CHAPTER VIII

OBSERVATIONS, SUGGESTIONS AND CONCLUSIONS:

In this chapter, the summary of the various steps involved in the long process of present research is given in brief with a view to giving the idea in nut shell. Besides this certain observations made by the investigator during the tryout of the programmed learning material (PLM) and actual field work are also discussed, along with the conclusion drawn after subjecting the data to a sufficient statistical treatment.

8.1 Review:

8.1.1 The previous researches and theoretical background of Programmed Learning:

As the problem of the study was to develop auto-instructional programmes in Geometry for Standard IX and to find out their effectiveness in relation to different variables, the investigator wrote the programmes in Modern Geometry [Appendix B] which were tried out in the class IX of different schools and the results were compared against the conventional teaching.

The review of literature of last decade reflects the tremendous technological development and also the development in teaching and learning techniques.
Recent research trends in practice are towards self-pacing sequence, step size, response mode, knowledge of result, reinforcement and confirmation.

The research results show that programmed learning does teach and can answer the questions of teaching problems that because of the vast increase in the number of students and explosion of knowledge. It is a fact that programmed learning is used in the developed countries like U.S.A., U.K., U.S.S.R. and Germany. The programmed learning is used in schools, industries, and in armed forces. In East Germany programmed learning is used by low too. In India programmed learning has become the expanding field in education. The institutions like N.C.E.R.T., CASR (PLA : and SIE in various states) of India are putting in special efforts to develop programmed learning materials in the different school subjects and popularising them. The research findings by the scholars and the educationists reveal that the programmed learning can be used fruitfully in Indian class rooms and also in T.V. (Audio Visual) instructions.

India is a developing country and she needs students who are creative and capable of solving problems. The students who are prepared in various knowledge areas must be capable of solving problems. Therefore they should be taught to conceptualize, to discriminate and to generalize, so that they may be able to apply what they have learnt. The innovative practice like programmed learning can cater
to the needs of each and every pupil.

As programmed learning is based on definite theories of learning, it promises to improve instruction. But more researches are still needed in this area. Besides this, it is also considered as the first step towards educational technology.

As a result of number of researches in this field, the two schools of programming that is Linear Style and the Branching style have come into existence. The Linear Style is also known as the Skinnerian Style of programming. The student proceeds in small steps and makes very few errors. It is written for an average child.

Crowder is the pioneer of the Branching Style. It is based on the principle that different students need different instructional methods. Here, the students' difficulties are diagnosed and on the basis of this remedial frames are prepared.

This approach is remedial sequencing. The third type of programming is the adjunct programming. Adjunct programmes are designed by Pressy. They are used to simplify the text books. They also accompany text books.

The present investigator has written the present programmes on Linear Style, where subject matter is sequenced in small steps. The mode of responding is recall and recognition type.
The responses are confirmed immediately.

Programmes differ from text books, work books, lesson plans, films and tests.

The difference is that the programme is objective centred and validated.

The major weakness in the tools of mass communication is that the traditional concepts in teaching are vague. Programmed learning makes teaching of those concepts possible which are definable in behavioral terms.

The effective teaching takes place only when the objectives are precise and clear, the method of instruction is well designed, and the tools of evaluation are made use of.

As the programmed learning is designed on the above lines, it facilitates learning. It is said that education in India needs a total change. Therefore, our schools will have to change their role in the present transitional period. Programmed learning will perform the role of the instructor, giving freedom to the teacher to perform more important role, which is the need of the present day.

Programmed learning is based on the psychology of learning. It is the outcome of Skinner's operant conditions. His theory is the result of the experiments in the laboratory. In operant conditioning, behaviours are emitted which are known as operant behaviours. The principle of re-inforcement
operates in the programmed learning as the continuous reinforcement is used, both in the content to be taught and in the behaviour to be shaped. The behaviour is shaped to reach the terminal behaviour by providing immediate reinforcement to each response in a sequence.

The programmed learning looks after the needs of the individual only. Therefore, desirable implication of group learning is lost.

But careful preparation and use of programmed learning material in the classroom can also serve as the synthesis between the individual learning and group learning.

8.2 Writing the Programme:

Prior to writing the programme, its objectives should be analysed thoroughly. These objectives should be searched from the relevant textbooks and also by interviewing various experts in the know-how of programming and in the content area of the subject matter to be programmed. Objectives should be written in behavioural terms.

The present investigator has analysed the terminal objectives. Test given to the users of the programme written on Modern Geometry, reflect these objectives. Use of the test is to know how well the students have learnt through the programmes.
To determine the instructional sequences the specific objectives of programmes 1 to 17 on modern Geometry are spelt out in behavioural terms. The specific objectives determine how to proceed effectively. The desired behaviour is defined by describing the conditions under which the behaviour will be expected to occur. The criterion objectives are also stated in statements, which describe expected behaviour of the student who is proceeding through the instructions.

After deciding about the instructional objectives, the subject matter in Geometry for standard IX was analysed and synthesised. In the subject of Geometry topics such as triangle and its parts, correspondences in triangles, congruent triangles, postulate of congruency (S.A.S.) results of S.A.S. postulate, bisector of the angle, theorems on congruency, S.S.S. Theorem, Perpendicular line segment, inequalities in triangle, and theorems regarding it, parallel lines and theorems on them, transversal and the angles made by it, postulate of parallel lines and measures of angles of the triangle are programmed in seventeen different units.

The processes of systems followed in the present programmes are chaining, discrimination, flow, generalization, and concept formation.

Chaining is the technical term for the sequencing of response where each response creates the stimulus for the next response, that is in some programmes some modifications
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in the backward changing procedure is tried out. It is on the line given by Prof. B.F. Skinner to teach the spelling of "manufacture". The investigator calls it an intervening, fading out process.

The purpose of the discriminating frames is not the remedial learning. The choice of the correct response when reinforced, helps to evoke similar response to appropriate stimuli. It is observed that rules or concepts can be taught with discriminating sequences.

Generalization is the process of seeing similarities. It is defined as making the same kind of responses to different stimuli. Concept formation is also seen in the present formation. Some units in the present study, show the possibility of developing the network of concepts which involve the generalization within classes and discrimination between classes of stimuli.

All the rules in the course content of Geometry can be taught by using sequences leading to conceptualization.

The task analysis is written by analysing the task or a job or a duty performed by a master, whose performances are to be learnt by the student. His behaviour is observed and recorded. This determines the course of action in verbal learning to be programmed.

The task analysis tells the programmer what to teach and how to teach, and physical and mental components of the
topic to be programmed is chalked out. The topic to be programmed is analysed into hierarchical sub-topics of Geometry.

The subject matter units and their behavioural characteristics do not help much. Therefore, the subject matter relationships must be taught. It is observed that the sub-topics of the triangle and its congruency, perpendicular bisector of a line segment, bisector of an angle, parallel lines etc., show the inter-relationships between subject matter units. The concept of knowledge and subordinate knowledge given by Gagne is similar to the analysis of subject matter into units and sub-units. He says that no individual can perform the final task without being able to perform the simple and more general tasks. The task analysis of rules helped the present investigator to write the present programme.

The programme should always facilitate learning. Prompts used in programmes keep the error rate low, as errors in the programme hinder learning. Prompts are either formal or thematic. Formal prompts provide the structure of the response and not its structure. Formal prompts are classified as partial rhyming and frame structure prompts. The present investigator used more thematic prompts and a few formal prompts. Skilful use of prompts guide the attention to the text and content of the subject matter which helps to gain new knowledge. Thematic prompts are classified into
(1) picture (figure) as thematic prompts (2) context-setting prompts (3) grammatical structure as prompts (4) synonyms and antonyms (5) analogy (6) rules (7) examples and (8) panels.

A picture (figure) used in a frame suggests the answer or a label attached to the figure suggests answers. There are many frames in which picture (Figure) prompts are used.

Context setting prompts, used in the frames of the present programmes, reduce the irrelevant programmes and the irrelevant answers and facilitate the relevant answers. These prompts are more useful in many sub-topics, which need inter-relation and review.

Grammatical structure on conjunctions, such as 'and', 'but', possessive case 'of' are used along with the contextual material. Grammatical structure prompts are used in some frames to prompt the correct response.

Synonyms and antonyms are used to prompt, like and opposite responses. Analogy brings together the subject matter. Here there are several frames in which analogy serves as strong prompts.

The deduction method of instruction is used in frames where rules are stated. Rules prompt the students to make deduction or prediction.

Examples in the frames also serve as prompts, they serve to give new examples or to generate rules as a response.
Panels are thematic prompts. The students are unable to respond to some frames, therefore, they are instructed to read the panels. Panels include figures etc.

Common properties of the stimulus class are involved in the frames. The sequences are so arranged that students come to state and use the general concept by themselves. The required behaviour is shaped through generalising sequences.

A chaining sequence is a series of frames which are designed to establish a self sustained series of responses.

The formation of concept involves generalization within a class and discrimination between the class and other classes. The formation of concept is said to be established, if the student can find out the example from the non-example. Examples of such series will be seen in the frames of some programmes.

In association forming series, the stimulus 'S' associates with an individual response 'R' in such a way that, whenever 'S' occurs 'R' follows.

In multiple discriminative series, the student is presented with the two or more confusable stimuli. He learns to make different responses and identifies these stimuli.

Principle is the chain of two concepts and it exhibits two links. To acquire principle or rule is the most common
form of learning. There are some frames in the programme teaching these principles.

Strategies can be defined as in discovering content principles, which are applicable to series of novel situations. The student performs mediating activities for the completion of the action.

Some units involve certain frames in the present programmes, using the principles of strategies.

After writing down the first draft of programmes 1 to 17 units, the frames were examined by the subject matter experts and the programme experts, who helped to finalize the programmes for the first try out.

To try out the frames initially, each frame was written on a hard paper at the back of it the responses to the frame were written. Instruction cards were prepared for the experiment, which was to be included in the programme.

In the beginning, with the help of three students who had some background of the topic, were selected, and each frame was tried out on them. Their comments and suggestions were used to develop the first draft.

The first draft was tried out on ten students of the IXth class of the same school. They represented higher, average and low ability group in the mathematics. The purpose of the try out was to find out the bad frames that did not teach,
workability of the sequences, achievement in the subject matter learnt through the programmes, the students' interests and the time needed to complete the programme. After the results of the try out some frames were reframed and many were resequenced.

The programmer noted the difficulties, for further improvement in the programme on experiment. The outcome of the first draft was very high. The test questions were revised and more difficult questions were included in the test.

Interest among the students was observed as they all remained present during the try out period, and showed liking in the technique of learning in a new way.

The second draft of the programme was revised and approved by the experts. Again it was tried on three students with high, average and low ability in mathematics.

The third draft had more frames, sequences were re-arranged, more figures as prompts were added and the sequences were grouped under sub-topics. They were cyclostyled in the form of seventeen units. Before giving for printing language experts corrected and subject matter experts screened them. The terminal objective test was also reconstructed.

The programmes were validated against 45 students of IXth class of the different school. The purpose of the field
testing was to improve the programme. The total time spent was noted, which included the time spent on testing.

The Experiment:

With the help of the rating tool, the workability of the programme on experiment was found out. The final version of the programme was the revised one. The programmes were reconstructed by reframing the frames, which had non-critical verbiage, non-critical artwork, and which had no prior strengthening. Final production was of the printed seventeen programmes, tests, and a questionnaire used in the seven experimental schools in the class IXth to study the effectiveness of programmed learning in the IX Std. in Geometry.

In relation to different variables fourteen schools from different districts of the Gujarat State were selected (Appendix A). Out of which IXth class of seven schools was treated as an experimental group and the IXth class of the other seven schools was treated as a controlled group. Prior to teaching through programmes on Geometry, the experimental group schools were also given the programme on Geometry of Std. VIII, with a view to acquaint the students with the programmed learning strategy. Initial test (Pre-test) was also administered to students of both the groups.

The students of experimental school were learning through programmed learning method under the supervision of the mathematics teacher, while the students of control schools were taught through conventional method. At the end of the
experiment, terminal behaviour test (Post test) was administered to students of both the schools. The data was then analysed keeping in view the objectives of the present study.

The investigator had focussed the attention on the study of the variables such as (1) Intelligence (2) Socio-economic Status (3) ability in mathematics (4) entering behaviours. Various tools were used to measure the above stated variables prevailing amongst the students of both the groups.

8.3 Observations:

The investigator had also made certain observations during the treatment period.

1. During the try out period, it was observed that the students learning through programmed strategy were eager to know about the purpose of this programmed learning method given to them. In the beginning many students were of the opinion that mathematics cannot be learnt through this programmed learning method strategy. From this observation, during pilot work, it was decided to give them practice in this new approach by using the five programmes on some units in mathematics for Std. VIII by the investigator.

2. Before implementing this programmed learning material on students, the teachers of the experimental schools were invited for giving them some understanding about
the work to be done. During the discussion about the work the teachers constantly opposed this new idea as they had no faith in the new approach, but the investigator convinced them after citing a number of experimental findings of the post studies. This facilitated the work of the investigator at the time of the final implementation on the students of experimental group of schools. The investigator had also observed that at the beginning of the experiment the head masters of the experimental schools had also no faith in this innovative approach of teaching, but when the results of the groups were communicated to them, all were happy and of the opinion that such materials should be made available to schools so that the teachers could use them, and when it was necessary.

3. The students of the experimental schools also showed greater interest after taking two or three programmes. They also discussed certain points about the programme with the teachers in charge and gradually realised the importance of feedback mechanism.

4. The marks that they got on the test after completing each unit really encouraged them for better study. At the same time it was also observed that there was an element of healthy competition amongst the students of the class. This showed that the students gave whole hearted co-operation in the experiment.
5. It was observed that the bright students were also able to finish the programme earlier than the below normal students.

6. The teachers of the experiment schools reported the investigator that some of the parents showed interest in the innovative approach.

7. Students of the experiment schools also asked the teachers for Programmed learning material (PLM) in other school subjects.

8. In the beginning it was observed that some of the students wrote answers of the frames without making any effort as the answers of the plates were given on the back. These students were given an advice not to see the answers given at the back of the frame plate, and they were asked to work honestly. As a result of this advice, it was observed that the students worked honestly later on.

8.4 Conclusions:

From this micro study the following few but important conclusions have been drawn which will be useful to mathematics teachers in particular and teachers' community at large.

1. From study No. 1 it is concluded that students having low I.Q. have achieved more through P.L.M. than the
students of low I.Q., learning Geometry through conventional method. Thus the students having low I.Q. do benefit more in learning Geometry through auto-instructional material. (The same thing has been concluded by the comparative study of the ogives of the scores made by the students having low I.Q.). This finding is supported by the comparative study of the ogives of the scores of the two type of students learning through programme learning strategy and the other learning through conventional method.

2. The study No. 2 also led to conclude that the students having high I.Q. do achieve more through programmed learning strategy than the students having high I.Q. learning through conventional method, thus here also the bright students are benefitted more than their counterparts. This thing gets support from the study of the ogives of the scores made by the students of the post test.

3. The study No. 3 deals with the comparison of the effectiveness of the programmed learning method versus conventional method of teaching mathematics on achievement of students. It was observed that the mean achievement score of the student of experimental group is 51.02, while that of the students of the controlled group is 40.00 thus there is a difference of 11.2 points in
In the beginning, it was decided to study whether the students coming from different S.B.S. benefit more learning through programmed learning strategy than the students of the same strata taught through conventional method. For this study No. 4 was carried out with students of high S.E.S. and low S.B.S. of the experimental and controlled schools. The comparative study of the mean achievement in Geometry of students coming from high S.E.S. belonging to experimental and controlled schools revealed that the mean difference of 17.14 in favour of students of experimental schools having high S.E.S. is very highly significant. This led to

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conclude that the students coming from high S.E.S. have achieved more through programmed learning strategy than their counterparts. Therefore it is established that the effectiveness of programmed learning is a function of S.E.S.

5. The mean achievement on the post-test of students coming from low S.E.S. of the experimental and controlled schools was also compared with a view to see whether it supports the previous findings. The mean difference of these groups is very highly significant, which led to conclude that the students coming from low socio-economic strata are benefited quite satisfactorily learning through programmed learning strategy than the students coming from low S.E.S. learning through conventional method. Thus this finding supports the previous one.

6. The students having high entering behaviour score in experimental schools have shown better performance on the post-test than the students having high entering behaviour scores in the controlled schools. Similarly the students having low entering behaviour scores in the experimental schools have achieved more than the students having low entering behaviour scores in the controlled schools. Thus this programmed learning strategy has proved to be effective in case of students having high and low entering behaviour.
7. It was one of the objectives of the present study to see whether the students learning through programmed learning strategy take more time than the students learning through conventional method. For this study No. 6 it was carried out. From this study, it is concluded that the students of the experimental schools could complete all the units in less time than the students of the controlled schools. Thus the students of the experimental schools could learn the same thing in less time than the students of the controlled schools. The programmed learning strategy when implemented in its right spirit, could help the teacher and students to save time and the time thus saved can be utilised in some more fruitful work.

8. The study of the opinions of the teachers in charge of the experiment revealed that more or less the opinions of all teachers in charge of the experiment was very positive. It is also concluded that the students of the experimental schools have developed full confidence in programmed learning. This could also be very well said in respect of teachers also.

9. From the study of error rate, it is concluded that 93% of the students of Class IX were able to learn Geometry with 93% of success.
8.5 Implications and suggestions:

Researches in the programmed learning have just begun. A day will come when its need will be recognised by the public and the educators. Till then it is the duty of the educators to popularise and push this innovative idea to more experimentations and researches to facilitate learning through programmed learning in schools. More programmes in different subjects should be written, tried out and be made popular amongst the students, teachers and parents.

Who can be the best programmer if not a trained teacher? Therefore, the vigorous training in programming should be given to the teachers under training. Programmed learning should be taught as a compulsory paper at B.Ed. and M.Ed. examination level. Thus the teachers will be trained in writing and using the programme effectively in schools. Programmed learning materials, if used wisely in the classroom, will relieve the teacher from the routine drudgery of the class room teaching. It will solve the problems of discipline amongst students, because each and every student is kept engaged in writing the responses.

It will also solve the problem of those students, who are academically backward. They will learn from programmed learning according to their individual capacity. It can be used in a single teacher school and also can be used very effectively at the time of listening to the AIR school broadcasts programmes and along with T.V. lessons.
To fulfill the great task of educating the children adequately, one of the many ways is programmed learning. The association should take over the tremendous task of preparing and trying out of programmed learning materials with the help of Extension Services Department in the training colleges.

Inspectors in the Department of Education should acquaint themselves with the know how of programmed learning. When they inspect the schools, they will be able to assess the programmes used in the school, and will be able to guide the schools in this innovative practice.

The post graduate research workers should devote more time, energy, and expenditure in writing, and evaluating programmes, catering to the varied needs of the pupils. Programmes for primary, secondary and college level should be prepared. Programmes for adult education should also be developed.

The science and mathematics curricula for Std. VIII of the secondary schools in Gujarat State were changed in 1974. It is suggested that such changes should be accompanied by the preparation of the programmed learning materials. This will help the students to learn independently and the teachers to improve professionally.

The Gujarat Government has switched over to the un-graded schools are to be implemented, the programmed learning materials will be the 'must' for the schools. The programmed
learning material will serve as a means to transfer child from one grade to another grade, provided the programmes based on the needs of the curricula are developed.

8.5 Need for further research:

Given the time to study how an individual learns, one can teach him anything. Programmes catering to the needs of an individual, given to all children, its primary claim is defeated. Therefore, programmes for individual differences should be prepared.

This means that for a given subject different programmes should be developed.

If the need of the future is to learn, how to learn, programmes on the development of skills and learning process should be developed.

As the student moves according to his speed, he will be able to progress according to his ability. Teacher will no longer say, "you will have to wait until next year. Next year's programmes can be tomorrow's programme if the student is ready.

8.6 Suggestions for further research:

The investigator as a result of his experience and training, during this long process of research, could see that there is still enough scope of further research. The following problems can be taken up for further research.
1. To study the extent of gains of pupils through programmed learning strategy in relation to their achievement motivation, intelligence and performance.

2. To prepare and try out the programmes on concepts of mathematics.

3. To study the relative gain of programmed learning strategy and other strategies of teaching on a selected sample of schools.

4. To prepare and try out the programmes for slow learners.

5. To prepare and try out the programmes for fast learners.

6. Study the effectiveness of programmed learning strategy in the context of reading ability.

If at all there is any one conclusion that could be drawn from this research, it is this, that the programmed learning technique is definitely and significantly useful to the pupils, as it gives them advantages in terms of quantum of learning and in the time for learning.