CHAPTER III

PLAN AND PROCEDURE OF THE STUDY

3.1 INTRODUCTION :

This chapter presents in details regarding the plan and procedure of the present study. An attempt has been made to present the details of steps taken to develop the CAI programme and later on to find out its effectiveness.

3.2 SELECTION OF THE CHAPTERS FOR SOFTWARE PACKAGE :

The main objective of this study is to develop a software package and to do so, three chapters of standard XI Chemistry textbook published by GSTB (1st edition 1997) was selected. The chapters were selected in the following way.

The textbook contains sixteen chapters. Analysis of all these chapters show that three different branches of Chemistry namely, Organic, Inorganic and Physical Chemistry are there in the textbook. The chapters on these three branches of Chemistry are as follows :

a) **Organic Chemistry** : This portion includes following chapters of the textbook 1) Organic Compounds; 2) Preparation and properties of hydrocarbons; 3) Purification Detection and Estimation of organic compounds.

b) **Inorganic Chemistry** : It includes a total of eight chapters viz., 1) Chemistry of Metals; 2) Chemistry of Non-Metals- part 1; 3) Chemistry of Non-Metals- part 2; 4) Redox Reactions; 5) Chemical Equilibrium;

6) Chemical Groups; Periodic Properties; 7) Bonding and Molecular structure and 8) Elements, their Occurrence and Isolation.

c)   Physical Chemistry : In this branch of Chemistry, the chapters included are : 1) Atoms, Molecules and Chemical Numerology; 2) States of Matter; 3) Solutions; 4) Structure of Atoms and 5) Energy.

The selection of the three chapters was done on the basis of difficulty levels of chapters in understanding the concepts which was expressed by seventy five students and five Chemistry teachers from few selected schools of Baroda city. For collecting this data, the schools following GSTB syllabus were taken. Baroda city has twenty five English medium secondary schools with science stream at Higher Secondary level. Out of these twenty schools follow the syllabus of GSTB. For wider use of the software, the investigator decided to prepare the software package for the three chapters from the GSTB Chemistry text book of standard XI. From these twenty schools, the investigator selected five schools and from each school a group of fifteen students were selected randomly. The subject teachers were also selected (one from each school). For collecting the attitude and views of students and teachers, they were administrated the unstructured interview schedules. A copy of the interview schedule is given in the appendix (XI). The aspects which were covered in the interview schedule for the students and teachers were as follows :

1) Difficulty in understanding the concepts in the chapters.

2) Difficulties in understanding logical sequencing of the different content points in the chapters.

3) Mode of explanation of the content.

4) The language used for explanation, and

5) Exercises given at the end of the chapters.

The responses collected were analysed qualitatively through content analysis and is presented in the table 1.

TABLE 1 :   THE OPINION OF TEACHERS AND STUDENTS WHO FELT THAT THE CHAPTERS IN GSTB CHEMISTRY TEXTBOOK (1994) OF STANDARD XI ARE DIFFICULT.

Sr. No.	Name of the chapters	Opinion of students in %	Opinion of teachers in %
1.	Atoms, Molecules and Chemical Numerology	40 (53.3)	2 (40)
2.	Elements Their occurrence and Isolation	15 (20)	1 (20)
3.	States of Matter	10 (7.5)	1 (20)
4.	Solutions	23 (30.6)	3 (60)
5.	Structure of Atom	35 (46.6)	2 (40)
6.	Chemical Groups: Periodic Properties	25 (33.3)	1 (20)
7.	Bonding and Molecular Structure	56 (75)	4 (80)
8.	Energy	52 (69.3)	5 (100)
9.	Chemical Equilibrium	15 (20)	2 (40)
10.	Redox Reaction	40 (53.3)	3 (60)
11.	Chemistry of Non-metals Part-1	35 (46.6)	2 (40)
12.	Chemistry of Non-metals Part-2	35 (46.6)	2 (40)
13.	Chemistry of Metals	28 (37.3)	1 (20)
14.	Organic Compounds	55 (73.3)	4 (80)
15.	Preparation and properties of Hydrocarbons	28 (37.3)	3 (60)
16.	Purification, Detection and Estimation of Organic Compound	19 (25.3)	2 (40)

N.B. : Figures within parentheses show % of respondents.

On the basis of this analysis, it was found that the chapters were viz., 7) Bonding and Molecular structure;

8) Energy and 14) Organic Compounds were having the highest difficulty level; These three chapters were selected by the investigator for developing the software package.

3.3 FIRST DRAFT OF THE PACKAGE :

The first draft of the package was prepared by following the steps mentioned below :

CONTENT ANALYSIS :

After selecting three chapters, the content analysis of the chapters was done by keeping in mind the following aspects.

a)   Listing of sub-points

b)   Logical sequencing of the subpoints

c)   Detailing out the sub-points

d)   Graph, figures and examples to be used

e)   Any additional points necessary to be covered.

The content of the chapters were further analysed and updated by taking help of the text books of Chemistry and some other Chemistry books which were relevant for the purpose.

Systematizing : After carrying out the content analysis of the chapters, the sub-points of the chapters were arranged logically. The sub-points were sequenced in a logical order. The order was simple to complex, known to unknown, and concrete to abstract.

3.3.1 DEVELOPMENT OF THE FIRST DRAFT FOR THE PACKAGE CHAPTERWISE :

For developing the package, first of all, computer language was selected on the basis of the requirements of the chapters i.e.

(1)   Size of the letters required.

(2)   Types of the figures, graphs and animated figures to be used.

(3)   Amount of information to be handled at a time.

(4)   Ease in processing the information.

The package was developed on the basis of the concepts of branching programming, wherein a concept is presented followed by the multiple choice questions. Students were given three chances for responding. If students failed to give a correct answer, they could refer home page/corrective feedback for getting the correct answer. Students had to score minimum 50% marks for referring next page or concept. Thus, the package was developed for three chapter as mentioned above in the branching type of programming and therefore Bortland C language was selected. After the development of the package, editing was done by the experts viz. Chemistry teacher, and Computer expert. After editing and finalizing the software package for three chapters, a pilot study was carried out.

3.4 PILOT STUDY :

The package being scrutinized and judged by subject teachers and experts was put to field try out by taking a sample of fifteen students with the following objectives.

1. To know the difficulties faced by the students in understanding the content covered in the software package in terms of logical sequencing of concepts, text language, illustrations and examples used.

2. To know their attitude regarding the evaluation items covered in the software package with respect to their number, type and difficulty level.

3. To know the average time taken by the students to learn each chapter through the software. The pilot study was conducted as follows.

3.4.1 SAMPLE :

For conducting the pilot study, fifteen students were selected randomly as the sample. Fifteen students were taken because the school computer lab has only 15 PC's. They were exposed to the software package prepared for the three chapters. The time duration was of one month. Another group of randomly selected fifteen students was taught through traditional method by school Chemistry teacher.

3.4.2 TOOLS FOR THE PILOT STUDY :

Following tools were constructed and implemented for the pilot study. Investigator had prepared two achievement

tests. One was pre-test and the other was post-test. These tests were constructed to achieve the objective no.2 i.e. to study the effectiveness of the software package in terms of the students.

1.   PRE-TEST :

This test was related to the topics which students have studied in standard 8th, 9th and 10th science textbooks, related to the chemistry portion. The pretest was administered on the students to see whether student's were initially different in terms of their previous knowledge. After preparing the first draft, it was given to the experts for the modifications with regard to the items provided in the test. They were also told to add or delete some items in the test. They were requested to provide necessary suggestions on separate sheet. After receiving their suggestions, the pretest was duly modified and the final version was made ready for administration. The pre-test was of 30 minutes duration and having 25 marks. All the items in the test were objective in nature. The pre-test is given in appendix (I).

2.   POST-TEST :

The second achievement test i.e. post-test was prepared by the investigator to measure the achievement of standard XI science students. In three units of Chemistry textbook i.e. Organic Compounds, Bonding and Molecular structure and Energy. For these three units, the investigater had prepared

and implemented the software package. The test was of 100 marks, having three hours duration. Items of the tests were objective as well as descriptive in nature. After preparing the first draft, it was given to the five experts in the field. They were requested to suggest modifications in the test with regard to the coverage of content, language used, types of evaluation items etc. On the basis of their comments, related to above mentioned aspects, the necessary modifications were done and the final version of the test was made ready for implementation. The post-test is given in appendix (II).

3. UNSTRUCTURED INTERVIEW SCHEDULE :

In order to know the feasibility and appropriateness of the software package prepared by the investigator, it was decided to administer unstructured interview schedule on fifteen students of the experimental group. It is proved in the appendix (VI).

4. STRUCTURED INTERVIEW SCHEDULE FOR CHEMISTRY TEACHER OF STANDARD XI :

This tool was prepared to collect the attitude of Chemistry teacher of standard XI regarding certain aspects of the software like presentation of content, comprehensiveness of the content, language used, adequacy and appropriateness of illustrations and examples and any significant change in students learning behaviour which they have noticed. This

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tool was prepared by the investigator and administered after the experiment was over. A copy of the tool is given in the appendix (VII).

3.4.3 PROCEDURE OF CONDUCTING THE PILOT STUDY AND COLLECTION OF DATA

For conducting a pilot study, the two groups viz., experimental and control were formed as mentioned in the selection of the sample. The students of both the groups were administered a pre-test before starting an experiment. Then the students of experimental group were exposed to the software package developed for the three chapters and the control group of students were taught through the traditional method by the school teachers. The duration of experiment was of one hour everyday before school hour and also for one hour during school hour for a period of one month. The students of the experimental group were told to take their own time for learning through the software package, while the control group students were taught by their regular Chemistry teacher. The method adopted by the Chemistry teacher was lecture method. Students of both the groups control and experimental had parallel classes. During the experiment, the investigator had a plan to record their attendance, difficulties faced by them in understanding the concepts presented, figures, graphs, examples etc. and time taken by them for learning three chapters. At the end of the experiment, students of both the groups were given the post test. Further, the students of the experimental group and two

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Chemistry teachers of standard XI of the school were interviewed by the investigator. Through unstructured interview schedule, students' views regarding comprehensiveness and presentation of content in the software package, adequacy of examples, illustrations, appropriateness of graphs and figures were collected. Similarly observations and views of Chemistry teacher were collected through structured interview schedule. On the basis of findings of pilot study, the necessary changes were made in the software package and that was implemented for the final phase of the experiment.

3.4.4 ANALYSIS OF THE PILOT STUDY DATA :

The data collected were analyzed with the help of ANOVA and ANOVA in order to compare the performance of two groups in terms of achievement scores. In order to se the significant difference in terms of achievement scores, the 0.05 level of significance was taken because, in this study the main aim of the investigator was to develop the software package and find out the usefulness of the developed package. The time taken by the experimental group and control group to learn the three units was compared. The data collected from the students of the experimental group and standard XI chemistry teacher of the school regarding the different aspects of the software package such as comprehensiveness, presentation, adequacy of examples, and appropriateness of graphs and figures in the package after the experiment was

analyzed qualitatively through content analysis. The details regarding analysis and interpretation of data is presented in chapter V.

3.5 FINAL EXPERIMENT :

The prepared software package was further validated for it's effectiveness in the final experiment.

3.5.1 Sample :

For carrying out the experiment, one English medium school namely Don Bosco School Baroda was selected as the sample of the study. This school was following the syllabus of Gujarat State Text Book Board. This school was selected as it had the necessary facilities for carrying out the experiment and above all, the readiness of the school to provide the co-operation. The school had full-fledged computer lab having fifteen PC's with LAN system. The students of the school had an advantage of having orientation and hand-on practice with regard to computers, right from the primary stage. Moreover, this school was having science stream at higher secondary level. Total number of students in the class was 70. As per the objectives of the study, it was necessary to see the difference in achievement of the students between experimental and control group. It was decided to divide the whole class into two groups having thirty students in experimental group and forty students in control group.

3.5.2   TOOL FOR THE FINAL EXPERIMENT :

The set of tools used by the investigator in the pilot study were also used in the final experiment. The tools are pretest, post-test, unstructured interview schedule, structured interview schedule. In addition to these tools, the following tools were also used by the investigator.

1.   ATTITUDE SCALE :

The attitude scale was prepared for achieving the objective no.4 i.e. to know the attitude of the students regarding different aspects of the software prepared as well as about it's implementation. The different aspects covered in the scale were as follows :

(1)   Content of the software

(2)   Presentation of the software

(3)   Examples and illustrations

(4)   Figures and graphs

(5)   Evaluation items

(6)   Instructions given in the manual

(7)   Learning through the software and utility of the software package.

The attitude scale contained twenty five statements related to the above mentioned aspects. The statements were put on a three point scale i.e. agree, undecided and disagree. The first draft was prepared and given to the experts for validation and accordingly it was modified and the final draft was prepared which is given in the

appendix (V). Views and observations were was also collected from Chemistry teachers on the above aspects.

2.   JIM SCALE :

This scale was implemented for studying the objective no. 3 i.e. to study the effect of software package on students achievement in relation to students motivation level.

The academic motivation of the students was measured by using the Junior Index of Motivation (JIM) Scale developed by Jack Frymier. The scores obtained by the students on the JIM scale were taken to represent their academic motivation.

The characteristic being measured through the JIM scale has been referred to by the scale constructor, sometimes as motivation to learn or motivation towards school (Frymier, 1970). The latter type of reference has been made mainly because of the fact that the scale was originally developed and standardized for school children, it measures internal motivation in the students to learn i.e., need in the student due to his own internal state and not developed due to the influence of another person or a competitive environment. Frymier (1970) has reported a split half reliability coefficient of 0.67. The scale consists of eighty items in the form of statement. Although there are 30 items of the scale are not scored, they should be administered because they are filler items. For each statement the student responds by making one of A,B,C,D which represents slight

agreement, strong agreement, slight disagreement and strong disagreement, with the content of the statement. It takes 30 minutes for students to complete the items.

For scoring, responses A,B,C,D re taken to represent 1, 2, -1 and -2 respectively. Student's score for the fifty items are added algebraically. This sum with sign reversed is the raw score value. This raw score value is then added to +100 algebraically. This score is the student's converted motivation score. Higher scores indicate higher motivational level and lower scores indicate lower motivational level. JIM scale is given in the appendix IV.

3. MADHOOKAR PATEL'S INTELLIGENCE TEST (MPIT) :

To study the effect of the software package on students achievement in relation to students intelligence level and to assure intelligence Quotient MPIT (1970) was selected. It is non-verbal group test for grades B-11 and has been standardized over a large population. The tests avoids any cultural content it presents geometric drawings designed to test the students power of abstract reasoning and space perception.

The test consist of 80 items grouped under four parts and it takes 45 minutes time to complete. The first three parts contains 15 items while the last part contains 35 test items, thus there are 80 items. The test retest reliability was 0.938 and split half reliability was 0.979 as reported by the constructor of the test.

For scoring, a scoring key is provided by the scale constructor, the total number of correct answer is the test score. The total number of correct answer is the student's test score, with the help of age of the students and test score on MPIT, the quotients provided in the table gives an IQ for the students. A copy of MPIT can be seen in appendix III.

3.5.3 PREPARATION FOR THE EXPERIMENT :

In order to ensure the validity of the experiment, it was decided to match the experiment and control groups on the basis of academic motivation and intelligence quotient. Hence, MPIT (1970) and JIM scale (1970) were administered on all the students separately. The two sets of tests scores of experimental and control group are attached in the appendix (III) and (IV) along with MPIT and JIM scale.

The MPIT was administered for 45 minutes in the actual classroom setting while JIM scale was administered for the duration of 30 minutes. Both these tests were administered by the investigator herself. In order to clarity doubts if any by the students, necessary instructions for the tests were provided to the student's before administering the test.

TABLE 2 : VALUES OF MEAN AND SD OF IQ AND ACHIEVEMENT MOTIVATION SCORE OF STUDENTS.

	IQ		Achievement motivation	
	Experimental group	Control group	Experimental group	Control group
Mean	125.76	123.58	107.833	111,028
SD	13.86	13.204	15.1062	15.87

On the basis of the scores obtained by the students on these two tests, the two groups were formed. After forming these two groups on the basis of IQ and achievement motivation score, pre-test was given to the students of both the groups. This test was based on the previous knowledge of the students regarding the subject of chemistry. The previous knowledge was consisting of knowledge inputs in the science text book of GSTB for 8th, 9th and 10th standard related to chemistry section. The scores obtained on this test were regarded as pre-test scores in this study. Pre-test is given in the appendix(I).

3.5.4 IMPLEMENTATION OF CAI :

After final version of CAI was prepared, it was implemented on the experimental group. The experiment was conducted for one and a half month (for forty five hours). The learning through CAI package was taking place in the computer lab of the school. While the learning for control

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group was simultaneously going on in the actual classroom through subject teacher's teaching. Each student in the experimental group had separate PC for the learning purpose.

When experimental group was learning through CAI, students' learning was closely observed by the investigator. But the control group was not observed by the investigator when the teacher was teaching there in the classroom. The students of the experimental group were allocated one hour per day for learning through computer and few extra classes were arranged after school hour on the request of the students. During the experiment, difficulties faced by the students were recorded and explanation was provided to the students. Regular attendance was taken and time taken by the students for learning three units was recorded. At the end of duration of one and half month when learning of all the three chapters got over for both the groups, post-test related to the three chapters was administered on both the groups. The time duration for the post-test was 3 hours and it was of 100 marks. The post-test is given in appendix (II). After this, the students of experimental group were given an attitude scale in order to collect their views and suggestions regarding effectiveness of CAI implemented on them, in terms of content of the software, presentation of the software, illustrations, figures and graphs, evaluation items, utility of the software and instructions given in the instructional manual provided with the software.

3.5.5 ANALYSIS OF THE DATA COLLECTED IN THE FINAL PHASE OF THE EXPERIMENT :

Analysis of the data was carried out objectivewise as follows.

(1) The first objective was to develop a software package for three chapters in subject of Chemistry for standard XI Science students. Accordingly, a software package was developed for three chapters of standard XI Chemistry by taking one chapters from each branch of Chemistry and then it was tested to find out it's effectiveness. The software package was developed through continuous monitoring by computer experts subject and feedback from students and teachers.

(2) The second objective was to study the effectiveness of the software package in terms of instructional time and achievement of the students. In order to see the effectiveness of the software in terms of achievement of the students the data collected at pre and post experiment stage through achievement tests was analyzed through ANOVA and ANCOVA. To see the significant difference in terms of achievement score, 0.05 level of significance was taken as mentioned under the title Analysis of Pilot Study Data earlier in this chapter. To see the effectiveness of the software in terms of instructional time, the average time taken by the two groups to learn the three units of Chemistry were compared qualitatively.

(3)   The third objective was to study the affect of the software package on students' achievement ion relation to students (a) intelligence level (b) motivation level and (c) attitude towards the package.

In order to achieve this objective, students of the experimental group were divided into two groups, one group of students having scores on IQ and motivation level lower than the mean score of IQ & motivation level and another group of students having higher values of IQ motivation level than the mean score of the two variables. These two groups were compared with their scores on post-test and their attitude towards the package. In addition to this a three way analysis of variance was carried out to find out the interaction effect of these variables on the academic achievement of students. For this the students of experimental group were distributed into eight groups i.e.

(1)   high IQ, high Motivation, positive Attitude;

(2)   low IQ, high Motivation, positive Attitude;

(3)   high IQ, high Motivation, negative Attitude;

(4)   low IQ, high Motivation negative Attitude;

(5)   high IQ, low Motivation, positive Attitude;

(6)   high IQ, low Motivation, negative Attitude;

(7)   low IQ, low Motivation, positive Attitude

(8)   low IQ, low Motivation, negative Attitude.

Students' were distributed into low IQ, high IQ and low motivation, high motivation based on their scores on IQ and Motivation. If a students' score of IQ and Motivation is lower than the mean score of IQ and Motivation the student was grouped under low IQ and low Motivation. After the grouping the scores were subjected to three way analysis of variance.

(4)   The fourth objective was to study the attitude of the students and teachers regarding the effectiveness of the CAI package. The data was collected from the students of experiments group and standard XI Chemistry teacher of the school regarding the different aspects of the software package such as comprehensiveness of the package, adequacy of examples and illustrations and appropriateness of graphs and figures etc. The data were analysed qualitatively through content analysis. The details regarding the analysis and interpretation of the data is presented in chapter V.