CHAPTER III

REVIEW OF THE PAST STUDIES AND WORK DONE IN THE FIELD

In 1954, B.F. Skinner wrote an article on the science of learning and the Art of teaching. Since then a number of researches have been carried out on the subject of programmed learning. There were about 165 research articles in 1959. This much amount of research work in programmed learning suggests that it is the most experimental area of instruction. Therefore, the review of these research work is necessary for further development in this field.

3.1 Areas of research:

The research in this field of programmed learning can be divided into three major areas (i) The effectiveness of programmed learning (ii) The study of variables such as self-pacing sequence, step-size, response mode, knowledge of results, reinforcement and confirmation. (iii) Evaluation of programmed texts written for different age groups and for different purposes. The first ten years of research reflects the researches on finding out the effectiveness of programmed learning, when compared to conventional teaching and also the effectiveness of programmed texts, compared to the traditional texts. Later on the trends in the research is on the study of the variables, writing out and evaluation of programmes suited to various age groups and for the consumer's needs in different vocations.
With the advent of technology in education (in early 1970) the trend is towards the analysis and organisation of the subject matter to be taught, the detailed study of the entering and terminal behaviour and the analysis of the tests used after studying the programme to find out whether learning has taken place or not. The results of such researches do not establish the clear superiority of the one variable over the other, as there might be some subject matter and some learning tasks for which one or the other method works better.

3.2 The Comparative studies of Programmed Learning and Conventional Teaching:

The researches show that students learn from programmed instructions, in which the mode of presentation may be linear or branching. Following are some of the comparative studies.

Study I:

"A study of supervised and non-supervised programmed instruction in the University Setting." 1

The study is on the comparison of programmed instruction with formal instruction. The results indicate that the non supervised completion of programmed texts is less efficient in terms of achievement than supervised instruction or formal

instruction. It is concluded that programmed texts are effective in the instruction of algebra provided the student's study is supervised.

Study III:

"Comparative Research on Method and medium for presenting programmed course in Mathematics and English".  

This problem, aims at studying the effectiveness of programmed course presented by (1) teaching machines (2) programmed text books (self paced) (3) film strips (externally paced) compared to conventional classroom teaching. The result of the study is that, there is no significant difference found in learning outcomes except that on the unit tests, the programmed treatment give higher scores and lower variance.

Study III:

"An evaluation of the Trainer Testers and punch Board Training".  

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The problem is peculiar in science, that it is a study of the comparison in intellectual work and the laboratory work. Results are that the group using the programme is found superior in intellectual work while the traditionally taught group in some cases proved superior in laboratory work.

**Study IV:**

"Comparative study of programmed and conventional instruction*. 

This study is on the comparison of programmed and conventional teaching. Programmed text book classes took less time to complete the book than the conventional classes. Programmed text book classes scored higher than the conventional ones. The difference is significant, even after the effect of difference in reasoning ability is partialled out. The students are favourable to programmed texts.

**Study V:**

"A Comparison of Programmed Instruction and Lectures in teaching of Electrocardiography*. 

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Programmed Instruction in the electrocardiography which is presented by teaching machine produced results similar to well prepared lectures. But the programme is proved better for low achievers and for those whose mother tongue is not English. In this study women learnt better from lectures and men from the programme.

**Study VI:**

"Comparison between Programmed Vs Conventional Instruction in Algebra".6

The experimental group was taught by simple programme and the controlled group, by conventioned classroom method. The experimental group scored high and retained more on questions actually covered in the programmed, but did less well in applying learning into new questions not covered in the programme.

**Study VII:**

"The effectiveness of Self-Instructional Techniques in Teaching selected phases of an Introductory course in Audio-Visual-Education".7


In this study, the two groups used self-instructional materials. One received the help from the instructor when it was needed, and the other group did not receive any assistance. One group was taught by conventional method and served as controlled group. The results revealed that (i) students can successfully master selected audio visual machine operation through self instructional techniques on an independent basis (ii) male and female students achieve at a comparable level when comparing one method to the another (iii) difference in achievement between male and female students irrespective of method were not conclusive (iv) student taught with self-instructional materials perform at comparable levels when taught with or without instructor. (v) Students approved the self-instructional material (vi) the amount of time to master audio visual machine operation can be reduced through the use of self instructional techniques.

Study VIII:

"A Comparative Effectiveness and Efficiency of the Teaching of Spelling by the use of Programmed Instruction Method and a conventional text book Method."

This study determines the effectiveness of programmed text book over a conventional method in the learning of spelling by the fourth grade pupils. The programmed text book method is more efficient than the conventional text book method of teaching spelling to fourth grade pupils. Provision for individual differences of fourth grade children learning to spell is accomplished more adequately than the conventional method of teaching spelling.

Study IX:

"Attitude and Learning in Performance on programmed and conventional Materials", 9

It is found that programmed text compared to the conventional one, is more liked, more preferred to lecture text and general text. Also the students preferred it for learning with a time limit and at leisure, and they also considered it better preparation for the examination.

Study X:

"A comparison of the effects of various learning procedure upon punctuation and content in a free writing situation" 10


experiment was meant to determine the skill of writing essays and was conducted separately in the 10th and the 11th grades. In both the grades, the programmed approach and the traditional approach were compared. Both the covariate and the dependent variable involved performance on an essay test. It was found that normal teaching approach is not significantly superior to the programmed learning approach in the teaching of punctuation. But one is not justified in stating that either the normal teacher approach or that programmed instruction is more effective for the teaching of punctuation as evidenced in a free writing situation.

Study XI:

"A study of the comparative effectiveness of programmed self-instruction versus the Demonstration Laboratory method in Teaching the operation of six types of Audio Visual Equipment".\(^1\)

To evaluate the effectiveness of programmed self-instruction; a linear programme was developed to teach six types of audio visual equipment. It was found that (1) programmed self-instructional method was significantly more effective than conventional method with equipment, which was difficult to operate.

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All the above studies reveal that the students learn through programmed learning easily and effectively. The same thing is revealed from the researches that even in skilled subjects like the handling of the audio visual aids or learning of the spelling the students are more benefitted by programmed approach.

3.3 Studies in India:

The following are the comparative studies done in India which throw light on the effectiveness of programmed learning. Miss Shah M.S. of the State Institute of Education, Ahmedabad, conducted the study of "A programme on solving equations" during her training in Research Methodology at the Department of Psychological Foundations, N.G.E.R.T., New Delhi. This is the first systematic attempt in the field of programmed learning. She developed the programme on solving equations and compared it to the conventional classroom teaching. She had applied sophisticated design and techniques of analysis. She states: "The data clearly show that the experimental Group I taught by programmed alone achieved more in less time than the control group. As regards the ability more in less time than the control group. As regards the ability dimension within a group, it seems that the programme was effective in terms of gain for all the ability groups. No significant interaction between treatment and ability was found."

It is rather surprising to find that the group taught by teacher with the programmed instruction did not do better than the group taught by programmed instruction alone.

Her thesis for the Ph.D. Degree is on, "To develop Auto Instructional Programmes in Algebra for Std. VII and to find out their effectiveness in relation to different variables."  

It is found that the total mean score achieved by the experimental group learning through Auto Instructional Programme was greater than the total mean score achieved by the controlled group taught by the conventional method. The average time taken by the experimental group is less than the average time allotted to the controlled group taught by the conventional method.

"The second study by Sharma J.M. is on Construction of Programmed Unit on sets for Class IX."  

He has conducted this study in part fulfilment of the requirements for the Degree of Master of Education, University of Delhi. He has developed a programme on sets (in Mathematics) for IX class students of Delhi Higher Secondary Board and


compared its effectiveness to the lecture method of teaching the same unit. The scores obtained by the programmed learning group are higher than the lecture method group. Although the difference is not found to be significant, the study provides enough evidence that the programmed unit is as good as the usual lecture method.

The third study is on "A comparative study of outcomes of teaching of Algebra by conventional class room method and Method of programmed instruction" by Sharma M.N. of Government Jodhri Higher Secondary School, Ladnun Rajasthan. He has compared the programmed method of teaching Algebra to the conventional class room lecture method. He states that the mean achievement of experimental group which was taught by the programmed learning method was found to be 2.5 points higher than the controlled group which was taught by the teacher through the lecture method. The obtained mean gain was significant at 1 percent level.

The fourth study is on "Programmed versus Traditional Approaches in the teaching of Gujarati" by Desai U.R. of the University School of Psychology, Education and Philosophy


of Gujarat University. She has attempted the techniques of programming in the teaching of language. She states that the programmed learning approach is more effective than the conventional teaching approach for students ranging from high I.Qs. to low I.Qs.

All the above studies, conducted in Indian class rooms, show that students learning through programmed learning method learn significantly better than those learning through conventional methods.

3.4 Some observations on Research Results:

There are large number of studies on the comparison between the programmed learning and the conventional technique. It is not possible to generalise that programmed learning is better than conventional technique from these studies as they differ in subjects, conditions and subject matter. They are all single studies; the only common point between them is the comparison between the programmed group and conventional group.

University of Keele has compiled the first comprehensive list of 112 studies comparing Programmed Instruction to conventional instruction. Eighty two of these studies are American and the rest are from U.K.

The results of 112 studies comparing Programmed Instruction to conventional instruction - can be analysed as follows:

**TABLE 3.1**

Comprehensive list of 112 studies comparing programmed instruction to conventional instruction, University of Keele

<table>
<thead>
<tr>
<th>Measures recorded</th>
<th>No. of studies recording those measures</th>
<th>Programmed Instruction Groups</th>
<th>Superior</th>
<th>Not significantly superior</th>
<th>Significantly worse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time taken</td>
<td>90</td>
<td>47</td>
<td>37</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Test Results</td>
<td>110</td>
<td>41</td>
<td>54</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Research results</td>
<td>33</td>
<td>6</td>
<td>24</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Note: Figures in the first column differ because not all the three measures are recorded for every one of the 112 studies.

There are some limitations of the studies reported in Table 3.1 such as:

a. Some of the experiments had very small samples.
b. Some have used very short programmes.
c. Long term retention is over looked.
d. Some of the data was not first hand data.
TABLE 3.2
Classification of studies conducted in industry, University and school

<table>
<thead>
<tr>
<th>Measures recorded</th>
<th>No. of studies recording those measures</th>
<th>Programmed Instruction Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Significantly</td>
</tr>
<tr>
<td>Military and Industrial studies</td>
<td>Time taken</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Tests results</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Retention</td>
<td>10</td>
</tr>
<tr>
<td>University studies</td>
<td>Time taken</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Tests results</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Retention</td>
<td>4</td>
</tr>
<tr>
<td>School studies</td>
<td>Time taken</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Tests results</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Retention</td>
<td>19</td>
</tr>
</tbody>
</table>

The above table evaluates the students which report the number of students, time taken and retention. The criterion of retention is not stressed much, as seen from the table. The comparison of learning by conventional and programmed method is not free from limitation. The basic theory of programmed learning conveys that 90 percent of the students achieved 90 percent knowledge on the test. The above studies do not justify it.
Recent Trends of Researches in Programmed Learning:

(a) A characteristic variable: Self pacing the problem under study was "Effectiveness of individual versus group pacing, as related to homogeneity or heterogeneity of group." It is found that in the homogeneous groups however, the time required by the group pacing, (i) is not significantly more than that needed by individual pacing. (ii) The time required by the heterogeneous and group paced subjects was significantly greater than that required by homogeneous and group paced subjects. Another study on step size is Theory and experimental research on the teaching of complex sequential procedure by alternate demonstration and practice. Results show that, self pacing procedures in which the student himself regulated the length of sequence before practice worked best for superior students.

(b) A characteristic variable: sequence. The study reported was on "factors in acquiring knowledge of a mathematical task." Results show that learning through the series


of steps, produced significant effects. Learning with high repetition and guidance produced performance superior to that produced by low repetition and low guidance. For a test of transfer no significant effects of the experimental variables of ability, or of their interaction were found.

(c) A characteristic variable: Step size: A study on "An investigation of variation in properties of verbal learning sequencing of the Teaching Machine type"20, has small steps programmes and the pupils performed significantly better on immediate and delayed retention tests than did other groups.

The second study was on "The programmed materials in Mathematics for superior students in rural schools and the relationship of intelligence to step size on a teaching machine".21 Both the studies have shown no significant difference between gains from the treatment i.e., small step, medium step size and large step size.

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(d) A characteristic variable: Response Mode. The following studies have been considered to find out the effect of different response modes.

**Study I:**

*A comparison of several response mode in a review programme*.22

In one treatment, the learner had to respond only after careful reading of the items. This was compared with the same type of programme but the learner had to respond only after simple reading of complicated statements. The post test results of the former technique of responding was superior to the latter one.

**Study II:**

Post test results showed the superiority of the overt responses over the covert responses. This is supported by research findings of study No. II. *Programming Method and response mode in a visual oral response task*.23


Investigations of learning variables in programmed instruction are as follows:

There are a number of studies on respond modes which show no significant difference in different respond modes. The reason is that the programmes used were very short.

The following is the problem studied to find out whether there is any difference in learning if the programmes used constructed responses or multiple-choice.

Study III:

"The Effect of Response characteristics and Multiple choice Alternative on learning during programmed Instruction"24

It was found that constructed responses provided better performance, in certain type of learning task e.g. to recall technical terms. When the student is asked to choose the equivalent word, multiple choice item is found to be better.

(e) A characteristics Variable: Knowledge of Results. The following are some of the results of such studies.

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Study 1, "The Effect of Immediate Knowledge of Quiz results and final examination scores in Freshman chemistry." 25

The result showed that final examination scores were significantly higher for students getting immediate knowledge of results. Study No. 2, is one, "The effect of receiving the confirmation response in context in programmed material." 26

The group that received confirmation in context of complete sentence was significantly better in applying the principles learned from programmes.

Reinforcement and confirmation: Reinforcement leads to correct responses. The problem under study was to study the effects of different kinds of reinforcement.

Study 1:

"The Effectiveness of confirmation plus trinket

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Results showed no significant difference in learning or test performance.

The following studies found clear advantage for confirmation as measured by a post-test results and errors within a programme.

Study 2:

"Report on the Initial Test of Junior High School Vocabulary Programme".28

Study 3:

"Positive and Negative knowledge of results on a Pressy-Type Punch-Board".29

The above studies using pressy type multiple choice test items show a significant advantage in confirmation. Kaess and Zeaman reported that the group which had no confirmation trial did not perform well on both the trials.


After 1965 many studies are found on writing and Evaluation of Programmes for different purposes. Following are the selected studies, which can be used for different purposes.

Study 1:

*Design and Development of Programme for Attitude Change* 30

The Programme was tried out with a group of students for critical evaluation. Analysis of the discussion provided basis for modifying the pictures and instructions. The final version was used in a family planning centre.

Study 2:

*On Programming Instructions for children* 31

The programmes for children should be developed in which intrinsic regard is considered. As children are born with


curiosity; if encouraged and fed with, such programmes will become more powerful agent for learning.

**Study 3:**

The following study is on student's variables such as "Motivation, step size and selected learner variables in relation to performance with Programmed Instruction". Results show that highly anxious students performed better without a pre-test while low anxious students did better with post-test. Small step programme produced more differentiation than long step programme.

**3.6 Brief review of the work done on Programmed Learning in Different Countries:**

Programmed learning in U.S.A. The use of programmed learning in U.S.A. is in schools, industries and in armed forces.

**Programmed Learning in Schools:**

Many educators have found out, as a result of experimentation that children learn effectively through programmed learning material, and there is significant gain in time taken for learning. As a result of National Survey it is

found out that in 1962, 11.42 percent and in 1963, 36.36 percent of the schools were using programmes.

Most of the programmes were in book format. Since the later part of 1965, Programmed learning has been the major criterion of educational technology. Programmed learning in industries, and armed forces is found to be very effective in imparting instruction to the adults.33

Programmed Learning in U.K.:

In the past years, programmed learning has been established as a means of teaching and training in schools, industries, and in armed forces. Each year a number of programmes are developed and published. The logical and factual subjects are more chosen for programming. The most favoured style is the linear style. Most of the studies and uses have shown that programmed learning works effectively.34

Programmed Learning in U.S.S.R.:

In U.S.S.R. more than one hundred organisations have


conducted research and other training courses in the field of educational technology.

The researches are conducted to find out the suitability of the style of programming, the conditions to use programmes, so that maximum results can be reached.

Recently the programmed learning in Soviet Nation is on the principles of cybernetics and algorithms. Programmes are written in the language of operations and decisions.35

**Programmed Learning in Germany**:

Both the parts of Germany i.e. Eastern and Western wings are using programmes similar to those in advanced countries. In West Germany programmed instruction in schools is not favoured much by some. They consider that education cannot be planned exactly. In many educational departments, one person is appointed to supervise the development of programmed instruction.

In Eastern Germany programmes are used by law, to improve instruction specially in Science.36


Programmed Learning in India

N.C.E.R.T. opened the door of programmed learning in India, during the early sixties. Since 1965, N.C.E.R.T. has been organizing seminars, workshops and training courses to acquaint the participants with the principles of programmed learning and also to train the programmers. The Indian Association of Programmed Learning (IAPL) which was founded in 1967, had its first convention in 1968. The first book in India on programmed learning explaining the principles and know how of programmed learning was written by Dr. G.E. Shah (Reader, CASE, Faculty of Education and Psychology, Baroda).

The following studies (given in IAPL newsletter Vol. 3; No. 1, 1968) have been conducted in the field of programmed learning.37

Besides Miss M.S. Shah's studies on programmed learning, there are others who have done some useful work on a large or a small scale. Therefore it will be worthwhile to mention their works in brief.

Study 1:

S.P. Mullick investigated the effectiveness of programmed learning material in a correspondence course situation. His

findings revealed that programmed learning material proved more useful than conventional method.

**Study 2**:

M.G. Gupta (1965) found that even adapted programmes can give more good results. The advantage that he pointed out was that adapted versions save much of our time and energy, which can be used for other programmed learning material essentially needed for Indian schools.

**Study 3**:

The studies of M.M. Sharma, V. Desai and Gibson (1965) confirm the view that performance is better when taught through programmed learning materials.

**Study 4**:

S.S. Dewan and Kulkarni (1967) have explored the possibility of applying programmed learning principles on T.V. instruction. The findings show superiority of experimental instruction. The findings show superiority of experimental group over conventional T.V. lesson group.

**Study 5**:

Dr. G.B. Krishnamurty has successfully applied techniques in training of family planning workers. His programmes "Guide to happy family" and a pictogram on condom utilization, the pill and a guide to better life, have met with wide success. He has also worked on a group programmes.
Study 6:

Dr. Krishnamurty and Rao (1969) have developed a programme manual for training persons in the technique of programming.

Study 7:

The Groupogram technique was used by Thiagrajan and Krishnamurty. They report that groupogram ensures the mastery of the material by the students and hence is much more effective than the lecture method.

Study 8:

Dr. G.P. Shah has developed programme in directed numbers which was used to introduce programmed learning material to the teachers of Gujarat.

Study 9:

Miss M.S. Shah from S.I.E. Ahmedabad, Gujarat State has developed and tried out many programmes in arithmetic, science and language for primary teachers as well as for the students of primary schools.

Study 10:

R.A. Sharma conducted a study as a part of training in research methodology course of the Department of Psychological Foundations, N.C.R.R.T., New Delhi. The author developed a lesson in Geography on the programmed learning model and then
compared it with a lesson on the same topic, taught by the teacher through the conventional method.

Study 11:

Shri P.V. Kulkarni from Poona University has prepared a programme on modern Algebra to find out whether the students of the 5th class can learn the subject independently. He found that even the 5th class can learn this topic and can get high scores of the criterion tests, but they require more time and practice than the 8th class students.38

Study 12:

Kum. Nalini L. Pandya from Sardar Patel University, Vallabhbh Vidyanagar, Anand has prepared programmes in Science, for her study of the effectiveness of programmed learning strategy in learning of physics in Xth class of secondary schools.39 She had focused the attention on the variables such as (1) intelligence (2) motivation (3) socio economic status (4) ability in science (5) entering behaviour. Various tools were used to find out the above stated variables prevailing amongst the students of experimental and controlled

38. P.V. Kulkarni: To prepare programmed learning material and to study in what different ways it can be used. Unpublished Ph.D. theses submitted to the University of Poona, December, 1968, p. 97.

groups. It was observed about the achievement at the post tests of the experimental and controlled group that when mean scores were adjusted, the adjusted means of the post tests scores of the experimental group were higher than the adjusted means of the post tests scores of the controlled group. This implies that the treatment of programmed learning is more effective than the conventional teaching.

CASE (Centre of Advance study in Education, in Baroda, has done some major and minor investigations in the field of programmed learning. The papers that are prepared as a result of these investigations are very well edited by Dr. G.B. Shah in the book on "Studies in programmed learning". The book is published by Charotar Education Society, Anand, July, 1974.

Studies covers certain aspects of programmed learning. They are: (1) Comparative studies with regard to relative effectiveness of programmed learning material (2) Experimental studies with regard to various forms and response mode, and (3) co-relational studies in relation to certain personality dimensions.

The book also contains a chapter of Conspectus of Research work done in other countries. The chapter further deals with certain down-to-earth problems of experimental design, educational administration and personal problems of a researcher in taking up a study in programmed learning in India either at the individual level or at the institutional level.
The review of the individual papers included in the book is not possible to give here. But the book has definitely helped the investigator, in planning, preparing and implementing the research design. The statistical calculations given in different papers have also helped to develop an insight in the statistical treatment to be given to the present study.

3.7 Significance of the research work done:

Programmed learning, a new technique, is further investigated and applied in the various fields of education in the developed countries. The results are promising. From the results, which have high claims to bring about the desired changes in the students' behaviour, we can anticipate similar results with the similar enthusiasm in the Indian classrooms.

To answer this problem, our teachers and researchers should develop a new technique and should try it out in Indian situation. It is undesirable to take to the method directly, which has proved effective elsewhere.

In India, since 1966, Indian Association of Programmed Learning has undertaken and sponsored the research projects in programmed learning to examine its effectiveness. The matter does not end here. The new field needs more and more inquiry to meet the challenges of different areas of the subject matter. Therefore, a number of programmes in
different subject matter taught in schools, should be developed and tried out. This will acquaint the teachers with the principles of programmed learning and they will be confident in using programmed learning material in their class rooms.

CASS, Faculty of Education & Psychology, M.S. University Baroda, has developed programmed learning material in different subject matter taught in the secondary schools. This work should be supported by further research work in the area of programmed learning. It can be said that there are very few research studies done in programmed learning in Gujarat State.

Hence, it was thought that the programmed learning material be developed in modern Geometry in Gujarati language and tried out in the class rooms of some of the schools in Gujarat State.

The present study falls in the category one: that is comparison of programmed learning to the conventional class room teaching.

It also aims at studying the effectiveness of programmed learning in the context of other variables such as intelligence, socio-economic status and time factor.

Thus the review of the related researches in the field of programmed learning or Auto instruction device has helped the investigator in a number of ways. First, it has helped in
arriving at a conclusion about the type of a programmed material to be developed and use for the present investigation. Accordingly the investigator decided to develop a linear type of programmed material. At the same time it also helped in arriving at a decision about the variables to be studied; the review in a way has also given an insight into the experimental design to be planned and implemented for the present problem. The details of the design and the development of the programmed material are given in the subsequent chapters.