CHAPTER IV

PLANNING AND PREPARATION OF PROGRAMMED MATERIALS

Many factors have contributed to the enormous amount of modification in the school mathematics curriculum in a short period, some of these factors were as under.

In the first half of this century, there was a lack of co-operation among the school curriculum makers and research mathematicians, college mathematics professors and others who kept up with new developments in mathematics. Thus a gap was created between the school mathematics programme and new developments in mathematics, and this gap widened considerably as the years passed.

The effect of lack of co-operation among the above groups becomes more vivid when one considers that there have been more new developments in mathematics since 1850 than in all previous years, and that there has been a change in the concept of the nature of mathematics.

What mathematicians think of as mathematics to-day is not consistent with the general notions of mathematicians prior to 1850. To understand the view of the mathematicians prior to 1850, one must consider the origin and nature of the development of mathematical entities. Real life situations involving quantitative settings demanded some type of number notations. As civilization progressed and quantitative situations became more complex, computations became necessary.
That is, physical situations induced the development of mathematical facts, rules, and skills. The nature of the development of mathematical entities generated a study composed of unrelated facts, rules, and skills to be memorized and each was invented because it was associated with a particular type of physical situation. Thus, new mathematical concepts were conceived and studied only if they could be perceived in physical situations.

The new look at the nature of mathematics began early in the nineteenth century but failed to gain momentum until the last half of the century. One factor which gave an impetus to the change in the attitude about mathematics was criticisms on the lack of foundations and unity in mathematics. The fundamental mathematical concepts served as a basis for the logical development of simple mathematical systems. The complex mathematical systems made it possible to explore and develop new theories about the universe. The nature of the new approach and the study of the structure of mathematical systems are new phases in the school mathematics curriculum. Much time, experimentation, and money are spent in efforts to study, evaluate, and improve the school mathematics curriculum.

Experimental programmes in new mathematics included by the CSCE (Community Science Centre), Ahmedabad, Gujarat State. Ganit Mandal Ahmedabad, S.I.E. Ahmedabad, few co-operating
schools in local area and a few schools in Gujarat State: CSC, Ahmedabad and SIE, Ahmedabad have provided financial support, which has also encouraged hundreds of teachers to come to CSC to acquire improved and up-to-date mathematical background. CSC and SIE have provided an opportunity for many pupils to acquire and improve the abilities to perceive and develop logical basis for considering and arriving at a satisfactory solution to each new question and problem that arise. It must offer the opportunity for each pupil to develop and improve the abilities to deduce more complex notions and relation from fundamental mathematical concepts. The acquisition of these abilities will provide a foundation for the future citizens to derive the mathematical skills and knowledge demanded of them.

4.1 The 'New' Mathematics:

The term new mathematics is misleading. It leaves the impression that the entire content of traditional mathematics has been replaced by something "New". In the first few grades few, if any, topics and skills of traditional mathematics are omitted in the new mathematics. However, there is an abundance of new concepts, language, and symbols whose functions are to provide a foundation for attaining the goals of modern (new) mathematics programme. One must guard against considering new language, new symbols and new ways of "doing" traditional skills as the only "new" part in new mathematics. It is not feasible to give in a few words a
words a complete picture of how the nature of new mathematics differs from the nature of the traditional mathematics. Yet a few prominent distinctions may be noted here. Two words that characterize new mathematics are logic and abstractness, that is, mathematics is a study of ideas. Thus student may become aware of the unifying concepts and deductive nature of mathematics, which received little attention in the traditional programme of studying symbols, manipulation with symbols, telling and drilling.

Therefore, the objectives of preparing programmed learning material are first decided.

4.2 Objectives of Auto Instructional Programmes:

After going through the programmes the learners shall be able.

1. to gain an understanding of significant geometric concepts,

2. to develop skills in using fundamental Geometric concepts,

3. to develop skill in using fundamental Geometric techniques,

4. to attain a significant comprehension of the fundamental characteristics of functional thinking and of the importance of seeking things in relation to each other.
5. to attain moderate proficiency in the use of Geometric symbolism and comprehend its effectiveness as an aid in organizing, analyzing and generalizing information and experience.

6. to develop self-study habit.

Pupils cannot achieve these objectives by listening to the teacher and watching the teacher's illustrations. Active participation of the pupils in the activities and in developing the related concepts are essential to the success and effectiveness of the program. Therefore, the investigator has decided to develop auto-instructional programmes in modern Geometry for the pupils of Std. IX and has selected topics from the syllabus which was prepared in 1971-72 by the CSC, Ahmedabad. With the help of a group of teachers studying modern mathematics in CSC, Ahmedabad, the investigator has first analysed the syllabus in terms of concept and teaching points. They are given below:

4.3 Concepts and Teaching points:

The proposed programmed book of modern geometry deals with the following concepts:

1. Triangle: Definition of triangle in simple words and in the language of set.

2. Symbol of a triangle.
3. Vortices of a triangle: Sides of a triangle two sides and included angle; the included side of the two angles; opposite side of a given angle in a triangle; opposite angle of the given side in a triangle.


5. Correspondence between two triangles.

6. Meaning of correspondence $ABC \leftrightarrow PQR$ meaning of $\angle A \leftrightarrow \angle P$, $\angle B \leftrightarrow \angle Q$, $\angle C \leftrightarrow \angle R$, $\overline{AB} \leftrightarrow \overline{PQ}$, $\overline{BC} \leftrightarrow \overline{QR}$, $\overline{AC} \leftrightarrow \overline{PR}$.

7. For which correspondence the two given triangles are congruent.

8. Postulate of congruency.

9. Meaning of parallel lines and theorems on parallel lines.


11. Theorems on congruency.


13. Perpendicular lines and theorems based on the principle.

15. Exterior angle of a triangle and interior opposite angles (Meaning and definition).


17. Meaning and definition of alternate angles, transversal, corresponding angles, the interior angles of one side of a transversal to the two parallel lines.

18. Sum of the measures of the three angles of a triangle (Theorem)

4.4 Steps of preparing programmed learning materials:

Keeping in view these concepts and teaching points, the programmes were to be prepared. Hence it is essential to see, the different steps involved in the preparation of instructional material.

For providing necessary background knowledge, prerequisites are determined and jotted down, and entering test is prepared. In order to provide learning experiences to achieve the specific behaviours listed, a series of frames are prepared.

Each frame prepared for the purpose consists of a statement or a principle to be taught, an illustration for it and statement requiring the response of the learner.

The frames are arranged in a sequence that may lead the learners gradually from known to unknown situation. The
necessary prompts or cues are given to lead a learner to the correct response.

At each step the learner has to answer a question or fill in a blank before proceeding further. Immediate confirmation or correction of answer is given at each step.

At the end of each sub-unit, criterion frames are placed to see whether the learner would respond without any help of prompts or cues.

With this in view the investigator has developed programmed learning material. As the programmed instruction is to be compared with the conventional method, the sequence of the behavioural objectives observed in conventional method is followed in developing the programmed learning material, in such a way that the content and the approach of modern Geometry may remain the same and only the technique of teaching may differ.

4.5 Units formation:

The syllabus in modern Geometry of Std. IX was studied and then it was divided into seventeen units. Each unit contained the review frames ascertaining the required previous knowledge in the beginning of the unit.

The unit also contained the lead-in items to orient the learner to a problem and prepare him for new information. Delayed review items were spaced throughout the programme.
Fading items in which the cues were gradually withdrawn, required the learners to gradually fill in the response independent of cues. To ascertain the achievement of the specific behavioural objectives, the criterion test items were introduced at regular intervals at the end of each teaching point in each unit.

4.6 The Self Evaluation:

To give the idea of an achievement to the learners as well as the teachers, a self-evaluation test was attached to each unit. The self-evaluation test contained the items testing each behavioural objective kept in view while developing the programme material.

All the concepts to be taught were taken into account and were arranged in their original sequence, which gave the tests a form of "learning set-tests". The programmed book of modern geometry contained in it all the seventeen "self-evaluation tests".

4.7 The Technique of the Programming:

The programmed book in modern geometry was developed mainly on the line of "linear programming", correct response immediately followed by appropriate knowledge of result leads the learner to the next step. Only the correct responses take the learner to the next programme. Hence it follows the principle of error-loop programming.
If the learner’s response is incorrect, it is followed by negative knowledge of results and the learner is to come back to the same frame again and has once again to respond to the original question or problem and is required to make another response. Eventually he makes the correct response before going to the next frame. Thus the last response should be always a correct response.

4.8 Editing the Programmes:

The initial draft of programme was edited from the view point of easy units to hard units and from the view point of sequence and construction of frames. It was also examined for cuing and fading techniques. Vocabulary and thought concepts were taken care of from the language point of view. Thus the programmed book in modern geometry for Std. IX was ready for 'try-out'.

4.9 Pilot Try-out and Modification in the Programmed Material:

The unitwise programmes were tried out with ten pupils of Std. IX who volunteered themselves for the work. Ten students were selected for the purpose of tryout. All the ten pupils who collaborated actively and sincerely had different achievement level (achievement).

These ten pupils worked daily one hour or so in the morning before the school hours on school day. The investigator remained with the pupils during this period to observe their
progress, to record their difficulties and to help them in the difficulties. A record of the time taken by each pupil, number of frames responded and the number of wrong responses were noted down. The difficulties of each pupil in the following the frames were discussed individually at the end of each period to know whether they were due to language discrepancy or there was some gap to be filled in between two frames for proper clarification or co-ordination. The programmed material was modified in the light of the suggestions and wrong responses of the group.

From this tryout it was found that a few units were a little boring to pupils as they were too difficult for them. So some prompts and new frames at necessary places were introduced. Some of the frames and test items were revised because they were little ambiguous from the language point of view.

Also it was found during pilot 'try out' that some revision was necessary at the end of some sub-units. And hence before starting with the new sub-unit, a few review frames were introduced. Proper care was taken in introducing new mathematical symbols at the proper place, for that, some new frames were also introduced. Thus the revised programmed book in modern geometry, after pilot try-out, was ready for field tryout.

In the light of these steps, the programme frames were prepared covering the concepts and teaching points
mentioned earlier in this Chapter. The concepts and teaching points are distributed in seventeen units for the sake of convenience in trying it out. The programmes are prepared in Gujarati language, as they were to be experimented in the schools having Gujarati as the instructional medium.

The English version of these seventeen units was prepared by translating Gujarati version. For English version please see Appendix B.

In this way the programmes were planned and the frame plates were written by the investigator. Not only this but the investigator has also discussed the programme plates with the programme experts. The investigator took about six months of time to brood over the frames and to revise them if necessary. This programme could be called a "semifinal programme", because the programme remained to be tried out on a small sample. The next chapter deals with the programme analysis, tryout and its finalization.