CHAPTER III
METHODOLOGY OF THE STUDY

The present chapter deals with the design of the study. It describes experimental design, sample, variables to be studied, tools, procedure and statistical techniques used for analysis of data.

The procedure of the study is described in this chapter in its different aspects:

- Design of the Study
- Sample
- Variables
- Development of Achievement test
- Tools and their Description
- Statistical Analysis of data

3.1 DESIGN OF THE STUDY

In the present investigation a 2 x 2 x 2 factorial design was employed to examine the influence of Instructional Design, Achievement Motivation and Personality Types on Achievement in Bloom's Taxonomic Categories in the areas of Knowledge, Comprehension, Application and Total of three Taxonomic Categories.

The study designed to investigate it is termed as a factorial study. According to Tuckman (1972) within the factorial design, it is possible to assess the effect of each independent variable separately as well as their joint or simultaneous effect. In an endeavour to improve the logical foundations of a scientific investigation, factorial design has proved one of the most fruitful developments.
3.1.1 Dimensions of the Design

The present study has been carried out in accordance with the requirements of $2 \times 2 \times 2$ factorial design. There are three independent variables viz., Instructional Design, Achievement Motivation and Personality Types. Each of the variables was studied at two levels.

Factor of Instructional Design is designated as "I" and it may be divided into two levels; that is, $I_1$, Computer Assisted Instruction (CAI) and $I_2$, Overhead Projector (OHP). Achievement Motivation is designated as "A" and its two levels are $A_1$, High-Achievement Motivation and $A_2$, Low-Achievement Motivation. Personality Types is designated as "P" and its two levels are $P_1$, Introvert group and $P_2$, Extrovert group.

The Achievement in Bloom’s Taxonomic Categories in the areas of Knowledge, Comprehension, Application and Total of three Taxonomic Categories was taken as dependent variable for the present study.

3.1.2 Design of the Study

Sample
[600 students]

1. Achievement Motivation $A_1$ (27%) $A_2$ (27%)

2. Personality Types (M ±0.50) $P_1$ $P_2$

3. Instructional Design $I_1$ $I_2$ $I_1$ $I_2$ $I_1$ $I_2$ $I_1$ $I_2$

Fig 3.1 Lay Out of the Design
The design given in Fig. 3.1 has been replicated four times by taking Achievement in Knowledge, Comprehension, Application and Total of these three Taxonomic Categories respectively as dependent variable for each replication. The factors of Achievement Motivation, Personality Types and Instruction Design have been varied at two levels each. The description of the levels of these factors is given in Table 3.1.

A treatment was obtained by selecting one level from each of three factors. The table number of different combinations came out to be $2 \times 2 \times 2 = 8$ as displayed below:

**Table 3.1**

<table>
<thead>
<tr>
<th>MAIN FACTORS</th>
<th>TREATMENT COMBINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&lt;sub&gt;H&lt;/sub&gt;, High-Achievement Motivation</td>
<td>P&lt;sub&gt;I&lt;/sub&gt;, Introvert group</td>
</tr>
<tr>
<td></td>
<td>P&lt;sub&gt;E&lt;/sub&gt;, Extrovert group</td>
</tr>
<tr>
<td>A&lt;sub&gt;L&lt;/sub&gt;, Low-Achievement Motivation</td>
<td>P&lt;sub&gt;I&lt;/sub&gt;, Introvert group</td>
</tr>
<tr>
<td></td>
<td>P&lt;sub&gt;E&lt;/sub&gt;, Extrovert group</td>
</tr>
</tbody>
</table>

The description of eight treatment combinations is given below:

1. $A_{1}, P_{1}, I_{1}$, High-Achievement Motivation, Introvert, Computer Assisted Instruction.
2. $A_{1}, P_{1}, I_{2}$, High-Achievement Motivation, Introvert, Overhead Projector.
3. $A_{1}, P_{2}, I_{1}$, High-Achievement Motivation, Extrovert, Computer Assisted Instruction.
4. $A_{1}, P_{2}, I_{2}$, High-Achievement Motivation, Extrovert, Overhead Projector.
5. $A_{2}, P_{1}, I_{1}$, Low-Achievement Motivation, Introvert, Computer Assisted Instruction.
6. A₂P₁I₂, Low-Achievement Motivation, Introvert, Overhead Projector.
8. A₂P₂I₂, Low-Achievement Motivation, Extrovert, Overhead Projector.

3.2 SAMPLE

In accordance with the design of the experiment, random sampling technique was employed to raise the sample. The research investigation was carried out on the students of diploma course taken from different Technical Colleges from the northern part of Thailand. The total sample consisted of 600 students. The structure of the sample is given in table 3.2.

Table 3.2

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of the College</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Chiangrai Technical College</td>
<td>200</td>
</tr>
<tr>
<td>2.</td>
<td>Phayao Technical College</td>
<td>200</td>
</tr>
<tr>
<td>3.</td>
<td>Nakhonsawan Technical College</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>600</td>
</tr>
</tbody>
</table>

The sample for final analysis was 120 students in the 2 x 2 x 2 factorial design. For the analysis of results as per requirements of the 2 x 2 x 2 factorial design, the grouping of the students forming the sample of the investigation was done by Kelley's (1939) consideration of taking 27% top and bottom scores forming the High-Achievement Motivation and Low-Achievement Motivation groups, whereas the criterion of Mean ± 0.50 SD was used for classifying students into Introverts and Extroverts on the variable of Personality Types. The sample for analysis in the 2 x 2 x 2 factorial design was randomly chosen in equal number of 15 students in each of the 8 combinations. Therefore, the total sample consisted of 120 students.
The number of students in the eight conditions warranted by the 2 x 2 x 2 factorial design is given in table 3.3.

<table>
<thead>
<tr>
<th>Instructional Design</th>
<th>Achievement Motivation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Introvert</td>
<td>Low Introvert</td>
</tr>
<tr>
<td>CAI</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>OHP</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

3.3 VARIABLES

- Independent Variables
  - Instruction Design
    - I₁, Computer Assisted Instructional (CAI)
    - I₂, Overhead Projector (OHP)
  - Achievement Motivation
    - A₁, High-Achievement Motivation
    - A₂, Low-Achievement Motivation
  - Personality Types
    - P₁, Introvert
    - P₂, Extrovert
• **Dependent Variable**

Achievement in subject of AutoCAD R14 of the Industrial Education Students of Thailand in Bloom's Taxonomic Categories in the areas of Knowledge, Comprehension, Application and the Total of these categories was taken as a dependent variable for each replication of the 2 x 2 x 2 factorial design.

### 3.4 DEVELOPMENT OF ACHIEVEMENT TEST

The investigator could not get an appropriate standardised achievement test in AutoCAD R14. The need was felt to develop an achievement test to evaluate the pupil's achievement in Knowledge, Comprehension and Application on the topics selected for the study.

Before constructing the items the investigator went through all test items prepared by experts in AutoCAD R14. The content and language of all of items were discussed with six different expert teachers of Three Technical Colleges from the northern part of Thailand.

In the present chapter the details of the various steps taken to develop the test have been given below:

♦ **Content of the Study**

The test devised covered the contents from the following four units selected for the study:

- **Unit 1 Starting AutoCAD**
  - Starting AutoCAD
  - Using the Mouse
  - Understanding the AutoCAD interface

- **Unit 2 Style setting**
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- Conforming to Standards
- Setting up New Drawings
- Using the Quick Setup Wizard
- Using the Advance Setup Wizard

Unit 3 Working with Polar and Cartesian Coordinates
- Using a Coordinate System to Specify Points
- Using Cartesian and Polar Coordinates Systems
- Entering Absolute X, Y Coordinates
- Entering Relative Coordinates
- Entering Polar Coordinates
- Specifying Units and Angles

Unit 4 Creating Objects
- Drawing Lines
- Drawing Polylines
- Drawing Multilines
- Drawing Polygons
- Sketching Freehand

♦ Objectives of the Study

The specific objectives selected pertained to Knowledge, Comprehension and Application in Bloom's Taxonomic Categories. The objectives have been given below:

Unit 1 Starting AutoCAD
- To enable students to start AutoCAD
- To enable students to practise using the Mouse
- To enable students understanding the AutoCAD interface
Unit 2 Style setting
- To enable students to practise conforming to standards
- To enable students to practise setting up New Drawings
- To enable students to practise using the Quick Setup Wizard
- To enable students to practise using the Advance Setup Wizard

Unit 3 Working with Polar and Cartesian Coordinates
- To enable students to practise using a Coordinate System to Specify Points
- To enable students to practise using Cartesian and Polar Coordinates Systems
- To enable students to practise entering Absolute X, Y Coordinates
- To enable students to practise entering Relative Coordinates
- To enable students to practise entering Polar Coordinates
- To enable students to practise specifying Units and Angles

Unit 4 Creating Objects
- To enable students to practise Drawing Lines
- To enable students to practise Drawing Polylines
- To enable students to practise Drawing Multilines
- To enable students to practise Drawing Polygons
- To enable students to practise Sketching Freehand

♦ First Draft

The first draft of achievement test consisted of 120 items and comprised items of Knowledge (60 items), Comprehension (37 items) and Application (23 items).

The administration of the first draft was done on a representative group of fifty students of Diploma level of Chiangrai Technical College of Thailand.
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The test was administered to a group which had already been exposed to the content of the test.

♦ Type of Items of the First Draft

The items in each level of Knowledge, Comprehension and Application were 60, 37 and 23 respectively. The total was 120 items and comprised items of multiple choice (48 items), matching type (48 items) and true-false type (24 items). The types of items of the first draft have given in table 3.4 and the table showing number of items of the first draft in Bloom’s Taxonomic Categories have given in table 3.5.

Table 3.4

<table>
<thead>
<tr>
<th>Unit</th>
<th>Multiple Choice</th>
<th>Matching</th>
<th>True-False</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>12</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>12</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>12</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>12</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>48</td>
<td>24</td>
<td>120</td>
</tr>
</tbody>
</table>

Table 3.5

<table>
<thead>
<tr>
<th>Taxonomic Categories</th>
<th>Learning-Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Knowledge</td>
<td>3,6,7,10,11,12,13,14,15,16,17,18,19,20,21</td>
<td>5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,25</td>
</tr>
<tr>
<td>Comprehension</td>
<td>1,2,4,5,8,9,26,27,28</td>
<td>1,2,3,4,27,28,29,30</td>
</tr>
<tr>
<td>Application</td>
<td>22,23,24,25,29,30</td>
<td>21,22,23,24,26</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>
For the test, item analysis was carried out in accordance with Kelley's (1939) consideration by taking 27% of the upper and lower groups for analysis. Item difficulty is the mean item score which stands for empirical probability that the target population will pass the item. In this study two groups of 27% students each falling under Upper Category and Lower Category were selected. In each group the investigator had \((0.27 \times 50 = 13.5)\) 14 students.

Difficulty Value (D.V.) and the Discriminating Power (D.P.) were calculated for these groups making the total of 28 students.

For calculating the Difficulty Value (D.V.) and the Discriminating Power (D.P.), the following formulas were used:

\[
\text{D.V.} = \frac{R_u + R_l}{N}
\]

\[
\text{D.P.} = \frac{R_u - R_l}{0.5(N)}
\]

Where

- \(R_u\) = Number of right responses in the Upper group.
- \(R_l\) = Number of right responses in the Lower group.
- \(N\) = Total Number of students in both groups.

The D.V. and D.P. for each item thus completed are given in Appendix C.

It may be noted from the Appendix C that the difficulty value of the achievement test items of the first draft ranged from .21 to .82 and the discrimination power ranged from .07 to .71. For the selection to the items the criteria recommended by Ebel (1966) were given due consideration as given below:

<table>
<thead>
<tr>
<th>Index of Discrimination</th>
<th>Item Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 0.40 &amp; above</td>
<td>Very good Items</td>
</tr>
<tr>
<td>- 0.20 to 0.39</td>
<td>Marginal Items Usually Subject to Improvement</td>
</tr>
<tr>
<td>- Below 0.20</td>
<td>Poor Items</td>
</tr>
</tbody>
</table>
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From the above criteria, the items which were accepted, modified and rejected are given in table 3.6.

Table 3.6
Discriminating Power (D.P.) of the First Draft of the Achievement test

<table>
<thead>
<tr>
<th>D.P.</th>
<th>No. of Items</th>
<th>Unit</th>
<th>Item No.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40 &amp; above</td>
<td>37</td>
<td>1</td>
<td>1,2,4,7,10,15,18,20,24,26,27,29</td>
<td>Accepted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1,2,3,4,7,11,13,18,20,25</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>1,3,8,9,16,22,25,26,27,29</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>8,14,15,19,26</td>
<td></td>
</tr>
<tr>
<td>0.20 to 0.39</td>
<td>50</td>
<td>1</td>
<td>3,6,8,9,17,19,21,22,23,28,30</td>
<td>Modified and accepted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>5,6,8,9,10,12,14,26,28,29,30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>2,10,11,12,13,14,15,17,18,19,30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>1,2,3,4,5,6,9,10,12,13,16,17,24,25,27,28,29</td>
<td></td>
</tr>
<tr>
<td>Below 0.20</td>
<td>33</td>
<td>1</td>
<td>5,11,12,13,14,16,25</td>
<td>Rejected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>15,16,17,19,21,22,23,24,27</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>4,5,6,7,20,21,23,24,28</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>7,11,18,20,21,22,23,30</td>
<td></td>
</tr>
</tbody>
</table>

The table 3.6 shows that the items having discriminating power .40 and above were selected as such and items having discrimination power ranging from .20 to .39 were revised and modified and items having discrimination power below .20 were rejected. Out of the total 120 items, thirty-seven were selected as such, fifty were revised and modified, and thirty-three were rejected.

Test items of the first draft having discriminating power from .20 to .39 were modified in the light of:

- Clarity of language
- Complexity of content
- Difficulty level of items
The language of ambiguous and vague items was improved. Directions for attempting the items were made more clear. Items, which seemed having the complexity of the content were made more communicative and readable than were in their original forms.

♦ Second Draft

The items after having been revised and modified on the D.V. and D.P. of the first draft of the achievement test were included in the second draft of the achievement test. The difficulty value and the discriminating power of the second draft of the test were established after administering the test on a sample of 100 students of Diploma level of Chiangrai Technical College in Thailand. The test was given only to those persons who had already been exposed to the content. The table for D.V. and D.P. is given in Appendix C2.

On the basis of Appendix C2 it may be noted that the difficulty value of the achievement test items of the second draft ranged from .11 to .92 and the discrimination power ranged from .00 to .85.

For the selection of items the criteria given by Ebel (1966), were given due consideration. Using Ebel's criteria the items which were accepted, modified and rejected are given in table 3.7.
The table 3.7 shows that the items having discriminating power .40 and above were selected as such and items having discrimination power ranging from .20 to .39 were revised and modified and items having discrimination power below .20 were rejected. Out of the total 120 items, ninety were selected as such, ten were revised and modified, and twenty were rejected.

Test items of the second draft having discriminating power from .20 to .39 were modified in the light of:

- Clarity of language
- Complexity of content
- Difficulty level of items

The language of ambiguous and vague items was improved. Directions for attempting the items were made more clear. Items, which seemed having the complexity of the content were made more communicative and readable than were in their original forms.

♦ Final Draft

After rejection and modification of the items on the basis of the discriminating power analysis the final draft of the achievement test was prepared. The final draft of achievement test consisted of 100 items and comprised items of Knowledge (60 items), Comprehension (25 items) and Application (15 items).

♦ Type of Items of Final Draft

The items in each level of Knowledge, Comprehension and Application were 60, 25 and 15 respectively. The total was 100 items and comprised items of multiple choice (40 items), matching type (40 items) and true-false type (20 items). The types of items of final draft have given in table 3.8 and the table showing number of items of final draft in Bloom's Taxonomic Categories have given in table 3.9.

Table 3.8

<table>
<thead>
<tr>
<th>Unit</th>
<th>Multiple Choice</th>
<th>Matching</th>
<th>True-False</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>40</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 3.9

The Number of Items of Final Draft in Bloom's Taxonomic Categories

<table>
<thead>
<tr>
<th>Taxonomic Categories</th>
<th>Learning-Unit</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td></td>
<td>3,6,7,10,11,12,13,14,15,16,17,18,19,20,21</td>
<td>5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20</td>
<td>1,2,6,8,11,12,13,14,15,16,17,18,19,20</td>
<td>2,3,4,5,11,12,13,14,15,16,17,18,19,20</td>
<td>100</td>
</tr>
<tr>
<td>Comprehension</td>
<td></td>
<td>1,2,4,5,8,9,12,21</td>
<td>1,2,3,4,15,16,17,18,20</td>
<td>3,4,5,7,9,10,22,23</td>
<td>1,6,7,8,9,10,21</td>
<td>25</td>
</tr>
<tr>
<td>Application</td>
<td></td>
<td>22,23,24,25</td>
<td>21,22,23,24</td>
<td>21,24,25</td>
<td>22,23,24,25</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>100</td>
</tr>
</tbody>
</table>

The table 3.9 shows that the total number of items in the final draft was one hundred. Since after the administration of the achievement test second time twenty items were dropped, the draft in the final form was accepted without going to the field again.

The achievement test was evaluated every time after its administration by finding out the reliability and validity. The reliability of the achievement test was calculated by the KR-21 formula. This was used for the simplicity of statistical calculation. One limitation of this method was that it always gave an under-estimate of the reliability coefficient when the items varied in difficulty. If a test included many items on which the average score was near perfect or near zero, the underestimate could be quite large. The use of this method could be defended in view of the remarks of Ebel (1966) that "If most of the items have average scores of more than thirty per cent and less than seventy per cent of the maximum possible score, the underestimate is much smaller." The analysis of both the drafts of the achievement
test reveals that most of the achievement scores fall in this range. The use of KR-21 formula is, therefore, justified.

The following formula was used for finding out the reliability coefficient:

\[ r_n = \frac{n \times S.D.^2 - M_i (n - M_i)}{(n-1) \times S.D.^2} \]

Where

- \( r_n \) = The coefficient of reliability
- \( n \) = Number of items in the test
- \( S.D.^2 \) = The square of the Standard Deviation of the test scores
- \( M_i \) = Mean of the test scores

For the first draft of the achievement test the reliability coefficient was .918 and for the second draft it was .945. The distributions of scores in this regard have been given in Appendix C\(_3\) and Appendix C\(_4\). Thus, the reliability coefficient is higher in case of the second draft of the achievement test.

♦ Normality of The Achievement test

The difficulty-wise distribution of the test in the final form, based on the difficulty level of the second draft minus the consideration of the rejected items is given in table 3.10.
Table 3.10

**Difficulty-wise Distribution of Items in the Final Draft**

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Difficulty Range</th>
<th>Unit</th>
<th>Item Numbers</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Between .00 and .25</td>
<td>1</td>
<td>5,8,9,13,15,21,23,28</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1,10,11,19,21,30</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>5,10,15,21</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>3,8,12,16,17,24,30</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Between .26 and .50</td>
<td>1</td>
<td>1,2,6,7</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>3,4,8,14,15,18,22,26</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>1,3,7,16,17,18,24,29</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>2,10,11,19,25</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Between .51 and .75</td>
<td>1</td>
<td>10,12,14,16,18,24</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>5,9,16,23,24,28</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>8,9,12,13,14,19,20,25</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>4,6,14,20,22</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Between .76 and 1.0</td>
<td>1</td>
<td>11,19,22,25,27,29,30</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>6,12,17,20,27</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>4,23,26,28,30</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>1,5,7,23,26,27,28,29</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.10 indicates that the items are distributed over the entire range of difficulty. Garrett (1958) has recommended the following distribution of items according to difficulty level for ensuring normality:

1. Items passed by 76 to 100 % (25 %)
2. Items passed by 51 to 75 % (25 %)
3. Items passed by 26 to 50 % (25 %)
4. Items passed by 0 to 25 % (25 %)

Judged on these standards we see that the difficulty-wise distribution of the final draft of the achievement which has been given in Appendix C2 compares favourably with the conditions recommended by Garrett for ensuring normality.

The achievement test was used as the test at the experimental stage of the study and a copy of the test has been provided in Appendix C.

### 3.5 TOOLS AND THEIR DESCRIPTION

Following tools were used for the study:

**3.5.1 Deo-Mohan Projective Test of Achievement Motivation (1986).**

Deo-Mohan projective test (1986) constructed by Dr. Pratibha Deo (Pune) and Dr. Asha Mohan (Chandigarh) was used for the collection of data on Achievement Motivation (nAch) of the subjects. It is a projective test for the measurement of Achievement Motivation of the students at the high/higher Secondary, College or University levels. A standard verbal measure, which sufficiently measures the Achievement Motivation in general is desired. The test contains of 50 items. Two stencil keys are to be used for scoring: one for positive items and one for negative items, 37 are positive and 13 are negative items. A positive item carries the weight of 4, 3, 2, 1 and 0 for the categories of Always, Frequently,
Sometimes, Rarely and Never. The negative item is to be scored 0, 1, 2, 3 and 4 for the same categories respectively.

For validity, the scale scores were correlated with scores obtained by administrating the Aberdeen Academic Motivation Inventory of Entwistle (1969) yielding a coefficient of correlation as .75 for a mixed sample of 93. This correlation is high enough to establish the validity of scale. For reliability, draft of the tool was administered on 51 students of government higher secondary schools by test-retest method with an interval of 4 weeks. The value was found to be 0.69 which was significant at .01 level of confidence.

In this study the questionnaire was translated into Thai language in order to administer the same to the students. Help was taken from experts in Thai language to see that translation was authentic and conveyed the real meaning of the original statement. This instrument was tried out on 50 Diploma level students of technical college from northern part of Thailand. The reliability of this try out was .83 by split half method. This was regarded as sufficient to warrant the use of this test.

3.5.2 Maudsley Personality Inventory (M.P.I.) 1986.

The Maudsley Personality Inventory (M.P.I.) is the result of many years of developmental work. It was designed to give a rough-and-ready measure of two personality dimensions-neuroticism or emotionality and extroversion. It has been reviewed in "The Structure of Human Personality" of Eysenck,H.J. (1960).

The M.P.I. has been administered to large numbers of subjects, both normal and neurotic. The original sample of 200 men and 200 women on whom item analyses and factor analyses were carried out has been supplemented by groups of students, industrial apprentices, nurses and a quota sample of the whole population; also available are data on various neurotic groups on prisoners and on sufferers from psychosomatic disorders.
Both split-half and Kuder-Richardson reliability coefficients have been calculated on many samples. For the neuroticism scale, these values nearly all lie between .85 and .90; for the extroversion scale, they lie between .75 and .85 with the majority above .80. Retest reliabilities are available only on about 100 cases; they are .83 and .81 respectively. As regards the short scale, split half reliabilities on a quota samples of 2,000 men and women are .80 and .72.

For calculating reliability, the draft is re-administered on the 31 teachers of secondary schools of Thailand. The statistical value of reliability alpha coefficient is found to be .70 (Sarataphun, 2001).

The inventory for this study is translated into Thai language in order to administer on the 50 Diploma level students of technical college from northern part of Thailand. The statistical value of reliability alpha coefficient was found to be .78 which indicated that the tool was reliable.

3.5.3 Instructional Design on CAI and OHP.

The AutoCAD software produced by Autodesk, Inc. (1997) which is standardised programme and OHP Instruction was developed by investigator on the content of AutoCAD R14 with reference to Diploma level course of the Department of Vocational Education (DOVE) Ministry of Education of Thailand.

The content was divided into four units in order of ascending level of difficulty. The first unit pertained to the Starting AutoCAD, Using the mouse and Understanding the AutoCAD interface. The second unit included the Conforming to standards, Setting up new drawings, Using the quick setup wizard and Using the advance setup wizard. The third unit dealt with the working with Polar and Cartesian coordinates, whereas the fourth unit consisted of the Creating objects.

The achievement of the students was measured through CAI and OHP instructions which classified achievement into Bloom’s Taxonomic Categories in
areas of Knowledge, Comprehension and Application. The items of test which evaluated achievement in areas of Knowledge, Comprehension and Application were 60, 25 and 15 items respectively.

The purpose of the test was to measure the achievement of the students learning through two different modes of instruction: CAI and OHP.

3.6 STATISTICAL ANALYSIS OF DATA

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

1. Descriptive statistics like mean, S.D., correlation etc.
2. A three way analysis of variance for $2 \times 2 \times 2$ factorial design.
   2.1 Main effects of Instructional Design, Achievement Motivation and Personality Types of students on Achievement in Bloom's Taxonomic Categories in the areas of Knowledge, Comprehension, Application and on the Total of Taxonomic Categories.
   2.2 Interaction effects of Instructional Design, Achievement Motivation and Personality Types of students on Achievement in Bloom's Taxonomic Categories in the areas of Knowledge, Comprehension, Application and Total of these Taxonomic Categories.
3. Calculation of intercorrelations among the variables under study.

The detailed results and discussions are presented in Chapter IV.