Abstract

The aim of the study is to develop and validate the mathetics style of programmed learning material and to administer the programme (Try-out on an individual and on a small group and large group of X std CBSE students). The development of the programme consist of five steps 1) Task analysis and Data collection, 2) Prescription for developing mastery of content, 3) Characterization and lesson plan, 4) Exercise design and 5) Editing. Evaluation of the programme is the final stage in the development of a programme. The researcher followed three type of testing, i) Individual testing, ii) Small group testing and iii) Field testing of validation testing. On the basis of internal and external criteria the effectiveness of programme material is evaluated. Pearson product moment correlation technique was followed, the reliability of the material is \( r = 0.6 \), hence the Mathetics style of programmed learning material is reliable and valid.

I. INTRODUCTION

“Education is the most powerful weapon which you can use to change the world.” The teacher plays a prominent role in the life of the students. The modern concept of education is that the teacher should aim at the complete development of the child. For this the modern teacher is motivated by a desire to make his teaching more facile and interacting. For the complete development of the child, the main focus of teaching should be to bring out
desirable changes in the behavior of the learner. These changes can bring out only by using appropriate teaching strategies.

In education, we use learning materials in various forms – print, audio, video, multimedia, web, etc. In order to help learners study these and learn in their own time and at their own pace, these materials are designed in such a way to have the teacher built in to facilitate the learning process. We call these the characteristics of self-learning materials. Everyone must be familiar with written technical reports, textbooks, chapters, academic results rather than self-instructional materials.

Self-instruction can be defined as the ability of one to cognitively plan, organize, direct, reinforce, and evaluate one’s own independent learning without a teacher's prompting. There are three powerful influences behind self-instruction: First the learning and modeling of materials, the ability of verbalization, and finally, self-regulation (metacognition). The use of imagery, which is fundamental in the development of one’s cognitive processing, is among the many connections that can be made through Education.

New techniques in education incredibly affect on the traditional approach of teaching learning process. Among all innovations in recent past the approach that have gain acceptance is Programmed Instruction. Programmed instruction has been considered as revolution in Educational Technology.

The term Programmed Instruction is probably derived from B.F.Skinner’s (1954) “The Science of learning and art of teaching”. Programmed Instruction sometimes referred to, as programmed learning is a process or techniques of teaching in a sequence of controlled steps. In most cases student work through Programmed material by themselves and at their own speed and after each step they test their comprehension by answering set question are fill-in missing terms. They are immediately shown their correct answers or given additional information.

1.1 Characteristics of Programmed Instruction Learning Material:

1. PI based learning material is Individual and only one person can learn by it at a time.
2. PI based learning material is divided into various small steps.
3. PI material is arranged into a series of sequential step.
4. Each step is related with another step.
5. The learner should have made active response.
6. Learner get immediate feedback in PI based material.
7. Students learn by “Principle of self pacing”.
8. PI material is Pre-tested and valid.
9. In PI based learning Error Rate and Fault rate is very less.
10. In PI based learning stimulus, Response and Reinforcement both are active.

1.2 There Are Three Types Of Programming.

1. Linear Programming.
2. Branching Programming.
3. Mathetics.
1.3 Mathetics Programming:

The founder of Mathetics is Thomas F. Gilbert. “Mathetics is defined as a systematic application of reinforcement theory to the analysis and construction of complex repertoires which represent the mastery in subject matter.” It is based on connectivist theory of learning. It is also termed as ‘Retrogressive Chaining’ or ‘backward chaining’. It is a reverse chaining approach. It is based on Principle of chaining, Discrimination and Generalization.

The term mathetics is being evolved from the Greek word ‘Mathein’ which means ‘to learn’. Like other programming styles, here also learning occurs by doing some activity by the learner.

- Mathetic and Learning Process:

The mathetical learning system is based upon S – R analysis of behavior. Basically learning process is response centered. The child learns the last step first, then goes to the next one before it and thus to the introductory part. This procedure where the tasks are connected from the last to the first is called chaining (Elias Jijish 2009). In Retrogressive chaining demonstrated, prompted, released(DPR) approach is used, in this students are first given to demonstrated exercise (Entire procedure is demonstrated to the student. The programmer supplies the student with all the steps up to the mastery step), then prompted exercise (The programmer supplies the student with all the steps leading up to mastery step and prompt him to perform the mastery step) and finally released exercise (the programmer provides all the steps, leading up to the step that immediately precedes the last sub mastery step, prompt this step and release the student to practice the mastery step). The programmer continues in this manner, each time allowing the students to perform an additional step until he/she has worked back of the first time step in the procedure and can perform the entire task (Mangal, S.K.2002).

Retrogressive chaining can be shown by the following diagramme.

1. 6
D
(1) …………………….6

2. 5 - 6
D P
(2) ……………….5 - 6

3. 4 - 5 - 6
D P R
(3) ………………4 - 5 - 6

4. 3 - 4 - 5 - 6
D P R R
(4) ………………3 - 4 - 5 - 6

5. 2 - 3 - 4 - 5 - 6
D P R R R
(5) ………2 - 3 - 4 - 5 - 6

6. 1 - 2 - 3 - 4 - 5 - 6
D P R R R R
(6) 1 - 2 - 3 - 4 - 5 - 6

7. 1 - 2 - 3 - 4 - 5 - 6
D P R R R R
(7) 1 - 2 - 3 - 4 - 5 - 6

8. 1 - 2 - 3 - 4 - 5 - 6
R R R R R R
(8) 1 - 2 - 3 - 4 - 5 - 6

Programmed learning is being used not only for self instructional purpose but also as mechanism of feedback for improving teaching efficiently. Mathetics style Programme is
also best for teaching Mathematics. Thus researcher developed a programme on “Arithmetic units”, which has been taken from Mathematics text book prescribed by N.C.E.R.T (National Council of Educational Research and Training) for grade X students, in English language. This programme consists of 55 frames. After the individual tryout the researcher went through small group tryout for determining whether the programme succeeds in bringing desirable change in learning. If the small group tryout reaches the standard, then the programme is ready for field testing.

II. OBJECTIVES OF THE STUDY
1) To develop and validate the mathetics style of programmed learning material.
2) To administer the programme (Try-out on an individual and on a small group and large group of X standard CBSE students).

III. SCOPE OF THE STUDY
The present study is confined to the following,
1) It is confined for 10th Standard students of CBSE.
2) Among different styles of programme instruction it is confined only mathetics style of programme instruction.
3) The study confined only Arithmetic units.

IV. DEVELOPMENT OF THE MATHECTICS STYLE OF PROGRAMME
1) Task analysis and Data collection.
2) Prescription for developing mastery of content.
3) Characterization and lesson plan.
4) Exercise design and
5) Editing

V. EVALUATION AND VALIDATION OF A PROGRAMME
Evaluation of the programme is the final stage in the development of a programme. Evaluation of the programme in this sense refers to the testing of the programme material during its developmental process and to the strategies to improve its effectiveness. Testing of a programme is a kind of trial situation for the frames and frame sequence brought out by the programmer. There are three type of testing,
1). Individual Testing:
The purpose of individual testing is to check how for the programme produced which is essentially still only a guess about how the material should be taught is, in fact, suitable for those for whom it is written. Here researcher selected 10-12 individual students of average and below average. The student is informed that he is not being tested, but that he is in fact, helping the programmer in revising, of the programme and every effort is made to put him at his ease. On the basis of student’s reactions, the researcher gathers some insight to improve and modified the frames.
2) Small Group Testing:
For the present study Descriptive survey method is applied to collect the data. In small group tryout researcher selected 15 students of X Std Kenbridge English medium School Kalaburagi (Karnataka). The researcher, before testing the programme administered pre-test to determine the extent of the student’s knowledge in the subject of mathematics. After pre-test, the printed exercises were presented to the student in actual classroom situation, the title of the programme was announced and specific written instructions were read out before the students.

The students were asked to take their own time while working on the programme. Investigator had given some time to the learners to discuss the difficulties faced by them while going through the programme. Immediately after the programme, a criterion test (CT) was administered as ‘posttest’ on all the students of small group, in order to check the competency attained by them.

After criterion test the researcher calculated reliability of the material. The reliability of the material is $r = 0.71$, hence the material is ready for field testing.

3) Field Testing Of Validation Testing:

Field-testing is more formal than development testing. The purpose of field-testing is to assess whether the programme satisfactorily achieves its stated objectives.

There are six steps in the validation of the programme or in field testing;

i) Selection of the Sample: The researcher selected 40 students of X Std. Aryan English medium school, Kalaburagi.

ii) Administration of Pre-Test: After having selected the sample, generally criterion-test is administered as pre-test in order to measure the learner’s knowledge of what they are about to taught.

iii) Administration of the Programme: After administration of pre-test, printed copies of the programme are distributed among the students. Instructions about the working with the programme are included in the beginning of printed programme. Here researcher taken down time by each student in completion of programme.

iv) Administration of Posttest: After completion of the programme, a criterion test is administered as posttest on the students.

v) Administration of Reaction Scale: The reaction scale is administered after the posttest has been completed by learners.

vi) Analysis of the Criteria of the Programme: Criteria of the validation of the programme are analysed after all relevant data have been collected.

These measures classified into two groups:

A) Internal Criteria:

a) Error Rate of the Programme: The error rate in criterion test was calculated on the basis of the responses given by the students by using the formula

$$\text{Error rate} = \frac{\text{Total No. of errors} \times 100}{\text{Total No. of available responses in the programme} \times \text{No. of individuals}}$$

[Where Total No. of errors= 764, N= 40]
Error rate = \(\frac{764 \times 100}{837 \times 40} = 2.281\)

Table 1: Concept-Wise Error committed by the students in various exercises in percentage

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Units</th>
<th>Error in(%)</th>
<th>% of success</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Real Number</td>
<td>2.58</td>
<td>97.42%</td>
</tr>
<tr>
<td>2</td>
<td>Arithmetic progression</td>
<td>1.95</td>
<td>98.05%</td>
</tr>
<tr>
<td>3</td>
<td>Probability</td>
<td>2.44</td>
<td>97.56%</td>
</tr>
<tr>
<td>4</td>
<td>Statistics</td>
<td>2.67</td>
<td>97.33%</td>
</tr>
<tr>
<td>5</td>
<td>Total</td>
<td>9.64</td>
<td>90.36%</td>
</tr>
<tr>
<td>6</td>
<td>Mean</td>
<td>2.41</td>
<td>97.59%</td>
</tr>
</tbody>
</table>

b) Density Of The Programme: Density is an independent measure of the difficulty of a programme. To find out density of a programme by using the formula

\[
\text{Type/ token ratio} = \frac{\text{Total No. of Sections}}{\text{total No of responses required}}
\]

Where, Total No. of sections = 215 and Total No. of responses required = 837

Type/ token ratio = \(\frac{215}{837} = 0.257 \approx 0.3\)

B) External Criteria:

The external criteria refer to learner performance after completing the programme material.

a) 90/90 Standard:

Total pretest score = 847, Total posttest score = 1739

The mean value of pre-test score is \(\frac{847 \times 100}{2000} = 42\%\) [where total score is 50×40 = 2000]

And post-test score is \(\frac{1739 \times 100}{2000} = 87\%\)

Expected gain = 100 – 42 = 58

Real gain = 87 – 42 = 45

Thus, Real gain/ Expected gain is 45/58.

b) Attitude Coefficient (Reaction Coefficient): Three point likert’s reaction scale is used. Here 79% of the students agree with all the principle and characteristics of the programme.

c) Gain Ratio: Mc-Guin and Peters (1965) suggested that best criterion of a programme effectiveness is the gain ration between amount of learned and the amount that could by possibly be learned. By using following formula we find out gain ratio;

\[
\text{Gain ratio} = \frac{\text{Mean of (post-test scores–pre-test scores)}}{\text{Mean of (Full scores–pre-test scores)}}
\]

Where, Mean of post test score = 1739, Mean of pre-test score = 847, Full mean score = 2000

Gain ratio = \(\frac{1739-847}{2000-847} = \frac{892}{1153} = 0.773\)
d) **Level Of Performance:** The post-test scores are used and their mean value is computed. The mean value is converted into percentage. A good programme should have 75 percent average performance.

\[
2000 \rightarrow 1739 \\
100 \rightarrow ? \\
100 \times \frac{1739}{2000} = 87\% 
\]

e) **Standardization Of Validated Material:** On the basis of internal and external criteria the effectiveness of programme material is evaluated. In the administration of both pre and post test scores/results were correlated. Pearson product moment correlation technique was followed, the reliability of the material is \( r = 0.6 \), hence the Mathetics style of programmed learning material is reliable and valid.

### VI. CONCLUSION

The Mathetics style of programme on arithmetic units was developed and validated by researcher. The programme material has been an effective instrument for making the students of Xth standard to learn arithmetic in mathematics. Mathetics style of programme material is very useful in the field of teaching Mathematics.

### VII. REFERENCES


To Cite This Article