CHAPTER I

PROBLEM

1.0 INTRODUCTION

Individual development through socialisation is the main purpose of the formalised system of education. Education should help the students have a harmonious development of their physique, intellect and affect and also develop in them a good value system. The Secondary Education Commission (1953) and Indian Education Commission (1966) point out that the aim of a democratic education is the full, all round development of the individual's personality and maximization of individual's potentiality. This assumption requires that education should take into account the different needs of the individual - physical, intellectual, moral, social and emotional - so that educational experiences designed would cater to all these needs.

Effective development and growth of an individual, a society or a nation would be possible by a system of education which is effective and dynamic. The educational practices must not only be flexible but also provide the base for the application of educational innovations which help to meet the problems which crop up and meet the challenges and demands of the society. The future of the society depends to a large extent upon the total development of boys and girls in schools. Therefore the choices they make
individually, the projects they carry out cooperatively and the manifold educational objectives they achieve in consonance with their capacities and abilities are very significant for the future of the society.

Schools of every type fulfill the goals of education in so far as they promote individual development of students and foster individuality and originality in them. The individual has to be developed to the extent he is capable of, in and through the life of a society. The 'social aim' of education should go hand in hand with the 'individual aim' of education. The school should attempt to continue the process of socialisation started at home. The social aspects which an individual has to develop are the good inter personal relations and a sense of belonging to a group. The school has to provide experiences to the student to develop such desirable social relations with others, as a member of the group.

1.1 INDIVIDUALISING INSTRUCTION

There are differences among individuals in their ability for certain tasks and fields of learning. The long established educational practice of class teaching may not be adequate to cater to the varying needs, interests and abilities of students in a class.

The system of instruction in India is still highly group oriented. Normally, a class consists of 40 to 50 students who are grouped together for the purpose of
instruction, irrespective of individual differences in their intellectual and specific abilities, skills, motivation, interests and various other personality factors. As Chauhan (1979) puts it eventhough the educators and administrators have always professed the need for an instructional system attuned to the background and abilities of the individual, nothing substantial has been done in India to individualise instructional process.

The process of teaching and learning has to be flexible to solve the problem of individual differences among learners. Meeting the educational needs of the individual student has long been a concern of professional educators and philosophers. Munn (1969) observes that the early Greeks discussed such differences and mention is made of it in Plato’s 'Republic'. Almost all prominent educators since Plato have recognized the importance of and the need for paying attention to differences among students while teaching.

Many educational techniques that gave prominence to the individual learner have been developed through the years. The Guru-Kula system in India was based on individualised approach to teaching (Gordon, 1960) and this system closely resembled the tutorial system. The early institutions of education did teach on an individual basis by classifying the students into groups according to their ability, especially ability in reading and arithmetic; each student recited indivi-
work. When the groups became larger and larger in the instructional set up, students were taught en masse. However in recent years the tendency is to break away from the traditional method of class teaching and to individualise instruction.

Some of the earlier plans for individualising instruction have been the 'Winnetka Plan' designed by Washburne (1968) the 'Dalton Plan' introduced by Helen Parkhurst (1930) and the 'Morrison Plan' devised by Morrison (1931). In the Winnetka Plan the Curriculum is divided into two parts, the 'Common essentials' the core curricula and 'group activities' described as socialized creative activities. The work on common essentials is fully individualised with individual assignments on different units accompanied by work sheets and test sheets. The student works at his own rate on each unit, gets immediate feedback in the form of answer sheets provided and offers to be tested by the teacher before taking up the next phase of work. Group activities such as discussions and excursions provide socialising experiences.

The Dalton Plan or the laboratory plan is also known as the 'assignment' system. The student works on different units for which assignment is divided and completed individually at his own rate. Each class room becomes a 'laboratory' for a special subject and the specialist teacher is the guide. Group work is encouraged if a number of students are working at the
same stage. General difficulties are explained in group lessons called 'Conferences'. (Parkhurst, 1930)

The Morrison plan is based on directed guidance and stresses unit assignment. Directed guidance includes a pretest, presentation, assimilation in which the students study to master the assignments based on the presented material, organisation in which each student presents his own outline of the material learned and recitation in which the assimilated material is orally presented by each learner. (Morrison, 1931)

These plans adapted in parts or totally by enthusiastic teachers all over the world have helped to enrich the teaching-learning process and improve the achievements of the individual student. The development of educational technology gave a filip to such attempts on individualising instruction.

1.2.0. **EDUCATIONAL TECHNOLOGY**

In the words of Collier (1977) educational technology is as wide as education itself. It is concerned with the design and evaluation of curriculum and learning experiences and with the problems of implementing and remodelling them. Educational technology is not to be confused with electronic gadgetory. Essentially it is a rational problem solving-approach to education, a way of thinking sceptically and systematically about learning and teaching.
Technology has enlarged the scope for individual instruction as well as mass instruction. Technology for individual instruction stands for equipments and materials designed for individual learning such as teaching machines, programmed instruction, auto-tutorial system, computer assisted instruction, language laboratories, learning modules or packages and personalised system of instruction. The mass media like radio, television, CCTV, slides, tapes and films are included in the technology for mass instruction.

Educational technology mainly aims at providing for individual differences in learning and is supposed to have broken new ground in the direction of individualised instruction. The equipment and learning materials are so devised as to cater to the individual differences in ability, skill, motivation, attitude, personality characteristics, and styles of learning.

In schools in India the use of audio-visual aids or technology for mass instruction is nothing new but the investigator is of the opinion that technology for individual instruction is mostly at the awareness level only with a few exceptions perhaps effectively operating. Researches in India in the field of educational technology have been restricted and limited to the area of programmed learning only (Buch, 1979) since only that is within the reach of an average school in India.
1.2.1 PROGRAMMED INSTRUCTION

Programmed instruction or programmed learning is an educational technology in which reliable instructional material is clearly presented in teaching of serially connected small frames. Every student is required to make some response relevant to the learning task which is reinforced by providing the correct answer, before he takes up the next frame or item. It is self-paced and auto-instructional.

The class room teacher should be aware of reliable instructional materials based upon educational technology and prepared to use them for the benefit of his students. Programmed learning material is an effective teaching material which the teacher can profitably use while individualising instruction. Individualised instruction with clearly defined goals and modes of achieving the same, provides for the differences in learner's needs and abilities, thus developing his potentialities and directing towards the achievement of those needs.

1.3 ACADEMIC UNDERACHIEVEMENT

Individual differences among learners are varied in nature and degree or extent of variation. Differences in personality make up bring about differences in intellectual pursuits and achievements. Learners may have the same intellectual gifts but because of diversity in interests and goals, habits and background, they seek diverse goals and means of
realization of these goals. Certain non-academic factors like socio-economic background or school attendance may influence or affect the development and expression of abilities. Some students have special abilities and disabilities which accentuate individual differences. Some achieve high in some subjects and low in others. Some have difficulty with mathematics, others with language. In general, students with more or less the same mental age (the measured mental capacity or ability) differ widely in the attainment level, in a certain subject area.

Some students do not achieve as much as others who are intellectually of the same ability. The intellectual capacity of these students is not optimally used by them for achieving what they can in the particular subject. What they actually do falls short of what they can. This falling short of their performance from their possible level of achievement is known as underachievement. Hurlock (1973) discussing academic achievement views the problem of underachievement falling under two distinct types, namely general underachievement and specific. Some students are general underachievers in the sense that their performance is below their capacities in all or nearly all areas; others are specific underachievers working below their capacities in a specific area. In the case of 'underachievement' the individual is performing below his capacity in general or specific abilities. The underachiever's performance may not be poor in
comparison with that of his classmates, but it is below what he is capable of doing. Underachievement being under utilisation of potentialities, the problem of underachievement in the field of education cannot be just ignored for then it amounts to ignoring the 'individual aim' of education.

Shaw and McCuen (1960) observe that while underachievement may reach its peak in adolescence, it usually begins during childhood, often as early as the second or third grade. This is the time when the child's attitude towards school often changes from a favourable to a less favourable attitude. Shaw and Grubb (1958) have pointed out that the underachiever brings with him the tendency to work below his capacity 'at least in embryo form, when he enters high school'. Yule and others (1974) after studying the distribution of over and underachievement in reading among high school students argue that over and underachievement are best defined in terms of a regression equation based on IQ scores and defined in this way reading ability follows a generally normal distribution with overachievement occurring with roughly the same frequency. However, there was a significant departure from normality at the extreme lower end of the curve such that gross underachievement in reading occurred at well above the expected frequency. This suggests that there is a meaningful group of children with specific reading retardation which is not explicable simply in terms of the bottom of the continuum.
1.4 **INDIVIDUALISED INSTRUCTION FOR UNDERACHIEVERS**

Underachievement results in wastage of human and economic resources and often causes much distress to the underachieving students. The neglect of underachievers leads to personal loss and national waste. The Indian Education Commission (1966) recommend that attention should be given to the underachievers in whom potential manpower often of high ability is dormant. Schools should take steps to diagnose the causes for inferior academic performance on the part of potentially superior students and adopt necessary remedial measures.

To help the underachievers perform better, and upto their capacity various approaches have been tried successfully. Bhatnagar (1976) found individual counselling of help to underachievers and Dandapani (1977) successfully used group guidance and counselling with the underachievers to achieve according to their capacity. Peer tutoring, individualised instructional techniques in some form or other and auto-instructional technique have been found to be profitable to the underachievers in specified areas of study.

The auto-instructional programmes such as Programmed learning have been found to be useful with underachievers (Shah and Kapadia, 1972). The teacher or a competent person working with each student on a personal one-to-one basis has been observed to be one of the earliest methods in tackling
the problem of individual differences in education; for example in reading or arithmetic a student finding any difficulty would be helped by the teacher or the monitor or a gifted student in the same class or even a senior student from a higher class. When the classes were small the teacher himself was able to pay adequate individual attention to the students who needed extra help.

Now, with the increasing enrolment in the primary classes and constructive measures taken to check dropout rate, wastage and stagnation, the classes at the primary and secondary levels are becoming larger with even 50 or more students in a class. Individual attention by the teacher concerned would be highly desirable but the practical difficulties such as large classes, wide variations in individual needs and abilities — because of the heterogeneity of the group, now the teachers are getting in their classes — compel the teachers seek for other individualised approaches which would provide for individual differences in learning.

Same-grade or cross-grade peer tutoring that has been found to be very successful in the developed countries can be tried in India as well. This procedure can be adopted not only to help underachievers but also for remedial and special programmes. When peer tutoring is attempted, guidance and counselling will be automatically incorporated in the system. The tutors are given some training before the sessions, on the course of work to be done and basic rates and work.
is another way of individualising instruction. If it is used in the peer tutoring process, it will be a natural blend of individual work and cooperative effort which takes into consideration the 'individual' and 'social' goals of education.

1.5 PROGRAMMED LEARNING AS AN INDIVIDUALISED TECHNIQUE

Markle (1971) describes programmed learning as a method of designing reproducible sequence of instructional events to produce measurable and consistent effect on the behaviour of each and every student. Popham (1964) envisaged greater instructional proficiency of the programmed learning technique because of its significant impact on six aspects: explicit educational objectives, appropriate student practice, student knowledge of results, concern for individual student differences, responsibility for learning, and curricular contents.

The principle of self-pacing of programmed learning incorporates the concept of catering to individual differences in teaching and learning. The learner is asked to respond frequently to questions and he has to remain active and attentive to the instructional material and the active involvement of the learner increases the learner's motivation in the work. A good programmed learning material, as a self instructional device will be tailored to cater to the needs of individual students in a class. Programmed instruction as an individualised technique is commonly used for regular instruc-
t ion with the teacher initiating the session, controlling, giving directions and necessary guidance in between and following it up. Programmed learning as an auto-instructional technique is used in enrichment programmes as well as remedial or corrective programmes. Programmed material in the linear or branching style is available in book form or on tapes and it is used through the media such as teaching machine, film, television and computer. A gifted individual, an average student or even a slow learner can use this learning technique profitably. Programmed instruction for underachievers too has been found to be beneficial as mentioned earlier.

If individual development is one of the major goals of education, individualised instructional techniques have to find a place in the teaching-learning process. In India many investigations on programmed learning have been completed, the findings being mostly in favour of this approach, but this individualised instructional technique has not made encouraging progress in the schools or at least in the schools in Tamilnadu, whereas in many developed countries, programmed instruction and other aspects of educational technology which develop self-directed learning have gained acceptance to a considerable extent. Markle (1971) is of the opinion that the minimal impact of programmed instruction on the educational system quantitatively and qualitatively may be due to 'educational administrative innovation' not keeping pace with the 'instructional innovation'.
1.6 CHANGING CONCEPTS OF PROGRAMMED LEARNING AND MODIFICATIONS IN PROGRAMMED LEARNING APPROACH

Programmed instruction has been described on the one hand as a revolution (Schramm, 1962; Gage and Unruh, 1967) and on the other hand as a bubble that has burst. (Pressey, 1964)

Programmed learning is based essentially on self-instruction. The most serious and genuine objection raised against the self-paced, individualised instruction is the consequent absence of social interaction among the peers which can add to the learning and retention. Thiagarajan (1974) senses danger in that, individualising instruction could be hazardous. He considers that the widespread use of individualised instruction programmes may lead to overtesting, procrastination by the learners, reduced socialization and decreased self-concept.

Many of the original concepts and characteristics of programmed learning have been altered to comply with a more modern learning situation. Skinner's emphasis upon size of step and the individual approach to learning which is self-paced have given way to skip linear and branching programmes and the group use of such programmes where learning is group-paced.

Leith (1969) opines that programmed learning
the group or team work on programmed tasks which have been shown to be advantageous by Amaria (1966) and Carpenter (1963). Leith concludes that many of the 'criterial' features of programmed learning have been modified and with them the techniques and range of applications. For example a programmer nowadays seeks to arrange an environment within which learning activities appropriate to the programme's objectives are provided. Sometimes a simple text book programme will do. Often cooperative learning, practical work, discussion, simulated situations, and audio-visual media are employed. Applications are as extensive as the fields of teaching and training; any form of tuition which is repeatable can be improved. Developing problem solving ability, aptitude and creativity are within the sphere of programmed learning.

Nickson (1971) refers to Amaria's study on learning in groups with programmed instruction and the experiments carried out at the National centre for programmed learning at the University of Birmingham and indicates that group learning using a single programme with the aid of audio-visual units of some kind improves motivation and results in effective learning.

Programmed learning material eventhough a self-instructional device can be used in a variety of ways and in combination with a number of methods of instruction with
different groups. Quite recently Jeyachandran (1980) used programmed film strips in the regional language, TAMIL, to teach History in some schools in Madras (Tamilnadu) and found it more effective than the conventional method. He also found that group-pacing was possible and the technique resulted in better learning and retention.

Mackenzie and others (1970) have cited a few studies on programmed learning and group-pacing, group-paced media and grouping students in small teams of two or three which proved to be effective in helping students learn and remember better. They have also suggested that these adaptations and modifications in the programmed learning approach according to the needs and requirements of the learners may be useful.

Leedham (1977) reports that the UNESCO appreciated the fact that programmed learning had outgrown its original behaviouristic parameters both as to theory and application; they considered that its self-correcting continuous exposure to testing and its affinity with systems methodology should lead to the development of a global theory of learning.

1.7 PAIRING IN LEARNING

Most of the individualised instructional techniques such as the Dalton Plan and Winnetka Plan have been supplemented by group activities to provide for the social
factor that is found missing in the former. The question often posed is whether the schools are for 'individuals' or for 'classes'. The individual student is important so also the 'class' or group of which he is a member. Large and small group teaching are common in education.

Small groups are more efficient than large ones observes Davies (1981) since the learners in a small group setting, experience a greater sense of recognition as individuals, greater personal satisfaction and morals, increased feelings of achievement and progress toward a goal, a more accurate knowledge of results, and increased feelings of cooperation and friendliness. Small groups permit better, wider and cooperative learning.

Abercrombie (1975) stresses the importance of physical proximity in human communication. In small group instruction, where the teacher attends to every individual learner sitting next to him, there is better rapport established and the communication between the teacher and the student is better as compared to a large group situation. Sometimes in a class room the teacher engages the able students in the class to attend to selected individuals who need special attention and help. This is nothing but the peer tutoring process. Same-grade or age or cross-grade or age peer tutoring is a common feature in some schools abroad as a measure of individualising instruction. The students work in
of the instructional or learning situations.

Learning in pairs, learning with a partner and same-grade peer tutoring or peer assisted learning, could all be looked upon as more or less the same approach in learning. There may be differences in the composition and effect. The composition may be academically or otherwise, homogeneous or heterogeneous. Whatever be the make up of the dyad, in each paired learning cell one student is working with the other, asking questions, clarifying, discussing and integrating ideas while learning cooperatively.

Learning in pairs is in a way, an individualised instructional technique, since teaching-learning is on an 'one-to-one' basis. Instead of the teacher helping an individual, an able student helps another student whenever necessary. The student helpers are also generally helped in that process. This technique includes self-pacing, mastery of the set task, clarification or discussion of some points and evaluation. The peer teaching or assistance, interactions and the social atmosphere provided facilitate learning. The tutor, tutee (learner) roles could also be exchanged so that teaching-learning process within the learning cell is mutual when students are paired. Tutoring is essentially viewed as informing by responding to the student's highly emotional desire to think and to know. Alexander and others (1974), Stone (1975), Ehly and Larsen (1976), and many others have shown that students
in dyads have interpersonal compatibility and learn significantly better than learners engaged in a similar task alone.

1.8 **PAIRED PROGRAMMED LEARNING**

The social factor which is apparently neglected in any self-paced teaching could be successfully overcome by involving pairs of students. The technique will still be individually paced but not individually placed! (Wilkinson, 1976).

Hartley (1973) reporting on the findings of some studies on programmed learning by pupils in pairs, lists the advantages of this approach over the individual programmed learning as (1) greater economy (2) less boredom for pupils and (3) greater inter-personal interaction leading to (a) better learning and (b) increased retention but with limited evidence.

The methods of pairing students to learn the programmed unit have also been probed into. The main approaches are: (1) pairing on the basis of ability or prior knowledge of the task in hand or the combination of these measures and (2) pairing pupils on the basis of some personality measures, to see if one method of pairing led to better results than the other. Programmes written originally for individuals have been used in paired work.
Hartley and Hogarth (1971), Hartley, Molt and Hogarth (1971), and Hogarth and Hartley (1973) compared the mixed-ability and like-ability pairs in learning programmes, replicated the experiment with mixed motivated and like motivated pairs; and repeated the basic design with teacher designated mixed ability pairs and own-choice pairs.

Programmed learning technique is self-instructional in that a student may gain certain knowledge, but the relevance and applicability of the knowledge must be indicated by the teacher (Nickson, 1971). An American study by Goebel (1966) reported that teachers in a programmed learning setting spent 68% of their time dealing with individuals as opposed to 3% in the conventional setting. In paired programmed learning to a certain extent the able partner substitutes the teacher.

Paired programmed learning is a modification in the programmed learning approach and it enhances the techniques and range of application, providing for individual learning together with cooperative learning in a stimulated, pleasant social set up.

In the light of the discussion so far, the following questions have been raised:
1. How far can programmed learning in pairs teach basic concepts and skills effectively?
2. Could it provide the right balance between group teaching and individual work?

3. Does it allow each individual learner develop his full potential?

4. Could it teach the students to think for themselves?

5. Does it encourage cooperation, responsibility and self-discovery?

6. How does it compare with the conventional approach on attitudinal and motivational aspects?

7. What kind of pairing modes or settings or conditions of the learning cell generally facilitate optimum

8. How effective is this technique in catering to individual differences in education?

9. Is this applicable to the effective learning and achievement in all subjects in the school curriculum?

These questions are important in the present context of large classes with 40 to 50 students with diverse interests and abilities in each class at the secondary level in schools in Tamilnadu and the updated curriculum in the wake of the new 10 + 2 + 3 pattern of secondary, higher secondary and University education in most of the states in India. The questions raised, have led to the problem of the study.
1.9.0 THE STUDY

The current investigation is on the 'EFFECTS OF DIFFERENT MODES OF PAIRING IN PROGRAMMED LEARNING OF MATHEMATICS ON THE PERFORMANCE OF UNDERACHIEVERS'.

1.9.1 SIGNIFICANCE

The investigator as a teacher educator and as one interested and engaged in mathematics education at the secondary and post or higher secondary levels is of the opinion that the technique in question, namely programmed learning in pairs with different modes of pairing students could be tried in the learning of mathematics at the secondary level for improving the performance of underachieving students. The results perhaps would reveal answers to some of the questions posed.

This investigation is important and significant because paired programmed learning of mathematics is an innovative technique which when tested or experimented in the present educational set up in the state could serve as an alternative or a supportive instructional approach to the traditional one of teaching and learning of mathematics. If the pairing modes are found to be effective with the underachievers in mathematics then there is yet another approach to provide for individual differences in learning mathematics. It is hoped that this method would enable the underachievers
loss' (Ebel, 1969) or wastage in education.

This variation in programmed learning namely 'different pairing modes in learning a programmed lesson' seems to be an interesting and useful exercise to provide for 'individual differences' in academic achievement and to meet the need for giving 'individual attention' to those who specially require it. Moreover 'programmed learning by students in pairs with different pairing modes' as a research study has not been undertaken so far in India as far as the investigator could find from available literature, eventhough there have been many investigations on programmed instruction and other aspects of educational technology (Bush, 1974, 1979). These facts motivated the investigator to undertake this study.

1.9.2 **STATEMENT OF THE PROBLEM**

The problem of the study is to examine the technique of 'Programmed learning in pairs' adopting three different pairing modes namely 1) mixed-ability pairing, 2) pairing based on teacher's knowledge of students (teacher choice) and 3) pairing based on student choice (own choice) and assess their relative effects on the achievement of the learners involved. In this study the subject is 'mathematics' and the major experimental group is 'undersachievers in mathematics', the other group being their able partners. The study is therefore stated as 'Effects of different modes of pairing in programmed learning of mathematics on the performance of
underachievers.

1.9.3 ASSUMPTION

The major assumption of this study is that 'Programmed Learning in Pairs' is more advantageous than 'Individual Programmed Learning'. Hartley (1973) has reviewed a few studies on programmed learning in pairs and confirmed that the paired programmed learning helps the learners to perform better than those learning as individuals, with the limited evidence available. Hoogstraten (1977), and Kratochvil (1979) too have confirmed the point in favour of programmed learning in pairs.

1.9.4 SCOPE AND LIMITATIONS

The study reckons with the following limitations:

(1) Of the many possible pairing modes only three have been experimented in this study.

(2) Though a comprehensive study involving underachievers in mathematics at various levels of education would have been more profitable, owing to constraints on time and resources this investigation is limited to underachievers in mathematics at the secondary level in Standard IX.
1.9.5.0 DEFINITION OF TERMS

It may be appropriate here to define specifically certain terms used in the statement of the problem and its scope for purposes of clarity even though most of them have been explained or described in general.

1.9.5.1 PAIRING MODES

The methods or ways of bringing two students together for learning or forming dyads or teams of two students with a specific purpose are referred to as the pairing modes. In each pair an underachiever in mathematics will be involved. The partner will be chosen from among the able peers or high achievers in one of the three modes i) mixed-ability ii) teacher choice and iii) student choice.

1.9.5.2 EFFECTS ON THE PERFORMANCE OF UNDERACHIEVERS IN MATHEMATICS

The effects of the pairing modes in programmed learning of mathematics on the performance of underachievers refer to the achievement of the underachievers involved in the three pairing modes after the paired programmed learning in the programmed mathematical unit as shown by the scores in the tests. By comparing the achievement of the three groups of underachievers the relative effects of the different pairing modes will be studied.
1.9.6 THE MAJOR OBJECTIVE

The overall purpose of the study is to examine the differential effects of programmed learning on the achievement in mathematics of the underachievers with respect to mode differences in the pairing of students.

1.10 CONCLUSION

In this chapter an attempt has been made to set forth the scope, limitation and importance of the problem of the study and its major objective.

The salient features of programmed learning technique for pairs as the rationale for the study together with the need to improve the achievement level of under-achievers in mathematics are presented.

The second chapter is devoted to a discussion of the theoretical bases and conceptual frame of reference. A resume of related research work to place the study in its proper perspective, to frame the hypotheses and elaborate the design has been carried out in the third chapter. The discussion of the specific objectives, the hypotheses, procedure adopted, preparation of the programmed learning material and other research tools and the research design in detail, follows next in the fourth chapter. The fifth chapter deals with data analysis and interpretation of results. The summary, findings, implications and conclusions based on data analysis have been