CHAPTER VI

SUMMARY AND SUGGESTIONS

6.1.0 Introduction

6.1.1 Research Design

6.1.2 Objective

6.1.2 Sample

6.1.3 Programmed Learning Material and Tools

6.1.4 Hypotheses

6.2.0 Procedure

6.2.1 Pairing Modes

6.2.2 The Experiment

6.3.0 Major Findings

6.3.1 Improved Performance of Underachievers

6.3.2 Differential Effects of the three Pairing Modes

6.3.3 Achievement to the predicted Level

6.3.4 Performance of Able Peers

6.3.5 Attitude towards Programmed Learning in Pairs

6.3.6 Sources of Variations in Achievement

6.4.0 Educational Implications

6.4.1 Paired Programmed Learning

6.4.2 Pairing Modes

6.5 Suggestions for further Study

6.6 Conclusion
CHAPTER VI
SUMMARY AND SUGGESTIONS

6.0 INTRODUCTION

The effects of three different modes of pairing in programmed learning, namely mixed ability (weighted score - rank order) pairing, teacher choice and student choice pairing on the performance of underachievers in mathematics have been investigated in this study.

6.1 RESEARCH DESIGN

6.1.1 Objective: The major purpose of the study was to investigate the differential effects of the three pairing modes in programmed learning in improving the performance of underachievers in mathematics.

6.1.2 Sample: Initially, 242 underachievers were identified from 1092 students of standard IX drawn at random from 10 randomly selected secondary schools, nine in the city of Madras (urban area) and one in Arakanam town (semiurban area).

6.1.3 Programmed Learning Material and Tools: The investigator made use of ten different tools for collecting data on the different variables selected for the study. The programmed learning booklet (linear style) on the unit 'statistics' was prepared and validated by the investigator. Besides this, the achievement test in mathematics, questionnaires on interest in mathematics, participation in extracurricular activities
and academic self-concept were also developed by the investigator. The general intelligence test, study habits inventory, personality test, socio economic status scale and adjustment inventory were either standardized tools or adaptations of standardized ones.

5.1.4 HYPOTHESES

The following hypothesis were formulated.

1. Programmed learning in pairs enables the underachievers in mathematics to improve their performance.

2. The 'mixed ability' pairing mode in programmed learning enables the underachievers in mathematics to improve their performance.

3. The 'teacher choice' pairing mode in programmed learning enables the underachievers in mathematics to improve their performance.

4. The 'student choice' pairing mode in programmed learning enables the underachievers in mathematics to improve their performance.

5. There is significant difference between the effects of the pairing modes in programmed learning namely
   i) 'mixed ability' and 'teacher choice',
   ii) 'mixed ability' and 'student choice' and
   iii) 'teacher choice' and 'student choice', on the performance of underachievers in mathematics.
The post test performance of the underachievers in mathematics in all the three pairing modes in programmed learning does not significantly differ from the level predicted on the basis of their intelligence.

7. The post test performance of the 'able peers' in all the three pairing modes in programmed learning does not significantly differ from the original level of performance in mathematics.

8. The underachievers express a significantly favourable attitude towards programmed learning in pairs.

9. There is significant difference between the attitudes of the underachievers in the three modes, towards programmed learning in pairs.

10. The 'able peers' in the dyads express a significantly favourable attitude towards programmed learning in pairs.

11. There is significant difference between the attitude of the able peers in the three modes, towards programmed learning in pairs.

6.2 PROCEDURE

The underachievers in mathematics were identified using the predicted scores in mathematics based on the intelligence test scores and scores on the achievement test in mathematics. The students whose actual achievement in mathematics fell short of their predicted scores by at least two stanines were designated as underachievers in mathematics.
6.2.1 Pairing Modes: The underachievers were grouped with able achievers in three ways. The first mode, mixed ability, paired an underachiever with an able peer who got high 'weighted score' on the significant correlates of achievement in mathematics in the rank order. The top ranking able peer was paired with the first among the underachievers on the weighted scores, the second best able peer with the next underachiever and so on. Only those able peers with higher 'weighted scores' than all the underachievers involved were considered for pairing. In the second mode, 'teacher choice' the underachiever was paired with an able peer by the teacher handling mathematics for the group. The third group, consisted of pairs where the underachievers themselves chose the partners from among the able peers with mutual consent and here the pairing mode was 'student choice'.

6.2.2 The Experiment: The post test was given as the pretest to assess prior knowledge of the unit programmed. The underachievers and the able peers paired with them, then learnt the programmed unit. The underachievers were helped by the able peers whenever necessary. The partners also checked the progress of the underachievers from frame to frame getting them to respond in appropriate ways. The checking of the frame responses was 'mutual' and that provided for dyadic interaction towards mutual understanding and learning. The underachievers felt free to raise questions and get their doubts clarified by the partners.
The investigator studied the performance of the learners involved on the short criterion tests on the five subunits primarily to assess the progress of the underachievers during the paired programmed learning process. The students in each dyad took up the subsequent subunit when they felt convinced that they had learnt the preceding one. The post test was administered after the paired programmed learning of the unit was over.

The experiment went on for nearly two weeks in each school, selected for the experiment. The post test was again administered to the same groups after a lapse of three weeks without prior intimation to test their 'retention' of the learning of the programmed unit.

6.3.0 MAJOR FINDINGS

6.3.1 IMPROVED PERFORMANCE OF UNDERACHIEVERS

Programmed learning in pairs was found to have helped the whole group of underachievers and able peers to gain significantly in the post test with 81 percent of the group significantly gaining individually. (Figures 6.1 and 6.2)

The performance of underachievers after paired programmed learning in three different pairing modes in the post test indicated significant gain for all the under- as a group acheivers in the different pairing modes with 78.1 percent individual gains in the post test.
As regards the pairing modes, the underachievers in the 'teacher choice' and 'mixed ability' pairs gained significantly in the post test. The underachievers in the 'student choice' pairs had a mean gain ratio 'g' of .49 in the post test. They missed the significant level (g > .5) by a very narrow margin.

In the semi-urban school groups, underachievers in all three pairing modes gained significantly on the whole and as individual groups. Among the urban school groups the underachievers in the mixed ability and teacher choice dyads only gained significantly. The underachieving girls in all three paired groups gained significantly through programmed learning in pairs. The underachieving boys gained significantly as one group but only those in the 'mixed ability' and 'teacher choice' pairing modes had significantly improved their performance.

Even when the effect of variation in intelligence scores of the underachievers was statistically controlled ANCOVA (F-ratio significant at .01 level) revealed that the different pairing modes were by themselves effective in improving the performance of underachievers in the post test after programmed learning of mathematics in pairs.

The performance of underachievers in the delayed retention test also indicated a significant gain for all of them in the different pairing modes. There was no significant difference between the post and retention test.
Mean gains ($g$) in the post/retenion tests of the whole group (W), underachievers (UA), and Able peers (A) ($g > .5$, significant)

<table>
<thead>
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<th>Group</th>
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scores of the underachievers in each of the two paired groups
'teacher choice' and 'mixed ability' pairs, indicating that the
learning was retained.

6.3.2 DIFFERENTIAL EFFECTS OF THE THREE PAIRING MODES

The underachievers in the teacher choice
and mixed ability paired groups performed significantly better
than those in the student choice pairs, (p < .01). There was
no significant difference between the post test means of
underachievers in the teacher choice and mixed ability pairs.
The findings relating to the mean gain ratios of the three
groups are similar to the ones on the post test results but
individual gains for underachievers in each of the three
modes indicated higher percentage for 'teacher choice' (90%)
than the mixed ability (82.9%) and student choice (61.8%)
modes, thus placing the teacher choice pairing mode on top.

The two-way ANOVA of mean gain ratios of
the underachievers in the urban and semiurban schools in the
three modes revealed that there were significant differences
between the gains due to the

i) pairing modes in favour of both the 'teacher choice' and
'mixed ability' pairing

ii) locality in favour of the semi urban school group and

iii) interaction effects in favour of the teacher choice mode
in the semiurban group.

The two-way ANOVA performed to examine the
effects of both pairing modes and sex and to test for inter-
action effect of the underachievers in urban groups indicated significant \(p < .01\) differences between the mean gain ratios of the underachievers in the three different paired groups and also between the mean gain ratios of underachieving boys and girls. There was no significant interaction effect between pairing modes and sex. In the urban groups there were significant differences in the gain ratios of the underachieving boys and girls in the mixed ability \(p < .05\) and student choice \(p < .05\) paired groups in favour of girls. In the semi-urban school groups no significant differences were indicated by the two-way ANOVA examining the effects of pairing modes and sex simultaneously. However among the underachieving boys those in the 'teacher choice' (.66) mode differed significantly from those in the student choice (.59) mode in the performance after paired programmed learning. There was no significant difference between the underachieving girls in the different pairing modes.

With the influence of intelligence and academic standards of the schools controlled also (by ANCOVA) the teacher choice and mixed ability pairing modes were found to be significantly different (more effective) from the 'student choice' mode. (Figure 6.3)

6.3.3 ACHIEVEMENT TO THE PREDICTED LEVEL

The underachievers as a whole reached their predicted level of achievement in the post test and the achieve-
### Mean Gains in the Post Test of Underachievers (UA) and Able Peers (A) in the Mixed Ability (MA), Teacher Choice (TC), and Student Choice (SC) Pairing Modes

#### Figure 6.1

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### Shifts of Underachievers on the Whole and in the 3 Pairing Modes in Post Test from Predicted Levels

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### Shifts of Able Peers on the Whole and in the 3 Pairing Modes in Post Test from Original Levels

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ment in the post test of the teacher choice and mixed ability mode groups went beyond the expected levels. (Figure 6.4)

The underachieving boys and girls involved in all three pairing modes in the semiurban groups had moved on to the favourable region of change, crossing the predicted stanines after paired programmed learning. In all these cases the performance of underachievers on the post test was significantly different for the better from the predicted level of performance in mathematics. In the urban groups while underachievers in the mixed ability and teacher choice modes had significant residual gains (favourable shift) over the predicted level of performance in mathematics, those in the 'student choice' pairs performed significantly below the predicted level.

6.3.4 PERFORMANCE OF ABLE PEERS

The able partners of the underachievers had not only maintained their original attainment levels in mathematics but had also significantly gained over them in the mixed ability and teacher choice dyads. Their shifts beyond the original position were found to be significantly favourable. (Figure 6.5).

6.3.5 ATTITUDE TOWARDS PROGRAMMED LEARNING IN PAIRS

The underachievers had a favourable opinion regarding paired programmed learning in mathematics.
There were significant differences between the opinion of the underachievers in the three different pairing modes regarding certain aspects of paired programmed learning. The underachievers in the mixed ability paired group indicated significantly greater satisfaction than those in other modes regarding the 'difficulty' of the learning tasks allotted; they liked working (learning) with a partner; and thought that they had learnt more in this fashion than what they would have done the usual way in traditional class teaching. The underachievers in the student choice pairs were significantly in favour of working with a partner always. They showed greater dissatisfaction over the criterion tests and post test and this was clearly reflected in their comparatively lower performance in the tests. Underachievers in the mixed ability and teacher choice paired groups were more satisfied with the content, presentation of learning and testing incorporated in the programme than in the own choice pairs.

Even though the attitude of all underachiever involved towards paired programmed learning was favourable, it was the group of underachievers in the mixed ability ('weighted scores-rank order pairing') group who found the different aspects of the learning strategy significantly more satisfying and advantageous.
The able peers had developed in general positive attitudes towards programmed learning in pairs. The able peers in the mixed ability mode liked working with a partner more than their counterparts in the other modes.

6.3.6 SOURCES OF VARIATIONS IN ACHIEVEMENT

From the regression analysis it was evident that the undersachievers in mathematics significantly lacked in motivation and interest in the study of the subject, had poor study habits, and self concept and more social and adjustment problems.

The factorial components of the ten variables studied were identified as 1) personal adjustment and motivational study techniques 2) mathematical ability 3) extraversion and purposeful social participation and 4) school attendance and self concept. These dimensions explain the sources of variance operating on the undersachievers in the study.

6.4 EDUCATIONAL IMPLICATIONS

The aforesaid findings have their implications to the various practical aspects of classroom instruction, individualised instruction, group work, intervention or remedial programmes specially in the teaching and learning of mathematics at the secondary level in Tamilnadu.
6.4.1 PAIRED PROGRAMMED LEARNING

Programmed learning in pairs irrespective of the modes has been found to be effective in improving the performance of the sample of underachievers studied. Now that this instructional mode is found to be successful with underachievers in mathematics, the students in pairs involving underachievers can be engaged in an effective teaching-learning situation with a programmed lesson in the class or during supervised study sessions. It need not necessarily be always for remedial or correction or improvement programmes. For new learning, revision or even enrichment programmes, programmed learning in pairs may be tried with underachievers with the gifted students as their partners.

6.4.2 PAIRED MODES

All the three pairing modes experimented in the study namely mixed ability (weighted score-rank order pairing); teacher choice and student choice have been found to be effective.

There have been significant differences between the effects of these pairing modes on the performance of underachievers in mathematics in favour of teacher choice and mixed ability pairing modes against student choice. If the dyadic approach in programmed learning is adopted to supplement class teaching, the teacher would do well to use
the 'own-choice' pairing mode in a learning context with more care, caution, control, direction and guidance.

The mixed ability pairing mode was found to be as effective as the teacher choice mode. Both are 'mixed ability pairing only but in teacher choice the underachiever and able peer were brought together by the teacher on the basis of his knowledge of the students, whereas in the 'mixed ability' mode described in this study the pairing was based on the 'weighted scores' on the significant correlates of achievement in mathematics and the rank order. The teacher choice and mixed ability pairing modes have helped the underachievers in this study not only to reach their potential but also to perform better than the predicted level of attainment (as per their scores in intelligence test) in mathematics. This factor is essentially the objective of any 'programme of improvement' for underachievers. It has been observed in this investigation that it is possible to assist the underachievers to shift even beyond their predicted level of attainment in mathematics.

For the able peers paired with the underachievers too the paired programmed learning has been found to be beneficial. The mixed-ability and teacher choice pairing modes have helped these helpers also to better the pre-course performance in mathematics. The able peers in the 'student choice' mode have reached the original level of achievement
in mathematics without significant shift. The motivation and interest may be high in the student choice groups but seriousness and commitment to the task in hand may be lacking and hence for purely academic work this pairing mode can be desisted in preference to other pairing modes as the able peers have expressed a favourable attitude towards paired programmed learning in general.

Dyadic approach in programmed learning is an interesting and effective adjunct to the conventional teaching of mathematics. There is the feasibility of training students in self-instructional skills, skills of participating in or initiating a discussion and working. With a partner, expressing freely his inability of understanding a particular concept or idea, getting the doubts clarified, raising questions to comprehend better, accepting other’s explanation, utilizing one’s potential to the maximum and other such dyadic interactions. In such approaches sufficient care must be taken to form the dyad or paired learning cell and its composition should be examined in the light of alternative pairing modes so as to optimize progress.

The use of students as peer ‘tutors’ or ‘proctors’ in the paired programmed learning affords an economic source of labour but can only be justified, if the student in acting as a helper gains some benefit for his endeavour. In this study the able peers as partners in the dyads improved upon their original standings in the teacher choice and mixed
ability modes and those in the student choice pairs main-
tained the original level of attainment in mathematics.

6.5 SUGGESTIONS FOR FURTHER STUDY

Paired programmed learning or the dyadic
approach in programmed learning which is comparatively new
to the Indian Educational scene demands the attention of the
researchers in its various theoretical and practical aspects
as applicable to local conditions. In this regard a few
suggestions for further studying are given:

In the present study teacher choice has
emerged as the most effective pairing mode enabling the under-
achievers to improve their performance. A comparison of
pairing modes in programmed learning other than the ones
tried in this study may be made with the 'teacher choice
mode'. An investigation similar to the current one with
'chance' or randomly assigned or mixed motivated pairs involving
underachievers can be undertaken. Pairing based on weighted
scores on variables like test anxiety and achievement motiva-
tion which have been found to be the significant correlates
of underachievement (Simons and Bibbs, 1974) other than those
considered in this study for mixed ability (weighted score
rank order) pairing, may be tried.
Investigation may be carried out to explore in detail the relationship between peer interaction and achievement or to examine the ways in which the dyadic interaction influences the learning using observer coding and rating schedules.

Influence of intelligence, self, personality or other factors on the effects of programmed learning in pairs with the class groups in general may be probed into.

Positive effects have been observed with underachievers in paired programmed learning as in all three pairing modes they could either reach the predicted level or shift beyond that favourably, but this was true of underachievers in standard IX with regard to just one unit in mathematics and so if a study similar to the present one with different units at different levels were to be undertaken it would throw more light on the possibilities of helping the underachievers in mathematics to improve their performance and achieve to the predicted level.

6.6 CONCLUSION

The two modes namely the 'mixed ability' pairing and the 'teacher choice' pairing have emerged as the most effective pairing modes as compared to the 'student choice' pairing mode in improving the performance of the underachievers. The underachievers in all the paired groups especially those in the student choice mode have developed positive attitudes
The implications of the foregoing results are two fold:

1) Programmed learning in pairs especially with pairing based on mixed ability and 'teacher-choice' facilitates improved learning, leading to academic success of the underachievers in mathematics according to their potential or even more.

2) Favourable attitude towards different aspects of the dyadic approach in programmed learning such as, peer assistance, interactions and interesting and stimulating cooperative learning is associated with enhanced achievement.

The present study is based on a theoretical model conceptualised and has empirically proved the efficacy of the 'teacher choice' and 'mixed ability' modes of pairing over the 'student choice' in learning programmed material in mathematics. The pairing strategy has helped the underachievers to reach the predicted level of achievement in mathematics and even more. The study has also opened further avenues for research.