Chapter III

Previous Studies

3.0 Introduction

3.1.0 Studies on Paired Learning
   3.1.1.0 Foreign Studies
      3.1.1.1 Primary Level
      3.1.1.2 Secondary Level
      3.1.1.3 Tertiary Level
   3.1.2.0 Indian Studies
   3.1.3.0 An Appraisal

3.2.0 Programmed Learning in Groups and Pairs
   3.2.1.0 Foreign Studies
      3.2.1.1 Programmed Learning and group pacing
      3.2.1.2 Programmed Learning in pairs
   3.2.2.0 Indian Studies
   3.2.3.0 An Appraisal

3.3.0 Studies on Underachievers
   3.3.1 Foreign Studies
   3.3.2 Indian Studies
   3.3.3 An Appraisal

3.4 Meta-Analytic Studies

3.5 Present Status and Needed Research in Paired Programmed Learning

3.6 Related Studies in Mathematics

3.7 Conclusion
CHAPTER III

PREVIOUS STUDIES

3.0 INTRODUCTION

A review of significant studies on different learning approaches other than the conventional classroom teaching-learning process is made in this chapter. Studies on learning in pairs, programmed learning in groups especially in pairs and studies related to underachievement with special reference to underachievement in mathematics are reviewed with a view to placing the present investigation in the context of such studies and building up its rationale.

3.1 STUDIES ON PAIRED LEARNING

The teacher works with individual learner when individual attention is required to improve the student's learning and achievement. In such a context, the dyad consists of the teacher and the student and only the student learns. When the dyad is formed of a pair of students engaged in learning one can speak of learning in pair or paired learning.

When the classes are large the teacher appoints a competent person or a good student in a higher class or an able peer in the class itself as a tutor to assist a learner who needs special help in a subject.
CROSS AND SAME-GRADE, PEER-TUTORING:

When a competent person or a student from a higher class or grade is paired with a student in a lower grade, the team of two mostly works towards the better learning of the tutee. When two classmates work together in same grade tutoring with a specific learning purpose, an able peer and his classmate requiring special attention work together towards a common goal of better attainment. In a lighter vein, for variety and motivation the teacher may follow the dyadic approach and organise the students of his class to work in pairs on a learning task. Here the pairs as individual units learn on their own with mutual assistance.

In peer-tutoring the common modes of pairing students are, the mixed-ability or heterogeneous and the like-ability or homogeneous ones, ability considered being variant according to the requirements of the learning task. Peer-tutoring refers to same-grade tutoring in this report. In the review that follows the cross-age and peer tutoring studies have been given separately eventhough the researchers refer to both the cross and same-grade tutoring as peer-tutoring.

3.1.1 PAIRED LEARNING—FOREIGN STUDIES

In countries outside India, such as the United States of America, Britain and Canada to mention a few, paired
learning in some form or other is found to be a common feature in their educational system at all levels as could be seen from the studies reviewed on paired learning.

3.1.1.1 PAIRED LEARNING - PRIMARY LEVEL

Cross-grade tutoring

Engelbrecht (1973) conducted a formative research in peer teaching using toys as a medium for instruction. 4th graders who volunteered to teach the kindergarten children using toys as medium of instruction were paired with them. This project was found to improve the self-concept of both the groups and resulted in significant gain for the kindergarten children in verbal comprehension. Increased awareness of human development and development of positive attitude for originality and creativity could also be observed among the children.

Erickson and Cromack (1972) of Springfield Public School, Massachusetts, U.S.A. paired 12 underachieving 3rd grade boys and used an oral-language approach to improve the reading of both the tutor (7th grader) and pupil (3rd grader). Relative change patterns of the students were compared to those of their classmates. The pupils' improvement was significant at .01 level but in the case of pupil-tutors improvement was just significant at .05 level.
Carlson (1973) of North Illinois University used 6th graders to tutor 4th graders, one-to-one in 21 pairs each. The 4th grade non-tutee group worked on individualised work sheets on their own. Results indicated that being tutored by 6th graders helped the 4th graders achieve significant growth in arithmetic computation compared to the performance of the non-tutored 4th graders.

Rodgers (1978) of the University of Hawaii designed an educational experiment in rural south-east Asia on children teaching children. The basic plan was to 'pair' every student in the three earliest grades of a primary school with a student (tutor) from the upper three grades in the same school. The content for the experiment was English language instruction. The goal was to have the older students become material writers for their younger partners. Thus the older students would develop writing skills while preparing stories, word problems etc. The younger students would develop reading skills in receiving and reacting to their partner-prepared materials. The pair - meetings occurred twice a week for four months. The administrators, teachers and the students themselves reported the four month experiment a success and promising in terms of more ambitious plans to expand the 'pair' project. In the above 'pair' project the most successful means of pairing students was according to a random procedure.
**Peer-Tutoring**

Harris (1973) of Kansas University studied the effects of peer-tutoring procedures on spelling and mathematics performance of elementary school children. Weekly gains from pre-test to post-test were consistently higher for tutored students. It was concluded that interaction between students during the tutorial sessions was responsible for the enhanced academic performance in spelling and mathematics.

In another American study with 48 sixth graders, Brown (1975) examined the differential effects of self, peer and teacher monitoring on achievement behaviour. Packets of social studies questions, were used for 30 minutes per day for 3 months. Contracts were monitored by students, their peer-choices or their teachers and points were awarded concurrently. Results demonstrated that peer and self-monitored contingency programmes were more effective than teacher monitored programmes.

Ehly and Larsen (1976) used peer tutoring to individualise instruction in which pupils who learn quickly assisted those who were slower and found it beneficial to both the tutor and tutee particularly in emotional areas. They have pointed out the benefits of peer tutoring for both members of the dyad and offered suggestions regarding the selection and pairing of students, the training of tutors and scheduling supervision and feedback.
Dineen, Clark and Risley (1977) studied the progress of three 9-10 year old elementary school students in a peer tutoring programme. One child tutored another child, the second child was tutored by another child and the third neither tutored anyone nor was tutored. Children's spelling improved in the first two paired learning situations and no change was observed in individual learning.

Levin and Feldman (1980) studied the effects of peer interaction as it relates to equilibration in the development of map drawing activity in 72 fifth graders. The children were placed into 36 same sex pairs for training on the basis of Piaget and Inhelder's six stage sequence of map drawing ability. A discrepancy (above, below or at the same stage) between each subject's protest model stage and a partner's model stage was used to define an external disequilibrium condition for each subject. Results confirmed a significant effect of discrepancy between peers at differing stages in promoting developmental change. External disequilibrium due to developmental differences between partners both within and between stages produced similar patterns of change. Pair involvement rating and frequency of on-task discussion were also found to be significantly related to advance (progress).

Bierman and Furman (1981) of the University of Denver, Colorado, in a study with 112 fourth graders (56 girls and 56 boys) examined the role of contextual factors; such as assignment
rationale on the attitudes of peer tutoring. Subjects were arranged in 'pairs' of same-sexed children from the same class room. Children were randomly selected to be either tutor or tutee and 'pairs' were assigned to one of four rationale assignment conditions: a) Competence rationale b) physical characteristic rationale c) chance rationale and d) no rationale. The task selected for the 'paired work' was 'German'. Tutors had more positive attitudes than tutees when they had been given a competence (better performance on a pretest of German words) or physical characteristic (having a clear voice like a teacher) rationale but not when the tutors were provided a 'chance' rationale or no rationale. Additionally, the tutors and tutees attitudes were enhanced when no rationale was provided. An ANCOVA of scores on the German achievement test revealed a significant main effect for sex (p < .001) with girls performing better than boys. There was also a non significant trend for tutees to perform better than tutors (p < .10) in the achievement test.

Fry and Preston (1981) of the University of Calgary, Alberta, Canada in a study on achievement performance of positive and negative 'affect' subjects and their partners under conditions of cooperation and competition hypothesized that the affective state/achievement relationship may be mediated by complex social interactional factors. Eighty children between the ages 7.5 and 9 were paired (similar or opposite) on the basis of positive, negative and neutral affective states in
Positive affect subjects paired together in the cooperative setting increased their performance most. Negative affect subjects improved their performance most when paired with negative affect partners in the competitive setting. The achievement performance of young children was influenced by their own affective state and by that of the peers or partners.

**Summary**

Of the 11 studies cited, seven reveal, significantly better achievement for the children at the primary level exposed to paired learning situations, two with significant gain on affective aspects and the remaining two on both the cognitive and affective conditions.

3.1.1.2 **PAIRED LEARNING - SECONDARY LEVEL**

The study on cross-age peer teaching by Mueller and Percy (1976) included the small group activities strategy and peer cross-age or cross-grade teaching for cooperative learning. It was found that a cooperative learning situation such as the above provided opportunities wherein each student using his or her total environment simultaneously pursued his or her own competencies and committed him/herself to see that other learners (partners) achieved their potential.

**Peer-Tutoring**

Darries and others (1974) of John. Hopkins University examined the effects of competition both among individuals and
weak period in high school social studies classes. When compared to individual competition, the team competition resulted in widespread positive effects on such variables as student peer-tutoring, the normative climate, students' friendship circles and mutual concern experienced among the students.

In a Canadian study Arkell (1975) studied the effectiveness of three student helper roles, 1) tutor, 2) clerical worker and 3) audio-visual operator, in changing students' self esteem, attitude towards school, performance in spelling and achievement in arithmetic; thirty six students at the secondary level were involved in the experiment. The analysis of data indicated no significant difference between the effectiveness of the three roles.

Gabel (1975) studied the effect of pairing and pacing on learning rate and achievement of Junior High School students in an individualised science programme. The effect of working with a 'partner' was found to be different when measuring learning rate and retention and for county and city children. Low ability children who worked with a partner did better on the retention test. In addition, working with a partner required less equipment than working alone, the cost of operating the programme could also be reduced by using this instructional mode.

Gordon (1976) investigated the effects of different 'pairings' of students by language (Spanish and English)
The partners exchanged roles after two weeks intervals for training, tutoring, weekly reviews and assessments of achievement and attitudes. Results supported the hypotheses that satisfaction, perceived achievement and actual achievement were greater on becoming the tutor than the tutee particularly if one was initially the more competent partner.

Downing and Bohlwell (1979) conducted a study on anticipation of peer interaction and development of cooperative interdependence with 42 same-sex pairs of varied racial composition, randomly selected from 8th graders in each of two matched schools with open versus closed-space architectural styles. Open-space students were more likely to develop cooperative interdependence in a mixed motive game and were more inclined to make proximal seating choices indicative of anticipated peer interaction. Females learned to cooperate in same race pairs and compete in mixed race pairs.

**Summary**

At the secondary level in four of the eight studies reviewed, significant gains in both the cognitive and affective aspects have been observed as a result of paired learning, with improvement in achievement alone in one, affective condition alone in two others, and no improvement either in achievement or affective state in the remaining study.
3.1.8.3 PAIRED LEARNING - TERTIARY LEVEL

The studies reviewed at this level are all on same-grade peer-tutoring. Alexander and others (1974) of Michigan State University conducted two experiments with 51 undergraduates to examine the effectiveness of peer assisted learning among college students. Results indicated that students in 'dyads' learned a problem solving skill significantly better than individual learners. Teaching-learning processes of 18 self actuated dyads have been described. The study included such variables as competence, commonality, motivation, interpersonal relations, decision making, conflict resolution, anxiety reduction and alienation. Sixty four percent of the students in the sample increased their course grades. Applications in class room instruction are suggested.

Stone (1975) designed, implemented and evaluated a peer-based instructional strategy involving dyads of learners working together in an introductory level teacher education course. In this peer-based instructional strategy, the learning cell was defined as a 'dyad' in which learners mutually teach and learn. A series of experimental tests indicated that there were no significant differences between treatment groups in respect to effective learning, solving course administrative problems or improving students' perceptions. However the results suggested that mutual teaching and mutual learning are critical elements
for successful learning-cell operations. Adequate preparation, similar rates of study, active dialogue and good interpersonal relationships were found to influence the dyadic operation.

Fraser and others (1977) of University of South California in two studies with a total of 621 undergraduates assessed the effects of a peer-monitoring procedure on student performance in a college course. In the first study students were assigned a learning partner and informed that their final grade would be determined by the average of their individual performances. In the second study grade averaging was again employed for experimental peer monitoring groups of two, three or four students. Both studies indicated the superiority of peer monitoring method over the typical traditional individual performance contingency.

Stanton (1977) of University of Tasmania, Hobart, Australia, recommended 'dyadic' discussion as a teaching method after designing two procedures to overcome the disadvantages of the conventional small group teaching method. Both the procedures are variants on the single theme of 'dyadic interaction' in which the two participants ask questions of each other. This technique has been found to be a means of 'breaking the ice' with a new group.

Rosen, Powell and Schubot (1977) conducted a field experiment with a sample of 178 undergraduate classmates engaged
in same-age peer tutoring. Same-sex pairs were formed such that the tutor had greater (the equity condition) equal or lower pre-test competency than the tutee. Partners in half the pairs changed roles for the second of two tutor training and tutoring sessions. ANOVA results clearly supported the model that attached greater desirability (a) to be the tutor than the tutee and (b) to be in an equitable (status-congruent) rather than an inequitable relationship.

Berkowitz and Szabo (1978) investigated the effects of grouping (individual versus dyad) and level of mental abilities on complex problem solving behaviour. The problem was open-ended, data rich and simulated by computer. Ninety undergraduates were selected for the study on the basis of their scores on a mental ability test. Hypothesised interactions between grouping (individual and dyad) and mental ability level (above average, average and below average) were found for a) fluency criterion measures of amount of data request and that received and b) the efficiency criterion measure of total time engaged in the problem. Significant main effects of ability level were found for data usage measures.

Coyne (1978) of Arizona State University studied the effects of peer-tutoring with group contingencies on the academic performance of college students. After three unit tests, 16 undergraduates in an introductory course were ranked according
to high medium and low levels of performance and assigned to a 'paired' (high-low, high-middle or middle-middle) or independent group. Results showed that compared to base line, performance during peer tutoring improved for every student paired with a 'high' partner and did not improve for those who studied independently.

Summary

Paired learning has been found to be beneficial to students at the tertiary level, to achieve significantly higher academically as seen in three of the seven studies reported; with positive affective effects through the dyadic interaction for progress in one study, development of both the cognitive and affective aspects in two other studies and no significant gains on these effects in just one study.

3.1.2 PAIRED LEARNING - INDIAN STUDIES

There are only a few studies in the area of group dynamics and peer group influences in education in the Indian context.

Malhotra (1963) studied paired friendship as a dependent variable with socio-economic status, language, culture, living habits, interests, intelligence, sentiments, psychological needs, proximity and physical appearance as independent variables. The study revealed that almost all the independent variables influenced the pairing except physical
appearance and sociological factors at a higher significant level than psychological factors. The sample consisted of a hundred boys and a hundred girls at the secondary and college levels.

Bhanot (1967) conducted and experimented with IX, X and XI standard higher secondary girls forming triads to study the effect of cohesiveness on goal setting behaviour of the group. It was found that high cohesive groups are more aspirants but the individual aspirations of this group are lower than that of their counterparts.

Teaching situation in small groups was studied by Mehrotra (1972). By means of a survey he found that various educational institutions in India were organising their instructional programmes in smaller groups to supplement the classroom work.

3.1.3 PAIRED LEARNING - AN APPRAISAL

It could be seen from the studies on paired learning reviewed, that cross-age teaching and same-grade peer tutoring have been experimented at the primary level. At the secondary and tertiary levels but for a stray case of cross-age tutoring the studies have been on same-grade peer tutoring. The advantages have been two fold as the results reveal, a) Academic achievement: Peer tutoring has resulted in enhanced academic achievement for the learners mostly, rather than for the tutors and for both the tutor
gains in the post test or retention, significant effects on the performance, improvement in performance, or increase in the course grades have been observed for both learners in the dyad in as many as eleven studies.

b) Affective aspects: Peer tutoring which results in paired learning leads to satisfaction for the learners concerned in all studies, significantly so in five studies reported. Good interpersonal relationships, cooperative interdependence, motivation, active dialogue and participation (interaction) mutual concern, friendship, total involvement by both the members of the dyad, development of positive attitude, originality and creativity, normative climate, commitment to the assigned task, developing the potential and competencies, students' attraction to one another, decision making, conflict resolution, have all been the plus points of paired learning apart from significant educational outcomes as found by the investigators in the experiments on dyadic approach in learning. Significant gains in both the academic and affective aspects have been reported in eight of the 26 studies reviewed. There have also been two instances when no significant effect or difference between paired and individual learning was found.

These empirical evidences regarding academic achievement and affective aspects from paired learning are in agreement with the theoretical expectations indicating
that this instructional technique will be a favourable adjunct to traditional teaching. The findings reveal that the 'dyadic approach' in learning ensures desirable educational outcomes and narrows down the psychological gap between the instruction and the learners in terms of their affective state.

3.2 PROGRAMMED LEARNING IN GROUPS AND PAIRS

Of late attempts have been made in a few studies to find out the effects of external pacing and group-pacing in programmed instruction even though programmed learning is based on self-pacing.

Mackenzie and others (1970) while reviewing the research in educational technology cite the study by Schramm in which only one third of the college level comparisons favoured conventional teaching. They refer to Hartley's review in 1966 which found considerable evidence in favour of programmed learning using three measures, time taken, test result and retest result.

The authors point out that even though adaptation to individual rates of learning has always been put forward as a traditional advantage of programmed learning, Gropper and Kress have presented data to suggest that self-pacing can be non-adaptive to the needs of the learner. It needs a
sophisticated device like a computer to present material at the optimum rate for each individual but in the absence of adaptive pacing, group-pacing can sometimes prove more efficient than self-pacing. Group-pacing can obviously help to speed up learners who lag behind, the authors contend. Grouping students in 'pairs' or small groups in programmed learning may however be a useful way of making the over impulsive take a second look at a problem, suggest the same authors.

3.2.1 PROGRAMMED LEARNING IN GROUPS AND PAIRS - FOREIGN STUDIES

3.2.1.1 GROUP PACING IN PROGRAMMED LEARNING

Alter and Silverman (1973) compared written responding with reading under conditions of external pacing and self-pacing and they found no significant differences between the two. Carpenter and others (1963) compared the effectiveness of a programmed course presented by 1) teaching machine 2) programmed textbooks (self-paced) 3) filmstrips (externally paced) and 4) conventional classroom method. There was no significant difference among the learning outcomes except in the unit tests where the programmed treatments produced higher scores and lower variance.

Frye (1963) compared group and individual pacing in programmed instruction and found out that the time required to complete the programme by heterogeneous learners varied.
was significantly greater than that of heterogeneous "individually-paced" team. The time required by heterogeneous "group-paced" team did not differ significantly from that required by homogeneous "individually-paced" team. The time required by heterogeneous "group-paced" team was significantly greater than that required by homogeneous "group-paced" team. The experiment provided evidence that homogeneous grouping of students had some advantage if "group-pacing" was adopted.

Baron (1968) has used personality factors as criteria for grouping pupils for instruction with the programmed material and found group-pacing in programmed learning profitable.

Kress (1969) studied the effects of administering programmed instruction to interacting groups of 166 eleventh graders working either individually or in a group of four classmates constituted so as to be either homogeneous or heterogeneous in ability, to complete a 660-frame programme. Groups of each type worked under one of three conditions that provided for increasing degrees of social interaction 1) group-pacing 2) group-pacing and public confirmation and 3) group-pacing, public confirmation and group discussion. Homogeneous and heterogeneous groups did not differ from each other on error rate, immediate and delayed proficiency scores and student
attitudes. The only observed differential effect of social interaction was in programme completion time which tended to increase as the degree of interaction increased.

Leith (1969) in his paper 'second thoughts on programmed learning' observes that self-paced programmed learning in individual study neglects the social interaction and cites some studies which have demonstrated that team learning is not only a feasible method of programming but can often achieve more than individual self-study. Thus Oldfield (1964) using mixed ability groups of four children, showed that the work of both high and low ability members was superior to that of individuals learning from essentially the same programmed materials. Amaria, Biran and Leith (1969) tried to elucidate some of the factors in cooperative programmed learning and consistently found that to be better than individualised work, especially for less able subjects. No additional time was needed.

Burgh (1971) compared three methods of presenting programmed material and found two different group-paced taped presentations more effective than self-paced learning using text programmes. It was also found that saving of time was possible. It has been suggested in this study that for the organisational difficulties created by self-pacing and shortage
of remedial programmes which prevented the instructors from using programmed instruction, group-paced taped presentation of programme or taped presentation cum workbook could be a possible solution.

Swanson (1973) tried a new approach to measuring externally paced programmed instruction in mathematics. He determined its effect and that of externally paced testing upon cognitive achievement of college freshmen and their attitudes. Results indicated that there was no significant difference in test scores achieved by students who used different natural working rates when using programmed material and also by students subjected to three different externally paced controlled rates of programmed instruction. There was a significant difference \( p < .05 \) in achievement by students who used externally paced tests measuring cognitive achievement at knowledge, comprehension and application levels. Students who were administered post tests under an average testing rate achieved significantly greater scores \( p < .05 \) than students who used a fast testing rate.

Huang-Mataragnon (1973) evaluated the use of programmed instruction principles in introductory psychology courses with 109 students in Philippines. Class one employed most of the features embraced in programmed courses in class teaching, class two was subjected to an additional treatment -
a mastery before proceeding contingency - and class three (control) employed traditional teaching methods. Final examination scores showed superior performance on the part of classes one and two, although class two did not significantly differ from class one.

Greenwood, Sloane and Baskin (1974) investigated the effects of a training procedure and two maintenance contingencies on consequence - dispensing behaviour. Four peer behaviour managers were trained to supervise small groups of four to six students working in programmed mathematics materials and were compared with a teacher skilled in the use of social and point reinforcement and response cost. Manager training was differentially effective in accelerating managers' rates of appropriate social and point dispensing.

Klaus and Gran (1976) studied the motivational effects of social stimulation on computer controlled arithmetic problem solving programme. They investigated the extent to which social stimulation on single versus group work with and without feedback influenced the rate and quality of work performed. Implemented computer controlled mathematical tasks of increasing difficulty were given to 48 seventh graders in West Germany who performed below median in arithmetic. On the average 60 percent less time was required in group work than in single work to master the programmed tasks.
Bateson and Lewis (1977) studied the effects of programmed learning as applied to solving a 'numeracy' problem in training and a group situation. The approach appeared to work for this particular group of students creating an enriched and more rewarding learning situation which both instructors and students liked. The end of course test results for both trials showed an average improvement of 19 percent for the trial groups over the control groups.

3.2.1.2 PROGRAMMED LEARNING IN PAIRS

Investigations on group-pacing of programmed learning include both small and large groups. The purely dyadic approach or the paired programmed learning is a compromise between the individualised and small group instructional techniques to cater to individual and social development simultaneously. Studies relating to programmed learning in pairs and different modes of pairing in programmed learning are presented here.

Dick (1963) studied the effects of paired and individual programmed instruction. He did not find any significant difference in the final examination, but re-testing of 80 percent of the original subjects one year later resulted in significantly better retention by the paired group.
Another study on the effectiveness of pairing was conducted by Dick and Segwin (1964). One group of students was paired on the basis of similarity in dominance submissiveness score; and the other group on the basis of dissimilarity. No significant difference was found in the results between the different pairing modes.

Austwick (1965), Meddis and Bowditch (1966) and Sewiris (1966) have shown little or no difference between the performance of students working individually and that of similar students working in pairs in the lower half of the secondary school.

Reid (1968) studied the interaction between the nature and conditions of instruction and the personality characteristics of the learner in programmed and computer assisted instruction and found that some students perform better alone at a computer assisted instruction terminal while those with different personality characteristics do better if working in cooperation with a partner.

Sutter and Reid (1969) tested the hypothesis that personality characteristics have an interactive effect with conditions of the learning situation in computer assisted instruction. Students were 100 undergraduate males assigned randomly among one control and two experimental groups. One experimental group (N=40) took a problem solving course alone
at the computer terminal and the other (N=42) took the same course with a partner. The students high in sociability and low in test anxiety achieved better in pairs. The students low in sociability and high in test anxiety achieved better alone. Attitude was most favourable toward computer assisted instruction in submissive students paired with dominant and in dominants working alone.

Love (1969) investigated the possibility of using 'paired learning teams' as a technique for improving instructional achievement and efficiency. Fifty four students from 9th to 12th grades were divided into 10 pairs and 10 individuals. Pairing was done by mutual choice. Individual and paired learning of an abstract algebra programme presented by computer were compared. No significant differences were found between the two groups on final examination scores, time variables, error rates, number of practice problems solved, criterion frame scores or daily quiz scores. It is concluded that with a pair of students at each computer assisted learning terminal educational costs may be substantially reduced and system efficiency increased.

Davies and Hartley (1972) have reported about some experiments on programmed learning in pairs. Hartley and Cock (1967) observed significant gain for pupils in schools when programmed learning had taken place in pairs and that
learning was retained. Hartley (1968) found that retention from paired programmed learning was significantly better than that from individual programmed learning with limited evidence. In one school, working in a mixed-ability pair significantly helped the poorer members of these pairs \( (p < .05) \). The pairs were based on pretest scores; not significantly different in I.Q. Amaria, Biran and Leith (1966) found mixed ability pairing profitable in primary schools. Pupils clearly enjoyed themselves and staff were far from isolated – encouraging and helping the individuals to discover.

Hartley (1973) of Keele University in a research report spotlights the neglected factor – the social aspect. Regarding the advantages of programmed learning by pupils in pairs compared with individual programmed learning Hartley observes that experimental evidence for the claimed merits of 1) less boredom and 2) greater inter-personal interaction leading to better learning, is limited. The little evidence available on 'increased retention' suggests however that programmed learning in pairs is a viable proposition: Pupils learning in pairs usually do no worse than pupils learning as individuals, and sometimes they do better (Hartley, 1968, 1970).

The comparison studies on the effects of different methods of pairing have also been reported. In one experiment
(Hartley and Hogarth '71) over 80 pupils from four unstreamed second year classes in a boys' grammar school in the age range 12 - 13 years took part as subjects. They were divided into mixed ability and like ability pairs on the basis of previously obtained intelligence test and achievement data, end of year school examination results and preknowledge of chemistry. The programme used was Hogarth's 'The Gram Atom', a linear programme of 120 frames which is divided into three parts and provides approximate two and a half hours instruction.

Overall the high-ability pupils performed significantly better than the low-ability ones (p < .01). There was no significant difference between the performance of the low-ability pupils working with low-ability or high ability pupils; or the high ability pupils working with low-ability or high ability pupils either on immediate or the retention test. The high-ability pupils in the mixed-ability pairs expressed less favourable attitudes to the situation.

Hartley, Holt and Hogarth (1971) replicated the above experiment with a difference. The pairing was based on a test of 'academic motivation'. There was no significant difference between the mixed - motivated and like-motivated pairs either in the high or low-groups. Hogarth and Hartley (1973) repeated the basic design but this time half the pupils were formed into mixed-ability pairs by the teachers and the other half were left free to choose their own partners. The
results were better than the above experiment and parallel with the first one. The own-choice pairs expressed a more favourable attitude to the situation than the teacher designated mixed ability pairs.

Amaria (1970) found with slightly younger children and a different shorter programme that learning was significantly better for pupils paired at random than it was for pupils paired according to their choice. Hartley winds up suggesting that more systematic research in this area could be undertaken adopting a number of different strategies for pairing pupils, particularly pairing based on the teachers' knowledge of the children.

Reid and others (1973) investigated performance in computer assisted instruction in scientific notation and experimentation in learning algebra for 81 pairs of undergraduates paired by sex and test anxiety. Low anxiety male pairs learned faster while mixed sex and anxiety level pairs tended toward lesser achievement. High mathematics aptitude pairs and high sociability pairs performed better. Achievement motivation flexibility and aptitude toward computer assisted instruction affected performance in certain subgroups. Dominance did not correlate significantly with performance.

Okey and Majer (1976) undertook a study to determine whether multiple simultaneous users at a single terminal could
significantly decrease the costs of computer assisted instruction without lowering the effectiveness of the system. Sixty undergraduates were randomly assigned to one of three groups according to how many students worked together at a PLATO IV computer terminal. Students worked alone, in pairs or in groups of three or four. Analysis of results of a cognitive criterion test attitude questionnaire and length of study time showed that as many as four students could use the terminal simultaneously and learn as much as students working alone.

Lovatt and Broderick (1976) compared like-ability pairs with mixed ability pairs in computer managed learning; studied over 130 girls in 10 classes in three secondary schools. Statistically the significance of the difference between the performance of individuals in the mixed-ability pairs and that of similar students in the like-ability was not high but the results supported earlier findings (Amaria and others, 1969) that mixed ability pairing for girls has important advantages. The results of the first experiment (Broderick and others, 1976) showed that students working in like-ability pairs were more successful than similar students working alone.

Hoogstraten (1977) of Netherlands summed up five field experiments with programmed study materials by comparing the performance of pupils in grades five and six working on
programmed materials either singly or in pairs. In each of five groups 10 students operated singly and 10 in five pairs. The pairs were classified as homogeneous or heterogeneous. The members of the heterogeneous pairs were further classified as having high or low intellectual capacities, scoring high or low on neuroticism and having high or low motivation. In general students operating in pairs were more successful than those operating individually.

Jordon (1977) describes a mathematics programme (one-on-one mathematics) that features the matching of a more advanced student with a student of low achievement. The less advanced student follows an individualised plan of instruction specifically set out in a contract signed jointly by the paired students and the Professor. The student is required to meet several 'hurdle quizzes' in which the student should score 85 percent or better. In terms of materials the system uses a programmed text and approximately 50 videotapes produced by the Professor.

Kratochvil (1979) of Czechoslovakia studied the characteristics of programmed learning in dyads and its didactic effect. It is suggested that programmed learning in dyads utilizes the students natural desire for social interaction and communication. The effect of social, psychological components in programmed learning in dyads is determined by
many factors such as encouraging the pair to be interactive and open to internal communication and a careful approach to guide the students' cooperation. The present experiment confirmed the effectiveness of programmed learning in dyads from didactic aspects. Results showed that students did significantly better on educational tests and retention tests. Students evaluated programmed learning in dyads positively with 83 percent believing they learned more in this fashion.

3.2.2 PROGRAMMED LEARNING IN GROUPS AND PAIRS - INDIAN STUDIES

No study has been reported on paired programmed learning in the two volumes of the survey of research in education in India (Buch, 1974, 1979).

But studies to identify the conditions to use the programmed learning material as a component of instruction have been undertaken by the M.S. University of Baroda. Yadav and Govinda (1977) evolved an instructional strategy for teaching the entire course on educational evaluation to B.Ed. students of that University. The instructional strategy involved the use of the techniques of programmed material, discussion, library work, and practical work in proper combination. Nearly 50 percent of the B.Ed. students scored 75 percent and above on the comprehensive test which is generally considered as performance with distinction. Sansarwal (1977)
conducted a similar study at the same centre evolving an instructional strategy for teaching a course on 'Research Methodology' to M.Ed. and M.S. (Home Science) students. Programmed material was used to impart the basic knowledge of the subject, and library work was directed as in the study by Yadav and Govinda (1977). Seminars and discussion sessions were organised at regular intervals. It was found to be effective to the extent that 70 percent of the students obtained above 70 percent marks on all criterion tests. The integration of library work with the programmed learning material, followed by discussion had enriched the instructional activity and is an evidence of the effectiveness of the combined use of those instructional components.

Seshadri (1979) had prepared programmes for an entire academic year consisting of two semesters in Algebra for the high school pupils. In this study the role of the teacher has been emphasised. Although programmed learning material developed for the study was self instructional the teacher was involved at the stage of introduction of each unit, tutorials and feedback sessions. The necessity of teacher involvement was indicated through this study.

Quite recently Jeyachandran (1980) conducted an experimental study of the efficacy of programmed film-
strips as a method of teaching history in the secondary schools in Madras city and found that group pacing was possible. The results also indicated that programmed learning material can be integrated with audio-visual materials for the development of cognitive abilities and better retention. The importance of the role of the teacher when self learning techniques are employed has also been established.

3.2.3 PROGRAMMED LEARNING IN GROUPS AND PAIRS - AN APPRAISAL

Paired programmed learning as an instructional technique and programmed learning in groups have been experimented at all levels mostly in countries other than India. Programmed learning in a group situation has been found to result in significantly higher academic success in seven out of the 13 studies reported with two, revealing better social stimulation and motivational effects; three, finding the technique advantageous and profitable in general and just one study indicating no significant effects.

Programmed learning in pairs has been found to be significantly more advantageous than individual programmed learning with regard to academic achievement as revealed by 10 studies reported and favourable attitude towards learning in three other studies; the results of four studies have indicated no significant differences. In studies on pairing modes significant differences between the effects of pairing
modes have been found to be in favour of mixed-ability, teacher choice, randomly assigned and high sociability, high mathematical aptitude pairs. In five of these studies combined, significant gains have been observed in both the cognitive and affective effects.

Of the Indian studies reviewed three have been exclusively on group-pacing in programmed learning, using programmed material and filmstrip. The studies on individual programmed learning or developing programmed learning materials have not been reviewed here. The investigator has not come across any Indian study on 'paired programmed learning' so far.

In the Indian context the need for more research is felt in the field of educational technology in general and programmed learning in particular, the criterial features of which have been modified along with the techniques and range of applications at present.

Programmed learning in pairs, triads or small groups if explored would throw more light on practical issues in education such as individual characteristics, differences and types of programmes and the technology of learning to be adopted to suit the requirements of learners.
3.3 STUDIES ON UNDERACHIEVERS

Underachievers are learners who are not achieving in a way that is consistent with their potential (Otto and Smith, 1980). Academic underachievement is a genuine problem in education which needs to be attended. The general classifications are over, normal and under achievement, general and specific, which have been the areas of interest and concern for researchers in India and abroad.

3.3.1 UNDERACHIEVERS - FOREIGN STUDIES

Lindgren (1969) reports that Shaw has conducted a number of studies on the factors related to underachievement. In one study he found that underachievers tended to learn as much as other students, as indicated by the scores they got on achievement tests. That they received lower grades may have been due to a constellation of background factors. When contrasted with other students, underachievers were more likely to come from small towns and rural areas (Shaw and Brown 1957). Another research showed that hostility was a greater problem for underachievers than for other students (Shaw and Grubb 1958). Underachievers scored significantly lower than overachievers on scales measuring capacity for status and self control based on their scores in a psychological inventory (Kaimowitz and Ansbacher, 1960). Still another study of a similar type reported that underachiever had less satisfactory
personality test scores than overachievers (Pierce, 1961). In a study of students at Yale University the underachievers were found to be spending less time in study and not taking their studies seriously. They were not punctual, responsible, efficient and democratically oriented (Rust, 1958).

The studies on underachievement compiled and edited by Ebel (1969) confirm that the 'talent loss' is not confined to the lower class or to some minority groups. Reviewing over 400,000 students Planagon and others (1962) reported that 20 percent of the students in the top quarter of their graduate classes failed to enter college.

1) Application of group counselling involving the families concerned produced better results. (Shaw, 1961; Shouksmith and Taylor, 1964).

2) The second strategy has been to modify the educational programme to take into account the limited ego strength or aspirations of the underachiever.

Small groups of underachievers were placed in classes with high achieving gifted children. Significant gains were noted in school achievement and intellectual influence (Karnes and others 1961). Mixed ability or heterogeneous grouping helped the low scoring learners to perform better in achievement tests (Borg 1966, Dockrell 1964, Douglas (1964) and Heathers (1967).
Shaver and Muhn (1971) investigated the effects of tutoring 198 underachievers in reading and writing at the 4th, 7th and 10th grade levels. Students were defined as underachievers if their reading and writing scores obtained in educational progress tests were lower than the scores predicted on the basis of their mental maturity scores. At all three grade levels there were significantly greater frequencies of tutored as compared to control students who reached their predicted potential or better. This difference was present two years later.

Barcai and others (1973) of Israel assigned 62 fourth and fifth grade underachievers from a low socioeconomic area to one of three intervention groups: group counselling, group remediation and art activity. Performance of the students in different tests, improved differentially as a function of the specificity of intervention. Classroom climate was found to be an important factor in determining the outcome of intervention.

Yule and others (1974) studied the distribution of over and underachievement in reading of 5062 students. They were from 9, 10, 11 and 14 year old British children in a major city and a small town. It was shown that reading achievement did not exactly parallel IQ scores at all levels of intelligence, confirming the inappropriateness of the achievement ratio and similar statistics. This explains the concept of underachievement.
Simms and Bibb (1974) assessed test anxiety and the need for achievement in 41 male and 27 female underachievers in the 4th, 5th and 6th grades. Chi-square analysis revealed that test anxiety was a significant factor in underachieving males ($p < .05$) and not in females. There were significantly more male underachievers than female.

Strong (1974) exposed 19 disadvantaged 6th grade underachievers to an automated technique which included an answering time delay audio-visual tutoring and extrinsic reinforcement for accuracy. These students showed impulsive cognitive patterns on pre-testing. The influence of automated techniques upon cognitive tempo shifts was confirmed as 53 percent of the experimental students (but no control students) showed shifts towards reflection.

Valine (1974) studied the effects of video feedback in group counselling of underachieving college freshmen on grade-point average. Three groups received either 1) counselling with immediate feedback via video tape 2) with delayed video feedback or 3) with no video feedback. Sixty four percent of the students indicated that video feedback was helpful in the group discussion.

Thomas (1974) found a sensitivity encounter group experience with 9th grade underachieving girls to be effective insignificantly improving their school grades.
Sontakey (1975) attempted to identify factors responsible for affecting the achievement of bright students. Fifty bright underachieving and achieving male students from 11 to 16 year olds at five boys middle schools were identified on the basis of verbal intelligence, teacher's ratings and academic achievement. Results showed poor study habits, emotional problems and needs being less cooperative and sociable, not having clearer self-concept and poor health in general could be the reasons.

Sharma (1975) of Dalhousie University, Canada investigated the effectiveness of a rational group approach in the academic recovery of underachievers. Eighty four high school underachievers were divided into four equal groups and were exposed to 1) rational group counselling 2) teaching of rational ideas 3) teaching of study skills or 4) no treatment. The students receiving rational group counselling showed significantly greater reduction in irrational beliefs and five months later they showed significantly greater improvement in school marks.

Barcai and Dreman (1976) found that a non verbal cooperative art activity was the most effective in improving performance on school related tasks of the three group approaches tried with 62 fourth and fifth graders from a school in a low socio economic area. Remedial and counselling approaches proved to be effective in improving performance on non-school
related tasks such as I.Q. and tell-a-story test scores which required interaction on a 1 - to - 1, dyadic basis.

Claes (1976) of Canada reported academic improvement in a sample of 28 male underachieving students of average age 15 years and IQ 100; after 30 hours of structured socialization.

Lowenstein (1976) examined underachievement in children. Parental attitudes and behaviours were seen as particularly important factors in fostering a sense of capability in children. Encouraging a wide range of interest, in children and more positive teaching strategies would also help.

Valine (1976) conducted a four year follow-up study of 54 underachieving college freshmen (originally studied by the author in 1970) to measure changes in self-concept of those still in college and those who had dropped out. It was found that those who attained senior level generally had a more positive self-concept than those who for various reasons dropped out of college. Dropping out of college might be a positive experience for some.

Otop (1977) of Poland investigated sources of frequent school failures of gifted pupils by having teachers describe on special rating scales the personality and behaviour of the ideal pupil, a (gifted) poor learner and a (gifted)
superior learner. It has been suggested that the general cause of academic failure of gifted pupils has been the school's failure to recognize their true capacities for learning.

Swanson and Willis (1979) observed that the gifted underachievers perform well below their singular capacities resulting in frustrations and failures in self fulfilment. They have referred to the research findings which have pointed out that lack of real challenge, poor study habits, superficial work, carelessness, becoming bored with routine classroom work, personality factors and social factors affect their school achievement. They suggest that this 'talent wastage' could be reduced or eliminated with proper identification, adequate programming and deliberate attempts of some type of external reinforcer to stimulate them.

Goodstein (1980) observed that identification of underachievers as manifesting a host of pathological characteristics such as poor peer relationships, negative and materialistic attitudes, social inadequacy, bad study habits, low self-concept and poor family relationships. This particular research has identified three distinct pathologies related to underachievement; 1) neurosis 2) the non-achievement syndrome and 3) the adolescent reaction.

Myers (1980) found that handicapped conditions, disadvantage and cultural differences, sex role stereotypes and inadequate education are the factors contributing to under-
were found to be poorly adjusted in school, home, social religious and miscellaneous areas.

Saxena (1972) identified underachievers on the basis of discrepancy between the actual and the predicted scores. These were the individuals whose actual achievement fell at least one standard error of estimate below the regression line of prediction of achievement. Poor study habits, self-concept and parents education were found to be some of the causes of underachievement. The underachievers were unaware of the actual difficulties and their need for individual help.

Studies relating to underachievement in general have been done by Sinha (1965); Srivastava (1967); Saxena and Pal (1970); and Pathak, (1972). Again poor study habits, negative self-concept, adjustment problems, lack of interest in studies, greater anxiety, neuroticism, extraversion and poor socio-economic background have been found to be the causes of underachievement.

In the NCERT financed study by Pal and Saxena (1970) underachievers were identified on the basis of ability scores and the achievement scores. The above average in ability and below average in achievement were identified as underachievers. Three universities and two affiliated colleges were taken for the study. Study habits, self-concept,
adjustment attitudes, interests and future vocational plans were probed into. It was found that the underachievement and the factors differed from curriculum to curriculum. The problem areas of underachievers in mathematics curriculum were found to be adjustment to classwork, finance, living conditions, teaching procedures, lack of adequate personal help from teachers. Teachers opined that underachievement might be due to chance factors in examination, poor background, non-academic activities and financial difficulties.

Bhatt (1971) studied 106 underachievers of both sexes from six mixed secondary schools and found the underachievers having relatively better level of adjustment than the overachievers. Bhatnager (1976) studied the effect of individual counselling on the achievement of 20 bright underachievers selected from standards VII through XI and the results revealed that there was an improvement in the achievement of pupils who had been given individual counselling.

Jayagopal (1974) of Madras University found the 275 underachieving students from standard IX to be characterised by spontaneity, vigour, spirit to associate with the group readily and uninhibited, in a study of their personality profile. Kaur (1974) investigated the difference between overachieving, normal achieving and underachieving 10th class students in study habits, personality characteristics
and personal problems and organised a special educational programme of teaching and learning to assist underachievers in basic subjects.

Kohli (1976) found the correlates of achievement common to both the groups of over and under achievers. Although the spectrum of some of the non-intellectual behaviour-environmental factors was differently related to academic achievement of over and underachievers, it did not clearly separate the over and underachievers.

Dandapani (1977) of Mysore University studied the effect of a group guidance programme upon the academic achievement of high school underachievers. It was found that the academic achievement of 30 under achievers in the experimental group was significantly greater than 30 non-counseled underachievers and 30 normal achievers as a result of the programme of guidance and remedial measures taken.

Tandon (1978) conducted a psychological and ecological study of underachievers at the High School and intermediate level and found the underachievers to be pessimistic and highly anxious. They took less interest in studies and were not diligent. Male underachievers were not regular in attendance and not obedient. The home environment was not found to be a relevant factor in the underachievement of females.
Somasundaram and Sivadasan Pillai (1974) identified 298 underachievers out of 902 pupils using quartiles of Intelligence and achievement scores. Emotional conflict, lack of motivation, poor study habits, cultural deprivation and economic handicaps were found to be the causes.

In the studies on underachievers reviewed by Buch (1974) there is only one study in which a remedial programme using programmed material was tried specifically on underachievers in algebra among students of standard VIII in a rural area successfully (Shah, and Kapadia 1972). Kulkarni (1969) and State Institute of Education (1970) reported that students using programmed materials for revision were significantly better than students who adopted other methods of revision. Programmed learning was used for remedial teaching in general by Joshi (1972) for the first year degree students at Hyderabad.

3.3.3 STUDIES ON UNDERACHIEVEMENT - AN APPRAISAL

Most of the studies on underachievers in general or in specific areas such as in mathematics conducted in India have been on identifying them and their problems or causes of underachievement.

While there have been many studies outside India on remediation or experimentation for improvement, there are only a few studies in India on intervention programmes for
underachievers.

Individual or group counselling or guidance, diverse grouping especially with high achieving gifted children, tutoring, extrinsic reinforcement, rational group approach, group experiences, structured socialization, individualized and compensatory laboratory programmes modified educational programmes such as programmed learning and positive teaching strategies have been used as remedial measures and approaches in the academic recovery of underachievers. Paired programmed learning for improved performance involving an underachiever in each dyad with a high achieving peer has not been tried in any of the studies reviewed under this head.

3.4  META - ANALYTIC STUDIES

Hartley (1977) collected 153 experimental studies of the efficacy of four techniques of mathematics instruction and synthesized using meta-analysis methodology. The effectiveness was determined by comparing the mathematics achievement of students by 1) Computer assisted instruction 2) Cross-age and peer tutoring 3) individual learning packets and 4) programmed instruction to that of traditional instruction. On the basis of the studies collected, tutoring was found a superior technique for increasing mathematics achievement Peer tutoring in which class mates tutor one another was as effective as paid adult aides, while cross-age tutoring in
was slightly better than the other two types of tutoring. Computer-assisted instruction was less effective than tutoring but more effective than individualised learning packet and programmed instruction techniques.

Ide and others (1981) in a quantitative synthesis of peer group influence on educational outcomes analysed 110 correlations taken from 10 prior studies to estimate the correlation of peer group variables at the elementary and high school level with a range of educational outcomes. Applying techniques similar to those of Glass (1978), (technique of meta-analysis to synthesize diverse research findings) Gage (1978), Jones and Piske (1953), Rosenthal (1976), and Light and Smith (1971), the authors conducted a synthesis of the research relating to the impact of peer group on achievement and aspirations. Peer influence was shown to be a small but consistent correlate of educational outcomes. The strength of the peer influence outcome relationship was found to be significantly higher in urban settings and was also higher in studies in which peer influence was determined by having individuals report the aspirations or achievement levels of their best friends.

3.5 **PRESENT STATUS AND NEEDED RESEARCH IN PAIRED PROGRAMMED LEARNING**

The investigations on paired learning, paired programmed learning, underachievers and programmes for improving
their academic achievement and the findings thereof serve more as pointers for further research than as hard facts upon which elaborate and far reaching practical decisions are to be based. Research studies on paired learning and paired programmed learning as reviewed in the chapter seem to be plenty in other countries as against a very few in those areas in India. Even regarding underachievement, many studies in India have been on identification of the underachievers and the causes of underachievement and inadequacies rather than on experimentation of a method or intervention programmes for improving achievement. Only in three studies, Shah and Kapadia, (1972); Bhatnagar (1976); and Danapani (1977) have ventured to evolve and experiment programmes of improvement to solve the problem of underachievement.

There have been studies on programmed learning as a remedial technique for underachievement (just one Indian study available has been reported); no study specifically aimed at experimenting paired programmed learning involving underachievers. However, Hartley and his associates involved underachievers in their studies on mixed ability pairing in programmed learning.

Kepler and Randall (1977) have criticized the educational trend towards programmed individualisation and its emphasis on basic skills, which incidentally is a case for programmed learning in pairs or groups.
3.6 RELATED STUDIES IN MATHEMATICS

The present study includes programmed learning and paired learning where different methods of pairing have been tried to study the effectiveness of each pairing mode as an instructional technique. The group on which these approaches have been tried has been that of underachievers in mathematics.

Ashlock and Herman (1970) have highlighted experiments in classroom with children on learning mathematics, selecting methods and materials, improving problem solving ability, developing curricula, evaluating instruction and achievement in mathematics and planning for individuals. A large portion of research on programmed instruction appears to indicate that for students of determined ability level in mathematics programmed instruction seems to be as effective as conventional teaching if not more. Generally the attitude towards programmed instruction was found to be favourable.

Zoll (1970) reviewing studies on programmed instruction in mathematics has mentioned about Farber's study of the use of programmed instruction in a group situation which resulted in the experimental group, with subgroups of four members performing significantly better than the control group. He observes that much remains to be learned about the merits of this method of instruction.
Hartley (1973) has emphasised the need for more research in paired programmed learning adopting a number of different strategies for pairing pupils to improve learning. As in the Indian setting there has been no work done on paired programmed learning, the investigator has undertaken this study to find out the differential effects of various modes of pairing in programmed learning of mathematics on the performance of underachievers.

3.7 CONCLUSION

The survey of researches conducted in the field of paired programmed learning and modes of pairing reveals a few gaps that are yet to be filled. The use of programmed learning material with changes in the criterial features such as step size, role of the teacher, techniques and applications has to be checked with different groups of students and with a variety of specific goals. The problem of individual differences in mathematics offers vast scope for the experimentation of paired programmed learning with various pairing modes. The present study would throw more light on the potential of each of the pairing modes experimented in evolving effective approaches in paired programmed learning which may be beneficial to the underachievers in mathematics.