CHAPTER – V

SUMMARY AND CONCLUSION

5.1 INTRODUCTION

This chapter presents a brief summary of study, statement of the problem, objectives, methodology and the major findings. It also discusses the implications of the study and the suggestions for further research. Any new discovery or intervention is beneficial to mankind only when brought to everyone's notice. Every research study is expected to add something to the existing amount of knowledge. In the present study, data were collected and were subjected to different statistical analyses and the results were interpreted. The interpretation is restricted to the sample used in the study. It is obvious that the significance of any research finding lies in the proper interpretation of the results.

The present chapter describes in brief, the design of the study, the statistical analysis of the data collected, and the researcher's interpretation of the data. There are suggestions for further investigations using different samples, different tools and with other variables. The present study being a nascent one offers scope for several further investigations.

5.2 NEED AND SIGNIFICANCE OF THE STUDY

The society is fast changing with technological advancements. Special children cannot be left behind. Mastery over the content matter alone is not sufficient. The academics should have a sound knowledge in various educational technologies available for the people with disabilities and the necessary skills in
using them in the teaching – learning process. The researcher analyzed various technologies used for visually challenged students and their limitations. In Tamil Nadu most of the schools use Braille. Very few schools use some other technologies; in particular JAWS for teaching visually challenged students.

One study found that Braille readers may be better able to process oral information than large print readers (Brothers, 1971). In two similar studies conducted at various times, Miller found that poor Braille quality can slow down reading rate and accuracy (Miller, 1977, 1987). This indicates that mere usage of Braille alone cannot guarantee quality in the education of visually challenged students. Shapiro (1993) suggested that part of the literacy issue is related to a growing reliance on technology. The National Reading Panel (2000) identified speech access, the use of hypertext, and the use of word processors as promising for the development of literacy. Two studies found that training in and use of low vision devices increases oral comprehension reading speed (oral and silent), and the amount of reading accomplished (Corn, Wall, & Bell, 2001; Smith & Erin, 2002). A study was conducted to find out the use of Palm Pilots in a sixth-grade classroom. Fifty percent felt that the handhelds were interesting and motivating. All participants remained enthusiastic about using the Palm Pilots, while many teachers were concerned about managing the new technology in the classroom setting. Bauer, Anne M and Ulrich, Mary E. (2002). Another study reports that 97% of kindergarten students and 98% of first graders with disabilities use computers (Rathbun & West, 2003). It also reports that in the classroom, children use computers most frequently to read, write, spell, learn math, and for fun. These studies indicate that ICTs are very much useful for teaching visually challenged
students. But, most of the studies are from foreign countries. So far very few studies had been conducted to find out the usage or effectiveness of the ICT in the teaching learning process of visually challenged students. Hence, the researcher feels the need of this study to find out the effectiveness of ICT in the education of visually challenged children.

5.3 STATEMENT OF THE PROBLEM

A major benefit of using ICT to teach visually challenged students is that it is possible to reach many students in a short time in an effective way. These technologies can be used to deliver instruction and information to these special children without much problems. This will benefit learners enormously. These technologies are useful to students in remote places also, as ICT access improves productivity and quality. Finally, as ICT reduces the need for travel, its use can reduce the burden of the visually challenged students to travel long distances for getting information. Studies show that ICT is a part of normal daily interaction for young students in foreign countries. Most of these visually challenged students are members of Social Media also. They are ‘always on’ and connected to geographically-dispersed friendship groups. The potential of ICT is already being demonstrated in hundreds of projects at higher studies. They have transformed the delivery of education. They lead to new types of educational systems. They heighten both the effects and expectations of the advent of new pedagogies.

Information and Communication Technologies are the most effective and efficient strategy in teaching - learning process. So far very few studies have been conducted to find out the effectiveness of ICT in the education of visually
challenged children in India. Hence the present study has been undertaken by the investigator and entitled as “EFFECTIVENESS OF ICT IN THE EDUCATION OF VISUALLY CHALLENGED CHILDREN”.

5.4 OPERATIONAL DEFINITIONS OF TERMS

The following are the operational definitions of various terms used in the present investigation:

**Effectiveness**: It is the degree to which something is successful in producing a desired result. The effectiveness of an experimental treatment is gauged to the extent students involved in the experiment achieve, whether it be in cognitive, conative or psychomotor domains.

**Information and Communication Technology (ICT)**: They are defined as a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information. These technologies include computers, Internet, broadcasting technologies (radio and television), and telephony.

**Achievement**: Achievement may be defined as any desirable learning that is observed in the student. It is a value judgement.

**Visually Challenged Children**: Children having greatly reduced vision. Anyone with reduced vision not corrected by spectacles or contact lenses is called visually challenged.

5.5 OBJECTIVES OF THE STUDY

The objectives of the study are:
1. To identify a suitable ICT enabled method to teach visually challenged students at secondary level.

2. To identify content in Environmental Science suitable to teach secondary class students in Braille method and ICT enabled method.

3. To examine whether there exist any significant differences between the mean scores of (a) Pre-test and (b) Gain on Achievement in Environmental Science of the Experimental and Control groups.

4. To examine whether there exist any significant differences between Mean Gain Scores on Achievement in Environmental Science of the Subgroups of the Experimental group students with respect to the categorical variables.

5. To examine whether there exist any significant differences between Mean Gain Scores on Achievement in Environmental Science of the Subgroups of the Control group students with respect to the categorical variables.

6. To examine whether there exist any association between Mean Gain Scores on Achievement in Environmental Science of the sub groups of the Experimental group with respect to the categorical variables.

7. To examine whether there exist any association between Mean Gain Scores on Achievement in Environmental Science of the sub groups of the Control group with respect to the categorical variables.

5.6 HYPOTHESES OF THE STUDY

The investigator formulated the following hypotheses for the present study:
1. There exist no significant differences between the mean scores of (a) Pre-test and (b) Gain in Achievement in Environmental Science of the Experimental and Control groups.

2. There exist no significant differences between **Mean Gain Scores** on Achievement in Environmental Science of the Subgroups of the Experimental group students w.r.t the following categorical variables: (a) **Age Group** (b) **Gender** (c) **Locality** (d) **School Type** (e) **Socio – Economic Status** (f) **Religion** (g) **Community** (h) **Nature of blindness** (i) **Type of blindness** and (j) **Technology Awareness**.

3. There exist no significant differences between **Mean Gain Scores** on Achievement in Environmental Science of the Subgroups of the Control group students w.r.t the following categorical variables: (a) **Age Group** (b) **Gender** (c) **Locality** (d) **School Type** (e) **Socio – Economic Status** (f) **Religion** (g) **Community** (h) **Nature of blindness** and (i) **Type of blindness**.

4. There exist no significant association between **Mean Gain Scores** on Achievement in Environmental Science of the subgroups of the Experimental group w.r.t the following categorical variables: (a) **Age Group** (b) **Gender** (c) **Locality** (d) **School Type** (e) **Socio – Economic Status** (f) **Religion** (g) **Community** (h) **Nature of blindness** (i) **Type of blindness** and (j) **Technology Awareness**.

5. There exist no significant association between **Mean Gain Scores** on Achievement in Environmental Science of the subgroups of the Control
group w.r.t the following categorical variables: (a) **Age Group** (b) **Gender** (c) **Locality** (d) **School Type** (e) **Socio – Economic Status** (f) **Religion** (g) **Community** (h) **Nature of blindness** and (i) **Type of blindness**.

### 5.7 LIMITATIONS AND DELIMITATIONS OF THE STUDY

1. The present study deals with only Achievement in Environmental Science. As far as the categorical variables are concerned, Age Group, Gender, Locality, School Type, Socio – Economic Status, Religion, Community, Nature of blindness, Type of blindness and ICT awareness are considered. The space and time constraints forced the researcher to limit the variables into a few.

2. The survey selects only 144 visually challenged students studying in various schools for the blind in Tamil Nadu as the sample. The number of schools for the visually challenged is very few in number. They are also not distributed uniformly throughout Tamil Nadu. Moreover, time, space and financial constraint, the difficulties faced by the researcher in obtaining permission from the management, travel problems etc made the sample limited only to 144.

3. With regard to technology, the researcher used JAWS only for teaching Environmental Science. There are numerous technologies available for the visually challenged students helping them in various ways. But, in reality only very few technologies are used in the teaching-learning process. JAWS is one of the most popular technologies used by the visually challenged.
students. Hence the researcher took it for his study. The future researchers may take up other technologies such as GPS, Social networking, etc for the teaching-learning process of visually challenged students.

4. The present study has compared the control group students studying with Braille method with the experimental group students studying with JAWS. The future researchers may take two ICT enabled methods and compare their relative effectiveness rather than taking Braille for comparison.

5. The present study has taken Environmental Science for finding the effectiveness of ICT enabled learning of the visually challenged students. As far as visually challenged students are concerned, taking subjects such as Science, Maths, Computer Science, etc for the research purpose needs more expertise in Special Education. Teaching of Science and Maths need many other high end technologies as well. On the other hand, Environmental Science is somewhat common for the secondary classes (IX and X). It is easy to handle and there is a plenty of real life examples available in this subject. This has limited the researcher to take up Environmental Science for the present study.

5.8 DESIGN OF THE STUDY AND METHOD OF INVESTIGATION

After selecting the problem, framing the objectives and reviewing the related literature, the following steps were taken by the researcher:

1. Clearly defining the word “Information and Communication Technology”.
2. Selection of the Dependent Variables (DVs) and Categorical Variables (CVs).

3. Selection of a suitable research design.

4. Preparation of the content for the study with suitable delivery mechanism.

5. Construction of tools to measure the Achievement in Environmental Education

6. Methods of establishing the reliability and validity of the tools constructed.

7. Designing suitable technological set up with necessary hardware and software requirements.

8. Selection of the sample for the study.

9. Conducting the Experiment and Data Collection.

**Content preparation for Control group**

The study follows the Pre-Test, Post-Test Control Group, Experimental Group Quasi Experimental design. This section briefly discusses about the selection and preparation of the content, experimental design, construction of tools, methods of establishing the reliability, validity, and item analysis of the tools constructed, sampling procedure, conducting the experiment and data collection.

The researcher had taken Environmental Science as the content to be taught to both the experimental and control groups. He prepared the Environmental
Sciences content suitable for classes IX and X by combining the Tamil Nadu Text Book Society's text books for classes VI to X. The material available was slightly edited according to the needs of the study. The content includes the following topics: Ecosystem, Components of ecosystem, Types of Ecosystem, Ecosystem - Structure and Function, Energy Flow in Ecosystems, Food Chain and Food Web, Ecological Pyramids, Environmental Pollution, Land or Soil Pollution, Air Pollution, Water Pollution, Noise Pollution, Green House Effect, Global Warming, Acid Rain, Soil Erosion and Causes of Soil Erosion, Depletion of Ozone Layer, and Ozone Hole.

The content was sufficient for 30 days (25 hours) teaching. The content was then converted into Braille using Braille printers. Sufficient number of copies were prepared to cover various experimental sites. Frequent evaluation questionnaires were also prepared along with the content.

Content preparation for Experimental group

Screen readers are a form of assistive technology (AT) potentially useful to people who are blind, visually impaired, illiterate or learning disabled, often in combination with other AT, such as screen magnifiers. It is a software that attempts to identify and interpret what is being displayed on the screen, or, more accurately, sent to standard output, whether a video monitor is present or not. This interpretation is then re-presented to the user with text-to-speech, sound icons, or a Braille output device. The researcher had chosen JAWS (Job Access With Speech) which is a popular computer screen reader program for Microsoft Windows for the present study.
The content was divided into 30 equal parts called episodes and converted into Word documents. They were fed into the computers installed with JAWS software. The software converts the text into voice which is easy for the visually impaired students to understand easily. Thus the content for the experimental study was prepared. The researcher set up hardware and software necessary for running the study at the concerned schools. He tested all the hardware and software well in advance. All the participants in the experimental group were provided with the computer systems pre-installed with JAWS software. The content was tried out on some students from the experimental group and modified as per the reactions and feedback received from the students and experts' opinions.

Variables of the study

Achievement test in Environmental Science was the primary methodological tool for the present study. The Gain Score obtained in the Achievement test in Environmental Science was the dependent variables and Age Group, Gender, Locality, Type of School, Socio – Economic Status, Religion, Community, Nature of Blindness, Type of Blindness and Technology awareness were the categorical variables.

Achievement test in Environmental Sciences

Two similar achievement test questionnaires, one for pre-test and one for post-test were prepared and used in the experiment. The questions were intended to test the knowledge, understanding, application, etc. The tests consist of twenty five multiple choice questions. Each question was provided with 4 answers. The student has to select the correct response. Each correct response was given a score of ‘1’ and
there was no negative mark for wrong responses. The sum of scores obtained in all
the items was considered as the total score and utilized for further analysis. The
minimum score was 0 and the maximum possible score was 25. Both pre-test and
post-test question papers were similar in content, typology, scoring, toughness and
discrimination power. The test papers were pilot tested, with 50 students and the
reliability, validity, difficulty index, and discrimination index were found. On the
basis of the feedback from the pilot test and the expert opinion the final draft was
prepared. The Chronbach alpha values of the tests are given in Table 5.2.

**Pilot Study**

A pilot study with a sample of 50 students was conducted to determine the
suitability of various test items, to find out whether all the students understand the
test items, and to select the best items with proper discrimination and difficulty
indices. The Difficulty index was determined by using the formula $P = \frac{PH + PL}{2}$.

Item – wise analysis was made to find out the proportion of the pupils answered
each item correctly in the high and the low groups, PH and PL. The item
discrimination D was obtained by using the formula: $D = (PH - PL)$. An item with
the Index of discrimination 0.35 and up, and difficulty levels between 0.40 and 0.60
were considered for the final instrument.

**Table 5.1**

<table>
<thead>
<tr>
<th>Test Instrument</th>
<th>Number of Samples</th>
<th>Number of Items</th>
<th>Cronbach’s Alpha Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>50</td>
<td>25</td>
<td>0.8657</td>
</tr>
<tr>
<td>Post-Test</td>
<td>50</td>
<td>25</td>
<td>0.8291</td>
</tr>
</tbody>
</table>
Sampling Procedure

All the students with visual impairment studying IX or X standard in State Board / Matriculation / C.B.S.E system is the population. The students may be studying in Government / Aided / Private schools. The sample is the true representative of the population. The reliability of results depends more on the quality of the sample. Random Sampling procedure was followed in the present study. Four blind schools from various places within Tamil Nadu were selected for the study. The students in the schools were chosen for the study in proportionate to the total strength in that school. The selected students were assigned into Experimental group and Control group randomly. Thus one hundred and forty four students (144) out of this population have been selected as the sample. Seventy two students were randomly selected for the Experimental group and another 72 students were selected for the control group. Both the experimental and control groups were almost similar in their gender, social economic status, etc.

Experimental Design

Pre-Test, Post-Test, Equivalent Control Group, Quasi Experimental Group design was adopted. The Control group and the Experimental group were made as equivalent as possible, by matching followed by random assignment to the Experimental and Control treatments. The experimental design is given in Table 5.2

Table 5.2

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-Test</th>
<th>Treatment</th>
<th>Post-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Yes</td>
<td>Braille</td>
<td>Yes</td>
</tr>
<tr>
<td>Control</td>
<td>Yes</td>
<td>JAWS</td>
<td>Yes</td>
</tr>
</tbody>
</table>
5.9 EXPERIMENTAL PROCEDURE

Prior to the experiment, the investigator contacted the participants personally and explained about the proposed study to them. He had prepared the questionnaires in the Braille format and in the ordinary Paper-Pencil format also. The participants were seated comfortably. For each student, scribes were assigned. The scribes explained the students about the content of the questionnaire and got the answer from the participants and entered them in the paper. First the researcher collected the personal data from them. Then the participants were distributed the Pre-Test Questionnaire. The researcher explained about the questionnaire and asked them to answer. Sufficient time was given to them to answer. The answer scripts of the participants were evaluated and the scores were recorded for further processing. Then the experimental procedure started.

Technology Infrastructure

The researcher ensured sufficient number of Desktop computers for the experimental set up. The experimental software JAWS for Windows needs a minimum hardware requirements for proper operation. The computers had Pentium V Processor with 80 GB Hard Disk and 2 GB RAM. They had inbuilt audio cards, high quality speakers and a microphone for clear voice. The computers were pre-loaded with JAWS software. Each system was well tested prior to the experiment. As most of the schools nowadays have a good computer lab, providing required number of systems for the experiment was not a big problem for the researcher. Thus technology did not pose any problem for the smooth conduct of the experiment.
Conduction of the Experiment and Data Collection

Control group

The researcher visited the schools, and met the students belonging to both the groups separately and charted out the programme and the course of study with the help of the concerned headmasters and the local subject teachers. A proper time table was drawn out for traditional group of students in each school. He made sure that the place of study was conducive for learning to both the groups. A study manual was prepared with the required materials for the control group students both in Braille and paper form. At each venue, the researcher taught to the control group students 1 hour every day for 30 days. After finishing the course, Post-Test was conducted. The scores obtained in various tests were taken for analysis. The experiment was conducted during May - December 2013.

Experimental group

The researcher also verified the technology facilities available in the experimental sites. He used the JAWS software for teaching the participants from the experimental group. Utmost care was taken to provide computer systems to the students. In one site, there were 24 computers. So, it was not a problem to provide individual systems to the participants. In another school, the number of systems was less than the number of participants. So, the researcher decided to allot 2 students per system in that situation. Anyhow, he ensured that all the students learn through JAWS software. The western accent of the English pronunciation was initially a problem. But, as days went on, the students felt comfortable with the accent of the pronunciation rendered by the software. At each venue, the experimental group students were taught one hour every day for one month. At the end of the course, a
Post test was conducted and the scores obtained in various tests were taken for analysis. The experiment was conducted during May - December 2013.

**Data Analysis**

The data collected from the sample were analyzed by using SPSS 16.0 version. Initially, the data were fed into the excel worksheet and then transferred to SPSS. The statistical analysis such as ‘t’ test, ANOVA, chi-square test, correlation analysis and regression analysis were used in this study.

**5.10 FINDINGS AND CONCLUSIONS OF THE STUDY**

The data collected by the investigator were analyzed by using the statistical technique like ‘t’ test, ANOVA, chi-square test, correlation analysis and regression analysis. The summary of the various findings of the study are given below.

1. ‘t’ test was conducted to test the hypothesis that there exist no significant differences between the Mean Scores of (a) Pre-test and (b) Gain in Achievement in Environmental Science of the Experimental and Control groups.

The findings revealed that:

- There is no significant difference between the Experimental and Control Groups with regard to Mean Pre-Test Score in Environmental Science at 5% level of significance. The Mean Pre-Test Score in Environmental Science of the Experimental Group is
15.93 and that of the Control Group is 16.01 respectively, which are similar.

There is significant difference between the Experimental and Control Groups with regard to Mean Gain Scores in Environmental Science at 1\% level. The Mean Gain Score in Environmental Science of the Experimental Group is 5.56 and that of the Control Group is 4.00, which are significantly different. The Experimental Group has obtained a significantly higher Gain score than that of the Control Group.

This finding is in agreement with the findings of the study conducted by LaGrow's (1981) which found that the reading rates of participants instructed by CCTV increased after systematic instruction.

This finding is in agreement with the studies, Corn, Wall, & Bell, (2001) and Smith & Erin (2002) which found that training in and use of low vision devices increases oral comprehension reading speed (oral and silent), and the amount of reading accomplished.

This finding is in agreement with the study conducted by Fenrich (2005) which found that by utilizing simulations, active experimentation, discovery learning techniques, questioning with feedback, video, animations, and photographs, practical hands-on skills can be taught virtually and that vision impaired students do not have the sight needed to access many of these multi-media sources of delivery.
This study is in agreement with that of Cronk, Stan and Parimi, Pardha (2007) which compared the tactile length estimation skills of blind students with the visual and tactile estimation skills of sighted students and found that the participants who had visual disabilities performed on par with the sighted individuals with only their sense of touch, but were slower and less accurate in task performance.

This study is in agreement with that of Helen L. Armstrong (2009) imparting advanced IT education for the vision impaired students via e-Learning. The study found that in all successive three intakes, the vision impaired students significantly outperformed the sighted students. The higher scores were explained by the dedication of the vision impaired students in response to a program specifically designed to improve their skills and employability.

This finding is not in agreement with the study conducted by Koenig & Ashcroft, (1983), which found that there were no significant differences between writing methods with the electric and regular Perkins Braillers.

2. Individual ‘t’ tests were conducted to test the hypothesis that there exist no significant differences between Mean Gain Scores in Environmental Science of the Subgroups of the Experimental Group students with respect to (a) Age Group (b) Gender (c) Locality (d) School Type (e) Nature of Blindness (f) Type of Blindness and (g) Technology Awareness.

The findings revealed that:
- There is significant difference between the age group (12 – 14) and (15 – 17) students of the Experimental Group with regard to Mean Gain Scores in Environmental Science. The age group (15 – 17) has scored higher than (6.18) the (12 – 14) age group students (4.57).

- There is no significant difference between male and female students of the Experimental Group with regard to Mean Gain Scores in Environmental Science. The females have scored higher than (6.48) than the males (5.18). Still, the difference is not statistically significant.

- There is significant difference between the Urban and Semi-Urban students of the Experimental group with regard to Mean Gain Scores in Environmental Science. The Urban students have scored higher than (6.21) in comparison with the Semi-Urban students (3.74).

- There is significant difference between the Aided schools and Government school students of the Experimental Group with regard to Mean Gain Scores in Environmental Science. The Aided school students have scored higher than (6.75) in comparison with the Government school students (4.36).

- There is significant difference between the born blind students and middle blind students of the Experimental Group with regard to Mean Gain Scores in Environmental Science. The students who had
become middle have scored higher than (7.00) in comparison with the born blind students (4.69).

- There is significant difference between the Experimental Group students with Total blindness and those who are with Low vision with regard to Mean Gain Scores in Environmental Science. The students with Low vision have scored higher than (6.50) in comparison with the totally blind students (4.61).

- There is significant difference between the Experimental Group students with Technology Awareness and those who are not having Technology Awareness with regard to Mean Gain Scores in Environmental Science. The students with Technology Awareness have scored higher than (7.32) in comparison with those without Technology Awareness (4.43).

This finding is not in agreement with the findings of the study conducted by NCPEDP (2004) which disclosed shocking facts of discrimination against disabled girls. That study found that among children with disabilities, the percentage of girls was only 33 and the study contents, reading materials, use of assistive technology, and individual need based support is lacking.

3. ANOVA was conducted to test the hypothesis that there exist no significant differences between Mean Gain scores in Environmental Science of the Subgroups of the Experimental group students with respect to (a) Socio – Economic Status (b) Religion and (c) Community
The findings revealed that:

- There are significant differences between students belonging to different SES groups with regard to gain scores in achievement. Based on Scheffe’s Post Hoc Analysis, the students in the Low SES and Moderate SES groups \{(\text{Low} - 6.53), (\text{Moderate} - 4.00)\} significantly differ with each other. But, there are no significant differences between the groups \text{Low} \& \text{High} (6.53, 4.97) and \text{Middle} \& \text{High} (4.00, 4.95) at 5% level.

- There are no significant differences between students belonging to different religions with regard to gain scores in achievement. Based on Scheffe’s Post Hoc Analysis, the students from Hindu, Christian and Muslim religions have scored 5.67, 4.87 and 6.00 respectively. The students from Muslim religion have scored slightly more than the other groups, but there is no difference statistically.

- There are no significant differences between students belonging to different communities with regard to gain scores on achievement. Based on Scheffe’s Post Hoc Analysis, the students from OC, BC, MBC and SC/ST communities have scored in 5.35, 6.14, 5.25 and 4.70 respectively. The BC community students have scored slightly higher than the other students. But, statistically there are no significant differences among the students from different communities.
Individual ‘t’ tests were conducted to test the hypothesis that there exists no significant differences between mean gain scores in Environmental Science of the subgroups of the control group students with respect to the (a) age group (b) gender (c) locality (d) school type (e) nature of blindness and (f) type of blindness.

The findings revealed that:

- There is significant difference between the age group (12 – 14) and (15 – 17) students of the control group with regard to mean gain scores in Environmental Science. The students of the age group (15 – 17) have scored higher than \(4.53\) than the (12 – 14) age group students \(3.00\).

- There is no significant difference between male and female students of the control group with regard to mean gain scores in Environmental Science. The males have scored higher than \(4.17\) than the females \(3.69\). Still, the difference is not statistically significant.

- There is significant difference between the Urban and Semi-Urban students of the control group with regard to mean gain scores in Environmental Science. The Urban students have scored higher than \(4.42\) in comparison with the Semi-Urban students \(2.90\).

- There is no significant difference between the aided school and Government school students of the control group with regard to
Mean Gain Scores in Environmental Science. The Aided school students have scored higher than (4.09) in comparison with the Government school students (3.86).

➢ There is significant difference between the Control Group students with born blindness and those who had become blind in the middle with regard to Mean Gain Scores in Environmental Science. The students who are born blind, had scored higher than (4.51) in comparison with those who had become blind in the middle (3.24).

➢ There is significant difference between the Control Group students with Total blindness and those who are with Low vision with regard to Mean Gain Scores in Environmental Science. The students with Total blindness have scored higher than (4.81) in comparison with the students with Low vision (2.48).

5. ANOVA was conducted to test the hypothesis that there exist no significant differences between Mean Gain scores in Environmental Science of the Subgroups of the Control Group students with respect to (a) Socio – Economic Status (b) Religion and (c) Community.

The findings revealed that:

➢ There are no significant differences between students belonging to different SES groups of the Control Group with regard to gain scores in achievement. Based on Scheffe’s Post Hoc Analysis, the students in the Low SES, Moderate SES and High SES groups have
scored 4.03, 4.00, and 3.95 respectively. The Low SES group has scored slightly more than the other groups; but they are not statistically significant.

There are no significant differences between students belonging to different religions with regard to gain scores in achievement. Based on Scheffe’s Post Hoc Analysis, the students from Hindu, Christian and Muslim religions have scored 5.67, 4.87 and 6.00 respectively. The students from Muslim religion have scored slightly more than the other groups, but there is no difference statistically.

There are no significant differences between students belonging to different communities of the Control Group with regard to gain scores on achievement. Based on Scheffe’s Post Hoc Analysis, the students from OC, BC, MBC and SC/ST communities have scored in 4.29, 3.70, 3.67 and 4.60 respectively. The SC/ST community students have scored slightly higher than the other students. But, statistically there are no significant differences among the students from different communities.

Regression Analysis was conducted to determine the statistical relationship between Gain Scores in Environmental Science (Dependent Variable), the (a) Age Group (b) Gender (c) Locality (d) School Type (e) Socio – Economic Status (f) Religion (g) Community (h) Nature of Blindness (i) Type of Blindness and (j) Technology awareness (Independent Variables) of the Experimental Group.
The findings revealed that:

- The multiple correlation co-efficient is **0.943** which indicates that the relationship between Gain Score and the independent variables of the Experimental Group is quite strong and positive. The R square value is **0.889** which simply means that about **88.9 %** of the variation in Gain Score is explained by the estimated SRP that uses independent variables and R Square value is significant at **1 %** level. The multiple regression equation is: \( Y = 1.642X_1 - 0.439X_2 - 1.986X_3 + 0.344X_4 - 0.357X_5 - 0.077X_6 - 0.266X_7 + 1.769X_8 + 1.737X_9 - 2.952X_{10} + 6.384. \) The coefficients of \( X_1 \) and \( X_8 \) are significant at **5 %** level of significance; coefficients of \( X_3 \), \( X_9 \) and \( X_{10} \) are significant at **1 %** level of significance and the other coefficients are not significant.

- The multiple correlation co-efficient is **0.873** which indicates that the relationship between Gain Score and the independent variables of the Control Group is quite strong and positive. The R square value is **0.7625** which simply means that about **76.25 %** of the variation in Gain Score is explained by the estimated SRP that uses independent variables and R Square value is significant at **1 %** level. The multiple regression equation is: \( Y = 1.441X_1 - 0.093X_2 - 1.418X_3 - 0.343X_4 - 0.066X_5 - 0.238X_6 + 0.368X_7 - 1.286X_8 - 1.922X_9 + 7.970. \) The coefficients of \( X_1 \), \( X_3 \), \( X_8 \) and \( X_9 \) are significant at **1 %** level of significance and the remaining coefficients are not significant.
The chi square test was applied to test the null hypothesis that there exists no significant association between the Levels of Gain Scores on Achievement in Environmental Science of the subgroups of the Experimental group students with respect to the following categorical variables: (a) Age Group (b) Gender (c) Locality (d) School Type (e) Socio – Economic Status (f) Religion (g) Community (h) Nature of Blindness (i) Type of Blindness and (j) Technology Awareness.

The findings revealed that:

- There is no significant association between the level of gain and age group. 60.7% of students from the age group (12-14) have low level of gain. 21.4% students from the age group (12-14) have high level of gain. 50.0% of students from the age group (15-17) have low level of gain. 13.6% of students from the age group (15-17) have high level of gain scores. Hence the students from the age group (12-14) with low level of gain scores are not significantly associated with students from the age group (15-17) with low level of gain scores. Similarly the students from the age group (12-14) with high level of gain scores are not significantly associated with students from the age group (15-17) with high level of gain scores.

- There is no significant association between the level of gain and gender. 56.9% of boys have low level of gain. 17.6% boys have high level of gain. 47.6% of girls have low level of gain. 14.3% of girls have high level of gain scores. Hence the boys with high level
of gain scores are not significantly associated with girls with high level of gain scores. The case is similar in the case of boys with low gain scores and girls with low gain scores.

There is no significant association between the locality and level of gain scores. 49.1% of students from Urban locations have low level of gain scores and 18.9% of students from Urban locality have high level of gain scores. 68.4% of students from Semi-Urban localities have low level of gain scores and 10.5% of students from Semi-Urban localities have high level of gain scores. The students from Semi-Urban localities with low levels of gain scores are not significantly associated with Urban students with low levels of gain scores. Similarly the students from Semi-Urban localities with high levels of gain scores are not significantly associated with Urban students with high levels of gain scores.

There is no significant association between the type of school and level of gain scores. 44.4% of students from Government Schools have low level of gain scores and 16.7% of students from Government Schools have high level of gain scores. 63.9% of Aided School students have low level of gain scores and 16.7% of Aided School students have high level of gain scores. The Type of School is not significantly associated with the level of Gain Scores.

There is significant association between the Socio Economic Status and level of gain scores. 50.0% of students from Low SES have low
level of gain scores and 11.1% of students from Low SES have high level of gain scores. 63.6% of students from High SES have low level of gain scores and 9.1% of students from High SES have high level of gain scores. Low SES students are significantly associated with low gain scores and High SES students are significantly associated with high level of gain scores.

There is no significant association between the Religion and the level of gain scores. 53.3% of students from Hindu Religion have low level of gain scores and 17.8% of students from Hindu Religion have high level of gain scores. 58.3% of Muslim students have low level of gain scores and 0% of Muslim students have high level of gain scores. Religion is not significantly associated with level of gain scores. Hence the hypothesis is accepted and we conclude that there are no significant association between Religion and Level of Gain Scores.

There is no significant association between the Community and the level of gain scores. 64.7% of students from FC Community have low level of gain scores and 17.6% of students from FC Community have high level of gain scores. 40.0% of students from SC/ST Communities have low level of gain scores and 20.0% of students from SC/ST Community have high level of gain scores. Community is not significantly associated with level of gain scores.
There is no significant association between the Nature of Blindness and the level of gain scores. 57.8 % of students with Born Blindness have low level of gain scores and 15.6 % of students with Born Blindness have High level of gain scores. 48.1 % of students with Middle Blindness have low level of gain scores and 18.5 % of students with Middle Blindness have high level of gain scores. Nature of Blindness is not significantly associated with Level of Gain Scores.

There is no significant association between the Nature of Blindness and the level of gain scores. 63.9 % of Total Blind students have low level of gain scores and 16.7 % of Total Blind students have high level of gain scores. 44.4 % of students with Partial Vision have low level of gain scores and 16.7 % of students with Partial Vision have high level of gain scores. Type of Blindness is not significantly associated with Level of Gain Scores.

There is significant association between the Technology Awareness and the level of gain scores. 32.1 % of students having Technology Awareness have low level of gain scores and 21.4 % of students having Technology Awareness have high level of gain scores. 68.2 % of students who are unaware of Technology have low level of gain scores and 13.6 % of students with who are unaware of Technology have high level of gain scores. Hence the Technology Awareness is significantly associated with Level of Gain Scores. Hence the hypothesis is rejected and we conclude that there are
significant association between Technology Awareness and Level of Gain Scores.

8. The chi square test was applied to test the null hypothesis that there exists no significant association between the Levels of Gain Scores on Achievement in Environmental Science of the subgroups of the Control Group students with respect to the following categorical variables: (a) Age Group (b) Gender (c) Locality (d) School Type (e) Socio – Economic Status (f) Religion (g) Community (h) Nature of Blindness and (i) Type of Blindness.

The findings revealed that:

- There is no significant association between the level of gain scores and age group. **80.0 %** of students from the age group (12-14) have low level of gain scores. **12.0 %** students from the age group (12-14) have high level of gain scores. **68.1 %** of students from the age group (15-17) have low level of gain scores. **17.0 %** of students from the age group (15-17) have high level of gain scores. Hence the students from the age group (12-14) with low level of gain scores are not significantly associated with students from the age group (15-17) with low level of gain scores. Similarly the students from the age group (12-14) with high level gain scores are not significantly associated with students from the age group (15-17) with high level gain scores.
There is no significant association between the level of gain and gender. 73.9% of boys have low level of gain. 10.9% boys have high level of gain. 69.2% of girls have low level of gain. 23.1% of girls have high level of gain scores. Hence the boys with high level of gain scores are not significantly associated with girls with high level of gain scores. The case is similar in the case of boys with low gain scores and girls with low gain scores.

There is no significant association between the locality and level of gain scores. 69.2% of students from Urban locations have low level of gain scores and 17.3% of students from Urban locality have high level of gain scores. 80.0% of students from Semi-Urban localities have low level of gain scores and 10.0% of students from Semi-Urban localities have high level of gain scores. The students from Semi-Urban localities with low levels of gain scores are not significantly associated with Urban students with low levels of gain scores. Similarly the students from Semi-Urban localities with high levels of gain scores are not significantly associated with Urban students with high levels of gain scores.

There is no significant association between the type of school and level of gain scores. 65.1% of students from Government Schools have low level of gain scores and 16.3% of students from Government Schools have high level of gain scores. 82.8% of Aided School students have low level of gain scores and 13.8% of
Aided School students have high level of gain scores. The Type of School is not significantly associated with the level of Gain Scores.

There is no significant association between the Socio Economic Status and level of gain scores. 65.6% of students from Low SES have low level of gain scores and 18.8% of students from Low SES have high level of gain scores. 84.2% of students from High SES have low level of gain scores and 5.3% of students from High SES have high level of gain scores. Low SES students are not significantly associated with low gain scores and High SES students are not significantly associated with high level of gain scores.

There is no significant association between the Religion and the level of gain scores. 71.8% of students from Hindu Religion have low level of gain scores and 15.4% of students from Hindu Religion have high level of gain scores. 75.0% of Muslim students have low level of gain scores and 6.2% of Muslim students have high level of gain scores. Religion is not significantly associated with level of gain scores.

There is no significant association between the Community and the level of gain scores. 85.7% of students from FC Community have low level of gain scores and 14.3% of students from FC Community have high level of gain scores. 70.0% of students from SC/ST Communities have low level of gain scores and 15.0% of
students from SC/ST Community have high level of gain scores. Community is not significantly associated with level of gain scores.

- There is no significant association between the Nature of Blindness and the level of gain scores. 74.4 % of students with Born Blindness have low level of gain scores and 11.6 % of students with Born Blindness have high level of gain scores. 69.0 % of students with Middle Blindness have low level of gain scores and 20.7 % of students with Middle Blindness have high level of gain scores. Nature of Blindness is not significantly associated with Level of Gain Scores.

- There is no significant association between the Nature of Blindness and the level of gain scores. 68.1 % of Total Blind students have low level of gain scores and 14.9 % of Total Blind students have high level of gain scores. 80.0 % of students with Partial Vision have low level of gain scores and 16.0 % of students with Partial Vision have high level of gain scores. Type of Blindness is not significantly associated with Level of Gain Scores.

### 5.11 EDUCATIONAL IMPLICATIONS OF THE STUDY

1. This study reveals the effectiveness of ICT in the education of visually impaired children and the relationships between the effectiveness and the categorical variables such as Age Group, Gender, Locality, School Type, Socio – Economic Status, Religion, Community, Nature of Blindness, Type of Blindness, and Technology Awareness.
2. This study helps the future researchers to conduct similar studies with different settings and variables.

3. This study is very much useful for the teachers, students with visual impairment, special educators, media experts, educational administrators, curriculum planners and government.

4. This study may serve the whole of humanity in developing a positive and right type of awareness towards the use of ICT in the education of visually impaired children, and in general, the use of ICT in other fields of disabilities also.

5. In this respect, the present study may shed light on the present condition of the education system, and will help people to improve it.

5.12 RECOMMENDATIONS

1. The experimental group has scored significantly higher than the control group in the achievement test. This shows that the ICT usage in the education of special children is really effective. In the present situation it is recommended that every educational institution for the visually impaired children should develop similar usage of ICT in other branches of study, such as Physics, Maths, Social Sciences, etc by employing suitable strategies such as media and techniques. It is very essential and necessary at the present scenario.

2. The JAWS software and similar other software are costly. The visually impaired children and their institutions in general may not have sufficient
financial assistance to procure the software and their installation. It incurs software as well as hardware specifications also. In this context, the government should take necessary steps to either produce similar software and provide them at subsidized rates to the needy or to make tie ups with software industries for the procurement of such software at subsidized rates. This is very essential. Otherwise, even though the software is effective in the education of the visually challenged children, its wider practical application may not be possible.

3. The JAWS software and similar other software are produced in English. The English pronunciation in these software are mostly of American, British, Australian, and other western dialects. In the present study, it was found that the Indian children found it very difficult to understand the English pronunciation. The researcher had given sufficient training to the participants in understanding the western accent. So, the language experts, and software industries should try to develop the software with Indian English accent. Otherwise, the practical usage of the software will be very difficult. The children, after some days, may stop using the software.

4. Similar software in other Indian languages is a must. Most of the visually impaired children and their families are very poor. Most of them have rural backgrounds and know only their mother tongues. Studying is a great task for them. In such situation, if software such as JAWS are developed in local Indian languages such as Tamil, Telugu, Malayalam, Kanada, Hindi, etc, that will have wider implications. The students may use them at their homes also, if possible through a mobile device. So, the education of visually impaired
children will have a boost. Not only in education, these software may be
used at various other situations such as market places, shops, bus stands,
railway stations, other public places, etc. By simply feeding the text the
mobile may convert it into voice, so that the user may immediately act
accordingly. The government, software industry and academia should take
necessary steps for this.

5. The study shows that there are significant differences in the achievement
scores among the sub groups with regard to Socio Economic Status, Gender,
Locality, Type of School, Nature of Blindness, Type of Blindness and
Technology Awareness. That means that the ICT is more useful to these sub
groups and less useful to some other sub groups. So, special care should be
taken in developing the software and its usage for the education of the
visually impaired students. The implementation of such software should be
deeply studied and the lacunae in the utilization should be removed or
modified.

6. The study shows that there are no significant differences in the achievement
scores among the sub groups with regard to Gender, Community, and
Religion. That means that the ICT is equally useful to all the sub groups.
This finding has a positive note on the usage of ICT among visually impaired
children. So far it is thought that females and certain religious groups and
communities in the society are in a backward condition and are not so good
in the usage of modern technologies. That is proved wrong from this study.
So, special care should be taken in the widespread usage of ICT among all
students irrespective of their gender, community or religion. This fact is strongly recommended.

7. Most of the students in the control group indicated that they do not have prior experience or awareness about recent developments in ICT. So efforts should be taken to introduce modern ICT software and hardware to the visually impaired children and the students should be encouraged to use them. If possible, the institution may procure or retrieve free software and install them in their institutions, so that it may not be a financial burden.

8. The teachers should encourage the visually impaired students to involve in the practical application of ICT in various subject or creative activities such as workshop, seminar, projects, field work, and exhibition etc., in order to create interest among the students in the proper use of ICT in education. This will help the future generations of visually impaired children to come at par with the normal children. Otherwise there will be a large gap between students with sight and those without it.

5.13 SUGGESTIONS FOR FURTHER RESEARCH

1. The present study has taken a sample of 144 students only. If a larger sample with a wider area has been chosen in further studies, it will substantiate the validity of the findings.

2. The present study has dealt with cognitive variables such as achievement in environmental sciences only. But the other variables such as attitudes,
behaviour, creativity, problem solving, reasoning, affective variables, etc., can also be taken in further studies.

3. The present study has taken the students in the age groups 12 - 17 only. Further studies may take the samples from other age groups such as young children, college and university students etc.

4. The present study has dealt with only students studying in formal education. At the same time, we cannot forget the fact that there is a lot of dropouts, illiterates, child labor etc. So future studies should consider these non formal and informal categories also.

5. The present study has taken the students learning from Braille for comparison. But, the normal students with sight can also be taken for comparison. In this way, the relative effectiveness of ICT in the education of the visually challenged students can be established and the shortcomings in its usage can also be identified, when it is compared with normal children.

5.14 CONCLUSIONS

This study was conducted to find out the effectiveness of ICT in the education of students with visual impairment in Tamil Nadu. The purpose of this study was to investigate whether there is significant difference among the experimental group which is taught with ICT and those who are taught in the traditional Braille method. It was also aimed to investigate the significant differences among the sub groups of the experimental group with regard to age, gender, socio economic status, locality, ICT awareness, community, religion, nature
of blindness, type of blindness, etc. The study has proved that ICT is effective in the
education of the children with visual impairment and its relationship of effectiveness
with other categorical variables. It found that there are significant differences among
various sub groups, meaning that the ICT is effective for some groups and not so
effective for other groups. In the case of some sub groups, there are no significant
differences observed. These observations should be looked upon seriously and the
results of this study should be implemented. ICT is a panacea for most of the
shortcomings of the present education system. Without it, it would be very difficult
to elevate the education system at par with that of the western countries. Hence,
many more such studies are to be taken to uplift the education of the students with
visual impairment. Then alone, we can say that we give equal opportunities to all the
citizens of the nation irrespective of their personal differences as enshrined in the
Indian Constitution. We have a social and moral responsibility also to provide
education to the most neglected section of the society, i.e., people with disabilities.
That will pave way to a better, stronger and egalitarian nation.