CHAPTER - 11

Method of Study
CHAPTER III
METHOD OF STUDY

In the introductory chapters the study has been mainly focussed on introduction of the theoretical rationale of the problem, review of related studies, and varied learning strategies; Persistence in learning, objectives, hypotheses followed by the development and description of the tools in the second chapter respectively. The present chapter is meant to emphasize on the method of study under the following heads:

- TOOLS
- SAMPLE
- DESIGN OF THE STUDY
- PROCEDURE
- STATISTICAL TECHNIQUES

❖ TOOLS:

Factual material or data unknown or untapped so far is essential in every study. Relevant data, adequate in quantity and quality and also reliable and valid in every respect, is a must. Thus the selection of suitable instruments is of vital importance for successful research, especially in an experimental research study of present type.

Following tools were used for collecting data:

- **10 units of multimedia CAI packages:**
  *(Developed and validated by the investigator)*

  10 units contained the information and knowledge of software CAI. These 10 units focussed on different objectives and content matter and information in Authorwares: electronics. These units were administered on two groups in the sample of 100 students of experimental groups. The development and validation of this package has been discussed in detail in the chapter II.

- **Formative unit tests:**

  10 formative unit tests were developed by the investigator corresponding to each unit of instructional package. These tests consisted of different
number of questions each focusing on different unit contents. There were different types of questions; multiple-choice questions, True or false questions were used in these tests. The unit tests were validated before use (Details have been presented in chapter II).

- **Criterion Test: (Summative Test)**

  *(Developed and validated by the investigator)*

  This criterion Test consisted of hundred questions. This test was used as pre-test and post-test for all the three groups, learning in individualised, cooperative and conventional learning situations. The details of the test have been given in chapter II.

- **A prerequisite Skill Tests:**

  *(Developed and validated by the investigator)*

  Two tests were used as pre-requisite tests. Computer Knowledge Test was meant to test the basic knowledge of students on computer and Electronic Background Test focused on content of pre-requisite for learning new instructional material. These tests were used as pre-pre-test.

- **Scale of Persistence:**


  The scale of persistence consisted of statements on persistence and the student is supposed to give response on a five point scale. It consisted of 56 items.

❖ **SAMPLE:**

The process of investigation or an experiment includes sample as one of the major ingredients. Sampling is an important aspect of life in general and enquiry in particular. We make judgement about people, places and things on the basis of fragmentary evidence (Garrett, 1966; 1981; Edwards, 1968; Smith, 1975).

*Cambridge Dictionary of Statistic* (1998) defined the word *Sample* as selected subject of a population chosen by some process usually with the objective of investigating particular properties of the parent population. The process of selecting some parts of a population to observe, so as to estimate something of interest about the whole population, is known as sampling.
In fact, every investigator will have some doubts in obtaining the sample and making observations and its best utility. Sampling is critical to external validity, the extent to which findings of a study can be generalised to people or situations other than those observed in the study. In order to generalise validity of the findings from a sample, some defined populations are required.

There are two types of sampling-probability and non-probability. A **probability sample** is one in which each individual in the population has a known, nonzero chance of being selected in the sample.

- **Probability sampling techniques:**

  Simple random sampling, stratified sampling, cluster sampling, systematic sampling, these are all referred to as probability sampling techniques because we can state the probability that a person in a population will be selected for the sample.

  The most basic type is the simple random sample. In a simple random sample, every individual (and every combination of individuals) has the same chance of being selected in the sample. This is the equivalent of writing each person's name on a piece of paper, putting them in plastic balls, putting all the balls in a big bowl, mixing the balls thoroughly, and selecting some predetermined number of balls from the bowl. This would produce a simple random sample.

  We take a sample from a larger group, or population. To be sure that our data generalizes to our population of interest we need to select a random sample. A random sample should be representative of the population from which it is drawn.

  - There is no pattern to choose a random sample. All members of the population have an equal chance of being selected. To select a random sample we use a table of random numbers or a computer program. Of course, the computer program is really the way to go (excel example: `rand()*(b-a) + a;` between b and a). To use the table of random numbers we simply assign participants numbers and then starting somewhere in the table pick those participants with the numbers listed in the table on computer.

  - The random sample will likely be representative of the population in terms of many characteristics of the population (proportion of sex, ethnicity, SES, etc). But it will most likely not to have the same exact proportions of these groups as the population.
Determining Sample Size:

- Will need a fairly large sample to generalize the population.
- General rules of thumb.
- If a population is 100 or smaller => sample entire population.
  - 500, sample 50%
  - 1500, sample 20%
  - as population gets bigger you should sample about 400.
- Sample size is also dictated by the number of variables that we plan on looking at, more variables require a larger sample.
- In reality the sample size is dictated by the size of the effect that we are looking for. The smaller the effect the larger the sample needed to find it.
- Larger effects will be detected with smaller samples.

Having a random sample is usually a prerequisite to doing inferential statistics (define descriptive and inferential statistics).

To ensure good representation in particular groups we should use stratified sampling.

- **Stratified sampling**
  - If we want to do research that involves a categorical variable (such as sex) we might want to have an equal number of girls and boys
  - One way to accomplish this is to use a stratified sample
  - The sample is first stratified or grouped based on the variable of interest. In this case sex is the grouping variable.
  - The researcher would then draw equal samples from the groups of boys and girls.

Subgroups in the population are represented in the sample in the same proportion as they are in the population;

- Can select specific sizes of subgroups to be representative of the population (voting, polling example) => this is called proportional stratified sampling
- Can also select equal-sized subgroups (nonproportional)

  Basically we just randomly sample within each subgroup or strata within each selected group. We could then divide the participants into two or more treatment groups if we wanted to stratify sampling. It would require to go to multiple locations to collect data, in order to avoid this we could use cluster sampling.
Method of Study

- **Cluster Sampling**
  It is often very difficult to gain access to entire populations, a complete random sample is difficult most of the time. Using cluster sampling we can identify a group of individuals in our population and sample groups instead of individuals. In this procedure we would want to randomly select more than one cluster to ensure better generalizability. Better chance, with cluster as opposed to random, of getting a nonrepresentative sample; it is likely, for example, that the district or school, might not be representative of the population.

- **Systematic Sampling**
  Selecting every Kth name from a list pretty much guaranteed to be nonrandom unless the list is random. But this is a rare case skipping over nationalities (not representative of groups), names of individuals from certain countries group together, using every Kth name might skip over a certain ethnic group.

- **Selecting a nonrandom sample**
  Much harder way to whom the results generalize to. Many have said that this is a problem in most psychology research (the college sophomore problem) => most participants are freshmen and sophomore students enrolled in an intro psyc class (this is an example of convenience sampling)

  A nonprobability sample is one in which each individual in the population does not have a known chance of selection in the sample. There are several types of nonprobability samples. For example, magazines often include questionnaires for readers to fill out and return.

- This is a volunteer sample since respondents self-select themselves into the sample.
- Another type of nonprobability sample is a quota sample. Survey researchers may assign quotas to interviewers. For example, interviewers might be told that half of their respondents must be female and the other half male. This is a quota on sex. We could also have quotas on several variables (e.g., sex and race) simultaneously.

The sample in the present investigation was selected at two levels.

- College Sample
- Student Sample
• College Sample: The selection of college sample for the present investigation was done from three Technical Colleges under Department of Vocational Ministry of Education in the Uthaithani and Chainat provinces of central Thailand. The three technical colleges were selected randomly from a list of technical colleges of Uthaithani and Chainat, viz: Uthaithani Technical College, Uthaithani Polytechnic and Chainat Technical College.

• Student Sample: The sample was considered on the age group of 16. Both boys and girls were included in the sample. A section of 50 students randomly chosen from each of these three colleges constituted the experimental groups and group III constituted the control group.

**Table 3.1**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Group</th>
<th>Name of the College</th>
<th>No. of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cooperative Learning</td>
<td>Uthaithani Technical College</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>Individualistic Learning</td>
<td>Chainat Technical College</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>Conventional Learning</td>
<td>Uthaithani Polytechnic</td>
<td>50</td>
</tr>
</tbody>
</table>

Persistence wise distribution of these students was studied at three levels of persistence (high, average and low). Persistence wise distribution of the sample has been presented in the table 3.2.

**Table 3.2**

<table>
<thead>
<tr>
<th>Groups</th>
<th>Levels</th>
<th>Total of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HP</td>
<td>AP</td>
</tr>
<tr>
<td>Cooperative Learning</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Individualistic Learning</td>
<td>13</td>
<td>21</td>
</tr>
<tr>
<td>Conventional Learning</td>
<td>17</td>
<td>16</td>
</tr>
</tbody>
</table>
The table 3.2 reveals that all the three groups had almost equal number of students in respect of high, average and low persistence.

**DESIGN OF THE STUDY:**

For any kind of study a proper planning and experimentation are essential features. Educational research is described as experimental when the researcher has
- firstly, specified the finite set of researchable hypotheses and
- secondly, established a systematic programme of the data gathering, under precisely defined conditions in an effort to test these hypotheses (Ingersoll, 1982).

The good experimental design should provide some information with respect to all the objectives of the experiment (Winner, 1971) and be kept as simple as possible (Montgomery, 1984).

The present study employed an experimental method with 3x3 factorial design. Computational procedures were followed according to the techniques given by Winer, (1971) and Brooter, (1999). In the 3x3 factorial design, instructional treatment and persistence levels were to independent variables. Out of these two independent variables, instructional treatment was studied at the three levels viz:
- CAI with Individualistic Learning (IL)
- CAI with Cooperative Learning (CL)
- Conventional Group Learning (CGL)

Whereas the second independent, classification variable, persistence was studied at three levels viz:
- High Persistence
- Average Persistence
- Low Persistence

The schematic layout of the design has been given in Figure 3.1.

However pooled treatment effect of CAI (in Individualistic Learning situation and Cooperative Learning situation) as against Conventional Group Learning was also studied and a 2x3 design was employed for this purpose, as shown in Figure 3.2.
Figure 3.1 Layout of the Design

Method of
Figure 3.2 Layout of the Design

Achievement Gain Scores

CAI
IL and CL

High Persistence
Average Persistence
Low Persistence

CGL

High Persistence
Average Persistence
Low Persistence

The layout codes:

HP : High Persistence
AP : Average Persistence
LP : Low Persistence

CAI : Computer Assisted Instruction
CGL : Conventional Group Learning
IL : Individualistic Learning
Method of Study

• Controls of the experiment:

Since the study involved manipulation of variables, it was necessary to exercise control on some intervening variable. Two separate analyses were done on these learning outcomes belonging to the two domains of behaviours.

• One of the main contestants in every empirical study is that conclusions always have to be inferred observations (Norton, 1952; De-Klerk, 1979). Identification and control of relevant variables are two of the most critical tasks confronting most researchers (D’Amato, 1970). Although the control of known or potentially relevant variables is often not difficult to accomplish, their identification frequently insight and ingenuity (Church, 1964; Rescorla, 1967; Solomon, and Lessac, 1968; Seligma, 1969). The matter of detecting unrecognized relevant variables rests entirely with the experimenter’s perceptiveness (Solomon, and Lessac, 1968). The reason the experimenter wishes to control known and potentially relevant variables is to avoid repetition and contamination (Seligma, 1969). One goal of experimental research is to determine how the independent variables of the study affect the dependent variables (D’Amato, 1970). Most control measures fall into one of the three general types of control techniques: Matching, Randomization, and Counterbalancing.

In matching techniques, the investigator obtains full control of the relevant variables for a particular experiment being investigated (Church, 1964; Scriven, 1967; D’Amato, 1970). Control is achieved by equalization of the effects of the relevant variables over all values of the independent variables of the study (Seligma, 1969). And this may be well equated in a particular experiment particularly if the number of the total sample involved is small (Rescorla, 1967). Counterbalancing techniques on the other hand, can provide either type of control i.e. equalization of the effects of the relevant variables in the single experiment or over the long run (Rescorla, 1967).

In the present investigation, the control was exercised using these control techniques:

• Matching of the groups was one control wherein all the relevant variables were controlled. The groups were matching on all the relevant variables like intelligence, age, gender, socio-economic status, and Entry Behaviour of
Method of Study

the learner etc. This was essential also because; three instructional treatments were administered in three different colleges to avoid contamination. The control of this experimental variable was also exercised by assigning the same teacher to all the treatment groups. Hence Pre-tests, Post-test and instructions were imparted under similar conditions of classroom environment and instructions. Since the experimenter could not administer the treatment exactly in the same period of time, there remained a gap of almost twenty days for each college. This limitation was however overcome by employing a 3x3 and 2x3 ANOVA on gain scores and the initial differences were taken care of by the statistical analysis.

- Randomization was another control, which was exercised for the selection of colleges and allocation of students to various treatment groups.

❖ PROCEDURE:

For an effective investigation every researcher follows a procedure of the experiment, which contain two stages:

- Selecting the sample
- Conducting the experiment

Selecting the sample: The process of sample selection has already been discussed under the heading sample in the previous paragraphs of this chapter.

Conducting the experiment: The experiment was conducted stepwise as presented below.

Step I : Administering Entry Behaviour / Prerequisite Skill Test.
Step II : Administering Scale of Persistence.
Step III : Administering Pre-Criterion Test.
Step IV : Providing 10 units of multimedia CAI packages, along with their corresponding formative tests.
Step V : Administering Post Criterion Test

Step I : Administering Entry Behaviour / Prerequisite Skill Test :

The investigator chose three groups of students from three Technical colleges selected in central part of Thailand. Irrespective of gender, students were selected for the experiment. The investigator interacted with the students and gathered the
impressions of the students on Multimedia in CAI, before supplying the material of CAI package units. The researcher conducted Entry Behaviour Test to test the basic knowledge of the computers and the basic pre-requisite skills required for studying content units of instructional package.

All the students (N=150) were given the Entry Behaviour Test. The test was designed by the investigator to evaluate the basic level of knowledge of the students. Since the students of experimental group were supposed to learn through multimedia computer assisted instruction, their proficiency to work with multimedia was essential. Hence Entry Behaviour test consisted of two parts—one related with knowledge of computer basics and the second with the pre-requisite skills. Both thesis tests helped in evaluating entry behaviour status of students in respect of computer proficiency and their pre-requisite skills.

**Step II : Administering Scale of Persistence:**

The purpose of the scale was to measure the response and to locate group of individuals selected under sample at some point on the continuum of persistence scale. During this step, scale of persistence was administered to all the students of the total sample, from three technical colleges. Separate answer sheets were provided for this purpose. The students were given one time of 30-40 minutes to give their response. The response sheets were collected after each student had filled it up. The investigator herself monitored this process. The response sheets were scored according to the prescribed scoring keys. These scores were later used to classify students.

The measurement of an individual student’s persistence was obtained by combining the scores made on number of statements. A draft of 56 statements was given to assess the score of persistence of students before they were subjected to instructional treatment. Each statement was supposed to be answered on a five-point scale. The scoring was done according to the prescribed scoring key of the persistence scale and students belonging to high, average and low persistence were identified. This was done to ensure that each of the three instructional treatment groups has an adequate and similar number of students in respect of levels of persistence.
Step III: Administering Pre-Criterion Test:

Before starting with the Instructional Programme, all the students of selected groups were given Pre-Criterion test. Space for answer was provided with questions. One hour and a half were given to complete the tests. Scoring was done to obtain the information regarding pre-treatment knowledge of the students on selected content. This was repeated in all the three selected colleges before implementing the treatment.

Table 3.3
Schedule of Pre-Testing of the Sample

<table>
<thead>
<tr>
<th>College</th>
<th>Prerequisite Tests</th>
<th>Scale of Persistence</th>
<th>Pre-criterion Test</th>
</tr>
</thead>
</table>

Step IV: Providing 10 units of multimedia CAI packages, along with their corresponding formative tests:

The investigator developed 10 units of Computer Assisted Instructional package for the purpose of providing basic information and knowledge of Authorware to the sample of 150 students selected randomly from three Technical colleges in the central part of Thailand. For the experiment the students were divided into three groups. Each group consisted of 50 students. Thus, two groups comprised experimental group and one group was considered as control group.

Instructional treatment was imparted to 150 students within intact group selection plan. Instructional treatment of Multimedia CAI in Individualistic situati
was imparted to one group of 50 students. Multimedia CAI through Cooperative
learning situation to another group of 50 students and a group of 50 students were
used as a Control group, who were taught through Conventional Group Learning
situation.

Following sequence of instructional events was followed:

(i) **Planing and Designing of CAI packages:**

Ten Instructional units were prepared and validated by the investigator as
explained in Chapter II. Each unit consisted of some information and questions, which
test the understanding of the student after learning each unit.

In order to know the learning standards of the sample group of students the
investigator prepared these 10 formative tests, one test for one unit in CAI material
respectively. These were used after each unit of first instruction. A summative test
was also designed to evaluate at-the-end achievement level of students.

- **Sequence of Events in the classrooms:**

  Each instructional unit was presented through computer classroom in the
  following sequence:

  The presentation of instructional material was followed by administration of
  10 unit formative tests. The score of these students obtained in these 10 unit formative
tests helped the investigator in finding out the achievement levels of the sample group
  of students. The investigator took initiation in guiding and helping the students
  whenever it was required.

- **For implementing multimedia CAI through Individualistic Learning Situation:**

  - **Instructions by the investigator:** Planning, defining and designing of
    learning strategies had already been carried out. The investigator developed
    instructional packages for multimedia in CAI and were validated also. Ten units were
developed along with two parts of formative test for each unit. A final summative test
    was also developed. Enrichment and remedial materials had been designed for each
    unit and for each trial. The investigator now was mainly concerned about step III i.e.
    implementing the instructional packages. Since it was ascertained earlier from records
    of the diploma students (Chainat technical college) that the colleges had almost
    matched groups with similar demographic, social and economic background. These
    colleges had a wider coverage of society where mainly students from middle class,
    were studying. With a very minor percentage of sample here and there, these students
Method of Study

were uniformly distributed. Hence it was decided that one experimental treatment be implemented to a specific group of diploma students so that there could not be any contamination effect of the treatments. It is quite imperative to point out here that before doing so the investigator had checked that each college had an adequate number of students at the three levels of persistence.

- **Sitting arrangement plan:** The sitting arrangement was done according to the number of students. Each student was provided with a computer and was seated at a handaway distance in front of their computers with the instruction package material in the computer lab.

- **Teacher activities:** The investigator and the regular electronic teachers were observing the student’s practice without any suggestions to them. Through this the teacher/instructor could find probability of learning in individualistic learning strategy.

- **Process of instructional package:**
  - Investigator herself provided the initial guidelines to students developed in advance and started with a brief orientation of the students.
  - The students were informed of what they were expected to learn. For this, the investigator acquainted them with the instructional objectives. They were detailed about the expected learning outcomes in terms of behaviours to give them knowledge about how would they demonstrate learning.
  - After this, teaching-learning process was introduced to explain how they had to learn. The students were provided all the conditions of working on their own and were not pressurized to work fast.
  - After the orientation of students the investigator started with initial instructional process, gradually progressing to the target behaviour.

- **Administrating Formative Tests:**
  - The formative tests were given to the students after learning unit I. The students were informed about their status and worked individually to learn hard spots again.
  - The second unit was introduced and the cycle was repeated for all the units. Each unit was followed by a Formative Unit Test.

243
• A final summative test was administrated at the end of all ten units.

• **For implementing multimedia CAI through Cooperative Learning Situation:**

  • **Instructions by the investigator:** A group of students was chosen from Uthaithani technical college to observe the teaching-learning process of CAI through Cooperative learning.

  • **Sitting arrangement plan:** The sitting arrangement was done by investigator according to the number of the students. Grouping of students was an important factor in Cooperative Learning. The investigator identified similar ability groups on the basis of scores on computer proficiency test, the scores on pre-requisite test and scores on pre-criterion test. Those who scored almost equal on all these three tests were grouped together as one team. About 3-4 students formed one team. These teams worked jointly on the same computer. Students in the team were allowed to discuss among themselves. In all 15 teams were formed for a class of 50 students.

  • **Teacher activities:** The investigator and the regular electronic teacher observed the student’s practice and gave suggestion to them, intermittently. The investigator was monitoring the teamwork. In two teams minor reallocations of students were done till the teams worked smoothly.

  • **Process of instructional package:** For getting very effective results the investigator started with a brief orientation of the students. The students were informed of what they were expected to learn. For this, the investigator acquainted them with the instructional objectives.

    • They were detailed about the expected learning outcomes in terms of behaviours to give them knowledge about how would they demonstrate learning.

    • Rest of the conditions were same as for Individualistic conditions.

    • The students were supposed to take a formative test after each unit.

• **For implementing through Conventional Group Learning Situation:**

  • **Instruction by the teachers:** In Conventional Group Learning, the sample selection was done as already discussed but the process of teaching-learning was different. The learning outcomes were observed through conventional method of
teaching by the teacher in the classroom in a stipulated syllabus assigned by the Ministry of Education, Thailand.

- **Sitting arrangement plan:** The sitting arrangement was done by investigator in the class without practicing with computers and without any tests, so that the student could attain a proper instruction from the teacher.

- **Teacher activities:** The regular teacher taught this group in a Conventional Group Learning situation. However the investigator had supplied a list of contents to this teacher to discuss in her class. Instructions were provided to the students in the class by the electronic teacher. This was mostly teacher-oriented activity. It generally refers to explaining out these chapter by the teacher as a first step and then solving exercise and providing notes for certain important questions of points in detail before students’ direct participation. No formative unit tests were administered to this group.

**Step V : Administering post criterion tests:**

A post criterion test was administered at the end of all the 10 units. Before starting with the instructional programme, the sample of 150 students were selected. Summative test was administered on all the students. Space for answers was provided with the questions. One and half-hour time was given to answer 100 questions in the test. Scoring was done to obtain the information regarding knowledge of the students on the selected objectives of the study of CAI. After administering of tools was over, each tool was scored according to prescribed keys and thus the data were subjected to statistical analysis.

**THE STATISTICAL TECHNIQUES:**

Following statistical techniques were used to analyse data.

- Means and Standard Deviations were used wherever required.
- Graphical presentations were done through Bar Graphs, Frequency Polygons, line diagrams.
Two way analysis of variance was employed on scores of computer knowledge test, pre-requisite skills test and pre-criterion test separately to ascertain similarity of groups.

Two way analysis of variance along with some descriptive statistics was used to analyse the results of Criterion Test (Summative Test). Gain scores were used separated in 2x3 and 3x3 ANOVA.

Each significant F-ratio was followed by t-test.

From the above statistical treatment of the data, the investigator could draw some conclusions after testing the various hypotheses. These have been detailed in chapter IV.