CHAPTER-IV

DEVELOPMENT AND VALIDATION OF
PROGRAMMED LEARNING MATERIAL

4.1 Introduction
4.2 Specification of Behaviour
4.3 The Course Content in the Context of Behavioural Objectives
4.4 Task Analysis
4.5 Programme Style, Response and Presentation Mode
4.6 Writing Frames
4.7 Validation Process
4.8 Conclusion
4.1 Introduction:

A century ago, Education was regarded exclusively as art. Since the advancement of scientific outlook in other fields, the great personalities in Education also were influenced by such atmosphere. They began to analyse the task of learning, started to measuring the amount of learning and eventually remained successful in controlling the learning. At the end of the first quarter of this century, Education assumed its position in Social Sciences. In the Education Commission report it has been asserted
that education should be developed as a Social Science. The entire learning process in the classroom is conducted in the light of the instructional objectives. The learning activities undertaken have been mainly centred round the instructional and general objectives. For seeing these objectives realised at the end of the learning activities are more and more intensively planned. However, in seeing the objectives realised the variability was perceived. It was attributed to various causes such difference in motivation level, basic ability, socio-economic background etc.

Finally it was established that each learner learns at his own rate in the context of his intellectual capabilities and social atmosphere. It is only in this context the auto-learning was upper most demand of that time and consequently the programme learning was evolved out.

Keeping in the large quantum of knowledge to be imparted to even larger population's with minimum resources within a limited time, programmed learning has shown a new path towards automation and individualization of instruction. Programmed learning, being
scientific and technical, should be well organised for a successful programme.

Planning should be so extensive and detailed that it becomes a model of the final product— the instructional programme and gives a clear cut idea about the exactness of the programme and how it will help a learner to learn.

Generally, planning covers the following aspects of a programme.
In this chapter, the investigator has tried to discuss all the above mentioned aspects in the context of development and validation of programmed learning material for the present study.

4.2 **Specification of Behaviours**

What the programmed learning has contributed to Educational practice is its emphatic insistence on the importance of specifying Educational objectives in terms of observable events.

What are the students expected to do after learning a particular topic through programmed learning material? How will the teachers know what and how much have the pupils attained? These are very crucial problems which are to be answered before the actual instruction is started. The terminal behaviour, as it is known in programmed learning language, tries to answer all the queries mentioned above. The emphasis is laid on two important points in the statements of terminal behaviour (i) Observable behaviour and (ii) Measurable behaviour.
Behaviour according to Marger\textsuperscript{1} refers to "any visible activity displayed by a learner." Unless the behaviour is observable, it is difficult to justify that a particular activity was performed. How well the activity was displayed can be judged only if one has some means to measure it. Hence observable and measurable are the key words to be borne in mind while specifying the behaviour before starting programming. Explicit specification of objectives helps an instructor in selecting the test items which in turn reflect the performance of the learner.

4.3 The Course Content in the Context of Behavioural Objectives:

The following general steps outline a procedure for organizing and analysing a subject matter domain before the programme is developed. These steps are given by Tabler, Glaser, Schoafer in their book learning and programmed instruction.\textsuperscript{2}

\begin{enumerate}
\item Tabler, Glaser, Schaefer: Learning and Programmed Instruction Addison-Wesley Reading Massachusetts, New York, 1965, pp. 77-82
\end{enumerate}
(1) Identification of Terminal Behaviour of the Students:

The 'terminal behaviour' refers to what is commonly designated as mastery of a given subject matter. An essential task involved in this step is that of analysing this behaviour. This specifies of what the student will be able to do when he had finished the programme. The terminal behaviour of the programme for unit 1 and 2 are as follows:

Unit-1 Transport Service

After completion of the programme, the students will be able to:
- Explain the concept of a transport.
- Define the meaning of the Transport.
- Give the mode of Transport.
- Give the example of different types of Transport.
- Define the elements of the land, water and Air transport.
- Give the illustration of the transport modes.
- Explain the subject.

Unit-2 Banking Service

After completion of the programme, the students
will be able to:

- Explain the concept of a bank.
- give the definition of bank.
- define the fundamental work of a bank.
- define the importance of the bank in modern commerce.
- define the services and functions of the bank.
- define the relation of public and the bank.
- define the relation of the Government and the bank.
- define the types of Bank accounts.
- give the definition of the cheque.
- define the types of cheques.

(2) Identification of the Entering Behaviour of the student:

Entering behaviour has been much less discussed in programming literature than terminal behaviour, but it is of no less importance. The behaviour which the student brings to the programme determines the level at which the programme must start and provides the base upon which the programme builds.³

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³ Ibid, p. 78.
This determines the initial competencies and skills with which the student begins the programme. On assessment of the entering behaviour the instructional sequences can be built. Whether the target population will be able to take the programme is determined from the entering behaviour test. The entering behaviour tests have the following objectives:

The students will be able to:

- know the importance of the services.
- know the types of transport and types of Banks.
- know the functions of the bank.
- know the elements of the modes of transports.
- know the relationship between the Trade and transport and Trade and bank.

After enlisting the entering behaviours, the next task before the investigator was to prepare the entering behaviour test. The vocabulary and language ability level of the students of class XI were kept in mind, while preparing and writing the entering behaviour test. The entering behaviour test prepared by the investigator is given in Appendix-A.

(3) Formulation of Measures of the Achievement Criteria

This step involves the construction of appropriate
test to measure the terminal behaviour. Student attainment must be assessed by achievement tests appropriate to the objectives of the programme.

The test involves the sample of the total amount of subject matter.

"It is desirable that the programme employ, an adequate sample of subject matter which gives the student a wide basis for generalization and then gives the student another sample of subject matter in which the student demonstrates his mastery and extent to which he has learned generalised behaviour." 4

The importance of the criterion achievement is that it measures the terminal behaviour laid down prior to the development of the programme. It is impossible to test each and every point taught by the frame of the programme, but it is possible to come close to teaching the universe of content, and generalised concepts are assessed. The test should conclude another relevant subject matter, in which the student can use his generalisation learnt in the programme. This procedure helps to get around the criticism of teaching for the test.

4. Ibid, p. 79.
(4) **Analysis of the Criterion Test:**

After specifying the terminal behaviour that is expected of the students at the end of the programme, it is essential to assess the performance of the students. This can be done by administering a test of terminal behaviour which is also known as a criterion test. A criterion test is a test that tests whether the behaviour goals are attained or not. Unlike an achievement test its objective is not to discriminate between good and bad students but to detect the steps arrived at the criterion behaviour to note. An additional advantage of a criterion test is that it allows a reappraisal of the sequence in a given programmed learning material. Hence it provides the feed back to the programmer which helps him modify the frames in the programme. Therefore, it is essential to prepare the criterion test before writing the frames so that it would help in sharpening the terminal behaviour. The criterion test also indicates the level of desired performance and the conditions under which the performance is expected from the learner.

The characteristics of a criterion test as stated by Kapadia are as follows:

It tests almost all the teaching points.

- It does not include the same examples and situations given in a programme.

- The types of questions or test items included in the criterion test are not the same as these included in the programme.

- The items in the criterion test are not in the same order as they occur in the programme.

- The difficulty value of the criterion test depends on the instructor's goals regarding the level he wants from the learners to attain.

In order to assess whether the programmes have been able to shape the behaviour as specified in the terminal behaviour, the criterion test was prepared by the investigator (Appendix.B). The test items were selected for the criterion test keeping in mind the statements of the terminal behaviour. Also care was taken not to include the same examples and situations as used in the programme, different types of test items such as fill in the blanks, multiple choice, true and false, short answer, simplify etc. were prepared.
4.4 **Task Analysis** :

The task analysis is the most important step in the process of developing programmed learning material.

To justify the importance of the task analysis Latterner says:

"The investigating analysis must do this for two reasons; first to clarify the overall purpose of the job; and second, to show the task relationship as the job progresses to the completion of the work cycle. Failure of the analyst to explain why an activity is undertaken will leave the impression that the job has not been fully reported and this can result in ambiguity in preparing training materials."  

Popham and Backer says that "Among the most serious problems facing an instructor is the decision about what he should do to help his students achieve his desired objectives. Certainly the statement of explicit behavioural goals is a necessary precondition for planning effective instruction. However, it is clear to any one who over- tried it that the statement

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of behavioural objectives does not solve the total requirements of instructional design. A teacher still must have some way of identifying and ordering the activities that will optimize his chances of being successful."

Task analysis includes analysis of all the activities that the students have to do during the instructional process or a programme. In general task analysis can be classified as such:

<table>
<thead>
<tr>
<th>Task Analysis</th>
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<tbody>
<tr>
<td>Content Analysis</td>
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</table>

It should be done by keeping in mind the students' behaviour rather than just jotting down the content paints, concepts, and skills. As defined by Popham and Baker, the task analysis should describe the students' enroute behaviour as "Any activity that the student must master as preliminary or basic skill to enable him to perform the terminal behaviour."  


8. Ibid.
Usually a single expert cannot prepare a complete task analysis without consulting others. In this study the investigator consulted a team of experts in the field of Education and subject matter experts for the task analysis.

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Task Analysis
Transport Service

Transport
Preliminary notions of a Transport

Notation for a Transport
Transport Meaning
Importance of Transport
Modes of Transport

Mode of Transport
Land Transport
Water Transport
Air Transport

Characteristics
Road
Railway
Pipe-line

Canals
Rivers
Lakes
Ocean

Characteristics
ROPE WAY
Aeroplane
Helicopters

Characteristics
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Preface of Banking Service

Definition of Bank and its meaning

The services and functions of the Bank

The importance of the Bank in Modern Commerce

Primary Functions

Functions of general usefulness

Agency Service

Accepting Deposits

Lending Money

Providing money for foreign Trade

Making Exchange of money simple Economical and speedy

Purchasing and discounting Bill vault of exchange and promissory notes

Safe deposit service

Incom Tax investment guidance

Collection & Payment of cheques on behalf of customers

Making other payments on behalf of customers

Invest fund of other customers

Collection of other dues

Work as legal/Agents

To give opinions regarding financial position of customers
Types of Bank Accounts

Current Account  Saving Account  Fixed Deposit Account

Kinds of the Cheques

According to the date written on the cheque
As per the Drawer Payment indicated

Pre-dated cheque  Post-dated cheque  Ordinary cheque

Bearer cheque  Order cheque  Crossed cheque

Crossed or A/C payee cheque  Open or uncrossed cheque
Task analysis guards against teaching too little and of teaching irrelevant material. Also it helps to define criterion measurement which can be used to evaluate the criterion behaviour.\(^9\)

Thus, the object of task analysis is to determine the what, why and how a person on a job does it. From this type of inventory, major tasks and the level of proficiency can be chalked out.

From this analysis, the components of learning were identified with a view to synthesizing them into hierarchical organization relevant to the writing of a programme.

While analysing the subject matter the physical components as well as mental components were considered.

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4.5 Programme Style, Response and Presentation Mode:

It is necessary to decide which programme style, response mode and presentation mode should be adopted before writing the frames for the programme, after describing and analysing the task.

(1) Programme Style:

The programme style adopted for the present study are Linear and Branching one, in which all the students follow the same sequence from first frame to the last one.

The following material was used for the conduct of the Experiment.

(i) Entering behaviour test
(ii) Linear Programme
(iii) Branching Programme
(iv) Criterion test.

Linear Programme:

A programme on Transport service and Banking service were prepared by the investigator himself, in Linear style. The development of the material was done according to the specifications of development
procedure. The programme consists of ninety four linear frames and types of responses mechanism—viz. blanks to be filled in and alternatives out of which one was to be selected, were used. The correct responses were given on the left hand margin of the frames and were required to be marked with a slider.

Branching Programme:

The second tool for investigator was a branching programme written on the same content. This was also prepared by the investigator according to the development procedure advocated by the expert in the field of programme learning. One by one frame was printed on one page. The frames fulfilled all the requirements of standard branching frames. The order of frames and pages were scattered according to the specifications of the branching text-book.

(2) The Response Mode:

The response mode used for the linear programme is overt. The students are supposed to construct the response either by filling the blanks or giving their own answers. In certain frames the pupils are also asked to select the correct answer from the choices given. The
responses are to be written on a separate answer sheet.

(3) Presentation Mode:

The presentation mode used for the programme is vertical format. The correct responses are given in the margin on the left side, the response of a particular frame is in the margin adjoining the next frame.

4.6 Writing Frames:

The investigator here used two types programmes (i) Linear Programme and (ii) Branching Programme. Investigator discussed them one by one as under:

(i) Linear Programme Frames Writing:

The preliminaries have been completed i.e. units have been selected for programming, assumptions have been made about the learners, the learning objectives have been stated in relation to the behaviours desired, a programme style has been chosen, now next, it is time for the main engagement, the construction of a programmed sequence. The sequence of the learning points is followed as per content analysis. Care was taken
not to include more than one learning point in a frame and to elicit a critical response which would result in the mastery of a particular learning point.

When the topic of the programme being informative and understanding oriented, it was difficult at times to elicit the critical response. In such cases different types of prompts are used and illustrations and examples appropriate for the particular learning point or concept are used. In the present study the types of prompts types frames and illustrations used are presented in the Appendix-C.

(ii) Branching Programme Frame Writing:

This is the typical branching programme advocated by Crowder. Each concept is elaborated in a paragraph or two, of about ten lines which followed by a terminal question of multiple choice type. Each alternative is provided with a different page number which should be followed by the student according to his choice. If his choice is right he is led to the next concept. If he makes an error, he is led to remedial information and then he is asked to read the question again. Here the student is expected to write down his choice.
4.7 Validation Process:

A programmed material is "a reproducible sequence of instructional events designed to produce a measureable and consistant effect on the behaviours of each acceptable student." Therefore, the investigator attempted to arrive at an optional sequence of the instructional events by trying it out on modifying it until he reached a point, where there was empirical evidence to the effect that the programme was successful in imparting the intended instruction. Validation of the programmed learning material prepared by the investigator was divided into two chronological stages as follows:

(i) The individual Student testing stage.
(ii) The field testing stage.

(i) The Individual Student Testing Stage:

Mullick and Dewal state that "This stage mostly follows the finalisation of the first series of frames including criterion frames in a programme. The methods

of this stage tend to be clinical, in the sense that more reliance is given to close observation or often interaction with a student individual.\textsuperscript{11}

The programmer wanted to obtain feedback from his students from the very beginning and wanted to test each frame word by word till he was sure of the effectiveness of each of the frames. Testing the programme to get systematic answers to questions of effectiveness, requires judicious choice of students. Care was taken that the selected students were possessed the entering behaviour which the programmes contemplates and the testing situation was made conducive for the students that they could become informal, vocal, bold and to pose teaching problems. Also in selecting the students, care was taken to make a representative sample of the target population, ability wise. Twelve students were taken from four different higher secondary schools of Anand Taluka. They represented different ability levels. Out of the twelve students four of them were bright students, four of them were average and four of them belonged to the category of below average students. These categories

\begin{itemize}
\end{itemize}
were accepted according to their achievement in the last examinations and further consultation with the teachers who know them closely.

For individual try out, the first draft of the programme was written on cards, having the size of 12 cm x 8 cm each. One frame on each card with the responses was written at the back side of the card.

The rapport was established by explaining the students the purpose of administering the programme. After making them quite comfortable the necessary instructions were given to them regarding how to read the frames, where to write the response, how to check their response etc..

Over and above the programmer followed the following guide line given by "Mullick and Dewal," in their book "A Hand book of Programmed Learning."

- Establish an effective rapport with the student. He should not feel threatened as if you are going to test him or examine him. Make the distance between you and the student small because this is not the time to insist on keeping a respectable distance.

- As far as the try-out phase is concerned, to err is
- For each frame you will record your editing comments.

- If the student commits an error tell him that his answer is not correct. Usually he will read the frame again and come up with an alternate answer. If the second answer is correct, ask him why he committed an error in the first place. Do not suggest any possible causes. Leading questions are ruled out. Probe into his reply till he becomes specific.

- If the second answer is also incomplete, correct his reasons for both the responses. If it suggests any defects in the frame, make suitable modification in the frames.

- Note the time at the beginning and at the end of the programme. Write down the number of the frame at which the student happens to be at every 5 minutes blocks. This procedure will give you a better indication of arriving at an optional step-size.

- Take the editing comments and the data collected in the individual try out stage and revise your programme if necessary in consultation with a subject matter expert.

The programmer had a proforma with him to record the time taken for each frame, whether the response was correct or wrong. Whenever the students felt confused, the frame was discussed with them to know the exact
nature of the difficulty.

Whenever necessary, the frames were changed on the spot or the sequence was modified. For certain frames the black-out technique was used and the unnecessary non critical verbiage was removed. The students were informed to step as soon as they felt tired or bored. None of them said that it was boring but they did go for a short recess. The following were the time range taken by the students to complete the different programmes.

<table>
<thead>
<tr>
<th>Linear Programme</th>
<th>Time Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit - 1</td>
<td>3 to 5 hours</td>
</tr>
<tr>
<td>Unit - 2</td>
<td>2 to 4 hours</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Branching Programme</td>
<td>Time range</td>
</tr>
<tr>
<td>Unit - 1</td>
<td>3 to 6 hours</td>
</tr>
<tr>
<td>Unit - 2</td>
<td>3 to 6 hours</td>
</tr>
</tbody>
</table>

All these programmes for individual test were given at the proper time. Keeping in view the yearly planning of the teaching subject matter prepared by the school i.e. care was taken that students should not aware of the subject matter of the programmes.
After each individual try-out, the necessary modifications were made in the frames. When it was felt that a particular content point or concept was not clear to the student, the frame was improved by either breaking it down into still smaller steps, adding appropriate illustrations or examples, prompting it adequately or putting it in more simple language as the case might have been the frames were modified.

After the testing of the first draft of the programmes with individual students and making necessary modifications, it was given to the language expert and the subject matter experts to evaluate from the language point of view and the subject matter point of view. This helped the investigator in making the programmed learning material almost flawless as far as language and subject matter were concerned.

During the individual try out some of the casual reactions and expressions of the students were found by the investigator. They were as follows:
-We had pleasure in self study.
-The content can be understood better if teaching is done by this method instead of traditional classroom teaching.
-We enjoy learning freely.
(ii) The Field Testing Stage:

As a result the pre-try out on individual students the programmer had undergone the changes as indicated below:

- The new draft had more frames
- rearranged sequence
- grouping of the sequences under appropriate sub-topics.

Thus, the programme for field testing was ready so far as the following two units of contents were concerned.

(i) Transport Service
(ii) Banking Service.

Before giving for cyclostyling, the material was examined by the language expert. He added necessary commas, semicolone, and fullstops, over and above the language structure. The subject matter expert examined the material from the point of view of relevance of content.

One class of XI standard of T.V. Patel Higher Secondary was for field testing. The number of students were 50. The purpose of field testing was to improve
the programmes and tests and hence the elaborate statistical calculations were not done. Experimentation was conducted by the investigator.

**Table - 4.1**

<table>
<thead>
<tr>
<th>Class</th>
<th>No. of Students</th>
<th>Correct Response on the two unit of linear programmed in %</th>
<th>Pre-test scores in %</th>
<th>Post-test scores in %</th>
<th>Gain in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>XIB</td>
<td>50</td>
<td>83</td>
<td>41</td>
<td>83</td>
<td>42</td>
</tr>
</tbody>
</table>

*T.V. Patel Higher Secondary Complex, Vallabh Vidyanagar

**Table - 4.2**

<table>
<thead>
<tr>
<th>Class</th>
<th>No. of Students</th>
<th>Correct responses on the two unit Branching Programme in %</th>
<th>Pre-test scores in %</th>
<th>Post-test scores in %</th>
<th>Gain in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>XIB</td>
<td>50</td>
<td>78</td>
<td>37</td>
<td>78</td>
<td>41</td>
</tr>
</tbody>
</table>


Results showed that 17% in Linear programmed frames and 22% in Branching programmed frames were to be improved, and the post-test revealed that it is still
harder. Total time spent was 25 periods i.e. 25 hours. This included the hours spent on pre-testing and post-testing.

4.8 Conclusion:

In this way the programmes were written, recast, tried out and finalized. The programmes were then given for cyclostyling. The programmes were cyclostyled according to each sub-unit because the programme was to be tried out according to the sub-units and not at a time.

Total frames in linear programmes initially were 120 which were finally reduced to 95 after the try out and revision. The next chapter deals with actual experiments carried out in different nine higher secondary schools of Kaira District.