CHAPTER II

REVIEW OF RELATED STUDIES

In the first chapter, the conceptual framework related to the development of multimedia instructional strategies with a view to systematising the process of instruction was presented. In this chapter, research and developmental efforts, which were reviewed for arriving at the conceptual framework, have been presented. They have been presented under three headings: (a) development of programmed instructional material ; (b) programmed instructional material combined with other media of instruction to evolve multimedia instructional strategies; and (c) relationships between certain learner characteristics and their achievement through the strategies. The above classification has been resorted to with a view to projecting the progressive trend noticed in the conceptual and methodological considerations in the studies dealing with systematisation of instructional process.

DEVELOPMENT OF PROGRAMMED INSTRUCTIONAL MATERIAL

The term 'Programmed Learning' though not very old in the field of psychology and education, its antecedents can be traced back to Watson, Thorndike and Pressey. Thorndike (1912), while studying stimulus response systems, held the view that if by a miracle of mechanical ingenuity, a book could be so arranged that only to him who had done what was directed on page one would page two become visible, and so on, much that

2 now requires personal instruction could be managed by print. A decade later Pressey (1926) devised the first teaching machine for scoring multiple choice tests for leading the student forward on the basis of immediate performance. Skinner (1954) gave further concrete shape to these ideas.On the basis of his experiments with the pigeons, he gave the first and the most common type of programme, viz., linear programmed instruction. The connection between Skinner's reinforcement principles of providing confirmation of responses in programmed instruction and Thorndike's 'law of effect' is probably a well known relationship. However, the use of the term 'Programmed Instruction' is associated with Skinner (1954).

Ever since the introduction of programmed instruction into the educational scene, a large number of studies have been carried out in establishing its effectiveness and efficiency in achieving certain specified instructional objectives. Research efforts were mainly focussed on problems such as whether programmed instruction could enhance learning; whether it is more effective and efficient in comparison to conventional teaching, and whether a programme of one design (Linear, Branching or Skip) is more effective than the other, etc. The studies conducted have shown equivocal and sometimes even contradictory results. A survey conducted by Finn and Perrin (1962) has revealed that there are a good number of programmes (more than 120) developed at junior, 3 middle and high school levels, and also for adult education and special industrial programmes such as training personnel for operating sophisticated machinery, equipments, etc. The survey has also revealed that most of the programmes have been developed for the subject matter in mathematics and natural sciences for the junior and high school level students.

Hartley (1966) after reviewing 110 programmes has reported that 41 per cent of the programmes, between 1960's and 1970's were significantly more effective in terms of greater achievement and efficiency than traditional methods; 49 per cent were equally effective; and 10 per cent significantly less effective. Popham (1969), considering the type of studies reviewed by Hartley, remarks that many of the so-called programmes used in these studies were nothing but primitive first drafts and did not even satisfy the replicability requirements as specified by Markle (1967). Komoski's (1966) findings from a formal survey led him to state that, for 291 programmes published in the past few years, "no evidence of testing is available for 40 per cent of these programmes".

An insight into the use of PLM in its different forms and at different levels, in recent years can be gained from the second year book of Association for Programmed Learning and Educational Technology (APLET, 1976), International Yearbook of Educational and Instructional Technology

(1976), Volumes of Aspects of Educational Technology (Vol.IX, 1975; Vol. XI, 1977), and the volume 'curriculum development' - 10th Annual Report (1977). Attempts have been made in the studies quoted in those volumes, to subject PLM to strict initial tryouts and judging its effectiveness through multiple criteria.

In India, programmed instruction made its first appearance on the instructional scene in the year 1963. Since then a good number of programmes have been developed and tried out in various parts of the country. Majority of the programmes have been developed by individual researchers working for their master's or doctoral degrees. Reviews of these studies have been done by Yadav and ~~Y~~ Govinda (1974), Sharma (1974), Kulkarni and Kapadia (1974) and Shah, et al. (1979). An examination of these reviews reveal the following. First, most of the programmes have been developed for primary and secondary school student population; second, the subject matters covered in these programmes have been often a few individual units, and not covering a set syllabus for any full course; three, most of the programmes have been of linear type, with a few on branching types; four, the experiments have been almost always comparative evaluative in nature, i.e., the developed PLM has been compared for its effectiveness with conventional teaching methods. An attempt has been made to represent a sample of the studies which reflect the above observations in Table 2.1.

TABLE 2.1

Studies Conducted with PLM at Various Levels for Different Content Matter

Sr. No.	Investigator's Name and Year	Subject	Topic	Sample on which it was tried out	Nature of the programme	Results
1.	Mullick, S. P. (1964)	Correspondence course	a few units in one course.	B.Ed. students	Linear	PLM was found effective than the conventional method of teaching.
2.	Shah, M. S. (1964)	Algebra	solving equations	VI std.students	Linear	Students taught through PLM achieved more in less time.
3.	Gupta, M. C.(1965)	Physics	force	VIII std. students	Linear	No significant difference was found between modified PLM and traditional teaching.
4.	Desai, U. R.(1966)	Language	types of compounds	IX std.students	Linear	PLM was found more effective than the conventional method of teaching.
5.	Kulkarni, P. V.(1969)	Algebra	Introduction to Algebra Simple equations	V,VI,VII and VIII stds. students	Linear	Students' achievement using PLM for revision was significantly better than students using summary review.
6.	Shah, M. S. (1969)	Algebra	complete syllabus for Algebra	VIII std. students	Linear	Students taught through PLM achieved more in less time.
7.	Hussain, M. (1971)	Population education	Concept of population education	-	Linear	-
8.	Nagar, P. S.(1971)	Biology	Flower	IX std.students	Linear	PLM was superior to heuristic teaching.
9.	Kapadia,G.G.(1974)	Biology	Heart and Blood circulation	VIII std. students	Linear and Branching	Less anxious people achieve more with PLM than highly anxious people.
10.	Krishna Murthy V. (1972)	Physics	Thermometer	VIII std. students	Linear and Branching	Response prompt covert reading was better than linear overt form, linear covert form, skip, branched and hybrid form.
11.	Mehta, S. J.(1973)	English	Programmed reading in English	V std.students	Linear	PLM was found effective in enhancing reading ability.
12.	Chauhan,S.S.(1973)	Educational Psychology	Eight units in Psychology	B.Ed.students	Linear	The density did not exceed 1.117 per cent and error rate 8.72 per cent.
13.	Gupta, O.N. (1973)	English	Structures and definitions	Undergraduate students of Meerut University	Linear	Programme density ranged from 0.4 to 0.08 and error rate 1.4 to 3.2 for structures and 0.4 to 0.15 density and 1.2 to 3.4 per cent error rate were found for definitions.

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Sr. No.	Investigator's Name and Year	Subject	Topic	Sample on which it was tried out	Nature of the programme	Results
14.	Pandya, N.L.(1974)	Physics	Light	X std.students	Linear	PLM was found effective.
15.	Patel, C.B. (1975)	Geometry	Units in Geometry	IX std.students	Linear	PLM proved effective than the conventional method.
16.	Shitole, C.B.(1976)	Agriculture	A few concepts in the syllabus.	VIII std. students	Linear	Students' achievement was greater through PLM, in less time than conventional teaching.
17.	Chandrakala (1976)	Sanskrit	A few topics in Grammar	IX std.students	Linear	PLM was found effective than lecture method and conventional method of teaching.

6 However, recently, there are a few programmes that have been developed for the entire subject matter of the courses, and being tried out as a regular instructional techniques. Bhusan (1973), at the graduate level, developed a programme on 'educational statistics' which is a part of Educational Psychology course for B.Ed. students. He rendered the full course on Educational Statistics in the programmed form. It was found through the study that the mean of attainment scores on post-test was 78 per cent and that of gain scores from pre-test to post-test was 76.8 per cent. Another programmed learning material on Educational Evaluation was developed by Govinda(1975) for B.Ed. students of The M.S. University of Baroda. It was developed for the prescribed course and tried out on 69 B.Ed. students belonging to the year 1973-74, under actual conditions of teaching and examination. All the tests were part of the formal programme of teaching and evaluation. The effectiveness of the PLM was determined experimentally by comparing the achievement of students who studied by using PLM with those who were taught by the structured lecture method. The results revealed that there was no significant difference between the achievement of students taught through PLM and those taught through the structured lecture method in respect of four of the six units selected for the study. However, with regard to two of the units, the difference in achievement by pupils were in favour of the programmed text. In many other studies which have sought to evolve instructional strategies for particular

courses at different levels of education, PLM has been developed and utilized as a major instructional medium (Sansanwal, 1978; Seshadri, 1979; Menon, 1977; Shah, 1978; Joseph, 1978). The studies presented in the parenthesis have been reviewed later under the section 'programmed instruction combined with other media to evolve multimedia instructional strategies'.

Considering the type of researches conducted with PLM in the beginning days of its introduction into educational scene, it may be mentioned that, in general, attention of researchers were focussed on the physical design of the programmed instructional material and on the methods by which these materials were applied in order to bring about learning. However, with the growing awareness that experiments dealing with grossly defined teaching methods and learning situations cannot provide the depth of analysis that is needed to understand the learning process that occurs within the learner, many recent studies have been concerned not only with physical design or programme methodology per se, but also with the interactions between auto-instructional methodology, task characteristics and learner characteristics, as these factors determine the efficiency of student learning. Research efforts have been directed towards considering PLM in perspective with other instructional techniques and to discover what combinations of methods and media will lead to most effective and efficient learning under specified conditions. This trend could be considered as a significant

8 advancement in the field of research conducted with auto-instructional methods. The underlying assumption in studies dealing with combination of techniques has been that while certain objectives could best be achieved by self-instructional techniques, others will require teacher presentation or group discussions, and still others require concrete experiences (Post-lethwait, 1970; Siemankowsky, 1969). The perspective to utilize PLM in combination with other techniques of instruction have led to evolving effective multimedia instructional strategies.

PROGRAMMED INSTRUCTIONAL MATERIAL COMBINED WITH OTHER MEDIA OF INSTRUCTION TO EVOLVE MULTIMEDIA INSTRUCTIONAL STRATEGIES

During the past few years, there has been a greatly increasing awareness, interest and activity involving the analysis of component behaviours, and an attempt to design instructional strategies. While these analyses are called by different names such as task analysis, hierarchical analysis, or learning set analysis, all have the basis purpose to identify all the component behaviours that enable the student to attain the terminal behaviours specified and to order them in some relationship to one another. When the sole purpose of instruction is to assist the learner in acquiring certain kinds of behaviour, the question of the most effective instructional strategy becomes imperative. Gagne (1965), Glaser (1966), Melton (1964) and others have offered

9 suggestions concerning a whole class of experimental investigations which might be useful in providing some scientific principles for instructional procedural development. The taxonomy of behavioural objectives and the related taxonomy of types of learning have implications for the selection of different media. Briggs (1970) has proposed to seek ways to use a single medium for the optimum length of time for the most appropriate set of objectives and decide among the alternatives of group instruction, individualised, teacher conducted and automated instruction. An example of the combination of programmed instruction with other devices is given in a study reported by Keisler and McNeil (1962). Cuisenaire blocks were used in conjunction with an auto-instructional programme to investigate the ability of first grade children to learn mathematics in terms of algebraic structures.

Goldbeck, Shearer, Campeau and Willis (1962) studied the effects of integrating programmed learning with classroom teaching. They found that programmed instruction integrated with conventional teaching was significantly effective than the conventional instruction. On similar lines is the study conducted by Hatch and Flint (1962). They noticed no significant difference in the group receiving programmed instruction and conventional instruction. However, the group taught through programmed instruction integrated with conventional instruction, performed about one standard deviation higher

10 than the groups taught through programmed instruction and conventional instruction alone.

Bartz and Danby (1965) studied the effects of supervised and non-supervised programmed instruction and found that supervised study of programmed instruction was better than non-supervised study of the same.

Information about multimedia instructional strategy has been given by several authors. Almost always, the term 'multimedia instructional strategy' has been referred to programmes in which auto-instructional devices are used in combination with other techniques. Frequently, the components include programmed work books, audiotapes. alone or with filmstrips, T.V. presentations and laboratory exercises. Rationale for the development of multimedia instructional sequences have been presented by Briggs, Campeau, Gagne and May (1967); extant multimedia programmes have been described by Brown and Thornton (1963), and Johnson (1969); procedures for multimedia sequences have been presented by Bannister (1970), and Postlethwait, Novak and Murray (1964); and descriptions of instructional systems have been presented by Banathy (1968), Oettinger (1969) and Trzebiatowski (1968).

Smith, Schgrin and Poorman (1967) reported on a multimedia instructional system used in conjunction with the Harvard Physics project which implemented many of the objectives of the Briggs report. Answers were sought by

11 designing, developing, field testing and evaluating a sequenced unit involving various types of media and consisting of materials produced by Project Physics in addition to programmed texts and commercially available films. These experiment~~s~~ -ers reported that they designed their multimedia system with the idea of changing the traditional role of the teacher to that of teacher and guide. They found evidence of increased instructional effectiveness, particularly in individualized instruction. Further, it was also observed that multimedia approach benefit~~t~~ed both high and low achievers and increased their interest towards Physics. Employment of the multimedia approach in introductory college physics increased the interest of the students, and enrolment in physics went up more than 100 per cent as compared to an all-university increase of only 11 per cent (Black and Poorman, 1970). The multimedia approach was superior to conventional methods in teaching physical science to non-science majors in college (Siemankowský, 1969). The approach made teaching more attractive and interesting to students and promoted acquisition of concepts and understanding of processes (Smith, 1969).

In another attempt to introduce multimedia approach at junior college level (St.Louis Junior College) for teaching courses - English, Chemistry and Psychology (Hunter, 1970), preliminary evaluations showed a significant increase in student achievement; the rate of failure in the Chemistry course dropped 10 per cent, and dropout rates were lower in

12 English and Psychology.

Damen (1974) tried to develop, tryout, describe and evaluate a multimedia programme in non-verbal communication. The two part study consisted of a description of the construction of the multimedia non-verbal programme, and a description and evaluation of its implementation. The programme utilized 14 multimedia lessons made up of learning activity packages, slide-tapes, films and printed materials. The programme provided students with an opportunity to identify, differentiate and use forms of non-verbal communication by providing them with journals, books, photographic and audio supplies and equipment. The effectiveness of the programme was evaluated in terms of student behaviour in the classroom, students performance with programmed materials and the teacher-student relationship. The study indicated that a majority of students increased their understanding and use of the eight categories of non-verbal communication.

Brawley (1975), while attempting to teach 'time-telling' to retarded children, found that an increased student learning through the utilization of his 12 multimedia instructional modules.

Boundreaux (1975) in his attempt to teach certain concepts in science to IX grade science students found that multimedia approach to science teaching was more effective in developing an understanding of science concepts in

13 learners than conventional science teaching (teacher text book approach).

At teachers training level, Theodore (1976) developed a self-instructional multimedia module for teacher trainees to produce their own classroom visual materials. The module comprised of filmstrips, audio-cassettes and printed materials. He found significant difference in the performance of teacher trainees exposed to multimedia modules as against trainees exposed to conventional training.

On the Indian scene, studies to identify the conditions to use PLM as a component of instruction have been undertaken by the Centre of Advanced Study in Education, M.S. University of Baroda. Using PLM as a major instructional component, Yadav and Govinda (1976) evolved an instructional strategy for teaching the entire course on educational evaluation to B.Ed. students of the M. S. University of Baroda. On logical consideration of the broad objectives of the course, the instructional strategy conceived involved the use of the technique of PLM, discussion, library work and practical work (different instructional inputs) in a proper combination. In this experiment all the one hundred and sixty eight students of the B.Ed. class (1975-76) were considered as subjects. It may be mentioned that this study was an extension of the study conducted by Govinda (1975), which has been reviewed earlier. The experimentation was carried out for one complete academic semester. The developed

14 strategy was evaluated for its effectiveness in terms of students' performance, on the criterion tests, feedback sessions, assignments and comprehensive tests. The strategy was found effective in achieving the objectives set for the course. About 50 per cent of students scored 75 per cent of marks and above on the comprehensive test which was considered in the study as performance with distinction. As an another index of validation, the effectiveness of the strategy was compared with the effectiveness of the PLM when used alone, i.e., with the results of the study of Govinda (1975), since the experimentation in both the studies were carried out in the same institution on B.Ed. students belonging to the two different academic sessions. For comparison purposes, it was assumed that the two groups were similar in nature, since the admission requirements and procedures remained same for both the years. Through such a comparison it was noticed that the students who were exposed to the strategy had performed better than the students who were exposed to PLM alone. It indicated that the enrichment brought into the instructional work (instructional strategy) by including components such as library work, practical work and discussion, and integrating them with the use of the PLM has positively influenced the achievement of the students.

It may be mentioned here that a similar strategy for teaching the course 'Educational Evaluation' to B.Ed. students of the SNDT University, Bombay, has been developed and tried out by Shah (1978). This study has been almost a replication

15 of the study of Yadav and Govinda (1976), in a different educational setting with variations in content and medium of instruction. The sample for the study constituted of 30 B.Ed. students of the SNDT College of Baroda. The instructional strategy developed comprised of components such as PLM, library work, discussion, practical work and introduction by the teacher. The effectiveness of the strategy has been studied through students' performance on criterion and comprehensive tests, practical work, assignments, observation schedule and reaction scale. The strategy was found effective to the extent that 90 per cent of students could get 70 per cent of marks. Students also showed favourable reactions towards the strategy.

Sansanwal (1978) has developed an instructional strategy to teach the course 'Research Methodology' to M.Ed. and M.Sc. Home Science students of the M.S.University of Baroda. The objectives considered for the course were imparting basic information, development of certain abilities like participation in seminars and discussions, etc. The strategy conceived of inputs such as PLM, library work, practical work, assignments, seminars and discussion sessions, etc. The working of the strategy as a whole as well as in terms of each individual input has been studied through criterion tests, comprehensive tests, and students' reactions towards the strategy as a whole and for each input separately. The strategy was found effective to the extent that 70 per cent

16 of the students obtained above 70 per cent of marks on all the criterion tests. The reactions of the students towards each component indicated that integrated use of the different inputs in the strategy had served the purpose of achieving the desired objectives.

While the above two studies have been conducted with college students, Seshadri (1979) attempted to evolve an instructional strategy for teaching 'Algebra' to standard IX students of one of the English medium schools in Goa. The strategy has been developed for the entire course in Algebra, and was tried out on samples belonging to two consecutive years 1976-77 and 1977-78. The instructional strategy comprised of inputs such as introduction by the teacher, PLM, assignments, tutorials, mathematical games, group activity, etc. One significant feature of the study is that, although PLM developed for the study was individual paced, the teacher's role was emphasised as that of introducing each unit, carrying out tutorials and feedback sessions, organizing group activities, etc. The effectiveness of the strategy has been studied in terms of students' achievement on criterion and comprehensive tests, and also on a test developed by an external authority (Headmaster's Association, Goa). The strategy has proved effective to the extent that 70 per cent of the students scored 35 per cent of marks on all the tests. And, on the test developed by the external authorities, students exposed to the instructional strategy performed

17 significantly better than students who were exposed to regular classroom teaching. Students' reactions towards the instructional strategy have shown that the strategy was effective in generating interest in students towards learning Algebra.

Arun Kumar (1978) developed a strategy for teaching the content 'Nuclear Chemistry' - one single unit to standard IX students. The strategy included components such as PLM in the main, along with certain other components such as introduction by the teacher, project work and discussion. An important feature of the study is that PLM has been developed in line with the principles of heuristic method of teaching. The theme in developing PLM in heuristic approach was to study whether higher cognitive ability like application could be developed through PLM. Evaluation of the strategy has been done with the help of criterion tests and students' reactions towards the components of the strategy, and the strategy as a whole. It was found that the execution of the strategy as a whole could develop better application ability than PLM alone could thus revealing the importance of the other components of the strategy.

Biswal (1980), at school level, developed and tried out instructional strategies for the effective utilization of the school broadcast programmes. School broadcast programmes were supplemented with components such as slides and taped commentaries, discussion, field-trips, assignments, etc. The

18 sample constituted of two groups of students (one urban and one rural) of VII Grade in Orissa. The strategies were evaluated in terms of students' achievement on criterion tests and their reactions. Students' achievement through the strategies was significantly superior to that of students' achievement through school broadcast programmes alone. The reactions of students' towards the strategies were also favourable.

A few more studies in this line of developing instructional strategies are under progress at CASE, M.S.University of Baroda. Joseph (1978) is trying to develop an instructional strategy for teaching 'English Grammar' to standards IX and X students of one of the English medium schools in Baroda. The instructional components planned to constitute the strategy are linear and branched PLM, structured lectures, discussions, deviated PLM, assignments, etc. Menon (1977) and Ankleswaria (1978) are trying to evolve multimedia instructional strategies for teaching different courses to M.Ed.and Home Science students respectively. Two more similar studies, Jayalakshmi (1978) and Bhatt (1978) are under progress for teaching 'Educational Psychology' to B.Ed. students. The main theme in all these studies have been utilizing multiple media in a coordinated manner for achieving different instructional objectives set at these levels. In the studies of Menon (1977), Bhatt (1978) and Ankleshwaria (1978) efforts have also been made to develop alternative instructional strategies for

19 teaching the same content. The findings of the studies reviewed in this section (studies which have been completed) point out that if instructional activities are planned, designed and sequenced in a systematic manner, it leads to greater achievement of instructional objectives.

RELATIONSHIPS BETWEEN CERTAIN LEARNER'S CHARACTERISTICS AND THEIR ACHIEVEMENT THROUGH THE STRATEGIES

One of the agreed upon tenets of good educational practice is that of meeting individual differences of learners. As a matter of fact, Educators for long have sought ways to adopt group methods of instruction in such ways that all children in the group progress at their own pace, and reach satisfactory levels of achievement in reasonable amounts of time. However, in recent years, educational thinkers are becoming greatly aware of the fact that research studies dealing with grossly defined teaching methods (both individually paced and group paced) and learning situations cannot provide the necessary depth of analysis that is needed if the instructional process is to be tailored to suit the individual needs of the learners. As a result, analysis of the task and learner's characteristics are given due importance in studies dealing with instructional procedural development or systematisation of instructional process. More explicitly, research efforts have been directed towards exploring the characteristics of media and learners, which may eventually

20 bring about effective learning in individual or group situations. In the following are reported studies - studies dealing with PLM and instructional strategies - wherein attempts have been made to correlate learning through different media and certain characteristics of the learners.

Gagne and Paradise (1961) in their study on solving 'linear algebraic equations' have dealt with sources of individual differences in rate of learning from a learning programme. They suggested that differences in rate of learning observed among learners are not due to variations on some underlying general ability to learn fast, but rather to:
(a) the number and kinds of learning sets (competencies, knowledge, etc.) the learner brings to the situation, and,
(b) his standing in respect to certain basic abilities relevant to the competencies to be acquired as they are identified in the theoretical hierarchy for the task and
(c) his level of general intelligence.

Gagne and Paradise (1961, p.3) in the same study have hypothesised that a substantial amount of the variability during learning is attributable to the attainment or non-attainment of~~x~~ learning sets relevant to the final task the programme is designated to teach. Accordingly, as the learner progresse~~y~~s upwards in the hierarchy, his rate of learning should depend increasingly upon relevant abilities. In contrast, the correlation of general ability with the

21 rate of learning should remain constant as the learning progresses up the hierarchy. As contrasted to rate of achievement, the fact of achievement rather than non-achievement in a moderately ineffective learning programme might depend increasingly on relevant abilities as one goes up the hierarchy. For instance, those of low ability "dropout" due to failure on some competencies while those of higher ability continue to master competencies in spite of defects in the programme.

Porter (1959) conducted an intensive study to determine the effects of a year long instruction through teaching machines and found a slightly negative correlation between intelligence and post-test achievement, although it was not statistically significant. Porter (1961) in another study compared the relationship between intelligence and achievement in spelling for a group of children taught through PLM and that for a group taught through conventional methods. In the latter study he found the correlation between intelligence and achievement lower for the group taught through programmed learning than that for the group taught through conventional method. Lambert, et al. (1962), in his study with school children found that intelligence was the most significant variable in immediate content matter acquisition through programmed instruction.

Reynolds and Glaser (1964) in their experiment with VII graders compared three teaching methods including that

22 of learning through a programme, correlated intelligence scores and students' achievement scores on a test administered after the completion of the programme. Through the study they concluded that intelligence scores cannot be taken as predictors of the amount of achievement that results from linear programmed instruction.

Stolurow (1964) conducted a study on 20 gifted students who participated in a problem solving experiment to investigate whether achievement through programmed learning is related to mental age. The students' learning experience consisted of studying auto-instructional programmed material over a six week period. He noticed in the study that mental age of students did not correlate significantly with post-programme achievement scores.

Schramm (1964) in his paper 'An Annotated Bibliography' after considering many studies dealing with relationships between learners' achievement and other characteristics of programmed learning material such as size of step, mode of response, item sequence, etc., has commented that 'there is some recent indication that research in programmed instruction is merging with the main stream of Educational Research'. He has further commented that, recently, personality, intellectual and cultural variables are coming to be studied in relation to programmed instruction, and "systems" approach and multimedia instruction have brought more examination of programmed instruction as a component of instruction. Also, the value of empirical methods of developing instructional materials emphasised heavily by programmes, is coming to be thought of by many as the greatest permanent effect of the programmed instruction movement.

One study relating a personality variable to a programming variable was conducted by Campeau (1965). Using a programme on earth-sun relationships, she found that among fifth-grade girls, those scoring high on test anxiety did best with a programme which provided feedback, while those low in anxiety did best with a programme without feedback. No significant interaction was found for boys between these two variables.

Woodruff, et al, (1966) correlated subscores on two personality tests (EPPS and Gorden Personality Inventory) with correct responses on programme frames. Significant values were 0.53 for achievement motivation, 0.50 for cautiousness, 0.74 for original thinking, 0.81 for personal relations, and 0.81 for vigor. The correlation of IQ with frames correct was 0.75.

Doty and Doty (1964) studied the effectiveness of programmed instruction in relation to five student characteristics, viz., academic ability, academic motivation, creativity, social need, and attitude towards the programmed instruction. It was noticed that achievement through programmed instruction appeared to be related to personality characteristics. They have also reported that achievement was found to be significantly related to creativity and attitude of male students towards programmed instruction, while in the case of female students there was a significant relationship between achievement scores and attitude towards programmed instruction.

Brinkmann (1966) administered a questionnaire designed to reflect the attitude of the individual towards programmed instruction in order to explore the possibility that a relationship might exist between the effectiveness of this particular technique of learning and students' attitude towards it. The study revealed that the students who preferred programmed instruction to instruction by teacher scored higher on the post-test. Further, it was also noticed that those students who indicated preference for only occasional utilization of programmed learning were found to have scored below the median.

Turning from personality and attitudinal variables to intellectual variables in the learner, Buckland (1967) administered programmes of three different response modes (written, thinking and reading) to students of high and low ability. Parallel tests were administered immediately after learning and after 27 days. No significant differences among response mode treatments at either ability level on either test was noticed.

25 On the Indian scene, Goel (1970) undertook an investigation to study the differences in the error rate on the programme and criterion scores for students with different intelligence levels. He found that the students of above average intelligence made significantly higher scores on the criterion test than those belonging to average and below average intelligence levels. On similar lines, Pandya (1973) compared the achievement of twenty students of high IQ (experimental group) with that of the twenty students of low IQ (control group) on criterion tests. It was noticed in the study that students of high as well as of low IQ gained in learning. However, the gains of the students of low IQ was more than that of high IQ. The difference was significant at 0.01 level.

Singh (1972) administered a programme on 'Fractions' for students of class VI in his study of the relationship between programme effectiveness and certain student characteristics. He found that in terms of achievement scores, the programme was more effective on students having a favourable attitude towards programmed learning than those who did not have. Bhusan (1973) administered an attitude scale (Likert type) to 42 B.Ed. students who had completed a programme on 'Educational Statistics'. It was found through the study that intelligence was significantly and positively correlated with achievement through programmes. Higher the intelligence of the student, the better were the chances of his benefit~~t~~ing

26 by the programme. Correlation between post-test scores and attitude scores was found to be significant at 0.01 level thereby revealing the position relationship between the two. Kapadia (1974) studied the relationship between the immediate achievement and the retention scores on linear and branching programmes and some personality variables such as anxiety, intelligence, self-sufficiency and introversion and extroversion. The study revealed that intelligence was positively related to achievement on both types of programmes. Anxiety was negatively related to achievement on the linear programme. There was no significant relationship between anxiety and achievement on branching programme; neither a significant relationship between self-sufficiency and achievement, nor between introversion-extroversion and achievement on both the types of programmes.

Govinda (1975) studied the relationship between intelligence, attitude towards programmed learning, academic motivation, reading comprehension and achievement through linear programme on 'Educational Evaluation'. It was noticed that intelligence, attitude towards programmed learning and reading comprehension were positively related to the achievement through programmed learning. These relationships were found to be significant at 0.01 level. The academic motivation was positively related to the achievement through programmed learning. It was found to be significant at 0.05 level.

27 Sansanwal (1978) studied the relationship between intelligence, academic motivation and reading comprehension and students' achievement through the developed instructional strategy. The findings of the study indicate that intelligence is significantly related to achievement. Neither academic motivation nor reading comprehension is related to achievement through the strategy.

Sansanwal and Joshi (1980) studied the relationship between achievement of students through an instructional strategy and their intelligence and personality characteristics. The instruments used in the study were Raven's Standard Progressive Matrices and Hindi Version of Mandsley Personality Inventory. The study revealed that high intelligence students benefited more through the developed instructional strategy than the low intelligence students. And also, both introvert and extrovert students benefited equally from the developed instructional strategy. However, the interaction between intelligence and personality did not influence the achievement of students.

Similarly, Seshadri (1979) studied the relationship between intelligence, academic motivation and study habits. The instruments used for measurement of these attributes were Raven's Standard Progressive Matrices, JIM Scale and study habit inventory developed by Palsane, respectively. The study has revealed that intelligence has a significant positive correlation with achievement even when the effects

28 of academic motivation and study habits were partialled out. The other finding of the study is that academic motivation and study habit indicated a positive relationship with achievement but do not show it to a significant level.

It may be noticed from the above section of the review that a good many studies have been conducted in establishing relationships between certain learner characteristics and their achievement through a particular medium or through the instructional strategy. As a matter of fact, many more studies have been conducted in the same line. They have been reviewed by Schramm (1964), Briggs (1968) and Yadav and Govinda (1974). The studies reviewed in this section are typical of those in this aspect of instructional process.

DISCUSSION

It may be observed from the studies reviewed that the process of instruction has been subjected to scientific scrutiny in the recent past, with a view to systematising it and bringing about greater effectiveness and efficiency in the attainment of instructional objectives. Considering the methodology adopted in the studies conducted on the Indian scene, they can be classified into two main categories. The first category is represented by studies conducted for a short duration of time, with limited content matter and under strict controlled situations. It is because of these characteristics, studies under this category can be labelled

29 as laboratory type of studies. The second category includes studied carried out for a longer duration of time, for a greater quantum of content matter and in actual classroom situations with minimum controls exercised. These studies could be called as developmental or field studies. What is appreciable of the above two categories of studies is that they have shown the possibility of bringing instructional process under scientific examination and systematising it. Besides, laboratory type of studies have also led to studying experimentally the effectiveness of appropriate learning conditions for realizing certain expected learning outcomes. Results of the studies indicate the extent to which certain learning outcomes can be obtained by providing appropriate learning experiences under specified conditions. Reflecting on the need and contributions of laboratory type of studies for the growth of knowledge in the area of instructional process and its systematisation, it may be mentioned that they contribute to discover certain relationships under 'pure' and 'uncontaminated' conditions; test predictions derived out of formal theories and to refine them or to build further theoretical systems. It is mainly due to these contributions, they find a definite place in this area of educational research.

However, in an action situation (real classroom situation) which is characterised by multiplicity of factors and their operation, the results obtained through laboratory type of experiments offer less scope for their utilization. This is for the very reason that the process of controlling in an action situation acts as an influencing factor, the contribution of which cannot be easily studied. Further, with each degree of the attainment of specificity through controls, the possibility of reproducing the specific instructional situation gets restricted because the effect of strict controls exercised on the situation in the study deviates it from real situation. It is this methodological issue that led to undertaking further studies, with designs other than those for the laboratory type of studies in this area of educational research at CASE, M.S.University of Baroda, Baroda (Yadav and Govinda, 1974). In these studies, attempts have been made to study the interrelated and sequential operation of various instructional inputs and actual classroom conditions over a considerably long duration of time, covering greater quantum of content matter, with minimum controls exercised during experimentation within the classroom situations as they exist, and gathering needed evidences in a cumulative manner with respect to the effectiveness and efficiency of these inputs. Specifically, these studies are developmental in nature as they aimed at concretising the process of instruction in terms of instructional material, specification of teacher's role and pupils' participation, organization and management of other conditions related to it, and establishing the effectiveness of instruction thus

31 generated with reference to specified instructional objectives. The rationale for the shift in methodology from laboratory type of studies to that of experiments in actual classroom situation or developmental studies is that the theoretical findings arrived at through strict laboratory studies could be put to further experimentation in practical conditions prevailing in actual classrooms. By this, better knowledge may be obtained as to how they operate under real conditions, and what modifications need to be made in the theoretical models, so that the practical difficulties which may arise in the implementation of the theoretical findings are studied and overcome. It is expected that such studies would provide contributory data regarding the introduction and absorption of innovative instructional practices. Further, these developmental studies characterized by longer duration of time and coverage of greater quantum of content matter, provide sufficient scope for the development of certain higher cognitive abilities, and affect attributes like tolerance, open-mindedness, social sensitivity, etc., which are the developmental or long range objectives.

What is discussed in the earlier paragraph should not give an impression that studies other than the developmental ones are de-emphasised. Further, it also should not given an impression that laboratory type of studies should always precede the developmental studies. As a matter of fact, a little contemplation on the contributions of these

32 types of studies to the growth of knowledge in this area of educational research would reveal that they have to be carried out simultaneously. Elaborating this point, through carrying out developmental studies, the process of instruction with all its multiplicity of factors and their operation could be subjected to scientific examination, which would facilitate hypothesising certain relationships between various factors operating in actual classroom situations and the effectiveness of different instructional models. These and certain other hypotheses regarding relationships arrived at through logic could be tested and concretised further in strict laboratory conditions. The results obtained through laboratory studies would help refining and evolving effective instructional models, which could be tried out in actual classroom conditions to study their workability, and how they could be absorbed into the regular instructional system without causing undue disturbance in the working of the very system. Thus, both the types of studies would act complimentary to each other. The discussion, presented so far, points out the need for having both laboratory and developmental type of studies in this area of educational research and their contributions towards further understanding of the instructional process.

The review reveals a shift in methodology from strict laboratory type of experimentation to that of developmental, in the study of Govinda (1975). In the study, PLM was used as a regular instructional technique for one semester, for teaching the entire course 'Educational Evaluation' to B.Ed. students of the M. S. University of Baroda. The results of the study revealed that PLM could serve as an effective instructional technique for imparting basic information. Further, it also suggested that to achieve other instructional objectives, PLM may have to be utilized in combination with other techniques of proven potentials. This led to undertaking a study (Yadav and Govinda, 1976) wherein PLM was utilized as a principal instructional technique along with other instructional components. The result obtained on the study sounded that learning could be maximized when PLM is utilized in combination with other instructional inputs. This encouraged further researchers to evolve instructional strategies with PLM as a principal component and study their effectiveness. The studies of Sansanwal (1978), Seshadri (1979) and Arunkumar (1978) are of this vein. The results of these studies substantiate the findings of Yadav and Govinda (1976). It may be mentioned that these studies have utilized PLM and other techniques such as library work, discussion, seminar, practical work, etc., in a fixed sequence throughout the teaching of the courses. However, these studies when considered in the light of the diversity that exists in the instructional objectives, the characteristics of the tasks and the learners, nature and sequencing of the content and the attributes of different media in realizing certain objectives, a

34 need would be felt for the utilization of multiple media in the instructional process. This contention led to undertaking of studies, Menon (1977), Joseph (1978), Jayalakshmi (1978), Bhatt (1978) and Ankleswaria (1978) with a view to developing effective multimedia instructional strategies for teaching different courses at different levels of education and study their feasibility in actual classroom situations.

It needs to be emphasised that multimedia instructional strategy is just not a congregation of few media utilized in some combination, but is a carefully planned and designed instructional system, organized to achieve the set instructional objectives. However, since there is every possibility of attaining certain instructional objectives through different media (as discussed in Chapter I) in isolation or in combination, the research task would be identifying such media of equal potentialities to develop alternative instructional strategies, and testing them for their effectiveness and efficiency. This would be a definite step further in the process of systematisation of instruction. Such attempts point out one more methodological consideration, viz., the adoption of several alternative strategies/components for the same group and for the same set of terminal behaviours so as to provide an opportunity for studying the effectiveness of each strategy/component individually as well as their relative effectiveness, and the cumulative effects of various components over a period of time. In other words, 35 studies incorporated with alternative instructional strategies/components bring several variables operating in actual classroom situation under systematic observation, thereby revealing the fluctuations possible in these variables under different known conditions, as well as help maintain the scientific rigour. For instance, while sequencing terminal behaviours, indicative or deductive approaches have been generally used, and sometimes even a combination of these two. It would be of research interest to study whether there would be any significant effects in achievement due to variation in the sequencing; whether they could be utilized as alternative instructional strategies, etc. It is presumed that when alternative instructional strategies of equal effectiveness are developed for attaining the same set of terminal behaviours and made available to learners, an option can be made possible for learners to choose the ones which suit their characteristics most. This may facilitate bringing in more flexibility in the organization of the instructional process. From the review, it may be noticed that the studies of Menon (1977), Bhatt (1978) and Ankleswaria (1978) are to this effect.

In the process of systematisation of instruction, an issue which gains importance is that of the variations that could be noticed in learner's characteristics, and how due to these variations they respond to organized instructional methods and strategies. This necessitates studying

36 relationships between those different learner variables and the achievement on criterion and comprehensive tests. It may be observed from the third section of the review that quite a good number of studies have attempted this. The knowledge obtained through studying such relationships throws light on the suitability of the instructional methods or the strategy for students of known characteristics, and thus enable further researchers in the field to match media attributes and learner's characteristics in a better way and evolve effective instructional strategies catering to the needs of the individual learners.

An examination of the studies conducted with PLM and multiple media reveals that the content matter considered in the studies has been always that of an individual course (Algebra, Physics, Educational Evaluation, etc.) or a few individual topics in the courses (flower, light, algebraic equations etc.). In the last few years, with the realization of the positive effects of integrating different disciplines, there is an increasing move towards incorporating the principles of integration in the curriculum construction (Blum, 1973). This forges the need for incorporating the principles of integration of subjects while developing instructional strategies for teaching different courses. Through the strategies, attempts should be made to bring home to students the interrelatedness of the disciplines with the unique characteristics of each discipline retained.

37 It need not be emphasised that development of such strategies aimed at integration of disciplines requires content exports from different disciplines, pedagogical experts and cooperation from the administrators. Thus, it would be more of a joint venture than individual attempt.

In the light of what has been discussed so far, and as a step further, in the trend of systematisation of instruction incorporating some of the methodological considerations made earlier, a project was undertaken at CASE, M. S. University of Baroda, Baroda with a view to systematising science instruction at secondary school level. Precisely, the project was an attempt at developing or duly validated multimedia instructional strategy for teaching the course 'General Science' of Gujarat Board Syllabus to VIII standard English medium students. The present investigation is a part of this project. The course 'General Science' considered for the project comprised of three parts, namely, Physics, Chemistry and Biology. Physics and Chemistry were dealt by another researcher working for doctoral degree, whereas Biology was dealt by the present investigator. The underlying theme in undertaking such a project was that through such an attempt the process of science instruction at one level of education could be subjected to scientific scrutiny, which would provide a comprehensive and systematic view of the process of science instruction and thus contribute more meaningfully towards its systematisation. It was also

38 presumed that such an attempt would bring in better coordination in the teaching of subjects Physics, Chemistry and Biology, and their integration. In the paragraph to follow are presented specific features of the present study.

The study, as it may be noticed from the objectives presented in Chapter I, specifically aims at developing a multimedia instructional strategy for teaching the course Biology at standard VIII level, and studying its effectiveness and operational feasibility in actual classroom situations. Various media have been utilized in a sequential and integrated manner to achieve different instructional objectives set for the course Biology at standard VIII level. The study being carried out for one complete year for the entire course content, an attempt has been made to develop certain long range objectives like application ability and scientific attitude and study the extent to which they have been developed in students. Further, an attempt was also made to develop alternative instructional components for a few concepts in one unit and study their relative effectiveness. Yet another significant aspect of the study is the attempt that has been made to integrate Biology with Physics and Chemistry.

Details pertaining to each objective and how they have been studied are presented objectivewise in the following chapters.