CHAPTER-III
DESIGN AND METHOD OF INVESTIGATION

3.1 INTRODUCTION
Methodology occupies a very important role in any type of research as the reliability and validity of findings depend largely on the methods employed for the study, population, sample, tools, techniques of data collection, procedure adopted for developing CAI package and statistical techniques employed there in.

3.2 NEED FOR THE STUDY
In Tamilnadu, the growth of multinational companies is more in number at present. At the time of their establishment, competent and efficient software professionals have been appointed as programmers at these multinational companies. The reason behind their success is efficiency in software development. This is attained through the method called “POINTER”, which is considered as one of the better methods in program development. Most of the computer science graduates failed to show interest towards developing software’s using “POINTERS” because of its complexity, i.e. manipulating and accessing of memory locations directly. The advantage of use of pointers is its direct reference to the memory locations, which speeds up the process, reduces the execution time, and indirectly improves the efficiency of the program.

Whenever the students are taught in classrooms, they find it difficult to understand the concept of pointers because of its complexity. It is better if it would be taught with the latest technology i.e. using educational soft wares, which will help them to learn POINTERS easier and to improve the level of efficiency in program development. Therefore, the investigator decided to make students’ learning easier, by developing software to teach pointers.

Further, the present research aims to develop and utilize the “POINTERS SOFTWARE” in enhancing program writing skill among computer science under graduate students. The broader area of research is narrowed down by the researcher to conduct the study in Tirunelveli district.

3.3 SIGNIFICANCE OF THE STUDY
Any research can be carried out only on the basis of its significance which in turn depends on its necessity, urgency, and utility value. The significance of the present problem is to develop and utilize the pointer software in enhancing program writing ability among computer science graduate students. It may also be due to its complex nature. A pointer can be defined as a variable that may contain the address of another variable. The address is the location where the variable exists in memory. A pointer variable can be declared using asterisk “*” in front of the variable. The computer science students lack awareness on the usage of pointers in program development. To develop programs using pointers, the students must possess the knowledge of referring the memory locations properly, and the knowledge of logical thinking. In ordinary classroom it is much difficult to develop this kind of skill. When the same concept is taught through this newly developed software, the above mentioned skills will be developed among students.

Therefore, the investigator sensitized the importance of pointers in development of high level programs. To enhance their program writing ability using pointers and create interest towards learning it through pointers software is the main aim of this research. To develop efficient programs one must have the knowledge of logical reasoning and mathematics which will help them to do so. But if a person’s self-efficacy level is low in the programming language he/she uses, it will definitely affect their program writing ability. Though a person has very good mathematical and logical intelligence and his/her self-efficacy level is also high, the knowledge of error diagnosis is very much required for debugging the program during program execution. Therefore inclusive of the above mentioned factors knowledge of error diagnosis is also included as one of the influencing factors in writing programs. To develop such efficient program one must have the knowledge of meta-cognition, which is closely related to the type of brain dominance. Therefore, the researcher had chosen the following psychological factors: meta-cognition, Self-efficacy in using C language, type of brain dominance, Mathematical and logical Intelligence, and knowledge of error diagnosis. In this study, the researcher would like to find the level of influence of the above mentioned psychological factors on the gain score and the retention scores of the first year computer science students. The result of this experimental research will reduce their difficulties in learning “Pointers” and helps them to develop efficient programs using pointers which in turn will fetch them an employment opportunity at multinational companies.
3.4 STATEMENT OF THE PROBLEM

The present problem is entitled as *Development of Pointer Software and Its Effectiveness on Program Writing Skill among Computer Science Graduate Students.*

3.5 OPERATIONAL DEFINITION OF THE TERMS

*Development*

According to Oxford Advanced Learners’ Dictionary “Development” means the instance of developing. In this present study it refers to the preparation of a learning package using the animation software “Macromedia Flash” and MS-Powerpoint.

*Pointers Software*

Pointer is a variable that may contain the address of another variable. The address is the location where the variable exists in memory. In this study it refers to the package developed by the investigator through which developing program writing skill using this specially designed software will become easier.

*Effectiveness*

According to Oxford Advanced Learners’ Dictionary of correct English by A.S.Horn by (OUP) “effective” means the power to bring about a result. As far as the study is concerned, effect refers to impressive result in the improvement of program writing skills using pointers software. The effectiveness is determined in terms of the gain scores obtained by the students in the experiment. The gain score is the difference between the pre-test score and the post-test score.

*Program Writing Skill*

Program is defined as a set of instructions used to solve a particular problem. In this study it refers to the skill which is required to write the efficient programs. This skill is based on Self-efficacy in using C language, metacognition, Mathematical – Logical Intelligence, Type of brain dominance and the Knowledge of error diagnosis of the students.
**Computer Science Graduate Students**

In this study it refers to the students studying in the first year Bachelor of Science (B.SC) in the colleges of Arts and Science.

### 3.6 GENERAL OBJECTIVES

1. To develop Pointers software in C-language for first year computer science students.
2. To find out the level of gain scores and retention scores of control and experimental group students.
3. To find out the effectiveness of the pointers software in teaching and learning of C-programming.

### 3.7 SPECIFIC OBJECTIVES

**Experimental group**

1.1 To find out the level of (i) gain scores and (ii) retention scores of experimental group students.

1.2 To find out whether there is any significant difference between pre-test and post-test scores of experimental group students.

1.3 To find out whether there is any significant difference between experimental group students who read computer journals and those who do not read computer journals in the gain scores.

1.4 To find out whether there is any significant differences between experimental group students who read computer journals and those do not read computer journals in the attainment of objectives: knowledge, understanding and application in their gain score.

1.5 To find out whether there is any significant difference among the left, right and middle brain dominant experimental group students in the gain scores.
1.6 To find out whether there is any significant association between gain scores of the experimental group students and their

   i. Order of birth
   ii. Father’s educational qualification
   iii. Mother’s educational qualification
   iv. Income of the families

1.7 To find out whether there is any significant relationship between gain scores of the experimental group students and their

   i. Self-efficacy in using C language
   ii. Meta-cognition
   iii. Mathematical and logical intelligence
   iv. Knowledge of Error Diagnosis

1.9 To find out whether there is any significant difference between experiment group students who read computer journals and those who do not read computer journals in the retention scores.

1.10 To find out whether there is any significant difference among left, right and middle brain dominant experimental group students in the retention scores.

1.11 To find out whether there is any significant association between retention scores of the experimental group students and their

   i. Order of birth
   ii. Father’s educational qualification
   iii. Mother’s educational qualification
   iv. Income of the families

1.12 To find out whether there is any significant relationship between retention scores of the experimental group students and their
Control group

2.1. To find out the level of (i) gain scores and (ii) retention scores of control group students.

2.2 To find out whether there is any significant difference between pre-test and post-test scores of control group students.

2.3 To find out whether there is any significant difference between control group students who read computer journals and those who do not read computer journals in the gain scores.

2.4 To find out whether there is any significant difference between control group students who read computer journals and those who do not read computer journals in the attainment of objectives: Knowledge, Understanding and Application in the gain scores.

2.5 To find out whether there is any significant association between gain scores of the control group students and their
   i. Order of birth
   ii. Father’s educational qualification
   iii. Mother’s educational qualification
   iv. Income of the families

2.6 To find out whether there is any significant relationship between gain scores of the control group students and their
   i. Self-efficacy in using C language
   ii. Meta-cognition
iii. Mathematical and Logical Intelligence
iv. Knowledge of error diagnosis

2.7 To find out whether there is any significant difference between control group students who read computer journals and those who do not read computer journals in the retention scores.

2.8 To find out whether there is any significant association between retention scores of the control group students and their
   i. Order of birth
   ii. Father’s educational qualification
   iii. Mother’s educational qualification
   iv. Income of the families

2.9 To find out whether there is any significant relationship between retention scores of the control group students and their
   i. Self-efficacy in using C language
   ii. Meta-cognition
   iii. Mathematical and logical intelligence
   iv. Knowledge of error diagnosis

**Effectiveness of pointers software**

To find out whether there is any significant difference between experimental and control group students in the gain scores.

To find out whether there is any significant difference between experimental and control group students in the attainment of the objectives: Knowledge, Understanding and Application in the gain scores.
To find out whether there is any significant difference between experimental and control group students in their retention scores.

To find out whether there is any significant difference between experimental and control group students in the attainment of the objectives: Knowledge, Understanding and Application in the retention scores.

3.8 HYPOTHESES

Experimental group

1.1 There is no significant difference between pre-test and post-test scores of experimental group students

1.2 There is no significant difference between experimental group students who read computer journals and those who do not read computer journals in the gain scores.

1.3 There is no significant difference between experimental group students who read computer journals and those who do not read computer journals in the attainment of objectives: knowledge, understanding and application in the gain scores.

1.4 There is no significant difference among left, right and middle brain dominant experimental group students in the gain scores.

1.5 There is no significant association between gain scores of the experimental group students and their

   i. Order of birth
   ii. Father’s educational qualification
   iii. Mother’s educational qualification
   iv. Income of the families
1.6 There is no significant correlation between gain scores of the experimental group students and their
   i. Self-efficacy in using C language
   ii. Meta-cognition
   iii. Mathematical and Logical intelligence
   iv. Knowledge of Error Diagnosis

1.7 There is no significant difference between experimental group students who read computer journals and those who do not read computer journals in the retention scores.

1.8 There is no significant difference among left, right and middle brain dominant experimental group students in the retention scores.

1.9 There is no significant association between gain scores of the experimental group students and their
   i. Order of birth
   ii. Father’s educational qualification
   iii. Mother’s educational qualification
   iv. Income of the families

1.10 There is no significant relationship between retention scores of the experimental group students and their
   i. Self-efficacy in using C language
   ii. Meta-cognition
   iii. Mathematical and logical intelligence
   iv. Knowledge of error analysis

Control group

2.1 There is no significant difference between pre-test and post-test scores of the control group students.
2.2 There is no significant difference between control group students who read computer journals and those who do not read computer journals in the attainment of the gain scores.

2.3 There is no significant difference between control group students who read computer journals and those who do not read computer journals in the attainment of objectives: Knowledge, Understanding and Application in the gain scores.

2.4 There is no significant difference among left, right and middle brain dominant control group students in the gain scores.

2.5 There is no significant association between gain scores of the control group students and their
   i. Order of birth
   ii. Father’s educational qualification
   iii. Mother’s educational qualification
   iv. Income of the families

2.6 There is no significant relationship between gain scores of the control group students and their
   i. Self-efficacy in using C language
   ii. Meta-cognition
   iii. Mathematical and logical intelligence
   iv. Knowledge of error diagnosis

2.7 There is no significant difference between control group students who read computer journals and those who do not read computer journals in the retention scores.

2.8 There is no significant difference among left, right and middle brain dominant control group students in the retention scores.

2.9 There is no significant association between retention scores of the control group of students and their
   i. Order of birth
ii. Father’s educational qualification
iii. Mother’s educational qualification
iv. Income of the families

2.10 There is no significant relationship between retention scores of the control group students and their
i. Self-efficacy in using C language
ii. Meta-cognition
iii. Mathematical and logical intelligence
iv. Knowledge of error diagnosis

Effectiveness of pointers software

3.1 There is no significant difference between gain scores of the experimental and control group students.

3.2 There is no significant difference between experimental and control group students in the attainment of the objectives: Knowledge, Understanding, and Application in the gain scores.

3.3 There is no significant difference between retention scores of the experimental and control group students.

3.4 There is no significant difference between experimental and control group students in the attainment of the objectives: Knowledge, Understanding, and Application in the retention scores.

3.9 DELIMITATIONS
i. The investigator has delimited herself with the B.Sc Computer Science First Year under graduate students.
ii. It is delimited to Tirunelveli district of Tamilnadu Only.
Though there are many psychological factors influence the program writing ability of the students, the investigator had chosen the following factors for her study. They are: type of brain dominance, metacognition, self-efficacy in using C language, Mathematical and logical Intelligence and Knowledge of error diagnosis.

3.10 METHOD USED FOR THE STUDY

The purpose of this study is to find the effectiveness of Pointers software on program writing ability of the first year computer science students. Based on the nature of the problem, the investigator has adopted “experimental method”.

3.11 DESIGN OF THE STUDY

Experimental design is the blueprint of the procedures that enable the researcher to test hypotheses by reaching valid conclusions about relationships between independent and dependent variables (Best, 2006).

The experimenter had chosen the Pre-test - Post-test Equivalent –Group Design for conducting the experiment. The pretest-posttest Equivalent – Groups design has the following structure.

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>O₁</th>
<th>X</th>
<th>O₂</th>
<th>O₁O₃</th>
<th>-</th>
<th>Pre-tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
<td>O₃</td>
<td>C</td>
<td>O₄</td>
<td>O₂O₄</td>
<td>-</td>
<td>Post-tests</td>
</tr>
</tbody>
</table>

R - Random assignments of subjects to groups
X - Exposure of groups to an experimental variable
C - Exposure of a group to the control

In this design pretests (O₁O₃) are administered before the application of the experimental and control treatment and posttests were conducted after the treatment period. The design of the present study is shown below.

Table – 3.0

Design of the Experiment
### 3.12 SAMPLE

A sample is a small proportion of a population selected for observation analysis. A total of 44 girl students studying first year computer science in Sarah Tucker College for Women, Palayamkottai constituted the total sample. The researcher had randomly selected the sample.

### 3.13 CATEGORIZING THE SAMPLES INTO EQUIVALENT GROUPS

Catell’s culture fair intelligent test was conducted to split the samples into two equivalent groups. Based on the intelligent test score, they were categorized into “Experimental and control group by matched randomization method. Here the researcher selected pairs or sets of individuals with identical or nearly identical I.Q scores and assigning one of them to the experimental group and the other to the control group. So, there were 22 students in each group respectively. The ‘t’ value between two groups were formed which was not significant. Hence, these two groups are equivalent.

**Table – 3.1**

**Formation of two equivalent groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>Sample Size</th>
<th>College</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>22</td>
<td>Sarah Tucker College,</td>
</tr>
<tr>
<td>Control</td>
<td>22</td>
<td>Palayamkottai</td>
</tr>
</tbody>
</table>

**Figure 3.1**

*DISTRIBUTION OF THE SAMPLE*

![DISTRIBUTION OF THE SAMPLE](image)

3.14 **LOCATION OF THE COLLEGE**

Figure shows the map of Palayamkottai where the study was conducted in Sarah Tucker College, Palayamkottai.
Figure - 3.2 – Map of Palayamkottai

3.15 TOOLS USED FOR THE STUDY

The instruments that are employed to gather new facts or to explore new fields are called tools. It is of vital importance to select suitable instruments or tools. The major tools used for the present study were
i. Personal Data Form
ii. Pointers Software- Developed by the investigator
iii. Achievement test in C-Pointers - Developed by the investigator
iv. Meta Cognition Test developed by Annaraja -2007
v. Logical-Mathematical Intelligence- Developed by the investigator
vi. Knowledge of Error Diagnosis- Developed by the investigator
vii. Self-efficacy in using C language- Developed by the investigator
viii. Brain Dominance Scale – Adapted by Loren D.Crane

3.15.1 DEVELOPMENT OF POINTERS SOFTWARE

The investigator studied the books on ‘C’ language for the first year computer science students. Then the investigator had developed the Pointers Software on the topic “Pointers in C Programming Language” for this study, for the first year computer science students. The following steps were used for developing the software.

Selection of the topic

The investigator conducted a pilot study among undergraduate computer science students to know the difficulty level of their subjects. The result of this study shows that most of the students in first year computer science found that “Pointers” is the difficult concept in learning C language. The result of the pilot study further shows that they find it difficult to access the memories and its addresses using “Pointers”. But Pointers is the most important concept to be learnt to develop computer programming by every computer graduate. Hence the investigator had selected this topic “Pointers” from first year computer science syllabus. Hence the concept is very abstract in nature; the students found it difficult to understand by traditional method of teaching. So, the investigator had chosen this topic for developing the software.

Identification of objectives

The investigator had identified the following objectives:
i. Pupils acquire the knowledge of Pointers and Arrays, Array of pointers, call by reference, Call by value and Functions returning pointers.

ii. Pupils understand on referring, accessing and manipulating the memory locations using Pointers and Arrays, Array of Pointers, Call by reference, call by value and Functions returning pointers.

iii. Pupils apply their knowledge of Pointers and Arrays, Array of Pointers, Call by reference, call by value and Functions returning pointers in the new situation.

**Selection of Appropriate Strategy**

After identifying the objectives, an appropriate strategy was decided in the programme. The investigator had selected the linear type of programming, because the programme could control the response of the learner in the form of knowledge of results. The learner could take one concept at a time and comprehend easily.

**Selection of the Multimedia Package**

The investigator had selected Macromedia Flash 8.0, Macromedia Dreamweaver 8.0 and Adobe Photoshop 7.0 for the preparation of the “Pointers Software”. The investigator had selected adobe Photoshop 7.0 for editing of images, Macromedia Dreamweaver 8.0 for creating the links between the frames and Macromedia Flash 8.0 for preparing the animated presentations with sound effects. Thus the investigator had selected the above application software for preparing the “Pointers Software” for the First Year Computer Science Students.

**Tools used to create the Pointers Software**

i. **Macromedia Flash Professional 8.0**

   a. Used to insert new “Layers”
b. Used to create user defined action buttons

c. Used to create Symbols

d. Used to create Labels
e. Used to change the properties of the controls available in Flash 8.0

ii. Adobe Photoshop
   a. Used to set the palette colors

b. Used to create shape tool
c. Creation of link layers

d. Creation of labels

e. Creating shadows and highlights of the image in the layers
f. Various types of shapes used to draw pictures

g. Used for marking anchor points
iii. Macromedia Dreamweaver 8.0

a. Workspace of Dreamweaver

b. To add common objects such as tables, images and media into the open document
3.15.2 VALIDATION OF THE LEARNING PACKAGE
To enhance the quality of Pointers software, the researcher validated the software using the following steps.

**Expert Validation**

After the development of pointers software, it is given to the experts in e-content developers, Web studio, IIT, Chennai and Expert in Computer Science, Manonmaniam Sundaranar University, Tirunelveli., for validation. The software was modified according to the suggestions given by experts.

**Individual try out**

After completing the expert validation, the pointers software was given to the first year B.Sc computer science student in Rani Anna government Arts and Science College for women, Tirunelveli. The software was modified as per the feedback given by the student for more user friendly.

**Small Group Try out**

The pointers software was given to the group of 5 B.Sc Computer Science students in St.John’s College, Palayamkottai. The researcher found that this type of group try out is meaningful, because the feedback of the students helped her to modify the software into more users friendly.

**Large Group Try out**

The pointers software was given to the group of 15 B.Sc Computer Science students from Rani Anna government Arts and Science College for women, Tirunelveli., and St.John’s College, Palayamkottai. Their feedback was carefully examined and modifications were made as per their suggestions.

The developed software can be used with the following hardware and software specifications.

**SYSTEM ENVIRONMENT**

The following are the system environment to develop and run the POINTERS SOFTWARE

**Hardware Specification**
The hardware specifications are furnished below

i. SVGA display colour monitor
ii. Intel® Core™ 2 Duo CPU
iii. 2 GB RAM
iv. Keyboard
v. Speakers
vi. Mouse
vii. 40GB Hard Disk
viii. Sound Card

Software Specification

The following Multimedia Group Tools were used to develop “Pointers Software”

i. Macromedia Flash Professional 8.0
ii. Macromedia Dreamweaver 8.0
iii. Adobe Photoshop


TOPICS INCLUDED IN THE STUDY

i. Arrays
ii. Pointers
iii. Array of Pointers
iv. Call by Value
v. Call by reference
vi. Functions Returning pointers

Figure 3.3 highlights the ‘Pointers’ concepts which are used in developing the ‘POINTERS SOFTWARE’.

FIG - 3.3
CONCEPTS OF POINTERS IN C IN THE POINTERS SOFTWARE

Fig 3.4 highlights the menu system of “Pointers Software”.

1. Isolated Variables
2. Dynamic Memory Allocation

i. Correlation between Arrays & pointers.
ii. Addition of a number to a pointer
iii. Subtraction of a number to a pointer
iv. Pointer to an array
v. Passing 2-D & 3-D array to a function
vi. Diagrammatical Representation
FIG - 3.4
MENU SYSTEM OF POINTERS SOFTWARE

Main Screen

Tutor

Post - Test

Exit

Pointers
Call by Value
Call by Reference
Functions returning Pointers
Array & Pointers
Array of Pointers

Scanning of the lessons
Scanning of the lessons
Scanning of the lessons
Scanning of the lessons
Scanning of the lessons

Exit
3.15.3 CATELL’S CULTURE FAIR INTELLIGENCE TESTS

Catell’s culture fair intelligence test consists of four sub-tests. They are series, classification, matrices and condition. There are three scales present in it, but the investigator used scale2 (Form A). A description of the subsets is given below:

**Test1**

In the first sub-test, the individual is presented with an incomplete progressive series of figures. His task is to select from the choices provided, the answers which best continues the series. The time taken for answering the test is three minutes.

**Test2**

In the classification sub-test, the individual is presented with five figures. One must select one, which is different from the other four. The time taken for answering the test is four minutes.

**Test3**

In the matrices sub-test, the test is to correctly complete the design or matrix presented at the left of each row. The time allotted for answering the test is three minutes.

**Test4**

The final sub-test, condition (Topology) requires the individual to select, from the five choices provided, the one which duplicated the condition given in the far left box. The time allotted for answering the test is four minutes. The scoring was done with the help of the manual given. Each correct response obtained is given one mark. Cattle’s Culture Fair intelligent test is appended (Appendix B).

The author has established the validity of the test as *0.84*. The Split-half reliability of the test is *0.76* and test-retest reliability of the test is *0.73*, which have been established by the author.

3.15.4 PERSONAL DATA SHEET
This tool was prepared by the investigator to collect the data such as community, educational qualification of parents, occupation of parents, knowledge about computer and habit of reading computer journals. The personal data sheet is appended (Appendix A).

### 3.15.5 ACHIEVEMENT TEST - POINTERS IN C

**Draft tool**

It is used to evaluate the effectiveness of POINTERS software used in the study and to compare the traditional and the experimental method of teaching. This test was prepared by the investigator based on the contents of the topics: Pointers Call by Value, Call by Reference, Functions Returning Pointers, Arrays and Pointers and Array of Pointers; selected for the study. This draft tool consisted of 45 questions, and each had 4 alternatives.

**Pilot Study**

To standardize the tool, pilot study was conducted to the samples consisted of 10 students in both experimental and control group respectively. The test consisted of 45 objective type questions. Each question had four alternatives. The papers were valuated and the marks were arranged in descending order. The highest 27% of marks (14 papers) were selected and it was called upper group and lower 27 of marks (14 papers) were selected and it was called lower group. The items that were answered correctly were noted down, and then the difficulty value and discrimination indexes were found.

\[
\text{Difficulty value} = \frac{R_u + R_l}{N_u + N_l} \times 100
\]

\[
\text{Discrimination index} = \frac{R_u - R_l}{N_u} \text{ or } N_l
\]

Where

- \( R_u \) = number of correct responses from the upper group
- \( R_l \) = number of correct responses from the lower group
\[ Nu = \text{number of students in the upper group} \]
\[ NL = \text{number of students in the lower group}. \]

The items which were having difficulty value below 50 and 60 and discrimination index above 0.4 were retained and other items were eliminated. Based on this, 20 items were deleted and modification was made in the required items. The final form of the test contained 25 objective type questions. This tool was used to conduct pre-test and post-test for this study. The achievement test tool and the scoring is appended (Appendix C).

The blue print of the achievement test is

**Table – 3.3**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Topics</th>
<th>Knowledge</th>
<th>Understanding</th>
<th>Application</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pointers &amp; Arrays</td>
<td>3 (2,3,6)</td>
<td>6 (1,4,5,14,21,25)</td>
<td>1 (15)</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Array of Pointers</td>
<td>2 (8,13)</td>
<td>3 (7,10,22)</td>
<td>3 (9,11,12)</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Functions Returning Pointers</td>
<td>4 (17,18,19,20)</td>
<td>1 (23)</td>
<td>2 (16,24)</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td><strong>Marks</strong></td>
<td><strong>18</strong></td>
<td><strong>20</strong></td>
<td><strong>12</strong></td>
<td><strong>50</strong></td>
</tr>
</tbody>
</table>

**Validity of Achievement Test**

The item validity was already found using item analysis. In order to establish content validity, the tool was given to a panel of professors in computer science. The panel consisted of professor in the department of computer science, MSU, Tirunelveli and Sarah Tucker College for Women’s, Palayamkottai and the Professor in the St. Xavier’s College of Education, Palayamkottai. Some of the items in the test were changed and modified according to the suggestions given by them. Thus, the content validity was established.

**Reliability of Achievement Test**

The investigator used split-half method to establish the reliability of the test. The test was administered among 20 first year computer science students studying in Rani Anna Government
Arts and Science College, Tirunelveli., and St. John’s College of Arts and Science for Men, Palayamkottai., respectively. Pearson’s Product Moment Co-efficient of Correlation was used to find the reliability of the tool and it was found to be **0.675**.

**Scoring**

The students had to choose the correct answer from the choices given below each question. Two marks were awarded for each correct answer and zero mark was given to each wrong responses. The maximum marks for the test is fifty and the minimum is Zero. The scoring key is appended (Appendix -).

### 3.15.6 METACOGNITION TEST

**Description**

This tool was consisted of seven dimensions namely

i. Figural Similarity and Discrimination  
ii. Figural Sequences or figural series  
iii. Numerical Series  
iv. Figural analogies  
v. Verbal Similarity and Discrimination  
vi. Verbal Analogies  
vii. Non-verbal Similarities and Discrimination

Each dimension consisted of maximum of 5 to 6 items respectively. The students had to choose the correct answer from the choices given below each question.

**Establishing Validity of the Test**
In order to establish content validity, the tool was given to the experts in the field of Educational Psychology. Some of the items in the test were changed and modified according to the suggestions given by them. Thus, the content validity was established.

**Establishing Reliability of the Test**

The investigator used test-retest method to establish the reliability of the test. The test was administered among 20 first year computer science students studying in Rani Anna Government Arts and Science College, Tirunelveli., and St. John’s College of Arts and Science for Men, Palayamkottai., respectively. After 15 days the same test was administered to the same set of students. Pearson’s Product Moment Co-efficient of Correlation was used to find the reliability of the tool and it was found to be 0.65.

**Scoring**

One mark was awarded for each correct answer and zero mark was given to each wrong responses. The maximum mark for the test is 40. The tool for metacognition test and scoring key is appended (Appendix - D).

**3.15.7 BRAIN DOMINANCE SCALE**

**Description**

This tool was adopted by Loren D.Crane. It consisted of 21 items. Each item has to be answered by choosing anyone of the alternatives such as A or B.

**Establishing Validity of the Scale**

In order to establish content validity, the tool was given to the experts in the field of Educational Psychology. Some of the items in the test were changed and modified according to the suggestions given by them. Thus, the content validity was established.

**Establishing Reliability of the Scale**
The investigator used test-retest method to establish the reliability of the test. The test was administered among 20 first year computer science students studying in Rani Anna Government Arts and Science College, Tirunelveli., and St. John’s College of Arts and Science for Men, Palayamkottai., respectively. After 15 days the same test was administered to the same set of students. Then, Pearson’s Product Moment Co-efficient of Correlation was used to find the reliability of the tool and it was found to be 0.6426.

**Scoring**

One mark was awarded for each correct response and zero mark was given to each wrong response respectively. The maximum marks for the test is twenty one and the minimum is Zero. The type of the brain dominance was found in the following manner. The tool for brain dominance scale and the scoring key is appended.(Appendix – E).

<table>
<thead>
<tr>
<th>Response</th>
<th>Brain Dominance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>Strong left brain</td>
</tr>
<tr>
<td>5 – 8</td>
<td>Moderate left brain</td>
</tr>
<tr>
<td>9 – 13</td>
<td>Middle brain</td>
</tr>
<tr>
<td>14 – 16</td>
<td>Moderate right brain</td>
</tr>
<tr>
<td>17 - 21</td>
<td>Strong left brain</td>
</tr>
</tbody>
</table>

**3.15.8 LOGICAL AND MATHEMATICAL INTELLIGENCE TEST**

**Description**

This tool was developed by the investigator. It contains 25 items, to test the logical and Mathematical Intelligence of the students. Each item in the test had four choices. The students had to choose the correct answer from the choices given below each question.

**Establishing Validity of the Test**
In order to establish content validity, the tool was given to the experts in the field of Education in St. Xavier’s College and Computer science in the department of Computer Science, Manonmaniam Sundaranar University. Some of the items in the test were changed and modified according to the suggestions given by them. Thus, the content validity was established.

**Establishing Reliability of the Test**

The investigator used Split-half method to establish the reliability of the test. The test was administered among 20 first year computer science students studying in Rani Anna Government Arts and Science College, Tirunelveli., and St. John’s College of Arts and Science for Men, Palayamkottai., respectively. Then, Pearson’s Product Moment Co-efficient of Correlation was used to find the reliability of the tool and it was found to be 0.817.

**Scoring**

One mark was awarded for each correct answer and zero mark was awarded to each wrong responses. The maximum mark for the test is twenty five and the minimum is Zero. The tool for logical and Mathematical Intelligence test and the scoring key is appended (Appendix -F).

### 3.15.9 SELF-EFFICACY IN USING C LANGUAGE SCALE

**Description**

This scale was prepared by the investigator with 3 points, to find the efficacy level in using C language. There are 35 items in the scale. Each item in the scale consists of 3 choices i.e. i. Always, ii. Sometime and iii. Never. The students are asked to respond the scale according to their confidence level of using C language.

**Establishing Validity of the Scale**
In order to establish content validity, the tool was given to the experts in the field of Computer Science and Educational Psychology. Some of the items in the test were changed and modified according to the suggestions given by them. Thus, the content validity was established.

**Establishing Reliability of the Scale**

The investigator used test-retest method to establish the reliability of the test. The test was administered among 20 first year computer science students studying in Rani Anna Government Arts and Science College, Tirunelveli., and St. John’s College of Arts and Science for Men, Palayamkottai., respectively. After 15 days the same test was administered to the same set of students. Then, Pearson’s Product Moment Co-efficient of Correlation was used to find the reliability of the tool and it was found to be **0.7393**.

**Scoring**

The scoring of each item in the scale was done in the following manner

<table>
<thead>
<tr>
<th>Response</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always</td>
<td>2</td>
</tr>
<tr>
<td>Sometime</td>
<td>1</td>
</tr>
<tr>
<td>Never</td>
<td>0</td>
</tr>
</tbody>
</table>

The maximum marks for the scale is 70 and the minimum mark is ‘0’. There is no negative marking and negative statements in the scale. The Self-Efficacy in using C language scale is appended. (Appendix – G).

### 3.15.10 KNOWLEDGE OF ERROR DIAGNOSIS TEST

**Description**
This tool was developed by the investigator and is used to test the knowledge of the students in debugging the errors during compilation and execution process of C programs. There are 30 items in the test.

**Establishing Validity of the Test**

In order to establish content validity, the tool was given to the experts in the field of Computer Science. Some of the items in the test were changed and modified according to the suggestions given by them. Thus, the content validity was established.

**Establishing Reliability of the Test**

The investigator used Split-half method to establish the reliability of the test. The test was administered among 20 first year computer science students studying in Rani Anna Government Arts and Science College, Tirunelveli., and St. John’s College of Arts and Science for Men, Palayamkottai., respectively. Then, Pearson’s Product Moment Co-efficient of Correlation was used to find the reliability of the test and it was found to be 0.6152.

**Scoring**

There are 30 questions in the test, and each item in the test has four choices, out of which one is the correct answer. Therefore, the students had to choose the correct response from the choices given below each item. One was awarded for each correct answer and no mark is awarded for wrong response. The maximum mark for the test is thirty and the minimum mark is zero. The Knowledge of Error Diagnosis Test is appended. (Appendix – H).

**3.16 CONDUCTING THE EXPERIMENT**

**Administering Pre-test**
Pre-test was administered to both experimental and control group students of first year computer science students, Sarah Tucker College, Tirunelveli. There were 22 students in each group. The test was completed by them within 60 minutes.

**Giving the treatment**
After conducting the pre-test to both control and the experimental group, the experimental group students were taught on the topic POINTERS in C language using the “Pointers Software” developed by the researcher. The topic was taught them using LCD projector for an hour per day, and it was conducted for around 21 days. The control group students were taught the same content using lecture method by the investigator, for the same period of time.

**Teaching with Pointers Software**
The experimental group students were seated in a good infrastructural facilitated presentation lab. The content was showed on the screen using LCD projector. The investigator presented the slides in an appropriate manner. The concepts were explained very clearly with the help of the projector and it was used for around 21 days regularly.

**Traditional Method of Teaching**
The control group students were seated in the actual class room. The same content was taught to them using lecture method by the investigator.

**Administering post-test**
After conducting the experiment both the experimental and the control groups were given post-test. Their responses were valuated with the help of the scoring key prepared by the investigator.

**Administering Retention test**
After the administering the post-test, retention test was conducted with the time gap of 15 days among the experimental and control group students to find the effectiveness of the “pointers software” in retaining the concepts learnt.
3.17 STATISTICAL TECHNIQUES USED

Statistics is the body of mathematical techniques or process for gathering, organizing, analyzing and interpreting numerical data. The researcher used the following statistical techniques for analyzing the data.

Mean

The researcher calculated mean, since it is the base from which many other important measures are computed.

Percentage analysis

It is used to classify the students into different categories like low, average and high using the mean and standard deviation value. The score below the confidence interval will be considered as low, within the confidence interval will be taken as average and above confidence interval will be high.

Standard Deviation

It is used to find the significance interval and how much the group is deviated from the mean scores. The researcher used this value to find the “t” value. Both mean and standard deviation, is used to classify the students into different categories based on levels.

Critical ratio

The researcher used ‘t’ test to verify whether there is any significant difference between means of samples are significant or not. In this study the researcher used ‘t’ test to check the significant difference in the gain scores of experimental and control group students.

Analysis of Variance

The researcher used ‘F’ test to verify whether there is any significant difference among the variances of sample are significant or not. In this study, the researcher used ‘F’ test to check the significant difference among the left, right, and middle brain dominant experimental and control group students in the gain scores and retention scores.
Chi-Square

The researcher used chi-square test to verify whether there is any significant association between the demographic variables: Educational qualification of the fathers and Mothers, order of birth, Income of the families and gain scores, retention scores of the experimental and control group students.

Correlation techniques

It is used for measuring the degree of relationship between two variables. It shows us the extent to which values of one variable is linked to another variable. Pearson Coefficient of Correlation was used in this study to find the coefficient of correlation between the post-test scores of experimental and control group students with respect to variables like Logical-mathematical intelligence, Self-efficacy in using C language, Knowledge of error Diagnosis and meta-cognition.