELLIGENCE AND PHYSICAL FACILITIES.

4.2 2×2 ANALYSIS OF VARIANCE ON THE GAIN SCORES OF INTEREST IN SCIENCE SUBJECT WITH ICT AND WITHOUT ICT MEDIATED CLASSROOM INSTRUCTIONAL STRATEGIES IN RELATION TO PHYSICAL FACILITIES.

4.3 2×2 ANALYSIS OF VARIANCE ON THE GAIN SCORES OF ATTITUDE TOWARDS INSTRUCTIONAL MEDIA OF THE STUDENTS WITH ICT AND WITHOUT ICT MEDIATED CLASSROOM INSTRUCTIONAL STRATEGIES IN RELATION TO PHYSICAL FACILITIES.

4.1 2×2×2 ANALYSIS OF VARIANCE ON THE ACHIEVEMENT GAIN SCORES WITH ICT AND WITHOUT ICT MEDIATED CLASSROOM INSTRUCTIONAL STRATEGIES IN RELATION TO INTELLIGENCE AND PHYSICAL FACILITIES.

The means of sub sample groups of 2×2×2 ANOVA for the achievement gain scores with ICT and without ICT mediated classroom instructional strategies in relation to intelligence and physical facilities have been calculated and same have been recorded in the table 4.1 given below:
### TABLE 4.1
MEANS AND STANDARD DEVIATIONS OF ACHIEVEMENT GAIN SCORES IN SCIENCE WITH RESPECT TO INSTRUCTIONAL STRATEGIES, PHYSICAL FACILITIES AND INTELLIGENCE

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>TREATMENT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EXPERIMENTAL</td>
<td>CONTROL</td>
</tr>
</tbody>
</table>

In order to analyze the variance, the obtained scores were subjected to ANOVA, the results have been presented in the table 4.2 below:
TABLE 4.2
SUMMARY OF ANOVA ON THE ACHIEVEMENT GAIN SCORES IN
SCIENCE WITH RESPECT TO INSTRUCTIONAL STRATEGIES, PHYSICAL
FACILITIES AND INTELLIGENCE

<table>
<thead>
<tr>
<th>SOURCE OF VARIANCE</th>
<th>SS</th>
<th>df</th>
<th>MSS</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAIN EFFECTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TREATMENT (A)</td>
<td>16769.025</td>
<td>1</td>
<td>16769.025</td>
<td>245.581**</td>
</tr>
<tr>
<td>INTELLIGENCE (B)</td>
<td>399.003</td>
<td>1</td>
<td>399.003</td>
<td>5.843*</td>
</tr>
<tr>
<td>PHYSICAL FACILITIES (C)</td>
<td>1043.803</td>
<td>1</td>
<td>1043.803</td>
<td>15.286**</td>
</tr>
<tr>
<td>INTERACTION EFFECTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TREATMENT × INTELLIGENCE (A × B)</td>
<td>918.403</td>
<td>1</td>
<td>918.403</td>
<td>13.450**</td>
</tr>
<tr>
<td>TREATMENT × PHYSICAL FACILITIES (A × C)</td>
<td>535.336</td>
<td>1</td>
<td>535.336</td>
<td>7.840**</td>
</tr>
<tr>
<td>INTELLIGENCE × PHYSICAL FACILITIES (B × C)</td>
<td>177.803</td>
<td>1</td>
<td>177.803</td>
<td>2.604</td>
</tr>
<tr>
<td>TREATMENT X INTELLIGENCE X PHYSICAL FACILITIES (A × B × C)</td>
<td>3.803</td>
<td>1</td>
<td>3.803</td>
<td>.056</td>
</tr>
<tr>
<td>ERROR (WITHIN)</td>
<td>24035.689</td>
<td>352</td>
<td>68.283</td>
<td></td>
</tr>
</tbody>
</table>

*significant at the 0.05 level of confidence
**significant at the 0.01 level of confidence

MAIN EFFECTS
TREATMENT (A)

It may be observed from the table 4.2 that the F-ratio for the difference in achievement gain scores in science between control and experimental group has been found to be significant at the 0.01 level of confidence. Hence, the hypothesis (1) viz. “There is no significant difference in the achievement of the students with ICT and without ICT mediated classroom instructional strategies.” has been rejected. The examination of the corresponding means table 4.1 suggests that ICT mediated instruction group yielded higher achievement gain scores in science than without ICT mediated instruction group.

The evidence from the literature also sustains the findings, as NCET (1994) inferred that ICT, especially in the form of simulations and models, greatly enhance the
learning experience. Worthen, Dusen, and Sailor (1994) established that student-teacher interactions were more student-centered and individualized during computer-based teaching and learning. Sindhi (1996) proved that the teaching through multimedia package is more effective in comparison to conventional method of instruction. Thatte (1998) concluded that AV aids used in teaching was found to be significantly more effective than the programmed learning method and the traditional method in terms of achievement.

Research has suggested that use of computer modelling and simulation increases the chance for learners to understand and investigate complex models and processes very easily when compared with routine laboratory work (Cox 2000; Linn 1999; Mellar et al. 1994). Samal (2000) inferred that both the Education Television (ETV) and School broadcast programmes have their good impact on students’ learning experiences. A mixed type of responses from both students and teachers were recorded about contents and presentations of the ETV and School Broadcast programmes.

Patel (2001) found significant gain through interaction with Computer Assisted Learning Material (CALM) on the topic solar system and Magnet. Tare (2001) explored on the effectiveness of branching type programmed instructional material as diagnostic and remedial tool and concluded that the achievement of the experimental group is high than that of the control group.

Mayer (2001) divulged that digital resources offer a variety of cognitive affordances for science learners. Using a combination of text and pictures together can enhance comprehension and retention.

Finding also corroborated with the other studies, like increase in visual impact and simulations can improve scientific understanding (Huppert et al. and Trindade et al., 2002). It was also authenticated by Chalmers (2002) that ICT has a potential to support and nurture science education. Murphy (2003) concluded that using presentation technologies enable pupils to communicate their work to their peers. Vasanthi and Hema (2003) inferred that there was no significant difference between the mean scores of the pre-test of control group taught through traditional teaching mode and experimental group taught by CAI.
Macwana (2004) unveiled that Computer Assisted Learning Material (CALM) was found effective in terms of achievement and reactions. Sharma (2005) revealed ICT enhanced sensitivity towards environmental concepts and better understanding of the environment.

Kohli (2005) asserted that Computer Assisted Model and Concept Attainment Model were found to be effective in improving the achievement level of students. Rogers (2006) concluded that Modelling software helped in the development of valuable skills for scientific investigation. 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 to science inquiry and understanding.

There is evidence that focusing on specific areas of difficulty in science and addressing those with carefully designed ICT-based simulations can lead to productive learning (Webb, 2008). Nimavathi and Gnanadevan (2008) conceptualized that there was no significant difference between the experimental group and control group in the achievement of science in pre test when instructed with multimedia program.

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

**INTELLIGENCE (B)**

It is apparent from the Table 4.2 that F-ratio for the difference in means of achievement gain scores in science between high and low level of intelligence group has been found to be significant at the 0.05 level of confidence. It specifies that two groups differ significantly in achievement gain scores in science. Hence, the hypothesis (2) viz., “There is no significant difference in the achievement in science of the students
with high intelligence and low intelligence group” has been rejected. Further, the observation of the respective group means from the table 4.1 suggests that low intelligent group was found to be superior to high intelligent group with respect to achievement gain score in science. The declaration suggests that the gain in achievement in science is higher in low intelligence group than high intelligence Group.

The finding also lends credence to the submission of Briggs (1962), Mitchell (1963) and Keller (1964) conclusions that intelligence is a major factor for influencing academic achievement. Torrance (1965) also concluded that more intelligent children with more capabilities are likely to accomplish more on academic tasks. Singh (1965) reported that academic achievement and intelligence are significantly related beyond the 0.01 level of confidence. Lewis (1968) found intelligence and achievement to be highly correlated. Berman (1970) found that expects only high achievement in final high school examination correlated significantly with high I.Q. Tyler (1974) pointed out that more intelligent children tend to get better grade in school, remain in school longer and have more positive attitude towards school. Srivastava (1974) found that intelligence is significantly correlated with academic achievement at 0.01 level of confidence. Seetha (1975) reported that high achievers possessed superior intelligence when compared with low and non-achievers. Contractor (1977) found that I.Q. was positively related with educational attainment. Desai (2004) traced that programmed learning approach proved better than the lecture method and the pupils scoring high in intelligence test also scored high in the post test and pre test and those having low scores on the intelligence test scored low in the post test.

All the exceeding studies are incongruous to the finding as the low intelligent group was found to be performing better in terms of gain in academic achievement in science than to high intelligent group. Probably most of the studies are in terms of how intelligence effects achievement. In this very investigation the finding is in terms of gain in achievement. High Intelligent group normally performs better at Pre-Test Level in comparison to low intelligent group. After treatment the extent of improvement in Low Intelligent Group was higher as the scope of improvement was higher. The finding also lends credence to the submission of Niedderer et. Al. (1991) established that there is consistent evidence from the earliest days of educational ICT that when pupils are
given autonomy to derive and test their own ideas and understanding, their ways of learning change, and there is improvement in their understanding and achievement.

Other findings also corroborate as Shute and Bonar (1986) conjectured that specialized computer programs are found to help in developing inquiry skills and increasing scientific knowledge. Mayer and Anderson (1992) speculated that instructive animation which helped students to perform better than learners who did not experienced any animations. Webb (1992) explored that students learn with logical strategies for categorizing scientific processes when the quality of construction of qualitative models measured with the help of software. Watson (1993) inferred that pupils who had used the computer database package were able to use more advanced data-analysis skills.

Boohan (1994) furnished that by using ICT in science, pupils develop novel strategies for problem solving. Mellar et al. (1994) inferred that with the help of new technologies students has developed new ways of learning reasoning, hypothesizing, representation, building of new knowledge etc. and this has resulted in the development of new mental models of learning. Williamson and Abraham (1995) supported that when acquired the support of atomic and molecular behavior simulators in a chemistry course. It was found that the simulations increased the conceptual understanding by helping students from their own dynamic mental models.

Cheney (1996) established that with the usage of CAI the learner’s knowledge get increased as multiple senses are used for this. Moreover learners have durable knowledge when the text combined with sound, graphics and video. Berson (1996) concluded that by using internet, students can gain access to expansive knowledge links and can broaden their exposure to diverse people and perspectives.

Taylor et al. (1997) divulged that pupils’ cognitive skills got honed when they were taught via modeling method to clear the concept of science. Basically in the initial years science was the main subject in which ICT was used as it was the site of varied discoveries and innovations. Tindall Ford, Chandler, and Sweller (1997) concluded that learners exposed to multimedia instructional activities, performed superior learning.

Hennessy (1999) exposed that the use of ICT changes the relative emphasis of scientific skills and thinking. Tao and Gunstone (1999) revealed that pupils built and complemented each other’s idea and shared common understanding when they
were taught physics for ten weeks in a simulation mode. Further studies pertaining to the finding that ICT based instructions have impact on intelligence is substantiated by Davelsbergh et al., Henderson et al.’s (2000) investigated that use of micro world simulation fetched improvement in the science students regarding recall, higher order thinking skills, usage of scientific language and conclusion drawing skills.

Same way Varied researches were reviewed and carried out over the past two decades by Cox (2000), on the educational use of ICT-based simulations and modelling, and concluded that the main contribution made by ICT was regarding pupils’ understanding of science by the acquisition of investigative skills and improved understanding of scientific concepts and processes. Linn and Hsi (2000) concluded that there were substantial improvements in understanding, problem-solving and inquiry skills in science lessons with ICT.

The study conducted by Chang (2000) also prop up that CAI was superior in promoting students' learning, knowledge and comprehension of concepts as compared to without CAI. Further, studies conducted (Becta, 2001; Leask and Pachler, 1999; Monteith, 1998) also authenticated that ICT used as a tool in science teaching and learning can increase students’ concentration, communication, metacognition, motivation and creativity. Sanjna (2001) conducted a comparative study on the effectiveness of CAI and CMI on Pupil’s achievement in Science, both CAI and CMI were found significantly supportive in achievement of science students. Further it was also reiterated that self concept more involvement of the students was recorded in science.

Some experimental studies have shown that computer simulations can be as effective as the real activity in teaching science concepts and improving scientific understanding across a variety of topics (Huppert, Lomask and Lazarowitz and Trindade, 2002). A study on the effectiveness of computer science instruction, (Permar, 2002) furnished that the achievement of rural area students in computer science practical has been found to be significantly higher than the mean achievement of urban area students. Ardac and Akaygun (2004) established that computer technology help students to understand more abstract ideas and chemical phenomena. Researchers (Kozma, 2005; Webb and Cox, 2004 and Kulik, 2003) 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. Barak and Dori (2005) concluded that increased student’s motivation and their understanding of the subject matter with ICT, Alev (2007) found that computer assisted instruction is more feasible than the traditional approach in terms of cognitive and affective behaviors, Butler and Lumpe (2008) evaluated the use of Scaffolding Software for Science teaching and its relationships with motivation and conceptual understanding and divulged that there is a positive relationship between the same and 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 that increase in the young students' knowledge and understanding of specific science concepts, Korakakis et al. (2009) inferred that students leave the time control of learning and decrease the cognitive load. Ferguson, Whitelock and Littleton (2010) divulged that ICT is very much helpful in communicating and representing ideas in science.

So ICT mediated instructions effects the intelligence level of the students in science and can increase the level of achievement even of low intelligent students.

PHYSICAL FACILITIES (C)

It is experiential from the Table 4.2 that the F- ratio for the difference in means of achievement gain scores in science between students in schools with rich and poor physical facilities has been found to be significant at the 0.01 level of confidence. Hence, the hypothesis (3) viz., “There is no significant difference on the achievement of the students belonging to rich physical facilities schools and students belonging to the schools of poor physical facilities” has been rejected. Further, the observation of the respective means from the table 4.1 suggests that students belonging to the schools with rich physical facilities were found to be better than poor physical facilities group with respect to their achievement gain scores in science.

This finding is in parallel with Leeper et. al. (1968) it was claimed that physical facilities help to enhance the learning of the students. According to Propst (1972), useful resources are to be contacted and used by the planners and the management team,
for quality education. Simpson and Anderson (1981) exposed that equipment perform specific functions while others such as computers perform multiplicity of functions for teaching and learning. Balogun (1982) submitted that no effective science education programme can exist without equipment for teaching. McGuffey (1982) in meta-analysis identified that age of the building, heat conditions, lighting, color and interior painting, acoustics, building maintenance, lab facilities, and school size plays a significant role in student’s achievement. Ogguniyi (1983) divulged that there is a general consensus among science educators that the laboratory occupies a central position in science instruction.

Nyong (1984) have shown that schools with well-equipped laboratories have better results in the school certificate science examinations than those that are having ill-equipped laboratories. A textbook constitutes an important tool for academic achievement. Many writers (Heyneman and Loxley 1982, Walberg 1984, Beeby 1986) have variously highlighted the contribution of textbooks to academic achievement. Nwachukwu (1984) discovered that teaching of Biology practical by teachers would be difficult and with that, students learning experiences would be limited without well equipped lab. Fuller (1985) revealed that collection of books kept for reading in the library is related to performance. Moreover, Fuller (1986) identified a school library as an instructional resource which may significantly influence pupils’ achievement.

According to Ango (1986) laboratory work stimulates learners’ interests as they are made to personally engage in useful scientific activities and experimentation. Akinwumiju and Orimoloye (1987) and Obilade (1989) unveiled that lack of physical facilities would result in sharp decline in the quality of the professional’s and student’s academic achievement in science. Arubayi (1987) found a 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.

In one of the other study on the relationship between instructional facilities and academic performance, Popoola (1989) discovered that well equipped library has positive co relation with the academic achievement. Schools which restrain well equipped library, their students usually acquired high academic achievement.
Ola (1990) opined that a well equipped library is a major facility which enhances good learning and achievement of high educational standard. World Bank publication (1990) citing Mwamwenda and Mwamwenda (1987) reported about survey conducted in 51 primary schools in Botswana and concluded that when adequate facilities pertaining to classroom like desks and books are provided students performed in better ways in the academic tests.

Laboratory provides a platform for the learners to exercise his believes, ideas, statements, theoretical propositions, principles etc. via experimentation (Soyibo, 1990).

Adesina (1990) asserted that adequate provision of school facilities in relation to the students’ population is important because the quality of education that our children receive is affected by the availability or non-availability of physical facilities. Hallak (1990) established that, facilities form one of the potent factors that contribute to academic achievement in the school system. It was further substantiated that their availability, relevance and adequacy also contribute to academic achievement. Lowe (1990) established that the ability to control classroom temperature is crucial to the effective performance of both students and teachers. Kovol (1991) examined the relationship of classroom physical features to the learning environment and found significance for every factor examined.

Oni (1992) conducted a study on the academic performance and recommended textbooks; a significant relationship was established between the same. Gamoran (1992) explored in one of his study that physical facilities, salary of teachers, availability of books in the library and the presence of science laboratory, have significant impact on students’ achievement one of the variables background of the students was also taken into account.

ICT has potential to generate interest, motivate and attract learners. Wang, Haertel, and Walber (1993) conducted an extensive Meta analysis on school learning and substantiated that there exists a positive relationship between the learner and the environment provided for learning. It was also explored that the availability and non availability of computers at home also matters.

Aliyu’s (1993) in one of the finding established that there is no significant difference in the academic achievement of the secondary schools students with or
without adequate instructional facilities. However, it was also corroborated that instructional facilities are very essential for students’ academic achievement for particular subjects.

London (1993) explored that in some of the developing nations, some schools are lacking required physical facilities and there are some cases where facilities are available but are of sub standard quality. It is matter of very much consideration, alarming and crucial that positive relation is found between the quality of facilities and academic achievement. The researchers (Wilcockson, 1994; Lawal 1995 and Ajayi, 1996) identified the significance of facilities in teaching learning process. It was revealed that the absence of educational facilities whether in deteriorating or of poor quality affect the academic performance of the students.

Earthman and Lemasters (1996) have pointed out that students surrounded by a safe, modern and environmentally controlled environment experience a positive effect on their learning. Writing on the situation of our secondary schools, Okoli (1995) reported that laboratories have become shelves of empty bottles of chemicals. Hines (1996) identified building age, windows, floor condition, heat and air conditioning, exterior painting, cleanliness, wall color etc effected students’ achievement.

Chan (1996) concluded that for the improvement of students’ performance their need and instructional entity must be assessed and must be suitably placed and designed. In terms of academic achievement, Soyibo (1996) and corroborating this, Gana (1997) reiterated that students instructed entirely by the laboratory methods had higher attitude scores but lower achievement scores than students instructed entirely by the traditional lecture or textbook mode.

Hsi and Hoadly (1997) concluded that 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.

Fabunmi (1997) asserted that school facilities, when provided will aid teaching learning programme and consequently improve academic achievement of students.

Farombi (1998) argued the saying that “seeing is believing” when usage and effectiveness of lab work for teaching of science was observed it was inferred that students have more understanding when they perform as compared to when they are
only informed. The success of teaching of science basically lies on the facilities dispensed in the labs as well as usage of these facilities.

Johnson (1998) established that instructional materials’ availability and usage is significantly co-related with students’ academic achievement. It was also corroborated that inadequate availability and usage of instructional material significantly effects the students’ achievement.

Libraries are said to be the power house of schools. There are many schools in which there is no library facility (Shodimu, 1998) whereas Ogunseye (1986) noted that total absence of an organized school library will result into low and poor academic performance as well as will not produce self learners.

“Technology is the inescapable companion of the 21st century citizen” (Day and Spoor, 1998) noted that the infusion of technology into the educational program had significant impact on the students and teachers.

Main importance is to be given to the design of the physical facilities for learning as the design of the physical facilities also affects the performance of the students. Blair (1998) observed that a be positive correlation exist between the design of facility and learning. 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. Farombi (1998) reiterated that school libraries may not be effective if the books therein are not adequate and up-to-date as its impact may only be meaningful if the library could be opened to the students always for a considerable length of time in a school day.

Jago and Tanner (1999) unveiled that adequate lighting and appropriate colour choices play a significant role in the achievement of students, affecting their ability to interpret the written word and their attention span. Becta (2001) substantiated that significant differences were found in science attainment of students, between the students of those schools where there was well managed and good quality of ICT resources and in those where there was poorly managed low quality of ICT resources existed.

Yadar (2001) opined that no course in science and mathematics can be considered as complete without including some practical work. It was established in the
study conducted by Day (2001) that flexible space in the classroom allows to have more student-student interactions in participatory learning activities. Classroom size and flexible interiors of the class gives opportunities to teachers to adopt modern educational strategies like project based learning and interactive laboratories, multiple group formation and individualized investigation.

Kang (2007) unveiled that addition to the educational investments like, providing physical facilities can strongly contribute to increase the academic performance of the students. It was acknowledged by Ajayi (2008) ICT based facilities involve audio and video conferencing, CAI, computer based feedback and network operation like internet/websites. Further it was also established that, it must be taken into consideration that the effective use of ICT based methods in classroom processes largely rely on the competency of teachers in using the ICT and availability of ICT resources.

In the discipline like science and mathematics practical work is regarded as of utmost importance (UNESCO, 2008). Different studies conducted by Ayodele (2000) and Vandiver (2011) showed that a positive relationship exists between availability of facilities and student academic performances. Studies of Gamoran (1992) is paradoxical as it avowed that facilities, teachers’ salaries, books in the library and the presence of science laboratory, had little impact on variation in student achievement once student background variables had been taken into account.

From over and above it can be concluded that physical facilities in teaching of science has a positive relation with the academic achievement.

**TWO ORDER INTERACTION**

**TREATMENT AND INTELLIGENCE (A × B)**

It may be observed from the Table 4.2 that the F-Ratio for interaction between treatment and intelligence has been found to be significant at the 0.01 level of confidence. Hence, the data provide sufficient evidence to reject the hypothesis (4) viz., “With and without ICT mediated classroom instructions, achievement gain scores in science is equal in case of high intelligent and low intelligent groups” It suggests that the effect of teaching with ICT on the achievement gain scores in science is not independent of their respective levels of Intelligence.
To analyze subgroups differences due to which F-ratio for the interaction between treatment and intelligence on the achievement gain scores in science was significant; t-ratios have been computed and are presented below in the table 4.4

**TABLE 4.3**
SUMMARY OF t-VALUES OF ACHIEVEMENT GAIN SCORES IN SCIENCE FOR TREATMENT AND INTELLIGENCE

<table>
<thead>
<tr>
<th>Two order interaction</th>
<th>D</th>
<th>SE</th>
<th>t- values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment group × Intelligence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M_E_HI-M_E_LI</td>
<td>5.3</td>
<td>1.48</td>
<td>3.57**</td>
</tr>
<tr>
<td>M_E_HI - M_C_HI</td>
<td>10.46</td>
<td>1.33</td>
<td>7.86**</td>
</tr>
<tr>
<td>M_E_HI- M_C_LI</td>
<td>11.55</td>
<td>1.18</td>
<td>9.80**</td>
</tr>
<tr>
<td>M_E_LI- M_C_HI</td>
<td>15.76</td>
<td>1.35</td>
<td>11.64**</td>
</tr>
<tr>
<td>M_E_LI- M_C_LI</td>
<td>16.85</td>
<td>1.21</td>
<td>13.98**</td>
</tr>
<tr>
<td>M_C_HI- M_C_LI</td>
<td>1.09</td>
<td>1.01</td>
<td>1.07</td>
</tr>
</tbody>
</table>

** Significant at the 0.01 level of confidence

It may be observed from the Table 4.3 that the differences between means of M_E_HI-M_E_LI, M_E_HI - M_C_HI, M_E_HI- M_C_LI and M_E_LI- M_C_HI groups on the achievement gain scores have been found to be significant at the 0.01 level of confidence except the difference between the means of M_C_HI- M_C_LI group. Further the examination of means from the Table 4.1 reveals that:

- 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 M_E_HI- M_E_LI.
- When high intelligent group is exposed to ICT mediated instructions in science their achievement gain score is significantly higher than those of high intelligent as well as low intelligent groups who are not exposed to ICT mediated instructions in science M_E_HI- M_C_HI and M_E_HI- M_C_LI.
- When low intelligent group is exposed to ICT mediated instructions in science their achievement gain score is significantly higher than those high intelligent group as well as low intelligent groups who are not exposed to ICT mediated instructions in science M_E_LI- M_C_HI and M_E_LI- M_C_LI.
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 $M_{C-HI} - M_{C-LI}$.

The results indicate that the two treatment groups experimental and control with different levels of intelligence namely high and low groups differ significantly on the means of achievement gain scores in science. The same has been depicted with the help of interaction graph in the Fig.4.1 given below:

**FIG.4.1: INTERACTION BETWEEN INTELLIGENCE LEVEL AND TREATMENT ON THE ACHIEVEMENT GAIN SCORES IN SCIENCE**

Finding is also supported by Joshi and Mahapatra (1997) who submitted that adjusted mean scores on overall reasoning ability in science and its aspects of the students taught through developed software package differed significantly from those taught through traditional method when intelligence was taken as a co-variate.

**TREATMENT AND PHYSICAL FACILITIES (A × C)**

It may be observed from the Table 4.2 that the F-Ratio for the interaction between treatment and physical facilities has been found to be significant at the 0.05 level of confidence. Hence, the data provide sufficient evidence to reject the hypothesis (5) viz., “With ICT and without ICT mediated classroom instruction, achievement in science is comparable at the two levels of physical facilities” has been rejected. It
suggests that the effect of teaching with ICT on the achievement gain scores in science is not independent of their respective levels of school physical facilities.

To analyze subgroups differences due to which F-ratio for the interaction between treatment and physical facilities on the achievement gain scores in science was significant t-ratios have been computed and are presented below in the table 4.4:

**TABLE 4.4**

**SUMMARY OF t-VALUES OF ACHIEVEMENT GAIN SCORES IN SCIENCE FOR TREATMENT AND PHYSICAL FACILITIES**

<table>
<thead>
<tr>
<th>SOURCES OF VARIANCE</th>
<th>D</th>
<th>SE</th>
<th>t- values</th>
</tr>
</thead>
<tbody>
<tr>
<td>( M_{E \cdot RPF} - M_{E \cdot PPF} )</td>
<td>0.97</td>
<td>1.53</td>
<td>0.63**</td>
</tr>
<tr>
<td>( M_{E \cdot RPF} - M_{C \cdot RPF} )</td>
<td>11.21</td>
<td>1.31</td>
<td>8.57**</td>
</tr>
<tr>
<td>( M_{E \cdot PPF} - M_{C \cdot PPF} )</td>
<td>17.06</td>
<td>1.20</td>
<td>14.16**</td>
</tr>
<tr>
<td>( M_{E \cdot PPF} \cdot M_{C \cdot PPF} )</td>
<td>16.09</td>
<td>1.22</td>
<td>13.23**</td>
</tr>
<tr>
<td>( M_{E \cdot PPF} \cdot M_{C \cdot RPF} )</td>
<td>10.24</td>
<td>1.32</td>
<td>7.77**</td>
</tr>
<tr>
<td>( M_{C \cdot PPF} \cdot M_{C \cdot PPF} )</td>
<td>5.85</td>
<td>0.91</td>
<td>6.35**</td>
</tr>
</tbody>
</table>

** Significant at the 0.01 level of confidence

It may be observed from the Table 4.4 that the differences between means of \( M_{E \cdot RPF} - M_{E \cdot PPF} \), \( M_{E \cdot RPF} - M_{C \cdot RPF} \), \( M_{E \cdot RPF} - M_{C \cdot PPF} \), \( M_{E \cdot PPF} \cdot M_{C \cdot RPF} \), and \( M_{C \cdot PPF} \cdot M_{C \cdot PPF} \) groups for achievement gain scores have been found to be significant at the 0.01 level of confidence. Further examination of means from the Table 4.1 reveals that:

- When both rich and poor physical facilities school students are exposed to ICT mediated instructions in science, the achievement gain scores of rich physical facilities school students is significantly higher than that of poor physical facilities school students \( (M_{E \cdot RPF} - M_{E \cdot PPF}) \).

- When rich physical facilities school students 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 school students who are not exposed to ICT mediated instructions in science \( (M_{E \cdot RPF} - M_{C \cdot RPF}) \) and \( (M_{E \cdot RPF} - M_{C \cdot PPF}) \).

- When poor physical facilities school students are exposed to ICT mediated instructions in science their achievement gain score is significantly higher than rich
as well as poor physical facilities school students who are not exposed to ICT mediated instructions in science (M_{E:PPF}, M_{C:RPF}) and (M_{E:PPF}, M_{C:RPF}).

- When both rich and poor physical facilities school students are not exposed to ICT mediated instructions in science, the achievement gain scores of rich physical facilities school students is significantly higher than that of poor physical facilities group (M_{C:RPF}, M_{C:PPF}).

The results indicate that the two treatment groups experimental and control with different levels of physical facilities namely rich and poor groups differ significantly on the means of achievement gain scores in science. The same has been depicted with the help of interaction graph in the Fig. 4.2 given below:

![Fig. 4.2: Interaction between physical facilities and treatment on the achievement gain scores in science](image)

**FIG. 4.2: INTERACTION BETWEEN PHYSICAL FACILITIES AND TREATMENT ON THE ACHIEVEMENT GAIN SCORES IN SCIENCE**

**INTELLIGENCE AND PHYSICAL FACILITIES (B × C)**

It may be observed from the Table 4.2 that the F-Ratio for interaction between Intelligence and physical facilities has not been found to be significant even at the 0.05 level of confidence. Hence, the data did not provide sufficient evidence to reject the hypothesis (6) viz., “There is no significant difference in the achievement of high and low intelligent students at both the levels of physical facilities” has not been rejected. Further the mean of table 4.1 suggests that the intelligence is independent at the levels of physical facilities for achievement gain scores in science.
THREE ORDER INTERACTION
TREATMENT, INTELLIGENCE AND PHYSICAL FACILITIES (A × B × C)

It may be observed from the Table 4.2 that the F-Ratio for the interaction between treatment, Intelligence and physical facilities has not been found to be significant even at the 0.05 level of confidence. Hence, the data did not provide sufficient evidence to reject the hypothesis (7) viz., “With ICT and without ICT mediated classroom instruction achievement scores are equal for high intelligent and low intelligent students at both the levels of physical facilities” has not been rejected. It suggests that the effect of teaching with ICT on the achievement gain scores in science is independent of their respective levels of Intelligence at the levels of physical facilities for achievement gain scores in science.

4.2 2 × 2 ANALYSIS OF VARIANCE ON THE GAIN SCORES OF INTEREST IN SCIENCE WITH ICT AND WITHOUT ICT MEDIATED CLASSROOM INSTRUCTIONAL STRATEGIES IN RELATION TO PHYSICAL FACILITIES

The Means and SDs of subgroups for 2 × 2 design for interest gain scores have been computed and are presented in the table 4.5 below:

TABLE 4.5
MEANS AND STANDARD DEVIATIONS OF INTEREST GAIN SCORES IN SCIENCE WITH RESPECT TO INSTRUCTIONAL STRATEGIES AND PHYSICAL FACILITIES

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>TREATMENT EXPERIMENTAL GROUP</th>
<th>TREATMENT CONTROL GROUP</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCHOOLS WITH RICH PHYSICAL FACILITIES</td>
<td>M₁=16.41, S.D₁=8.65, N₁=90</td>
<td>M₂=9.1, S.D₂=5.11, N₂=90</td>
<td>Mₑ=12.75, S.Dₑ=7.79, Nₑ=180</td>
</tr>
<tr>
<td>SCHOOLS WITH POOR PHYSICAL FACILITIES</td>
<td>M₃=12.73, S.D₃=6.47, N₃=90</td>
<td>M₄=7.32, S.D₄=4.94, N₄=90</td>
<td>Mₚₑ=10.03, S.Dₚₑ=6.36, Nₚₑ=180</td>
</tr>
<tr>
<td>TOTAL</td>
<td>Mₑ=14.57, S.Dₑ=7.84, Nₑ=180</td>
<td>Mₙₑ=8.2, S.Dₙₑ=5.1, Nₙₑ=180</td>
<td>Mₑ₋ₙₑ=11.4, S.Dₑ₋ₙₑ=7.33, Nₑ₋ₙₑ=360</td>
</tr>
</tbody>
</table>
In order to analyze variance in interest gain scores, the obtained scores were subjected to ANOVA. The results have been computed and recorded below in the table 4.6:

**TABLE 4.6**
**SUMMARY OF ANOVA ON THE INTEREST GAIN SCORES IN SCIENCE WITH RESPECT TO INSTRUCTIONAL STRATEGIES AND PHYSICAL FACILITIES**

<table>
<thead>
<tr>
<th>SOURCE OF VARIANCE</th>
<th>SS</th>
<th>df</th>
<th>MSS</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (A)</td>
<td>3641.73</td>
<td>1</td>
<td>3641.73</td>
<td>87.074**</td>
</tr>
<tr>
<td>Physical Facilities (B)</td>
<td>669.669</td>
<td>1</td>
<td>669.669</td>
<td>16.01**</td>
</tr>
<tr>
<td>A × B</td>
<td>81.23</td>
<td>1</td>
<td>81.23</td>
<td>1.942</td>
</tr>
<tr>
<td>Error</td>
<td>14889.144</td>
<td>356</td>
<td>41.82</td>
<td></td>
</tr>
</tbody>
</table>

** Significant at the 0.01 level of confidence

**MAIN EFFECTS**
**TREATMENT (A)**

Glance at the Table 4.6 explore that the F-ratio for the difference between means of the control and experimental groups for the interest gain scores in science has been found to be significant at the 0.01 level of confidence. Hence, the hypothesis (8) viz., “There is no significant difference in the interest in science with ICT and without ICT mediated classroom instructional strategies” has been rejected. The analysis of the mean table 4.5 indicate that the mean interest gain scores of students between control and experimental groups differ significantly, the experimental group students have scored significantly higher in their interest gain scores than the control group. Much interest in science subject has been affected by ICT mediated instructional strategies. The finding also lends credence to Gay and Greschler (1994) did a comparison between immersive groups using Virtual Learning Environment (VLE) and non-immersive treatment groups specially designed to teach children about the structure and function of cells, the immersive subjects demonstrated better retention of symbolic information, and further more interest was observed in the students who were provided Virtual Learning Environment (VLE) experience.
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. 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.

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. Osborne and Hennessy (2001) reported that ICT enhances the effectiveness of information presentation and also stimulates student’s interest.

Earl (2002) 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 where its use is tailored to lesson objectives and the specific needs of the students.

McFarlane and Friedler (2003) studied the motivational effect of portable computers and established a positive effect on student’s motivation. However, despite of teachers’ perceptions about the motivational effect of ICT alone cannot sustain the motivation to use computers. Rather it is the teacher who use and integrate ICT into the curriculum that plays a pivotal role in keeping students motivated. Dori, Barak and Adir (2003) found that ICT enhanced learning motivates and engage students for learning.

Rosas, et al. (2003) authenticated that computer games make learning meaningful and create a learning culture that is more in correspondence with student’s interests. Researcher had found that ICT tools effectively promote pupils’ interest in learning science. Further it was established that ICT involving sight, sound, movement or animations can maximizes pupil’s interest.

The research done by Kajee (2004) found that researchers based on ICT believe that ICT would harmonize the teaching and learning environment as well as promote equal participation among the students.
Further studies are also sustained by Trimmel and Bachman (2004) studied the impact of introducing laptops into classrooms and one of their conclusions was that information technology has a positive impact on school attendance and learner’s interest. Sefyrin (2005) and Jackson, Ervin, Gardner, and Schmitt (2001) divulged that competence in ICT could be seen as a question of interest in ICT, where men are more interested in ICT than women. Denby and Campbell (2005) recognized that, with ICT students are more engaged in activities, they show increased interest and longer attention span. Korakakis et. al. (2009) examined the use of specific types of visualization (3D illustration, 3D animation, and interactive 3D animation) combined with narration and text, contributing to the learning process of students in science courses. The results indicated that multimedia applications with interactive 3D animations increased the interest of students and made the material more appealing to them.

Students who are taught with ICT mediated instruction their interest gain score in science was considerably high as compared to without ICT mediated instruction students.

**PHYSICAL FACILITIES (B)**

It may be observed from the Table 4.6 that the F-Ratio for the difference between rich physical facilities and rich physical facilities school students on the scores of the gain interest has been found to be significant at the 0.01 level of confidence. Hence, the data provide sufficient evidence to reject the hypothesis (9) viz., “There is no significant difference in the interest in science between the students belonging to rich physical facilities school and students belonging to poor physical facilities school” has been rejected. Further, the examination of the means table 4.5 suggests that school students with rich physical facilities have significantly higher interest gain scores than the students with poor physical facilities.

**TWO ORDER INTERACTIONS**

**TREATMENT AND PHYSICAL FACILITIES (A×B)**

It may be observed from the Table.4.6 that the F-Ratio for the interaction
between treatment and physical facilities has not been found to be significant even at the 0.05 level of confidence. Hence, the data did not provide sufficient evidence to reject the hypothesis (10) viz., “Difference in interest in science with ICT and without ICT mediated instruction is not qualified at the two levels of Physical facilities” has not been rejected. It suggests that the effect of instructional treatment on the interest in science is independent of their respective physical facilities.

The results indicate that the two treatment groups experimental and control with different levels of school physical facilities namely rich and poor groups differ significantly on the means of interest gain scores in science. The same has been depicted with the help of interaction graph in the Fig.4.3 given below:

![Fig. 4.3: Interaction between Physical Facilities and Treatment on the Interest Gain Scores in Science](image)

**FIG. 4.3:** INTERACTION BETWEEN PHYSICAL FACILITIES AND TREATMENT ON THE INTEREST GAIN SCORES IN SCIENCE

4.3 2 × 2 ANALYSIS OF VARIANCE ON THE SCORES OF ATTITUDE TOWARDS INSTRUCTIONAL MEDIA OF THE STUDENTS WITH ICT AND WITHOUT ICT MEDIATED CLASSROOM INSTRUCTIONAL STRATEGIES IN RELATION TO PHYSICAL FACILITIES.

The Means and SDs of subgroups for 2×2 design for attitude gain scores have been calculated and are presented below in the table 4.7:
TABLE 4.7
MEANS AND STANDARD DEVIATIONS OF ATTITUDE GAIN SCORES IN SCIENCE WITH RESPECT TO INSTRUCTIONAL STRATEGIES AND PHYSICAL FACILITIES

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>TREATMENT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EXPERIMENTAL GROUP</td>
<td>CONTROL GROUP</td>
</tr>
<tr>
<td>SCHOOLS WITH RICH PHYSICAL FACILITIES</td>
<td>M₁ = 28.83 S.D₁ = 19.4 N₁ = 90</td>
<td>M₂ = 20.29 S.D₂ = 17.04 N₂ = 90</td>
</tr>
<tr>
<td>TOTAL</td>
<td>Mₑ = 27.11 S.Dₑ = 17.81 Nₑ = 180</td>
<td>Mₑ = 21.63 S.Dₑ = 15.88 Nₑ = 180</td>
</tr>
</tbody>
</table>

In order to analyze variance in attitude gain scores, the obtained scores were subjected to ANOVA. The results have been recorded below in the table 4.8:

TABLE 4.8
SUMMARY OF ANOVA ON THE INTEREST GAIN SCORES IN SCIENCE WITH RESPECT TO INSTRUCTIONAL STRATEGIES AND PHYSICAL FACILITIES

<table>
<thead>
<tr>
<th>SOURCE OF VARIANCE</th>
<th>SS</th>
<th>df</th>
<th>MSS</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (A)</td>
<td>2695.07</td>
<td>1</td>
<td>2695.07</td>
<td>9.50**</td>
</tr>
<tr>
<td>Physical Facilities (B)</td>
<td>12.47</td>
<td>1</td>
<td>12.47</td>
<td>0.04</td>
</tr>
<tr>
<td>Treatment × Physical Facilities (A × B)</td>
<td>849.47</td>
<td>1</td>
<td>849.47</td>
<td>2.99</td>
</tr>
<tr>
<td>Error</td>
<td>101025.37</td>
<td>356</td>
<td>283.78</td>
<td></td>
</tr>
</tbody>
</table>

**significant at the 0.01 level of confidence

MAIN EFFECTS
TREATMENT (A)

It may be observed from the Table 4.8 that the F-ratio for the difference between means of the control and experimental groups on the score of attitude towards
instructional media has been found to be significant at the 0.01 level of confidence. Hence, the hypothesis (11) viz. “There is no significant difference on the attitude towards instructional media of the student with ICT and without ICT mediated classroom instructional strategies” has been rejected. This indicates that the mean values of the attitude towards instructional media of students of control and experimental groups differ significantly. Further the analysis of means table 4.7 reveals that there is significant high gain in attitude towards instructional media in experimental group than the control group. Meaning thereby, attitude towards instructional media improves significantly better when taught through ICT.

Many studies supported with the findings as Blanchard (1975) found no pattern of relationship between achievement and attitudinal data. Breckler (1984) viewed attitude as a hypothetical response to an object and regarded its affect, on cognitive behaviour in which attitude was expressed in observable responses.

The earliest research that examined attitudes toward computers was conducted by Lee (1970) and two dimensions of attitude were identified: (i) the beliefs in the computer as a beneficial tool and (ii) beliefs that the computers are autonomous entities.

When an individual has both affective and conative influenced response for some individual, event or object with a negative or positive state of mind or sentiment is called attitude. Attitude is learned, acquired, developed or organized with experience (Ajzen and Fishbein, 1980).

Society views computers as highly technical and is a part of a male domain (Campbell and Mc Gabe, 1984). Haunsel and Hill (1989) found out that pupils using computers had more positive attitude towards biology and natural sciences than pupils who were educated by traditional styles. Several studies found gender differences in attitudes toward ICT.

Price (1989) conducted an attitude survey and observed that student progress in a middle school science project where CAI was used as a tutorial and research tool. It was concluded that the use of CAI in this way encouraged an overall improvement in motivation and interest in the science research project. Winfred (1991) quoted in his study that initial computer experiences may play role in the formation of computer attitude. Park (1993) in his study Co-operative Learning and Individual Learning with
Computer Assisted Instruction in an introductory University level Chemistry course established that the majority of the students in the university level showed positive cooperation on group work and positive attitude toward using computers in the classroom.

It was generalized by Kaplan (1994) that when personal computers (PCs) are used by female they find that computer using is fun. Male, on the other hand use the computer to get mastery over the commands they want to own that type of computers which have special features like voice recognition and features that extend their senses. Basically men wanted to command the machines and women to be able to use the machines.

Younger pupils, boys and girls have more positive attitudes toward computers than the older (Comber, Colley, Hargreaves, and Dorn, 1997; Laguna and Babcock, 1997). Yu (1998) found that computer assisted instruction increase students’ performance and attitudes towards science. Winter, Chudoba, and Gutek (1998) found a correlation between attitude toward technology and number of hours spent in using computer.

Brosnan (1998) explored that 6 to 11 years old boys had more positive attitudes towards computers than girls. The successful integration of computers in educational environments depends, to a great extent, on teachers’ and students’ attitudes towards the computers (Selwyn, 1999).

Researchers intended to find out the attitude of females towards usage of ICT. Ray, Sormunen, and Harris (1999) it was established that women have positive attitude towards the use of computers than men. Further it was also asserted by females that ICT increase productivity by simplifying the tasks. Women were found to be more comfortable in technology usage.

Pupils’ attitudes towards computer exercises were highly positive (Ogilvie, Trusk and Blue, 1999) and additionally, most of students worked at their own speed and with that their computer literacy got improved.

McKinnon, Nolan, and Sinclair (2000) found that students in their experimental group became enthusiastic computer users and performed significantly better compared to the ones in the non-experimental group. 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. Computer attitude evaluation usually encompasses statements that examine user’s interaction with computer hardware, computer software, other persons relating to computers, and activities that involve computer use.

Rothman (2000) in his study examined the impact of computer-based science instruction on content achievement, attitude about learning, critical inquiry skills and level of cognition. Study concluded that nontraditional, computer-based instruction in science significantly improved the students’ attitudes toward science learning.

Bozionelos (2001) exposed that there are many studies, where it is reported, that older students have more positive attitudes to computers than the younger.

It is believed all over the world that technology is more appreciated by the boys as they are seen more concerned and connected towards it. It is also practiced by the society that technological knowledge is more encouraged for boys as compared to girls (Clegg, 2001; Facer, Sutherland and Furlong, 2001).

Cooper and Brna (2002) reported evidence that pleasure and variety keep students engaged and motivated. Further it was concluded that if ICT is carefully planned and pedagogically implemented, it can support relationships and motivation that in turn support long-lasting engagement and learning.

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.

Lim and Tay (2003) unveiled that by using the Virtual Learning Environment students were not only engaged in the learning tasks, but also willing to spend more time on learning and hence developed a positive attitude towards learning. Additionally, they could also develop other skills like communication, social and higher order thinking.

Dorup (2004) found males had more access to computers at home, and held more favorable attitudes towards the use of computers in their studies as compared to females.
Passey, Rogers, McHugh, Allaway (2004) conducted a study on the motivational effect of ICT on pupils to investigate the effects of ICT on pupils’ motivation. This study has found that ICT positively impacted on motivation, particularly in relation to engagement, research, writing and editing and presentation. Pupils reported that the Internet, interactive whiteboards, writing and publishing software, and presentational software were the most useful. There was also evidence that ICT positively influenced attitudes towards school work and school behaviour.

A study Effectiveness of CAI in Biology at secondary school level (Pandian, 2004) made public that the CAI students demonstrated significantly higher achievement gains in biology. The variables self-esteem, attitude towards Biology and computer were also influenced by the CAI.

The study of Palaigeorgiou, Siozos, Konstantakis, and Tsoukalas (2005) confirmed that both men and women had similar engagement with computers and had concerns for the future effects of continuous computer use, but women were more anxious about hardware usage, and judged the consequences of computers in personal and social life.

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.

Boys use computers more for playing and recreational purposes, they are more interested in hardware, and they take on more independent challenges for learning computers and ICT than girls do (Papastergiou and Solomonidou, 2005; Hakkarainen et al., 2000).

Mizrachi and Shoham (2004) and Shashaani (1997) pointed out, that more interest was shown by boys in the usage of computers as compared to girls and more over boys have better ICT and computer skills. In relation to attitude towards computer it was found that boys use computers more in their leisure time, and their attitudes toward computers are more positive than the attitudes of girls.

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. Female have negative attitude towards computer (Bebetsos and Antoniou, 2008), they are often less computer literate than males and this may result in different ways of using the computer.

From the exceeding it can be corroborated that when ICT is used for imparting instructions there is change in students ‘attitude and they spent more time in learning. Further studies are also revealing that there is gender difference in the usage of computer.

**PHYSICAL FACILITIES (B)**

It may be studied from the table 4.8 that F- ratio for the difference for means of attitude towards instructional media between rich and poor physical facilities has not been found to be significant even at the 0.05 level of the confidence. Hence, the hypothesis (12) viz. “There is no significant difference in the attitude towards instructional media of the students belonging to the schools with rich physical facilities and poor physical facilities” has been accepted. This indicates that the means of the attitude towards instructional media of students belonging to the schools rich and poor physical facilities do not differ significantly.

**TREATMENT × PHYSICAL FACILITIES (A×B)**

It may be observed from the table 4.8 that the F-Ratio for the interaction between treatment and physical facilities has not been found to be significant even at the 0.05 level of confidence. Hence, the data did not provide sufficient evidence to reject the hypothesis (13) viz., “Difference in the attitude towards instructional media with ICT and without ICT mediated classroom instruction is not qualified by the levels of physical facilities” has not been rejected. It suggests that the effect of teaching with ICT and without ICT on the attitude towards instructional media is dependent of their respective Physical facilities.