Chapter Three

ANALYSIS OF RESULTS - ONE

This chapter covers the descriptive and correlational analysis of the data. In the first section, descriptive analysis of the dependent variable is given. The second section is devoted to the descriptive and correlational analysis of independent variables. Along with quantitative descriptions, qualitative descriptions are also offered wherever necessary. Several generalisations regarding existing practices of concept teaching and rule teaching are derived and presented with the analysis of instructional variables. The correlations of each independent variable with mathematics achievement are given; and the intercorrelation matrix is presented in each subsection, for understanding the relationship of each variable with other variables in the set.

3.1 : Dependent Variable

Mathematics achievement is the dependent variable of the study which is studied at two levels viz. individual and class levels. The descriptive analysis of the dependent variable at each of these two levels is presented in the following subsections.

3.1.1 : Mathematics Achievement - Student Level (MA)

There are two mathematics papers in the S.S.L.C examination. As the maximum score of each paper is 50, the dependent variable is assessed out of 100, which is the total of two separate papers.

A comparison is made between mathematics achievement and total academic achievement. Academic achievement is assessed by the total scores obtained by students in twelve papers each valued out of 50 giving a maximum total of 600. 35 percent (210 marks) is needed for a pass.

The sample was selected from the secondary schools of Palghat district, Kerala State. For the purposes of comparison, the results of the population as well as that of the sample are given in Table 3.1.

Table 3.1 : Pass Percentages of the Population and Sample in the S.S.L.C. examination

		Pass Percentage
1.	Kerala State	56
2.	Palghat district	37.85
3.	Total students of the sample (N = 2359)*	40.65
4.	Incomplete group - students removed from the analysis (N = 518)	27.99
5.	Effective sample - students in the analysis (N = 1841)	44.215
6.	Restricted sample (N = 1116)	48.12

* Total number of students in the selected 15 schools: 2432
Number of students who appeared in the S.S.L.C examination : 2380
Number of students whose results are not available due to various reasons : 21
Number of students whose results are available : 2359

From the table, it is evident that the sample more or less represents the population of Palghat district though the results of the sample are a little higher. Further, the incomplete group is not that random but consists of low achievers. This fact made the effective sample less representative of the population than the total sample. One more point which is clear from the table is that Palghat district does not represent the state of Kerala as the results are very different.

In the restricted sample, the results are a little above as compared with that of the effective sample. Previously it has been mentioned that the selection of restricted sample was not random. This limitation may affect the generalisability of the analysis in the restricted sample.

Table 3.2 presents the descriptive details of the mathematics achievement and the total academic achievement.

Table 3.2: Mean and S.D. of mathematics achievement and Academic achievement

	N	Mathematics Achievement (out of 100)		Academic Achievement (out of 600)	
		Mean	S.D.	Mean	S.D.
1. Total Sample	2359	24.52	19.89	189.08	111.07
2. Incomplete Group	518	18.76	15.19	152.22	89.29
3. Effective Sample	1841	26.15	20.74	199.45	114.34
4.Restricted sample	1116	27.72	21.93	208.97	119.72

It has to be noted that the average academic achievement is less than the pass-mark as a total mark of 210 is needed for a pass. In the total sample, mean achievement is 189.08 though it is 199.45 in the effective sample. In a system of education, where the majority fail, the quality of education can be easily inferred. Students secure a failure-certificate after studying ten long years in the school. Educators try their maximum to give a pass-mark to students by the low quality question papers, liberal valuation, group system and moderation. Still, the result is totally low. These results should be interpreted as the failure of the system of education rather than as the failure of students.

In the case of mathematics learning, the results are further lowered. While the percentages of the mean scores of academic achievement are 31.5 and 33.2, that of mathematics achievement are only 24.5 and 26.2 for the total sample and the effective sample respectively. The quality of mathematics learning is very poor for which the responsibility should be attributed to the prevailing system of education.

As in the case for pass percentage, the mean scores of the restricted sample are better for mathematics achievement and academic achievement.

For understanding the extent to which mathematics achievement is related to academic achievement, the product moment correlation is calculated between them. The obtained coefficient is 0.923. This high value indicates that achievement in mathematics is really a meaningful representation of achievement in different subjects. Variability in total achievement can be accounted for, to a large extent, in terms of variability in mathematics achievement.

3.1.2: Mathematics Achievement - Class Level (MA-C)

There are 56 classes in the sample. For each class, mean mathematics achievement is calculated. The statistical

properties of MA-C are given in Table 3.3

Table 3.3 : Statistical Properties of MA-C

1. Mean : 25.44
2. S.D. : 10.73
3. Maximum Score : 55.82
4. Minimum Score : 10.3

Based on the mean and S.D., MA-C is categorised into eight levels. The nature of categorisation of MA-C and the frequency in each of the categories are presented in Table 3.4.

Table 3.4 : Frequency Distribution of MA-C

Categorised Score of MA-C	Raw Scores of MA-C	Frequency	Percentage
1	14 or less	7	12.50
2	15 - 18	10	17.86
3	19 - 22	9	16.07
4	23 - 25	6	10.71
5	26 - 28	7	12.50
6	29 - 32	6	10.71
7	33 - 36	3	5.36
8	37 or more	8	14.29
	TOTAL	56	100

For all the further analysis, MA-C is considered as a categorised variable. MA-C is positively skewed as 57 percent of cases fall below the mean of class means.

3.2 : Independent Variables

The following five sets of independent variables are analysed in the following sub-sections:

a) Student Variables
b) Instructional Variables
c) Teacher Variables
d) Class Variables
e) School Variables

In the final sub-section, a holistic picture is presented in which the descriptive and correlational details of all the variables are included.

3.2.1 : Student Variables

There are eight student variables in the study: five measures of entry characteristics, socio-economic status, tuition, and use of text-book and guide. The descriptive details of each variable are presented one after the other. Finally a correlation matrix is given.

3.2.1.1 : Student Entry Characteristics

The following are the five measures of student entry characteristics:

a) Cognitive Entry Characteristics (CEC) assessed out of 75.

b) Knowledge of Basic Operations in Mathematics (KBOM). Maximum score is 20.

c) Affective Characteristics : Academic (ACA)
In the scale, maximum score is 30.

d) Affective Characteristics : Mathematics (ACM)
Maximum Score is 20.

e) Academic Self-Concept (ASC). It is a five-point rating.

The descriptive nature of these variables is given in Table 3.5.

Table 3.5 : Mean and S.D. of Student entry Characteristics

Variable	N	Mean	S.D
1. CEC	1841	23.98	14.97
2. KBOM	1841	10.42	5.23
3. ACA	1841	20.4	5.48
4. ACM	1841	11.8	5.7
5. ASC	1841	2.5	1.08

The status of CEC and KBOM has to be explained in a little more detailed fashion. CEC speaks of the cognitive readiness of students to attend tenth class mathematics. Students can understand the instruction of tenth class mathematics if only they have mastered the essential prerequisites. It follows that if students lack prerequisites, they will not be able to gain from instruction, whatever be its quality. It is really very difficult if not impossible, for a teacher, however sincere and motivated he/she may be, to teach all the prerequisites wherever necessary. So, if students score low in the test of cognitive entry characteristics, the teaching has to end up in frustrating results.

The mean of CEC is just 24 which is too low compared to the maximum score of 75. Though the researcher has not drawn the boundary line of mastery, it has to be essentially much higher compared with the mean score of 24. The data make it clear that most of the students lack the essential prerequisites and more than fifty percent cannot gain anything from instruction unless the teachers are that capable and motivated to find and utilise time for teaching the prerequisites. It means that most of the students are cognitively less prepared or unprepared to learn tenth class mathematics. For more clarity, frequency distribution of CEC is presented in Table 3.6.

Table 3.6: Frequency distribution of CEC

Score	Cumulative percentage of cases upto the score
8	11.4
11	20.6
14	33.1
16	41.3
19	50.3
23	59.7
29	70
37	80.1
48	90.6
60	98.2
75	100

It has to be further noted that one student obtained the score of zero and two students got full marks. The number of students who received 60 or above is only 40 out of 1841. The distribution is evidently positively skewed as the mode is 10, median is 19 and the mean is 24. The fact that 50 percent of students score below 19 makes the situation really pathetic.

The frequency analysis of KBOM will make the situation further clear. KBOM measures the most elementary kinds of

prerequisites. The items in the test are simplest questions of basic operations in Mathematics. The basic minimum for any system of education is that the students should have mastered the basic essentials of all the subjects. So, in a test like KBOM, it is not logical to expect a normal distribution; the expected distribution is negatively skewed in which all students score highly in the test of basic operations. As the status result in KBOM is so important for understanding the quality of education, item-wise analysis is presented in Table 3.7.

Table 3.7 : Item-wise analysis of KBOM

Item No	Item	Rounded % of Mistakes	Order of difficulty (1-most difficult)
1.	267 + 46	12	20
2.	-6 + 9	23	17
3.	4/5+6/5	55	9
4.	3/4 + 1/2	89	1
5.	- 5 + 5	15	19
6.	8 x + x	58	8
7.	3.67 + 36.7	63	6
8.	12 - 21	50	11.
9.	419 - 32	27	15
10.	8.35 - 6.5	63	5
11.	5.2 - 3.17	77	3
12.	326 X 78	41	13
13.	- 9 X - 4	38	14
14.	1.4 X 0.6	62	7
15.	0.14 X 0.6	69	4
16.	x X x	21	18
17.	x^2 X x^3	54	10
18.	72 ÷ 8	23	16
19.	3766 ÷ 7	45	12
20.	4818 ÷ 6	78	2

Results are self-explanatory. An average student knows only half of the basic operations being tested. High value of standard deviation (5.23) indicates that students vary drastically even in the basics. While some students know fairly well, some do not know anything at all. From these results, quality of schooling can be easily inferred.

There are three measures of affective entry characteristics. ACA and ACM are affective entry measures in relation to school learning and mathematics learning in the respective order. For the purpose of convenience, the scores of these measures are transformed. Four categories are formed for each, and the basis for categorisation is mean and standard deviation. Details of categorisation and frequencies in each category for both ACA and ACM are given in Table 3.8.

Table 3.8: Frequencies of different categories of ACA and ACM

Transformed Score	Raw scores -ACA	Percentage of cases-ACA	Raw Scores - ACM	Percentages of cases-ACM
1	0-14	16.6	0-5	17.3
2	15-20	30.4	6-11	29.7
3	21-25	33.2	12-16	24.6
4	26-30	19.8	17-20	28.4
Total		100		100

Academic self-concept (ASC) is assessed by an item with five response categories - scored from one to five. The frequency distribution of ASC is given in Table 3.9.

Table 3.9 : Frequency distribution of ASC

Score	Frequency	Percentage
1	308	16.73
2	744	40.41
3	442	24.01
4	256	13.91
5	91	4.94
Total	1841	100

The variable of the home background (SES) and the variables of extra facilities are also included in the category of student variables. The descriptive details of these variables are presented one after the other.

Table 3.2.1.2 : Socio-Economic Status (SES)

Socio-economic status (SES) is the composite index of five variables - education, occupation, income, social participation and material possession of family members. In the SES scale, the maximum possible score is 39. In the

present sample, scores range from 2 to 33. Tables 3.10 and 3.11 present the descriptive details of SES and it is evident that the majority of students come from low and lower middle socio-economic status groups.

Table 3.10 : Statistical properties of SES

1.	Mean	7.581
2.	Median	7
3.	Mode	4
4.	S.D.	4.088

Table 3.11 : Frequency Distribution of SES

Score	Cumulative Percentage
3	10.4
4	24.2
5	37.8
6	49.1
7	58.3
10	80.7
13	91.0
15	95.2
20	98.9
33	100

3.2.1.3: Tuition (TN)

It is logical that even if entry characteristics are the same, due to the differences in extra facilities like tuition and guide, achievement of students may differ. These facilities may be more influential especially when the quality of instruction in the school is poor. Out of 1841 students in the effective sample, 689 (37.43%) go for tuition. As one can expect, there is a sharp urban-rural difference in the case of tuition. While only 29.8 per cent (379 out of 1272) go for tuition in eleven rural schools, the percentage is 54.5 (310 out of 569) in the case of four urban schools.

3.2.1.4 : Use of Text-book and Guide (UTG)

Though there is a prescribed text-book available for tenth class mathematics, how many of the students effectively utilise it? Do students at least read it? For understanding this, one item was included in the 'Personal Data Schedule': "Do you read and study mathematics text-book?" Out of 1841 students, 829 answered 'yes' and the rest answered 'no' to this dichotomous item. It is frustrating to note that 55 per cent of students report that they do not use text-book. The real percentage of non-users may be much more considering the social desirability of the item. The conclusion that, at least for

mathematics, students mainly depend on class-notes, is further verified by the informal discussions with teachers. For the question of why he is giving too-detailed class-notes, one teacher told that it is because students do not read text-book. The investigator seriously doubts whether non-reading of text-book is a cause or effect of too-detailed class notes.

The use of guide has to be discussed along with this. The percentage of users is 23 which is quite less. The uses of text-book and guide are clubbed together and a single scoring system is followed which is presented in Table 3.12.

Table 3.12 : Frequency Distribution of UTG

Category	Score	Frequency	Percentage
Use of text-book and guide	4	178	9.67
Use of text-book only	3	651	35.36
Use of guide only	2	249	13.53
None	1	763	41.44
TOTAL		1841	100

Next section is devoted to the correlational analysis of student variables.

3.2.1.5 : Correlational analysis of student variables

The correlations of each of the student variables with mathematics achievement (MA) and the intercorrelations are presented in Table 3.13.

Table 3.13 : Product-moment correlations of student variabales and mathematics achievement (N = 1841) *

Variable	1	2	3	4	5	6	7	8
1-CEC								
2-KBOM	.7013							
3-ACA	.4280	.4112						
4-ACM	.4495	.4373	.5822					
5-ASC	.5668	.5102	.4073	.4679				
6-SES	.3102	.3065	.2287	.2489	.3162			
7-TN	.2920	.3547	.2738	.3003	.2492	.2577		
8-UTG	.1620	.1364	.1399	.1442	.1572	.1240	.0807	
9-MA	.7462	.7464	.4579	.4729	.6258	.3259	.4104	.1788

* All correlations are significant at 0.001 level.

The following points can be derived from the matrix:

1. All the variables are correlated significantly with one another and all the correlations are positive.

2. The two cognitive entry measures - CEC and KBOM - are correlated highly with the dependent variable. Both the correlations are almost equal.
3. All entry characteristics are related to achievement, but the cognitive ones are more closely associated.
4. Cognitive and affective characteristics are only moderately related among themselves. High or low interest does not always follow from high or low knowledge respectively.
5. Though ACA and ACM are related to a large extent, the value of the coefficient of correlation is only 0.58 which means that each one has some unique contribution to make to a considerable extent. This fact implies that general and specific motivational aspects should be treated differently.
6. Among affective entry measures, it is the academic self-concept (ASC) which is more related with the dependent variable. After the cognitive measures, ASC is the highest determiner - among student variables - of achievement. This finding reinforces the observation of Bloom (1976).
7. From the above-mentioned points, it follows that the selection of five different measures of entry characteristics is justified.
8. As the correlations of cognitive and affective entry measures with achievement are approximately 0.7 and 0.5

respectively, the results are in line with other researches, especially the estimations made by Bloom (1976).

9. SES is moderately related to all variables. Achievement is less related to SES compared with cognitive and affective entry characteristics. The coefficients of correlation of SES with cognitive variables i.e., CEC, KBOM and MA, are almost the same and are around 0.3.
10. The variables of extra facilities i.e., tuition and UTG, exert some influence on achievement, and tuition seems to be more important than UTG. Tuition is more highly related with achievement than SES. Further, tuition is more highly related with achievement than with any other variable.

3.2.2 : Instructional Variables

Theoretically, instructional variables act upon student entry characteristics to determine the level of learning. Two measures of instructional quality are included in the study. Both of them are global assessments of instruction. Based on the principles that are derived from empirical studies and theoretical models, the quality of instruction is assessed by interview (5-point rating) and by observation (10-point rating). While the interview ratings are available for all the mathematics teachers in the sample,

observation has been done in only 32 classes termed as 'restricted sample'.

3.2.2.1 : Descriptive Analysis

The frequency distributions of 'quality of instruction: interview' (QII) and 'quality of instruction: observation' are given in Tables 3.14 and 3.15.

Table 3.14 : Frequency Distribution of QII

Rating	Frequency	Percentage
1	1	1.79
2	18	32.14
3	19	33.93
4	18	32.14
5	0	0
Total	56	100

Table 3.15 : Frequency Distribution of QIO

Rating	Frequency	Percentage
1,2	0	0
3	8	25
4	4	12.5
5	7	21.88
6	6	18.75
7	3	9.37
8	4	12.5
9,10	0	0
Total	32	100

Both through interview and observation, one fact is apparent : teachers are more similar than different. Their approaches are basically the same. Almost all teachers are average with very few exceptional cases. Even with the exceptional teachers, the basic apporach seems to be the same. The following are the conclusions derived from interviews:

1. Most of the teachers possess B.Sc., B.Ed. degrees with very few having post-graduate degrees.
2. Only 16 teachers out of 56 reported that they have selected teaching because of interest; others have

given other reasons.

3. Most of the teachers told that they are satisfied with the job, but not with the results.
4. Most of the teachers view in-service programmes as formal, ritualistic and meaningless. Most of them had attended the 'Massive Teacher Orientation Programme'. Some teachers were resource persons. The majority told that there was nothing new in it, and for the question, 'what effect the programme made on your teaching', the majority frankly said - 'no effect'.
5. Teachers generally do not read anything on Mathematics or on Education other than the text-book.
6. Almost all the teachers told that they are practising lecture-cum-demonstration method.
7. Because of the large class-size (which varies from 35 students to 53 in different classes), teachers are not in a position to provide individual attention.
8. All teachers reported that their instruction is directed towards average students.
9. At times, teachers give some difficult problems meant for gifted students. This is the only special thing meant for them.
10. Teachers told that they give detailed elaborations meant for weak students.
11. Most of the teachers complained that students do not know prerequisites and they expressed their helplessness

regarding this aspect. Even when the teachers come to know that the children have not acquired the necessary prerequisites, they feel it almost impossible to teach these prerequisites considering the time-frame. Though they give some explanations here and there, teachers do not generally teach prerequisites. Moreover, these explanations are only meant for brushing up the memory of students who know the prerequisites.

12. Though in some schools chapter tests or monthly tests are followed, most of the schools have only two term-tests.

13. Though there are some question-answer sessions after the test - that too in some classes - most of the teachers do not practise corrective teaching.

14. Mastery of the students is rarely considered as the target. Most of the teachers think that by teaching, their job ends; learning has to be done by students.

15. Teachers generally attribute student failure to the lack of ability or motivation or regularity of students. It is never attributed to teaching.

16. Most of the teachers use models for three-dimensional figures like cylinder or prisms. But teaching aids are not generally a part of regular teaching.

17. Half of the teachers regularly give homework and half of them correct it or give feedback. Many teachers

complained that students do not take home work seriously.

18. All teachers-with one or two exceptions - are able to cover the portions before annual examination.
19. While some teachers find time for revisions, some do not. Chapter-wise revisions and working out previous question papers are the usual methods of revision.
20. Most of the teachers do not have clear views or opinions about the larger system of education. They do not have any recommendations for making modifications in the system. Some have suggested some changes in the pattern of examinations.

The interview was meant for having information about the general aspects of teaching. The methods and procedures the teachers use for teaching concepts and rules are of special importance in the study. For understanding these, the method of observation was made use of. Thirty two classes were selected from the 56 classes of the sample and was termed 'restricted sample'. Three mathematics periods were observed randomly in each class. The following are the generalisations made from these observations:

a) General Aspects of Teaching

1. Instruction is teacher-centered. Each and every aspect of instruction is decided by the teacher. Teacher assumes a dominant direct role.

2. In most of the classes, communication is one way - from teacher to students. Even when teacher asks some questions, it is the teacher to decide who should answer the question. For questions, students generally give fairly brief answers. The role of student is that of a passive listner.
3. Lecture-cum-demonstration method is followed by all teachers. Participation of students is generally less. Active thinking by students is still less. Students rarely ask doubts.
4. The steps of introduction and presentation are followed by teachers. Review is rarely done. Testing of the learning, whenever it is done, is carried out by asking some questions to some slected students, usually the bright ones.
5. Testing and/or teaching of prerequisites are rarely attempted. Teachers generally seem to assume that students know prerequisites. Sometimes, brief explanations of the immediate prerequisites are attempted. This is helpful for those students who know the prerequisites but face problems in recollecting them. So, instruction is basically directed towards above average students. It may be of some help to average students, but of no help to below-average students.
6. Most of the teachers follow the typical pattern of text-book.

7. Teachers usually give detailed notes.
8. When problems are given for solving, only some of the students attempt them seriously; others just copy from others. In some of the classes, many students do not try to solve either by themselves or by copying - they just sit without any kind of botheration. Same is the case with home-work.
9. Students either fear their teachers or do not care. Except in two or three classes, students do not seem to have any kind of positive affective regards for their teachers.

b) Aspects of Teaching Concepts

10. In most of the classes, concepts are taught at the definitional level. Mechanical reproduction of defintions is given overemphasis by which essence of concepts is often lost. Definitions are rarely explained sufficiently. Moreover, usually learning of concepts is tested by merely asking definition. Same is true with examination questions.
11. Usually, expository examples are offered by teachers. Quality of instruction differs drastically in this area with respect to the divergence, coverage of difficulty levels, and the mode of presentation of examples.
12. Except in two or three classes, expository non-examples

are seldom presented. Teachers seem to be unaware of their use. As concept-teaching is carried out without using non-examples, the questions of pairing and matching of examples and non-examples do not arise.

13. With respect to attribute elaboration, most of the teachers stress the essential attributes of a concept by underlining, writing on the black-board etc. They usually try to relate the example with the definition. But as the use of non-examples is lacking, proper differentiation is difficult to occur.
14. Students usually are not specifically trained for testing whether a given instance is an example or not. Strategy information is rarely offered.
15. Some of the teachers attempt interrogatory presentation. They usually offer corrective feedback also. If a student gives the correct answer (for which the chance probability is 0.5), he/she is not further questioned. If the answer is wrong, the teacher corrects it.
16. Students are rarely asked to give their own examples.
17. Wherever review is attempted, it is limited to the definition only.
18. Except by one or two teachers, cognitive structuring (in which the relationship of the concept in question with other concepts in the taxonomy/hierarchy which are already learned by the students, is clarified) is not attempted.

19. Explanation of applicability is rarely done.

20. To summarise, concept teaching is far from satisfactory. Many of the students are exposed to concepts for which they are not cognitively prepared to learn. Even for those students who possess needed prerequisites, concepts are not taught as intellectual skills. Teaching is mostly limited to definition with one or two examples. The capacities of differentiating examples from non-examples, deriving one's own examples, understanding the concept in its possible divergent forms, and relating the concept with other concepts are not properly nurtured. Even the students of best teachers do not learn concepts in their real essence.

C) **Aspects of Teaching Rules**

21. The question of non-mastery of prerequisites becomes very serious with respect to rule-learning.

22. Some of the teachers seriously attempt deduction of rules.

23. Most of the teachers clearly give rule statements and explain them in simple terms. Though rule-statements are generally adequate, explanations are not sufficient especially with respect to the specifications of the conditions under which the rule can be used.

24. Teachers usually give some demonstrations. In this area, teachers differ much in relation to the number and quality (divergence and difficulty levels) of demonstrations. While some of the teachers relate the demonstrations with the definition of the rule, some do not.
25. Teachers give many practice problems both as class work and as homework. Practice problems generally cover different difficulty levels. But only a small number of students who have prerequisites and who are success -ful in following the instruction, perform these practice problems adequately.
26. Usually, feedback and corrective feedback are offered. As they are done at a group level, individual attention is lacking. Even when teachers give individual attention, it is limited to 'good' students.
27. Specific difficulties faced by students are rarely located and dealt with.
28. Explanation of applicability is limited to the solving of problems in which the rule in question and other rules and concepts (previously studied) are involved. Practical applicability and theoretical applicability are rarely explained.
29. Even when review is offered, it is limited to the rule-statement only.

30. In general, rule-teaching seems to be more adequate than concept-teaching. Quality of instruction seems to make some difference only for those students who have a sufficient mastery of prerequisites.

From the descriptive analysis of instructional variables, it can be concluded that instruction is teacher-centred and very few opportunities are offered for active participation by students. 'Success-for-all' is never considered as an ideal. The vast majority of students who do not possess the needed prerequisites are totally neglected. Of course, teachers are more or less helpless with respect to this. The traditional approach of lecture-cum-demonstration method with an average of 43 students in a class with a majority lacking prerequisites, has to result in 'nonsuccess-for-the majority'. We have already noted that the entry characteristics of the majority of students are far below the expected standard and they are the neglected lot. Teachers reproduce the same distribution of entry characteristics in achievement, but add a little positive skewness from their part. The present system of instruction is meant for the 'able', 'intelligent', 'hard-working', 'good' students.

For those students who possess prerequisites, quality of instruction seems to make some difference. Even the best

instruction among the observed, is far from optimal. Teachers do not stress even the ideal of 'success-for-all who possess prerequisites'. Mastery is not properly ascertained. Further, existing practices of instruction do not give much challenging opportunities to the gifted students. These generalisations necessitate drastic changes in teacher-training courses.

3.2.2.2 : Correlational Analysis

Tables 3.16 and 3.17 present the correlations of instructional variables with the dependent variables along with the intercorrelations.

Table 3.16 : Correlations of QII, QIO and MA

Variables	QII	MA
QII (Sample Size : 1841)		.1402 (P = .000)
QIO (Sample Size: 1116)	.8430 (P=.000)	.0446 (P=.068)

Table 3.17 : Correlations of QII, QIO and MA-C

Variables	QII	MA-C
QII (Sample Size : 56)		.2516 (P = .031)
QIO (Sample Size: 32)	.8339 (P = .000)	.1392 (P = .224)

Two points are evident from the tables: instructional variables are less related to achievement; intercorrelation is high. This trend is not very unexpected. It naturally follows from the descriptive analysis. The basic patterns of instruction are the same. Further, even the highly rated instructions are non-adaptive for students with low entry characteristics. For the vast majority of students who suffer from the lack of prerequisites, instruction does not seem to make any sense. They are not able to understand what is communicated through instruction. Quality of instruction seems to be differential in influencing those students who possess sufficient knowledge of prerequisites. Even in this case, general influence seems to be far more than the differential influence. For gifted students, this differential influence is still less. Becuase of these reasons, the correlation between quality of instruction and

achievement has to be low. This result does not imply that instruction is not very influential in determining the level of student learning. But the implication is that in the present context, differential influence is less. Instruction is not successful in changing the basic trend determined by the entry characteristics. The same trend extends to achievement irrespective of the instructional quality.

3.2.3 : Teacher Variables

There are four variables in the set of teacher variables. Two are direct attributes of teacher characteristics and the other two, ratings given by the teacher.

'Teacher experience' is a categorised variable with three levels. The frequency distribution is given in Table 3.18.

Table 3.18 : Frequency distribution of 'Teacher Experience' (TE)

Categorised Score	Years of experience	Frequency	Percentage
1	3 years or less	2	3.57
2	4 - 7 years	12	21.43
3	8 years or more	42	75.00
	Total	56	100

As TE is more or less homogeneous, this variable may not be effective in determining the level of achievement.

'Teacher interest' is a dichotomous variable. The investigator asked teachers about the reasons for selecting teaching as their profession. If the reported reason is interest in teaching, then a score of 2 is given. For all other reasons, a score of 1 is assigned. The frequencies of each categories are presented in Table 3.19.

Table 3.19: Frequency Distribution of 'Teacher Interest'(TI)

Score	Frequency	Percentage
2	16	28.57
1	40	71.43
Total	56	100

It is interesting to note that only 16 teachers selected the profession of teaching because of interest in it. It is natural for a state like Kerala where unemployment and underemployment are very high.

The third variable in this category is 'teacher-rated efficiency of HM' (EHM). Mathematics teachers are requested to rate their headmasters on a five-point scale. The frequency distribution of EHM is given in Table 3.20.

Table 3.20: Frequency distribution of 'teacher-rated efficiency of HM' (EHM)

Score	Frequency	Percentage
1	2	3.57
2	7	12.50
3	14	25.00
4	23	41.07
5	10	17.86
Total	56	100

The last variable in the section is 'teacher-rated facilities for teaching mathematics'(FTM). Mathematics teachers are requested to rate the facilities on a three-point scale. The frequency distribution of FTM is given in Table 3.21.

Table 3.21 : Frequency distribution of 'teacher-rated facilities for teaching mathematics (FTM)

Score	Frequency	Percentage
1	3	5.36
2	20	35.71
3	33	58.93
Total	56	100

Most of the teachers consider the facilities in their school as good and sufficient.

The correlation matrix of teacher variables is presented in Table 3.22. In the matrix, intercorrelations of teacher variables are not included as they do not make sense. Each of the teacher variables is correlated with mathematics achievement - student level (MA) and class mean mathematics achievement (MA).

Table 3.22: Correlations of teacher variables with the dependent variables (Significance levels in brackets)

Variables	MA (N=1841)	MA-C (N=56)
1 - TE	.0132 (.285)	.0127 (.463)
2 - TI	.1300 (.000)	.1915 (.079)
3 - EHM	.1974 (.000)	.4314 (.000)
4 - FTM	.1014 (.000)	.2166 (.054)

Highest correlations with dependent variables occur in the case of EHM, i.e., teacher - rated efficiency of HM. It has to be remembered that it is not the efficiency of headmaster per se that makes the difference, but the subjective perceptions of it made by mathematics teachers. These perceptions influence the way they teach. A totally different interpretation could be that in high achieving schools, teachers rate the efficiency of HM more favourably.

As hypothesized during the descriptive analysis, teacher experience (TE) is not correlated with the dependent variables. But the variables 'teacher interest' (TI) and 'teacher-rated facilities for teaching mathematics' (FTM) are correlated with the achievement variables though the correlations are at a low level.

The next section is devoted to an analysis of class variables.

3.2.4 : Class Variables

There are 56 classes in the sample. Classes differ in a number of aspects. Some class rooms are large and well-lighted while some are not. In some of the classes, number of students and the size of the classroom matches, while in some other ones, it is not the case. Number of students differs from 35 to 53 with an average of 43 students. While 37 classes are mixed, 19 are single. The major question with class variables is that whether the differences in classes influence student learning. In other words, does the particular class which a student occupies really matter in determining the level of his/her achievement? Even if student variables, instructional variables and teacher variables are the same, do class variables alone exert any kind of influence? If they do, what are the dimensions of the class which are relatively

stronger in their influence? Descriptive and correlational analyses of class variables are offered in this section.

First variable in this cluster is attention and participation of students (APS). This variable is assessed only in the 32 classes of the restricted sample. Ratings on a five-point scale are done based on observations. The frequency analysis of APS is given in Table 3.23.

Table 3.23 : Frequency distribution of Attention and Participation of Students (APS)

Score	Frequency	Percentage
1	4	12.50
2	7	21.88
3	13	40.62
4	6	18.75
5	2	6.25
Total	32	100

We have three measures of class ability - class mean CEC (CEC-C), class mean KBOM (KBOM-C) and teacher-rated class ability (CA). These are categorised variables with four levels, three levels and three levels respectively. The frequency distribution of these variables are presented in Table 3.24.

Table 3.24: Frequency distribution of CEC-C,KBOM-C and CA.

Score	CEC-C		KBOM-C		CA	
	Frequency	%	Frequency	%	Frequency	%
1	11	19.64	18	32.14	27	48.22
2	19	33.93	21	37.50	25	44.64
3	12	21.43	17	30.36	4	7.14
4	14	25.00	-	-	-	-
Total	56	100	56	100	56	100

Similarly, we have three measures for class motivation also - class mean ACA (ACA-C), class mean ACM (ACM-C), and teacher-rated class motivation (CM). All are categorised variables with three levels each. The frequency distributions of these variables are given in Table 3.25.

Table 3.25: Frequency distribution of ACA-C,ACM-C and CM.

Score	ACA-C		ACM-C		CM	
	Frequency	%	Frequency	%	Frequency	%
1	20	35.71	12	21.43	21	37.50
2	19	33.93	27	48.21	21	37.50
3	17	30.36	17	30.36	14	25.00
Total	56	100	56	100	56	100

With respect to socio-economic level, we have the variable 'class mean SES' (SES-C). It is a categorised variable with 3 levels. The frequency distribution is given in Table 3.26.

Table 3.26: Frequency Distribution of SES-C

Score	Frequency	Percentage
1	14	25.00
2	26	46.43
3	16	28.57
Total	56	100

Mathematics teachers have rated the study regularity and participation of students, each on a three-point scale. The frequency distributions of 'teacher-rated study regularity' (SR) and 'teacher-rated participation'(PN) are presented in Table 3.27.

Table 3.27: Frequency distributions of SR and PN

Score	SR		PN	
	Frequency	Percentage	Frequency	Percentage
1	18	32.14	22	39.28
2	19	33.93	17	30.36
3	19	33.93	17	30.36
Total	56	100	56	100

Mathematics teachers are also requested to rate the quality of class room environment on a five-point scale. The frequency analysis of QCE is given in Table 3.28

Table 3.28: Frequency distribution of QCE

Score	Frequency	Percentage
1	10	17.86
2	16	28.57
3	12	21.43
4	16	28.57
5	2	3.57
Total	56	100

The last variable in the set of class variables is 'non-absenteeism' (NA) which is categorised with four levels. The frequency of each category of NA is given in Table 3.29.

Table 3.29: Frequency distribution of 'Non-absenteeism'(NA)

Score	Frequency	Percentage
1	10	17.86
2	14	25.00
3	24	42.86
4	8	14.28
Total	56	100

As the frequency analysis of class variables is completed, the matrix of correlations is presented in Table 3.30.

Table 3.30 : Correlation Matrix of Class Variables (1)

[Values multiplied by 100. * = p<.05, ** = p<.01]

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1-APS (N=32)												
2-CEC-C (N=56)	33 *											
3-KBOM-C (N=56)	32 *	84 **										
4-CA (N=56)	17	37 **	39 **									
5-ACA-C (N=56)	01	55 **	42 **	24 *								
6-ACM-C (N=56)	19	69 **	56 **	28 *	56 **							
7-CM (N=56)	34 *	33 **	31 **	52 **	19	37 **						
8-SES-C (N=56)	01	62 **	65 **	23 *	58 **	54 **	29 *					
9-SR (N=56)	38 *	24 *	28 *	26 *	-03	18	54 **	15				
10-PN (N=56)	31 *	27 *	35 **	28 *	-06	22 *	40 **	30 *	35 **			
11-QCE (N=56)	39 *	45 **	44 **	61 **	15	40 **	79 **	37 **	61 **	73 **		
12-NA (N=56)	32 *	27 *	13	25 *	41 **	22	31 **	15	24 *	-12	17	
13-MA (N=1841)	17 **	42 **	39 **	20 **	29 **	33 **	25 **	33 **	20 **	14 **	27 **	22 **
14-MA-C (N=56)	36 *	84 **	78 **	40 **	53 **	63 **	47 **	68 **	37 **	39 **	58 **	33 **

(1) Variables 1 to 12 - Class Variables
Variable 13 - M.A. - Mathematics Achievement - Student level
Variable 14 MA-C Mathematics Achievement-Class level

The following are the major points that can be derived from the table:

1. All class variabales are positively and significantly correlated with the dependent variables.
2. Objective indices of class are more powerful in determining the level of achievement than teacher ratings.
3. Class variables are more strongly related to the class mean mathematics achievement (MA-C) than to the mathematics achievement of individual students. Former correlations are almost double of the latter.
4. Ability measures (CEC-C, KBOM-C and CA) are more strongly related to achievement. Among ability measures, CEC-C is more closely associated.
5. After ability measures, class mean SES exerts more influence.
6. Out of the affective measures, ACM-C is the highest correlate of achievement.
7. Considering the teacher ratings (CA, CM, SR, PN and QCE), the global rating of class environment (QCE) is more powerful in determining the level of learning. QCE seems to be the representative of teacher ratings. Out of the teacher ratings, class motivation (CM) is mostly related to QCE. Looking at the correlations, it is

clear that QCE is related to the cognitive readiness, interest in mathematics, and the attention and participation of students.

8. 'Attention and Participation of Students' (APS) exerts significant but comparatively low influence on the dependent variables as well as on other class variables.
9. The case of 'non-absenteeism' is unique as the relationships of it with other class variables are comparatively less but that with the dependent variables are moderate. The relationship of this variable with affective readiness of students is evident from the fact that the highest correlation with 'non-absenteeism' occurs in the case of ACA-C.
10. On the whole, measures of cognitive readiness determine around 64 per cent (r =.8) of the variance in class achievment while other indices determine 25 per cent (r=.5) of the variance.

3.2.5 : School Variables

There are nine school variables in this last cluster of independent variables. Each of these variables is described below and at the end, correlational analysis is presented.

Out of the nine variables, five are student body characteristics. School mean CEC has four levels; other

student body characteristics have three levels each. The frequency distributions of these variables are presented in Table 3.31.

Table 3.31: Frequency Distributions of Student body Characteristics

Variable	CEC-S		KBOM-S		ACA-S		ACM-S		SES-S	
Score	F	%	F	%	F	%	F	%	F	%
1	3	20	3	20	5	33.33	3	20	4	26.67
2	6	40	7	46.66	7	46.66	8	53.33	7	46.66
3	3	20	5	33.33	3	20	4	26.67	4	26.67
4	3	20	-	-	-	-	-	-	-	-
Total	15	100	15	100	15	100	15	100	15	100

The cross-table of school locality and school type is given below.

Table 3.32 : Frequency Distribution of School Locality (SL) and School Type (ST)

SL / ST	Urban (2)	Rural (1)	Total
Private (2)	2	6	8
Government(1)	2	5	7
Total	4	11	15

The frequency distributions of Past achievement of the school and Psycho-social environment of the school are presented in tables 3.33 and 3.34 respectively.

Table 3.33: Frequency Distribution of Past Achievement of the School (PAS)

Score	Frequency	Percentage
1	8	53.33
2	5	33.33
3	2	13.33
Total	15	100

Table 3.34: Frequency Distribution of Psycho-Social Environment of the School (PSE)

Score	Frequency	Percentage
1	2	13.33
2	6	40
3	3	20
4	2	13.33
5	2	13.33
Total	15	100

Some qualitative explanations about the ratings of psycho-social environment will be helpful. The following are some of the positive aspects which are present in some of the schools:

1. Calm and quiet atmosphere.
2. Well-equipped and well-maintained laboratory and library. Not the mere presence of them, but utilisation by students.
3. Daily assembly in which headmaster, teachers and students participate.
4. Regularity, sincerity and seriousness of teachers.
5. Efficient management strategies of headmaster.
6. Regular teacher-meetings characterised by democratic concerns.
7. Good parent-teacher contacts.
8. Students feel free to approach teachers and headmaster for discussing their problems.
9. Participation of students in co-curricular activities like exhibitions, sports, youth festival etc.
10. Student discipline.
11. Chapter test or monthly test.
12. Issue of progress cards.
13. Special programmes for weak students.

Along with the absence of these aspects, some specific negative aspects are also present in some of the schools and they are listed below:

1. Absence of headmaster.
2. Lack of seriousness or lack of efficiency of headmaster.
3. Indiscipline of teachers - going late to classes, strikes etc.
4. General noisy atmosphere and teacher-less classes.
5. Lack of facilities.
6. Lack of sufficient number of teachers; in-between transfer.
7. Presence of teacher-teacher or teacher-headmaster tensions.
8. Various kinds of indiscipline by students.

It is to be noted that no school is totally positive or totally negative. But some schools are characterised mostly by positive elements and some, otherwise. Ratings for psycho-social environment were assigned by considering the domination and extent of positive and negative aspects. The ratings are comparative in nature. Even the best schools in the sample do not represent the ideal condition.

As the descriptive analysis of school variables is completed, a correlation matrix of these variables is presented in Table 3.35.

Table 3.35 : Correlation Matrix of School Variables(1)

[values multiplied by 100. * p < .05 ** p < .01]

Variables	1	2	3	4	5	6	7	8	9
1 : CEC-S									
2 : KBOM-S	93 **								
3 : ACA-S	53 *	42							
4 : ACM-S	54 *	53 *	29						
5 : SES-S	81 **	89 **	51 *	54 *					
6 : SL	35	52 *	32	16	62 **				
7 : ST	63 **	55 *	20	48 *	37	-04			
8 : PAS	86 **	76 **	68 **	47 *	77 **	55 *	41		
9 : PSE	82 **	64 **	56 *	73 **	59 **	13	55 *	79 **	
10 : MA	39 **	34 **	34 **	24 **	32 **	19 **	17 **	42 **	39 **
11 : MA-C	77 **	70 **	60 **	39 **	61 **	38 **	26 *	79 **	67 **

(1) For all intercorrelations of School variables, N=15.
For correlations with MA, N = 1841.
For correlations with MA-C, N = 56.

The following points can be derived from the table though the intercorrelations of school variables suffer from the limited sample size:

1. All school variables are correlated positively and significantly with mathematics achievement both at student level and at class level.
2. Highest correlations with the dependent variables occur in the case of past achievement of the school (PAS).
3. All variables are more closely associated with class mean mathematics achievement (MA-C) than with the student mathematics achievement.
4. Student body characteristics are highly related with achievement and the relationships of cognitive measures are comparatively more. Among affective measures, general motivation (ACA-S) is more closely associated with achievement than specific interest in mathematics (ACM-S). This is an unexpected result. Also, the intercorrelation of ACA-S and ACM-S is very low. The reasons for this trend are far from clear. Still, to make a logical observation, ACA-S may be considered as an index of school discipline which may have a profound influence on student learning. School discipline is highly related to the general level of motivation of students and interest in specific subjects may not be much influential.

5. Though school locality and school type are related with the dependent variables, the correlations are comparatively low.
6. The global rating of psycho-social environment of the school (PSE) is highly related with achievement. Also, the correlation of PSE, with PAS (past achievement) is high. It means that high-achieving schools, in general, have better academic climate.
7. The high correlations of student body characteristics with past achievement can be interpreted to imply that good students go to high-achieving schools. Student body characteristics are fairly well represented by past achievement of the school.

3.3 : Concluding Remarks

In this chapter, descriptive and correlational analysis of variables were presented. Analysis was done at two levels - student and class. For descriptive analysis, statistical methods were generally utilised. For some important variables like student entry characteristics, quality of instruction, and psycho-social environment of the school, qualitative descriptions and interpretations were also presented. In correlational analysis, intercorrelations of each set of independent variables were given together with their correlations with the dependent variables.

The following are the major conclusions that can be derived from the descriptive analysis:

1. Academic performance of students is far from satisfactory. The majority of students fail. The average mark falls below the pass-mark. Compared with other subjects, students are weaker in mathematics learning.
2. The majority of students are not cognitively prepared to learn tenth standard mathematics. They perform poorly in a test of prerequisites. Even in the case of basic operations in mathematics, an average student knows only half of the basic operations that are being tested.
3. Teachers, generally, do not attempt to improve the level of prerequisites. So the majority of students, who start with a deficiency, are totally neglected. As they lack prerequisites, they cannot gain anything from the instruction, irrespective of its quality. In other words, failure is almost predeterined.
4. The focus of instruction is directed towards the better ones among students. Instructional quality seems to have some influence only on such students. But, the pattern of instruction does not seem to suit the gifted students.

5. Instruction is teacher-centered. The role of student is that of a passive listner. Only in the classes of some exceptional teachers, students participate in learning activities. The traditional 'lecture-cum-demonstration method' is followed by almost all teachers.
6. Teachers do not seem to be aware of the recent developments in concept teaching. One major problem with concept teaching is that teachers do not make use of 'non-examples' which is an essential condition for enhancing discrimination. Even the examples are not very divergent. A proper cognitive structure is not developed as the teachers do not relate the particular concept with other concepts in the taxonomy/hierarchy.
7. Rule-teaching is more satisfactory than concept-teaching. There are more qualitative differences in the instruction of rules. But, even the best teachers do not explain the applicability of rules.
8. Both the extremes are present with the variable 'Attention and Participation of Students'. In some of the classes, students are not at all attentive - they do not listen; they do not take down class notes; they do not attempt to solve the problems given by the teacher. But in some other classes, students are not only attentive, but also they participate in the learning activities to a large extent.

9. Urban government schools are more disturbed and less disciplined. Some kind of lack of responsibility can be evidently seen in most of the government schools. Private schools seem to be more academic in nature.
10. In a large section of schools (8 out of 15), the psycho-social environment is characterised by negative aspects. Only in the case of four schools, many positive elements are observed. The major dimensions of psycho-social environment of the school seem to be discipline and academic thrust.

The following are some of the generalisations that can be derived from correlational analysis:

1. The highest of all the correlations with student mathematics achievement occurs in the cases of cognitive entry characteristics. Cognitive entry measures (CEC and KBOM) typically account for 50% of the variance (r = .7) of mathematics achievement of individual students. Affective entry measures account for 25% of the variance (r = .5). These results are in line with prior research studies.
2. Instructional variables and teacher variables are less correlated with the dependent variable than other sets of independent variables. It can be partly attributed

to the similarity of instructions. The result follows from the observation that qualitative differences in instruction exert influence only to a smaller section of students.

3. Class variables and school variables have moderate relationships with the dependent variables. All correlations are positive and significant.
4. Among class variables, objective measures seem to be more meaningful in the explanation of student learning than teacher ratings. Among objective measures, cognitive variables are more influential. Among teacher ratings, the global rating of the class environment is more powerful.
5. With respect to school variables, locality and type are less related to achievement than student body characteristics. But, past achievement and psycho -social environment of the school are strongly related to achievement both at student level and at class level. All the student body characteristics are highly related to past achievement of the school. It can be said that past achievement of the school fairly well represents the student body characteristics.

The next chapter presents the results of stepwise regressions, analysis of variance and multiple classification analysis.