Chapter One

CHAPTER ONE: The Study. 1-60

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THE STUDY

1.1 Overview

The education system and other aspects of social functioning in India seem to be qualitatively similar.

India is a country where some 300 to 400 million men, women and children go to bed everynight hungry; where two-thirds of the population has no access to safe drinking water; where the infant mortality rate is 11.4 per cent; where the primary health centres and subcentres function in such a manner that there is hardly any medical attention of any kind available to 75 per cent of the rural live births; where half of the total six lakh villages have no road or electricity..... (Adiseshiah, 1988).

The prevalent education scenario testifies to the social situation depicted above. Over 60 per cent of the adults are illiterates. Almost half of the children in the age group of 6 to 14 either do not enter the school at all or drop out at an early stage. Many of those who have enrolled in schools have to stay outside the educational system due to strong economic compulsions. Only about 5 per cent of the children manage to reach the higher secondary

stage and a still smaller percentage go on to higher education. A negligible number from the disadvantaged sections are able to complete school education.

Looking at the phenomenon of school learning more closely, it becomes imperative to ask : what really happens in our schools? In 1971, Block, in an introductory article on mastery learning, made the following observation about schooling in America:

> " American education is approaching a critical period in its history. Despite great advances in knowledge about student learning and the investment of tremendous amounts of time, effort, and money, our schools still have not moved very far toward the goal of increased learning for all students .... the schools continue to provide successful and rewarding learning experiences for only about one-third of our learners." Block (1971 a).

Same is the case with Indian education, even in 1991. The situation is much more extreme here. For instance, it is baffling to find that in the most literate state of the country, i.e. Kerala, only 40 out of 100 school students manage to struggle their way up to the tenth standard. And even out of this 40, only 20 manage to pass the S.S.L.C.

public examination (Kerala State Educational Statistics Reports: 1980s). High drop-out rate implies that schooling is not attractive to the young and the schools are not successful in eliciting and sustaining the interests of children. In a recent national sample survey (cited by Ramamurthy et al, 1990), it is observed that about one-third to one-half of students find school either boring, irrelevant or even threatening.

It is in this context that the present study attempts to analyse school learning. The study focuses on those students who are successful in their struggle in reaching tenth standard. The study is designed to uncover the quality of the end-products of the schooling. It attempts to analyse the role of instructional and other school-related factors along with student variables in determining the level of student learning. It tries to discover which of the cognitive and affective characteristics of the learner and which of the interpersonal and social aspects of the learning environment affect subject matter learning outcomes. It attempts to make generalised judgements about the existing practices of teaching. The study is designed to derive implications for making the system of education more effective and worthwhile - a system which ensures success for all students rather than for a fortunate few; a system

which moves toward the goal of increased learning for all students.

The prime purpose of the study is to derive implications for desirable changes in school learning. With this objective, the study is designed to analyse the causal and predictive influences of different sets of factors on student learning. This orientation necessitated the selection of variables on the basis of their manipulability and alterability. The attempt is to explain and predict academic success in terms of manipulable factors. The results can provide guidelines for changing the situation - they can provide a framework in which it would be possible for all or almost all students to achieve highly.

The present study attempts to analyse the factors influencing one learning outcome, viz. intellectual skills. The term 'intellectual skill' is derived from the theory of Gagne (1985). He defined it as the 'procedural knowledge' or 'Knowing how'. In his theory, intellectual skill is one of the five different types of human capabilities that are learned. Other four learning outcomes are : cognitive strategies, verbal information, motor skills, and attitudes. Gagne (1985) stresses the need for differential instruction for different learning outcomes.

Intellectual skills form the major part of school learning especially when it comes to science and mathematics. As "the content of school mathematics is virtually all intellectual skills" (Gagne, 1985), achievement in mathematics forms the focus of the present study. The specific dependent variable of the study is the mathematics achievement of tenth standard students. The major independent variables of the study are:

1. Cognitive entry characteristics - the prerequisite learning deemed necessary for learning tenth standard mathematics.
2. Affective entry characteristics- the motivational readiness of students for school learning in general, and mathematics learning in particular.
3. Quality of instruction - the degree to which instruction is matched with the principles of concept teaching and rule teaching that are derived from empirical studies and theoretical models.

For making the analysis more meaningful and integrated, the variables pertaining to the teacher, class, school, home, and extra facilities are also included in the study. Through review of relevant research findings, the

investigator arrived at a list of 35 independent variables. These variables are organised in five sets - student variables, instructional variables, teacher variables, class variables, and school variables. The variables of the home and extra facilities are clubbed with student variables. The present study attempts to establish empirically the relationship of each of these sets of factors with mathematics achievement.

The theoretical background of the study is explained in the next section.

1.2 Theoretical Background

Though the content of education may vary significantly between nations and regions within a nation, the process of schooling is more or less similar everywhere. Much of the content in schools is intended to be systematic in that the learning that takes place in one term or year is regarded as a base or prerequisite for the learning to be provided in subsequent terms or years. At each stage in the schools, some measure of achievement is used as a determiner of the students' status and as a basis for decisions about the further opportunities for learning to be provided in subsequent stages. In the present context of education,

achievement in academic subjects is the main concern of the teachers, students and parents. Schools have been successful in providing rewarding learning experiences to only a small section of students. As a strong reaction to this trend, Carroll (1963) developed a model of school learning in which he reasoned out the alterability of achievement. According to him, if students are normally distributed with respect to aptitude for some subject and if all students are given exactly the same instruction, in terms of both quantity and quality, then achievement measured at the completion of the subject will be normally distributed. Conversely, if the quality of instruction and learning time allowed are made appropriate to the characteristics and needs of each learner, the majority of students will achieve mastery of the subject. His model provided basic guidelines for the essential goal of education : success for all. Since education is a purposeful activity in which we seek to have students learn what we teach, the achievement distribution should be very different from the normal curve if our instruction is effective. As Bloom (1971) pointed out, our educational efforts may be said to be unsuccessful to the extent that student achievement is normally distributed.

Carroll's model and approach strongly influenced subsequent theorising. At least four models of school

learning evolved, albeit partly, from his conceptualisation : Cooley and Leinhardt (1975); Bloom (1976); Harnischfeger and Wiley (1976); and Bennett (1978). However, it was Bloom who transformed the conceptual model of Carroll into an effective working model for mastery learning.

Bloom defined mastery in terms of a specific set of major objectives the student was expected to exhibit by a subject's completion. The subject was then broken into a number of smaller learning units and the unit objectives were defined whose mastery was essential for mastery of the major objectives. The instructor taught each unit using typical group-based methods, but supplemented this instruction with simple feedback/correction procedures to ensure that each student's unit instruction was of optimal quality. The basic framework of mastery learning include the following procedures : (1) diagnosis, (2) prescription, (3) orientation, (4) feedback and (5) correction (Block, 1982).

Equality in education has traditionally been equated with equality of opportunity, not equal outcomes for all, regardless of aptitude or prior learning. The reality of individual differences was expected to extend to the achievements of students; some would surely achieve more than others. Mastery learning approach challenges this belief. This instructional strategy was designed to ensure

that all, or nearly all, students reached the same level of achievement.

If we accept 'success for all' in principle, then the question is : how can we teach for mastery? The proponents of mastery learning offered principles which were very general in nature. The basic idea was that instruction should be linked with the existing characteritics of children. Theories of mastery learning did not specify the particular methods of instruction that could be followed for the achievement of objectives. Is it possible to derive an optimal strategy of instruction? What do the hundreds of studies on teacher effectiveness offer?

The early years of research on teaching have not paid off in solid, replicable, meaningful results of considerable theoretical or practical value (Gage, 1972). One of the reasons for such a result, according to Gage, was the approach of 'global criterion of teacher effectiveness'. That approach implied the possibility of having some magic variable that could be applicable to all of teaching, for all students, at all grade levels, in all subject matters, and for all objectives. As the global criterion approach proved to be sterile, one of the alternative approaches that was tried was the analytic approach. This apporach was used

to analyse the teaching process into relatively discrete components that could be used in different combinations in the continuous flow of the teacher's performance. These component skills formed the basis for microteaching. Though this approach is largely helpful in making the activities of the teacher more efficient, the utility of this approach is doubtful, especially in the absence of a guiding theory, in making decisions about when to use a particular skill.

Most of the models on school learning make generalised prescriptions for instruction. For instance, the model of Bruner (1966) included the following instructional processes : implanting predisposition towards learning; structuring knowledge (mode of representation; economy and power); sequence of materials and specifying rewards and punishments. Bloom (1976), in his model, defined quality of instruction in terms of :

a) the cues or directions provided to the learner;
b) the participation of the learner in learning activity;
c) the reinforcement which the learner secures in some relation to the learning; and
d) feedback and correctives.

These models did not make differential principles for various school subjects, types of contents or specific learning outcomes, and levels of schooling. The same is true

with most of the researches on teacher effectiveness. These general principles, though highly valuable and necessary, are not sufficient. This trend of deriving and suggesting general principles is dominant in the field of educational research. Even the teacher-training courses end up with teaching such principles.

As an alternative, another trend is gradually developing. This approach stresses the need for principles which are more specific. Gagne (1985) writes:

"A serious consideration of practical knowledge of learning, I believe, must go beyond the most general principles of the learning process, such as contiguity and reinforcement. One must recognise that learning results in retained dispositions which have different properties, different organisations, and which accordingly require that different conditions be established for their attainment."

The essence of his theory of instruction is the stress on differential instruction for different learning outcomes. In his theory, while the events of instruction that support learning processes fall into common categories irrespective of the learning outcome expected, the specific operations that constitute these events are different for each of the

five learning outcomes.

This approach is followed by Robert Tennyson, who with others, had done a series of experiments and eventually developed an empirically - based instructional design theory for teaching concepts (Tennyson & Cocchiarella, 1986).

The investigator holds the opinion that the approach should become much more specific to include different levels of education, i.e., elementary, secondary, etc.. Specific principles should be derived for teaching specific contents to students who are at a particular level of schooling. This opinion is elaborated in the next chapter.

This approach is attempted to follow in the present study. From empirical studies as well as from theoretical models, specific principles for teaching concepts and rules to secondary school students are derived. These principles are utilised not only for assessing instruction but also for making interpretative descriptions of concept teaching and rule teaching. Making generalisations about the existing practice of teaching in the secondary schools of Kerala is one of the important objectives of the study.

If instruction has to be made effective, it should consider the initial states of knowledge of the learner.

Mastery learning approaches necessitates the assessment of initial characteristics of students - particularly the content-specific prerequisites. Prerequisites have a direct impact on achievement unless instruction is made suitable to the level of existing prerequsities of a learner. If students lack the necessary prerequisites, it is theoretically impossible for them to adequately learn the tasks in question. No amount of effort, persuasion, reward or quality of instruction will enable the learners without these prerequsities to master the content. Given this view, only if the student acquires the necessary entry behaviour can he/she possibly attain the criterion of achievement. If all the learners do possess the necessary prerequisites, then it is theoretically possible for all of them to adequately learn - if they are motivated to do so and if the quality of instruction is high (Bloom, 1976).

'Cognitive Entry Behaviour' is one of the three major components (other components: affective entry characteristics and quality of instruction) of the theory of Bloom (1976). All models on school learning consider the cognitive preparedness of students as important in explaining achievement. Different models stress on different aspects of it. The following are some examples:

a) Aptitude; ability to comprehend instruction (Carroll, 1963)

b) General ability; prior achievement (Cooley & Leinhardt, 1975)

c) Task learnings already acquired; prerequisite learnings; cognitive style; Task specific aptitudes; General mediating abilities (Glaser, 1976)

d) Aptitude; prior achievement (Bennett, 1978)

e) Internal conditions of learning (Gagne, 1985)

From these models, three kinds of constructs emerge : general ability, task-specific aptitudes, and prior learnings. The cognitive characteristic which seems to be most important is the specific set of prerequisites which are essential for learning a particular task or a series of learning tasks. In the present study, the variable 'cognitive entry characteristics' is conceptualised as the set of content-specific prerequisites needed for learning tenth standard mathematics. For this task, it was necessary to do a logical and pedagogical analysis of the syllabus and the prerequisites assumed or required to be possessed by students. Here, the hierarchical types of analysis proposed by Gagne (1968, 1985) was utilised.

Even if students possess cognitive prerequisites, learning will not be necessarily effective if they are not motivated. More highly motivated students will be able to

learn more quickly and more efficiently than those who are less motivated. When students encounter the learning task with enthusiasm and evident interest, the learning will be much easier, and other things being equal, they will learn it more rapidly and to a higher level of achievement. Models of school learning give sufficient importance to the motivational aspects. Carroll (1963) conceptualised motivation in terms of perseverance. It refers to the amount of time the learner is willing to invest on learning. Perseverance is characterised by behaviours like working beyond the time required, working even though environmental conditions are uncomfortable or continuing to work on content after receiving feedback of failure. The model of Harnischfeger & Wiley (1976, cited by Haertel et al, 1983) emphasises on intrinsic motivation; the basic assumption is that active learning time is a function of pupil's task involvement and intrinsic motivation, as well as the teacher's motivating skills and surveillance. Bruner (1966) used the construct 'predisposition' which corresponds broadly to motivation for learning. According to him, appropriate motivational incentives depend upon the cultural context in which instruction occurs. The instructor must be concerned with the activation, maintenance and direction of this predisposition by maintaining an optimal level of uncertainty, communicating instructional goals and indicating the relevance of alternatives already explored.

In Bloom's (1976) model, the variable,'affective entry characteristics' occupied a prominent place. According to him, affective entry characteristics include school-related affect, subject-related affect and academic self-concept. Affective characteristics are relatively unformed and weak early in the individual's school learning career, but become more structured and effective as the individual accumulates a history of learning (Bloom, 1976). He theorised that if the school could assure a history of successful experiences in school learning, especially during the elementary school period, the student's subsequent school history is likely to be positive with respect to both cognitive achievement learning outcomes as well as affective entry characteristics. According to him, affective characteristics are alterable.

Following the conceptualisation offered by Bloom, there are three measures of affective entry characteristics in the present study. They are :

1. Affective characteristics : Academic
2. Affective characteristics : Mathematics
3. Academic self-concept

Though there are some conceptual deviations especially in relation to quality of instruction, the present study is

based on the theoretical framework offered by Bloom (1976). According to him, student learning is dependent on these three conditions:

a. Cognitive entry behaviour - the extent to which the student has already learned the basic prerequisites to the learning to be accomplished.
b. Affective entry characteristics - the extent to which the student is (or can be) motivated to engage in the learning process.
c. Quality of instruction - the extent to which the instruction to be given is appropriate to the learner.

These three are the central variables of the present study. These variables seem to be the most important proximate factors of achievement. Other factors - such as the home, school, etc., seem to be more distant to achievement compared with these variables. In a prior study, the investigator (Sasidharan, 1987) has theorised that school learning is a direct result of learning activities as experienced by the learner. These experiences are the products of interaction between his/her cognitive and affective entry characteristics and the quality of instruction. The present study attempts to analyse the nature of these influences.

Other than these three proximal variables, many different kinds of variables seem to influence achievement. The review of empirical studies and theoretical models done by the investigator (Sasidharan, 1987) shows that there are at least seven sets of factors which determine student learning. These factors are listed below:

1. Student variables
2. Instructional variables
3. Teacher variables
4. Class variables
5. School variables
6. Home variables
7. Extra facilities

These variables seem to exert direct, indirect or interactive influences on school learning. The present study attempts to establish the relationship of each of these sets of factors with achievement. The relative importance of these sets of factors is also analysed. From the review of studies, relevant variables from each set are identified. For this selection, manipulability of factors and their proximity with achievement together with their theoretical importance are considered. Then, each of these selected factors is defined and operationalised in relation to the

specific learning outcome - intellectual skills. Hence, the conceptualisation and assessment of independent variables are largely dependent on the particular learning outcome.

Related research studies are reviewed in the next section. The purpose of the review is to frame research questions accurately. The review is helpful in identifying and selecting important independent variables. It also serves as a background on which the theoretical framework and the structure of the present study are logically formulated. Using secondary sources at some places, research studies have been reviewed in brief.

1.3 : Review of Related Studies

The review is presented in six sub-sections:

1. Student Variables
2. Instructional Variables and teacher variables
3. Class variables
4. School variables
5. Home variables and extra facilities
6. Relative importance of variables.

Each of the first five sub-sections analyses the relationship of one set of variables with student learning.

1.3.1 : Student Variables

As learners are the principal actors in learning activities, it is quite natural that their psychological characteristics have important consequences with respect to acheivement. Learners may vary in a number of aspects and the task of the researcher is to determine which of these aspects are relevant in explaining individual differences in school learning. Once it is determined, the task of the researcher extends to the development of instructional strategies that will suit the needs of learners, and thereby reducing the individual differences in school learning. The instructional strategies should be optimal in making sure that all students are able to achieve very high level of learning.

One cluster of student variables that are studied by researchers can be termed cognitive. With the introduction of intelligence tests, it was almost taken for granted that intelligence alone would be a sufficient predictor of academic success. It was anchored on the premise that intelligence is a relatively permanent attribute of the individual. The prevailing view was, and is, that some are good learners and some are poor learners. This is a safe defensive position for educators as failures of students can

easily be attributed to the inability of students.

The whole history of research on prediction of school achievement demonstrates that cognitive characteristics of learners differentially influence their achievement. This is true with general intelligence, specific abilities, aptitude, prior learning or prerequisites. Cattell et al (1966) reported that IQ, when it was a measure of "pure" intelligence, typically accounted for about 25 per cent of the variance in achievement. The same conclusion was reached by Larrin (1965, cited by Bloom, 1976) who noted that general intelligence tests typically correlated about.5($\pm$.1) with achievement over a great variety of courses and subjects. After a detailed analysis of longitudinal studies, Bloom (1976) concluded that the correlation between intelligence and achievement was reduced to .3 or less when prior achievement was held constant.

Studies using the specific factors of intelligence reveal that non-verbal reasoning (Youngman, 1980), and structure of intellect abilities like cognition of semantic units, cognition of symbolic implications and convergent production of symbolic systems (Chauhan, 1984) have significant relationship with academic achievement.

The review done by Bloom (1976) showed that the aptitude tests, either the composite test score or the specific subtests correlated with later achievement in the vicinity of .5 to .7. He also noted that the correlations between prior achievement and later achievement averaged about .8. The high correlation between prior learning and achievement is verified by some recent studies (for instance, Youngman, 1980; Gupta, 1984). It can be concluded that early achievement in school has a powerful effect on later achievement - as the school subjects are at present taught. If the instruction is made suitable to the needs of each learner, the correlation between ability and achievement will decrease. This is exactly what several studies on mastery learning reviewed by Bloom (1976) show. There was a sharp difference between mastery (.47) and non-mastery (.67) students in the median correlation between achievement in a learning task and achievement in the next learning task. Moreover, while the median correlation between achievement in the first learning task and the summative achievement was .68 for non-mastery students, it was only .36 for mastery students. These results imply that achievement is alterable if the feedback and correctives thereof are used to improve the student learning in each task.

It has to be noted that most of the studies, which attempted to relate cognitive characteristics with achievement, made use of general measures like intelligence and aptitude. These constructs are frequently viewed to be more or less stable and less easily alterable characteristics. The cognitive characteristic which seems to be highly relevant and which is rarely studied is the specific set of prerequisites that are essential to learn a particular task or a series of learning tasks. Bloom (1976) made the following observation:

" The determination of what the learners need at the beginning of an entire course or set of learning tasks is more difficult .. A great deal of research will be needed to identify some of the necessary cognitive entry behaviours for particular school subjects."

From the discussion, it follows that it is the variable 'cognitive prerequisites' which is the important theoretical variable among the category of cognitive variables. Only in such a situation where all the students enter the learning situation with all the needed prerequisites, other specific higher level cognitive variables will gain prominence. In the present study, two variables of 'cognitive

prerequisites' are made use of :

1. Cognitive Entry Characteristics - defined as the set of content -specific prerequisites that are essential for learning tenth standard mathematics.
2. Knowledge of Basic Operations in Mathematics.

When we consider specific personal factors other than the cognitive ones, studies are there which attempted to correlate even attractiveness (Zahr, 1986) and biochemical measures (Vats, 1983) with academic achievement. Considering the proximity with achievement and meaningfulness, only motivational variables are included in the study. So the discussion which follows concentrates on the impact of motivation on student learning.

A bulk of empirical evidence clearly demonstrates the relationship of motivation with student learning. Researchers use many different kinds of measures for affective characteristics - general motivation, achievement motivation, academic motivation, hope of success, interest, academic self-concept, attitude towards a particular subject, attitude towards school, attitude towards a teacher etc.. All these measures tend to be correlated with achievement. In most of the studies, motivation and

achievement are measured concurrently. This is more true with large-scale studies. Only a smaller number of the studies relate prior affective characteristics to subsequent achievement measures.

Low achievers were found more motivated than others to affiliate with peers while high achievers were more motivated academically (Ringness, 1967). The academic achievement of the 'Hope of Success' type pupils surpass the 'Fear of Failure' type pupils in all the subjects of study (Patel, 1977). Though there are some studies showing exceptions (for instance, Manava, 1984), achievement scores are found significantly and positively correlated with self-concepts in academic areas but not in non-academic areas (Sharma, 1981; Marsh et al, 1986). Maqsud (1983) obtained a significant difference in academic acheivement between high and low self-esteem groups.

Considering the quantity of studies on motivation, it is attempted to review only some of the reviews. Uguroglu and Walberg (1979) made a quantitative synthesis of 40 studies in which the relationship of motivation with achievement was studied. Variables included general, academic or mathematics self-concept, locus of control and achievement motivation. For first grade to twelfth grade,

232 uncorrected observed correlations showed a mean of .338 indicating 11.4 per cent of variance in achievement was accounted for by motivation. Further, it was found that motivation and achievement were more highly correlated in the case of students in later grades. The same conclusion was reached by Bloom (1976) after reviewing several studies which attempted to study relationship of subject-related affect with achievement. He further observed that this trend was more evident in the case of mathematics, less evident for other subjects and not present in reading.

Quantitative synthesis done by Kremer and Walberg (1981) showed that the mean correlation for motivation and science learning is .37.

The main assumption regarding motivation is that each individual's initial perception of the learning task may be different and that each individual may perceive his/her learning task in relation to the previous experiences and history. Precisely for a student to learn well, he/she should have an openness to the task, some desire to learn it well, and sufficient confidence in him(her)self to put forth the necessary energy and resources to overcome difficulties and obstacles in learning, if and when they occur. What is important is the initial perception and what effect it has

on the learner's approach to the learning task in question.

Bloom (1976) presented summaries of studies in each of the areas of the three components of affective entry characteristics : subject-related affect, school-related affect and academic self-concept. Studies which attempted to examine subject-related affect and achievement showed the average correlation of .31, with slightly lower correlations in the primary school period and slightly higher correlations in the junior and senior high school period. The average correlation between school-related affect and achievement was found to be .45. He further observed that the academic self-concept was the strongest of the affect measures in predicting achievement. Under appropriate methods of measuring academic self-concept and general school achievement, it accounted for about 25 per cent of the variation in school achievement after the elementary school period.

According to the estimations made by Bloom, cognitive entry characteristics can account for about 50 per cent of the variation in achievement; affective entry characteristics can account for about 25 per cent; student entry characteristics, i.e. cognitive and affective in combination can account for about 60 per cent.

Among student variables, cognitive variables seem to be more important than affective variables for two reasons. First, the impact of the former is more than the latter on achievement. Second, cognitive variables seem to limit the possibility of achievement. If students do not possess needed prerequisites, it is impossible for them to master the content, irrespective of their motivation and the quality of instruction. But, if they possess cognitive prerequisites, they may be able to learn even if they are less motivated, especially when the quality of instruction is high and motivating.

In the present study, there are two cognitive entry measures and three affective entry measures. These variables represent the initial preparedness of students to learn tenth standard mathematics.

1.3.2 : Instructional Variables and Teacher Variables

Historically, studies conducted before the mid-1950's tended to focus on the relationship between the characteristics of the teacher - their background, personality, and moral qualities - and criterion measures, such as supervisor rating or, occasionally, student achievement. This line of research tended to neglect the

activities of the teacher in the classroom - the actual processes of instruction. It adopted a "black box" paradigm which conceptualised teaching as being determined by inputs, such as teacher personality, and leading directly to student outcomes (Forman & Chapman, 1982). Recent developments in research seem to be concentrating more on what teachers do in the classroom. This approach is usually called 'process-product' in comparison to the traditional approach of 'presage-product'.

Reviewers hold different opinions about the utility of research on teaching. Many of the reviewers of 50's and 60's (reviewed by Gage, 1972) argued that empirical research on teaching was not successful in yielding much enlightenment about successful teaching. Stephens (1967), for instance, concluded after looking at the research reports and summaries, that practically nothing was observed to make any difference in the effectiveness of instruction. According to him, most educational techniques seemed to hinder as often they did aid learning. After a thorough review, Dubin and Taveggia (1968, cited by Gage, 1972) concluded that college teaching methods did not make any difference in student achievement. Forman and Chapman (1982) argued that "research on teaching has had, as yet, little pay off". On the other hand, authors like Gage (1972), Brophy (1982) and Walberg et al (1982) held the opinion that recent reviews of research

yielded a number of consistent, positive results with definite policy implications. They questioned the conclusions made by some previous writers that past research has been essentially fruitless. They seem to feel that the existing pessimism is due to examining the results of single studies rather than attempting to synthesise the research and discover convergent findings. Brophy (1982) writes:

> "Teachers make a difference. Contrary to the theorizing of Stephens (1967) and the implications of projects like the Coleman report (Coleman et al, 1966), which, unfortunately, analysed data only at the school level, research that analyses at the teacher level makes it clear that certain teachers elicit much more student learning than others, and that their success is tied to consistent differences in teaching behaviour".

> Contrary to this opinion, in a very recent review, Anderson and Burns (1989) made the following generalisation :

> "Differences in individual teaching behaviours are not reliably associated with differences in student achievement."

Searches for the characteristics and qualities that define good teachers have occupied the time and energy of a large number of researchers. They have utilised a variety of variables. In relation to the increasing proximity with

student learning, the variables of teacher and instruction can be ordered in the following manner : Status variables of teachers, psychological characteristics of teachers, teacher behaviours and instructional processes.

Many of the teacher variables are considered to be proxies. For instance, let us consider the case of teacher experience. An increase in the experience of a teacher is expected to show corresponding increase in related attributes like teaching skills, ability in formulating learning tasks, ability in classroom management and so on. Teacher experience is treated as a proxy for these attributes. The assumption is that experience is likely to develop insight and enhance one's competence in teaching. As with most of the teacher variables, empirical researches show inconclusive evidences in relation to teacher experience. In many of the large-scale studies reviewed by Welch et al (1982), teacher experience was seldom found to be important determinants of student outcomes. But the analysis done by Biniaminov and Glasman (1983) showed that in their study, as well as in some other studies, the experience of teachers exerted significant positive effects on student achievement.

In general, the relationship of teacher variables with

achievement is found to be low. For instance, Bloom (1976) observed that the characteristics of teachers rarely accounted for more than 5 per cent of the achievement variation of their students - and usually much less. He suggested that the emphasis should be shifted from teacher to teaching.

Though there are several criticisms, the research on teacher effectiveness has shown some definite trends. On the basis of an extensive survey of studies on teacher effectiveness, Medley's (1982) conclusion was that dependable correlations seemed to pertain to three aspects of teacher's class room performances : the learning environment that the teacher created and maintained, the use that the teacher made of pupil time, and the strategy that the teacher followed in classroom discussions. In effective teachers' classrooms, the pupils were more orderly; the teacher was less permissive and spent less time "managing" the class; and the pupils received more praise and fewer rebukes. With respect to the use of pupil time, more effective teachers' pupils spent more time in academic activities; spent more time organised in a single large group with the teacher in charge; they spent less time in small, autonomous groups or working as individuals; and when they were doing seatwork, pupils of more effective teachers

were supervised more closely. These results have led to the definition of a variable called "academic engaged time" or "academic learning time" which is found to be (for eg. Leach & Tunnecliffe,1984) closely related to pupil learning outcomes.

The abstracts of several studies on mastery learning are presented in the book edited by Block (1971 b). These studies consistently showed the superiority of mastery learning compared to conventional instruction in relation to achievement, retention, and attitudes. The same conclusion was reached by Bloom (1976) and Walberg et al (1982). Mastery learning has the following elements : clear goals and procedures for what is to be learned, specific instructional objectives, small units of learning, corrective feedback on progress, flexible learning time, alternative modes of instruction, and cooperative learning with peers. As with the results of mastery learning, personalised systems of instruction, analytic revision of instruction, and programmed instruction were found to be superior in the review given by Walberg et al (1982). Their review also showed the following results: achievement is enhanced under teachers who are clear about their expectations, goals and methods for learning; who are flexible in their responses to students; who show enthusiasm

for the lesson and for student learning; who are business like and task-oriented; who use students' ideas in leading the lesson; who attempt to elicit answers to questions by students rather than tell the answers; who use structuring comments that inform the student of the purpose and organisation of the lesson content; and who avoid excessive criticism.

What we can derive from these hundreds of studies are some general principles for teaching. These principles need not be much inter-related. The assumption is that these principles hold good irrespective of the nature of the content or the level of schooling. All these principles can be included in the first category of the four different kinds of principles that are needed:

a) General principles of teaching
b) Principles of teaching a specific type of content
c) principles of teaching at each level of education, i.e. elementary, secondary, etc.
d) principles of teaching a specific type of content to students who are at a specific level of education.

In his theory, Gagne (1985) offered principles for the first and second categories. In the theory, the events of instruction that support learning processes fall into common

categories irrespective of the learning outcome expected. There are nine events of instruction which are sequential:

1. Gaining attention
2. Informing learners of the objectives
3. Stimulating recall of prior learning
4. Presenting the stimulus
5. Providing " learning guidance"
6. Eliciting performance
7. Providing feedback
8. Assessing performance
9. Enhancing retention and transfer

These events represent his general principles for teaching. According to him, the specific operations that constitute these events are different for each of the five learning outcomes. These specific operations suggested by him, are the principles of the second category i.e., the principles of teaching a specific type of content.

Once these four categories of principles are evolved, they can be utilised for many purposes. Teacher training courses will become more meaningful and effective if these principles are taught. If these principles are practised in schools, students will attain higher levels of achievement.

These principles can also guide research for the conceptualisation and assessment of quality of instruction. In the present study, an attempt is made to derive principles for teaching concepts and rules in the secondary schools. These derived principles formed the basis for the assessment of the quality of instruction as well as for making interpretative descriptions of the existing practices of teaching. Quality of instruction is assessed in the study by using the methods of observation and interview. Though quantity of instruction is a major determinant of student learning (see Fredrick & Walberg, 1980, for an extensive review), this aspect is not included in the study since the quantity is more or less the same in the schools of Kerala.

Along with the instructional variable - quality - which is theoretically more proximate to achievement, the following four teacher variables are included in the study:

1. Teacher experience
2. Teacher interest, inferred from the reported reasons for selecting the profession
3. Teacher rated efficiency of the headmaster
4. Teacher rated facilities for teaching mathematics.

These four variables are proxy measures, which, theoretically, influence the behaviour of teachers.

As mentioned earlier, Bloom (1976) conceptualised quality of instruction in terms of cues, reinforcement, participation, and feedback/correctives. Strong effects of these variables are obtained by the quantitative synthesis of 54 studies done by Lysakowski and Walberg (1982). Bloom (1976) estimated that about 25 per cent of the achievement variance could be explained by the variable 'quality of instruction'. According to him, under ideal conditions, the combination of cognitive entry behaviour, affective entry characteristics and quality of instruction could account for as much as 90 per cent of the variation in student learning.

1.3.3 : Class Variables

Do class related variables influence student learning? More specifically, is there any differential impact of class variables on achievement when other sets of variables are ruled out? The answer is 'yes' as per research evidences. In research studies, it is attempted to relate achievement with the structural dimension, perceptual dimension and the process dimension of the class. Logically and empirically, the perceptual and process dimensions are more important than the structural dimension. This result logically follows from the fact that variables of the structural dimension are considered to be proxies for the process dimension.

Results with the structural dimension are generally inconsistent. For instance, the review done by Anderson (1982) showed that class size per se had no effect on student achievement even though in some studies, it appeared that instructionally effective schools tend to have small classes.

Empirical evidence suggests that the nature of other students in the class does have an impact on achievement - their mean ability, mean SES, colour, religion, etc.. Veldman and Sanford (1984) obtained significantly high correlations between class mean ability and acheivement. Within classes, higher ability students achieved higher levels than did lower ability students. Significant interaction effects were found indicating that both high and low ability students do better in high ability classes and that the impact of the class level is more pronounced with low ability students. Coleman et al (1966), in their well known study of equality of educational opportunity found that Negro children from 'more than half' White classrooms scored higher than other Negro children both in reading and mathematics achievement; and this effect is strongest among

those children who began their education (inter-racial schooling) in the early grades.

A large number of studies is carried out which attempted to relate perceptions of classroom climate with achievement. Most of them report significant correlations. The review done by Fraser (1986) suggested that both learning post-tests and regression-adjusted gains in learning in a variety of subject areas were positively associated with student-perceived cohesiveness, satisfaction, difficulty, formality, goal direction, democracy and material environment; and negatively associated with friction, cliqueness, apathy and disorganisation. After reviewing several studies, Anderson and Walberg (1974, cited by Fraser, 1986) found that student perceptions of classroom environment accounted for between 13 and 46 per cent (median of 30 per cent) of the variance in cognitive, affective and behavioural post course measures beyond that accounted for by parallel pre-course measures.

Despite a longstanding tradition for researchers to concentrate either on persons or situations, there is evidence of a recent movement towards a synthesis of the two and strong encouragement for educational psychologists and researchers to direct more attention to the study of

person-environment interaction as a key determinant of students' classroom functioning and achievement (Hunt, 1975). The research conducted by Fraser and Fisher (1983) is consistent with Hunt's recommendation. They defined a variable called 'person-environment fit' and found that achievement was related to interactions between actual and preferred individualisation.

It appears that class factors affect achievement mainly through the affective characteristics of children. The analysis done by Slavin (1983, cited by Fraser, 1986) reinforces this assumption. He synthesised 41 studies and concluded that the effects of cooperative learning in achievement are primarily motivational. Working with others to achieve a group goal creates peer norms supporting learning and these motivate students more to achieve and help one another.

Other than the motivational effect mentioned above, it is possible that the teacher-perceived class characteritics do have an impact in determining the quality of instruction. For this reason, teacher ratings of the class are also included in the present study along with the objective indices. These include the ratings of class ability, motivation, study regularity and participation, and a global

rating of the quality of classroom environment. Objective indices include mean scores of cognitive and affective entry characteristics and SES. Two more class variables are included : (1) attention and participation of students while teaching, which is expected to have a direct impact on the efficiency of learning, and (2) non-absenteeism, which reflects the seriousness of students. In a recent study, Coleman et al (1982) found that students who reported missing school or class or being late, achieve consistently less well, than those from the same types of family background who were not prone to these things. Of the three types of behaviour, late-coming was the least related to achievement. Further, it was found that mathematics achievement was more sensitive to behavioural problems such as absenteeism, being late and cutting classes than is achievement in reading comprehension or vocabulary.

1.3.4 : School Variables

Summers & Wolfe (1976) state:

"Recent major studies seeking answers to questions about students' educational achievement have found the answers everywhere but in the school. James Coleman attributed student achievement chiefly to family background; Arthur Jensen, primarily to heredity and race; and christopher

Jencks, mainly to luck."

In this context, the major question is : Do schools matter in achievement?

With the introduction of large-scale cross-sectional surveys of American and international samples of students in 1960s and early 70s (Project Talent, Equal Educational Opportunity Survey by Coleman et al and several of its reanalyses,studies by Jencks, IEA studies etc.,), it has become apparent that school facilities have little effect on student achievement. But, as Armor (1972, cited by Shea,1976) pointed out, this only means that observed variations in achievement was not associated with observed variations in school facilities. Contrary to some interpretations, this says nothing about the uniform effect that all schools have on all students. These large-scale studies were criticised on several grounds and especially important was the statistical criticism that regression analysis with cross-sectional data can tell us little about how a dynamic system has worked in the past, or how it could be made to work in the future (Luecke & Mc Ginn, 1975).

The relation between student achievement and characteristics of the classrooms or schools including such

variables as number of students, equipment and facilities available, expenditure per student, and school organisation and administration rarely yielded correlations which accounted for more than 5 per cent of the achievement variation as reported in the Coleman, Plowden or in the IEA studies (Bloom,1976). Based on an extensive review on studies on school effectiveness, Madaus et al (1980) concluded that, in general, the processes, press and atmosphere of schools and classrooms seemed to be more highly related to variations in pupils' measured achievement than did the physical presence of particular types of resources and facilities or the status characteristics of teachers. It was what people did in schools and classrooms - how they reinforce, interact, spend their time and persue common goals which seemed to influence student learning. The same conclusion was reached by Coleman et al (1982) who asserted that the structural variables of the school showed little or no consistent relation to achievement. The characteristics of schools that were found to be related to achievement, in their study and those of several others,were of a different sort. They were attributes of a school's functioning, sometimes called 'process variables'in educational circles. The two broad areas of process variables found in the Coleman et al study (1982) to be related to achievement were academic demands and discipline.

Madaus et al (1980) concluded that schools, particularly at the secondary level, made a difference in subject-specific instructions. Further, this difference was, to a large extent, independent of home background, and was related to the structure, discipline, homework, and general thrust in schools to achieve. These informations are utilised in the present study to define the variable 'psycho-social environment of the school'.

It is a common observation that achievement of students in private schools is far superior to those in government schools. Is it due to the qualitative differences among schools or due to the selection into private schools based on ability? It is inconclusive from the following researches that are conducted outside India. In a recent study, Keith & Page (1985) reported that Catholic schools did seem to have real influence on minority high school seniors' (but not for White seniors) academic achievement, and that this effect was largely accomplished through the more stringent curricular demands of catholic schools. In an earlier study (1981), the same authors found that private (mostly Catholic) school effect for students in general (Both minority and majority) was almost entirely due to the selection factors. But, Coleman et al (1982) found that

achievements in vocabulary and mathematics for comparable students in Catholic and private schools were higher than in public schools (family background factors were controlled). Two major reasons were observed: more extensive academic demands and the disciplinary climate. However, Sassenrath et al (1984), in a longitudinal study with subjects matched on age, ethnicity, gender, SES and IQ found that private and public schools did not show any mean differences in achievement test scores. In the present study, type of the school (government/private) is considered as an important school variable. One related variable is also included - school locality (Urban/rural).

An environment of a school is a social-psychological phenomenon which emerges from the interaction between human and material elements existing within the school system. It is not sure whether the difference in school quality arises from school-related factors or student body characteristics of the school or both, leading to variation in output - academic success. The findings of the classic study of Coleman et al (1966) and several of its reanalyses proved that the major determinant is the social class climate of the school's student body. This variable was measured by the social class origins of all of a schools' students; and it appeared most critical in the later grades and somewhat

more important for Negro than White children. The children of all backgrounds tended to do better in schools with a predominant middle-class milieu; and this trend was especially true in the later grades where the full force of peer- group influence was felt. The finding that Blacks are affected more than Whites by the student body could be interpreted in terms of reference group theory, which suggested a process of homogenisation (Shea, 1976). In the present study, student body characteristics and school related variables are included so that a comparison is possible.

In the present study, the following school variables are included : School mean entry characteristics (four measures), school mean SES, psycho-social environment of the school, past achievement, school locality and school type.

1.3.5 : Home Variables and Extra Facilities

Home is the most influential primary agency investing in the cognitive and non-cognitive development of the child. It is the main source of socio-physical environmental inputs for the child. It sets forth a basic structure for the total development of the child over which a superstructure is

built from time to time by other agencies of socialisation like school, religion and occupational groups.

With respect to the academic achievement, home has a multifunctional role to play. This role becomes prominent when the primary source character of the home is perceived in relation to its role in shaping the cognitive and affective entry behaviour of learners. The development of basic abilities and competences is largely dependent on the quality of home environment. Moreover, it is the home which decides which school the child should attend. Home, as a supportive educational agency, not only provides material facilities but also serves the supplementary functions, especially in the early years of schooling.

Considering the importance of home in the educational development of the child, researchers have analysed home environment in terms of structural, attitudinal and process dimensions. The most frequently examined educational environment of the home is that involving structural variables. The commonly used structural variables are occupational status, educational level and income of parents, the composite index SES, size of the family, house-spacing and material facilities. The structural variables may not influence educational outcomes directly;

yet they are correlated to other correlates of environment and may be seen as exerting an indirect influence (Husen, cited by Keeves, 1972).

The home environment is also characterised by the attitudinal dimension involving the objectives, attitudes and expectations held by the principal actors at home. The problem with this dimension is that expressed attitudes may not be those implied by the person's actions. This aspect is evident in the discussion by Katz (1968). He observed that high-level aspirations and demands made by minority group parents were so discrepant with the amount of effort lower class parents actually devote to their children's educational needs and so unrealistic in view of the typical lower class child's academic retardation.

He wrote:

> "Apparently the typical black mother tries to socialise her child for scholastic achievement by laying down verbal rules and regulations about classroom conduct, coupled with punishment of detected transgressions, but she does not do enough to guide and encourage her child's efforts."

The process dimension of home deals with the parents' concern for the child, their relations with the child, their

involvement in the child's learning and the provisions they make for the child to support its education. This dimension of home environment can be considered as having more direct influence and greater explanatory power than either the structural or attitudinal dimensions.

Rosen (1961, cited by Marjoribanks, 1983), proposed that the family learning environments could be categorised by variations in the inter related components of achievement training, independence training, achievement value orientations and educational occupational aspirations.

In the present study, SES is included which is conceptualised as a proxy for home environment. A large number of studies have undoubtedly demonstrated the relationship of SES with achievement. Rather than this obtained direct relationship, SES is found to be correlated with many other potential factors of achievement.

A number of studies have tended, by and large, to characterise the training of children in lower class as impulsive and uninhibited, in contrast to the middle class pattern which has been interpreted as more rational, controlled and guided (for instance, see Tumin, 1969). Kumar and Mehta (1983) reported that the psychological climate in which socially deprived children had to live to grow in was

characterised by inadequate mothering, inconsistent and harsh training pattern, cold parent-child relationship and lack of parental models.

Cognitive skills of a low SES child are progressively retarded, whereas those of a high SES child develop quickly. The experiential factors that go with SES may be crucial in determining developmental rates; hence the low SES children suffer from a cumulative deficit in their cognitive competence rather than being able to compensate for the earlier disadvantages (Jachuck & Mohanty, 1982).

Due to several reasons, specifically of the nature of home experiences, children coming to school vary widely in cognitive and affective characteristics. In general, children from higher social class, especially urban, comparatively are more tuned to the standardised academic activities. If the system of education is effective, it will be able to cater to these initial differences in children and make them learn. If it is not, these initial differences will determine the quality of student achievement.

Along with its role in shaping entry characteristics of children, home serves the supplementary functions. Providing extra facilities is one important aspect. In the present

study, the variables of tuition, and utilisation of text-book and guide are included. At present, tuition is not limited to the students of upper or upper middle social class. Even many of the lower class parents send their children for tuition. This is more true with urban parents. Similarly, many parents try to give their children guidebooks. The present study attempts to analyse the role of these variables in determining the level of achievement.

1.3.6 : Relative Importance of Variables

What is evident from the presented review of studies is that student learning is determined by different sets of factors including home environment, instructional and environmental factors of school,and cognitive and affective characteristics of students. Effects are always not additive. Some variables appear to mediate others so that the effect of the distal variables on student outcome operates through the effect of the more proximal variables. Cognitive and affective entry characteristics of learners and quality of instruction appear to be the central proximate factors of achievement. These are the major independent variables of the present study.

Apart from the direct and mediated influence, interactive effects are also studied by some researchers.

For instance, as the intellectual ability decreases from above average to below average, the effect of SES on academic achievement increases greatly (Singh, 1985). Among those of high ability secondary students, introverts do better while among those of lower ability, extraverts do better (Lewis & Simko, 1973). While the achievement of internally oriented Blacks improved more than did the achievement of externally oriented Blacks, internally oriented Blacks increased their performance most when competing with the Whites or when co-operating with the Blacks (Fry & Coe, 1980). Barling (1982) assessed the role of self-determined performance standards (stringent vs lenient) and locus of control beliefs (self Vs external) on children's self-regulation of academic behaviour. Stringent standards were found to be more important for children with an external orientation. Napier & Riley (1986) reported that subjects who were higher in motivation and lower in anxiety and who were taught in low student choice classes that were higher in teacher support, performed higher in cognitive achievement. These studies imply the possibility of several kinds of interactions among independent variables. However, the present study does not attempt to analyse interaction effects.

There are differences in the emphasis on the different sets of factors among the various studies done in the area

of school learning. Austin's (1973, cited by Khader, 1985) analysis suggested that student characteristics, particularly ability, were the most important factors in determining academic success. Many large scale studies, including Coleman et al (1966) and IEA studies, showed that social class and family background exerted far more influence than differences between schools on student learning. The relative importance need not be the same in developed countries and developing countries. Featherstone (1976) observed:

"The most dramatic fact in the IEA surveys is the huge gap in achievement scores between children in the wealthy, developed nations and children in the poor, developing nations. Differences in reading scores among affluent nations are not great, whereas reading scores in three developing nations - Chile, India and Iran - are so low that 14 year old students seem almost illiterate by comparisons."

Reinforcing this observation, Heyneman's analysis (1983, cited by Khader, 1985) using data from the developed and developing countries, including India, revealed that the quality of schools, particularly the classroom tools, in low income countries was shown to explain three, and even four, times the differences in achievement than it can in

high income countries. For Heyneman, the poorer the country, the larger the impact on acheivement, the school quality seemed to have.

In the light of the above findings, the present study attempts to analyse the relative importance of different sets of independent variables on student learning in the schools of a developing country, that is, India.

1.4 : Theoretical Framework of the Study

The present study is an attempt to analyse the factors pertaining to a particular learning outcome-intellectual skills. Though large number of studies are available in the area of academic acheivement, detailed analysis of specific outcomes are generally less. Many potential factors which can influence the learning of particular learning outcomes are ignored in this process of averaging achievements. The focus of the present study is the learning of intellectual skill. 'Intellectual skill' is one of the five different types of learning outcomes proposed by Gagne (1985). According to Gagne, for each type of learning outcome, the internal and external conditions of learning are different. The present study attempts to establish empirically, the relationships of these conditions with learning.

By internal conditions, Gagne was concerned only with the cognitive prerequisites. In the present study, the concept of internal conditions is extended to include affective entry characteristics also. Theoretically, cognitive and affective entry characteristics of learners interact with the quality of the 'givens' (external conditions) to determine the nature of learning experiences, which directly result in learning.

Learning in one term or year can be conceptualised as a result of a series of learning activities, some inside the school, some outside. The learner experiences the learning activities in relation to the cognitive and affective characteristics he/she possesses. The quality of the 'givens' has a direct impact on these learning experiences. These 'givens' may include school instruction, home instruction (if any), tuition, text-book, guide, etc. Even in self-study, the learning will depend on the characteristics of the learner and the quality of the study material. So when learning in one academic year is conceptualised globally, the important proximate factors are : cognitive and affective entry charactersitics of learners, and the quality of 'givens'. In the present study, the following 'givens' are considered: School instruction,

tuition, text-book and guide. However, the quality is assessed for only one variable - instruction. Presence/ absence of tuition is considered, use/non-use of text book and guide is considered. These variables - student variables, instructional variables and extra faciltities - are the direct determinants of student learning. As the quality of extra facilities is not assessed, the major variables of the present study are student entry characteristics and quality of instruction.

The cognitive and affective entry characteristics of the learner, in turn, are determined by the quality of prior learning experiences. If prior learning experiences are successful and rewarding, students will be sufficiently prepared - both cognitively and affectively to learn new tasks. On the other hand, if the prior learning experiences are characterised by failure, frustration and disgust, students will enter the learning task essentially lacking the cognitive prerequsites coupled with lack of enthusiasm and evident disinterest. This stresses the need for mastery learning approaches especially for elementary school grades.

Factors other than the entry characteristics, quality of instruction and extra facilities,seem to be more distant. Home influences the level of cognitive and affective entry

characteristics when the child joins the school. Further, it is the home which selects the type of school he/she may attend. Moreover, through the support facilities, home consistently makes changes in the cognitive and affective characteristics.

Much of the influence of class variables on achievement seems to be motivational. The nature of other students in a class may make changes in the entry characteristics of a learner. Further, the quality of the class may influence the quality of instruction.

Teacher variables seem to influence achievement through instructional variables. Instructional variables are determined by teacher variables, class variables and school variables. School variables seem to influence achievement through instructional variables and class variables.

These mechanisms of influence should be understood well for a meaningful explanation of achievement. It is only through a detailed analysis of the existing trends in school learning, we can derive implications for changing the situation. Our goals are essentially 'success for all' and 'increased learning for all students'. The present study attempts to analyse the nature of the influences of

different sets of factors on student learning. The nature of these influences, the nature of the distributions of entry characteristics and achievement, and the nature of the existing practice of school instruction,will be able to provide, it is expected, guidelines for changing the situation.

In the next section, the objectives of the study are presented.

1.5 : OBJECTIVES

The dependent variable of the study is learning intellectual skills operationally defined as tenth standard mathematics achievement. A total of 35 independent variables are selected in the study. They are organised in five sets - student variables, instructional variables, teacher variables, class variables and school variables. The variables of home and extra facilities are clubbed with student variables.

The following objectives are formulated:

1. To determine the nature and extent of inter relationship of entry characteristics, quality of instruction and student learning.

2. To assess the explanatory power and relative importance of each set of independent variables with respect to the variance in mathematics achievement.
3. To identify the minimum number of variables from each set which represents the statistical relationship of that set with the dependent variable.
4. To derive an optimal prediction equation of the dependent variable.
5. To evolve interpretative descriptions of concept teaching and rule teaching in Mathematics in the secondary schools of Kerala.

1.6 : CHAPTER ORGANISATION

Conceptualisation,operationalisation and assessment of variables together with the various aspects of development of tools and methodology are included in the next chapter: 'Variables, Measurement and Methodology'. Results and analysis have been spread across the third and fourth chapters. Correlational and descriptive analyses of the variables are given in the third chapter. Several generalisations regarding concept teaching and rule teaching are also presented in the same chapter. In the fourth chapter, the results and interpretations of stepwise regressions, analysis of variance, and multiple

classification analysis are given. Results are holistically analysed, inferences drawn, and implications discussed in the final chapter : 'Inferences and Implications'.