CHAPTER VII

SUMMARY AND CONCLUSIONS
The present investigation entitled "Identification of variables of Educational Environment as Related to the Acquisition of Mathematical Concepts at the Junior Secondary Stage" was intended for identifying the variables associated with the student, the home, the teacher, the school structure and the school characteristics, which were related to the acquisition of mathematical concepts at the junior secondary stage.

The study was advanced within the framework of the following hypotheses:

**HYPOTHESIS RELATED TO STUDENT VARIABLES:**

(i) Intelligence is significantly related with the acquisition of mathematical concepts individually and in unique constellation with other variables.

(ii) Students who devote more time to study mathematics and have the advantage of additional help, show superior performance on the MC Tests.

(iii) Student's participation in co-curricular activities and acquisition of mathematical concepts are independent of each other.

(iv) Interest of the student in mathematics is significantly related with the acquisition of mathematical concepts.
(v) Sex difference is significantly related with achievement on the M3 Tests.

HYPOTHESES RELATED TO HOME VARIABLES:

(i) Socio-economic status of the parents is significantly correlated with the acquisition of mathematical concepts.

(ii) Father presence or absence, size of the family, ordinal position of the child in the family and acquisition of mathematical concepts are independent of each other.

(iii) Father's income is significantly related with the acquisition of mathematical concepts.

(iv) Working or non-working mother, and the encouragement given by the parents are independent of the achievement on the MC Tests.

(v) Education of the parents is significantly related with the acquisition of mathematical concepts.

HYPOTHESES RELATED TO TEACHER VARIABLES:

(i) Teacher's qualification both academic and professional and achievement on the MC Tests are significantly related with each other.

(ii) Significant relation is expected between size of the class and achievement of the students on MC Tests.

(iii) Amount of home work given by the teacher, teaching experience and inservice training received by the teacher shows no difference in respect of the acquisition of mathematical concepts.
Encouragement given by the head of the institution to the teacher is significantly related with the acquisition of mathematical concepts.

Use of A.V. aids, nature of the test and feedback given by the teacher and achievement on the MC tests tend to go together.

The qualification, class size teaching experience, feedback and other variables of teacher when considered jointly, they produce significant variance in the acquisition of mathematical concepts.

Attitude of the teacher towards teaching profession, professional growth, students, teaching method, student discipline, school discipline and toward, self-concept is significantly related with the acquisition of mathematical concepts.

HYPOTHESES RELATED TO SCHOOL STRUCTURE VARIABLES:

A significant relation exists between the size of the school and student achievement on the MC Tests.

Acquisition of mathematical concepts in pupils depend on the teacher pupils ratio and mathematics teacher-pupils ratio.

Significant differences in the acquisition of mathematical concepts emerge due to the different expenditure on salary of the teacher, non-recurring expenditure and non-recurring expenditure per student.
Type of school namely government (boys), private (boys), government (co-education), private (co-education), and government (girls) contributes to significant differences in relation to the acquisition of mathematical concepts among children.

The size of the school, teacher pupils ratio, expenditure and other variables of school structure when considered jointly account for significant differences in the acquisition of mathematical concepts.

HYPOTHESES RELATED TO SCHOOL CHARACTERISTICS:

(i) The curriculum press ($C_1$) and achievement on the MC Tests are significantly correlated with each other.

(ii) The press of teaching methods and nature of student teacher interaction in the classroom ($C_2$) share a significant correlation with the achievement scores on the MC Tests.

(iii) A significant correlation exists between press of school rules, regulations, policies ($C_3$) and student achievement on the MC Tests.

(iv) No significant correlation exists between press of curricular activities ($C_4$) and performance on the MC Tests.

(v) Press of school traditions ($C_5$) contribute to significant differences with regard to the understanding of mathematical concepts.
HYPOTHESIS RELATED TO MULTIVARIATE ANALYSIS:

In a multivariate analysis, the variables of educational environment as related to student, home, and school conjointly predict significant variance in respect of acquisition of mathematical concepts.

PROCEDURE AND TECHNIQUES

TOOLS:

To evaluate the understanding of Mathematical Concepts Tests of pupils at the Junior Secondary Stage, survey technique was employed. For this purpose Geometric Concepts Test was prepared by the investigator whereas Arithmetic Concepts Test and Algebraic Concepts Test were already available for use with the local population. Raven's Standard Progressive Matrices and Jalota Group Test of General Mental Ability were used for evaluating the non-verbal and verbal intellectual status of the pupils. Scores on arithmetic, algebra and geometry were obtained by using Numerical Ability Test, Algebraic Concepts Test and Geometric Concepts Test respectively. Socio-economic Status of the parents was assessed by employing Trivedi and Pareek Socio-Economic Status Scale. To measure the attitude of mathematics teachers, Grewal's Teacher Attitude Scale was used. Three information proforma student information proforma, Teacher Information Proforma and School Information Proforma were prepared to collect the desired information from the students, teachers and schools. School characteristics index was used for assessing the characteristics of the schools.
The sampling method was resorted to in two phases: (1) for the standardization of the Geometric Concepts Test; (2) for the data collection for the final phase of the study. The sampling for the standardization of the Geometric Concepts Test was further undertaken in three stages: (a) for preliminary tryout of the GC Test; (b) for final tryout of the GC Test; and (c) for establishing reliability and validity of the GC Test. However, in the first phase of the sampling rigorous method of randomization was not employed. The preliminary tryout of the GC Test was conducted over a sample of eight students drawn from three institutions and for conducting final tryout of the GC Test a sample of 217 students was drawn from seven institutions of Chandigarh, while the reliability and validity studies were conducted over a sample of 60 and 80 students respectively taken from two institutions.

For the final data collection, the method of sampling was based on multi-stage randomization of clusters. Sampling was resorted to at three stages—selection of locale, selection of schools and selection of students and one class room was taken as a sampling unit. To give representation to urban population, Chandigarh was selected and to this one more school consisting of rural population was added to give representation to rural area. In this way the method of sampling for selecting locale was a combination of both random and purposive sampling. Government, private, urban,
rural school and co-educational schools were selected for the final sample. In those schools, where more than one section of 8th class students were available, students were drawn from randomly selected two or three sections depending on the size of the class. The final sample for the second phase in the present study for the administration of MC Tests was multistage stratified randomization of population comprising 510 students (352 boys and 158 girls) taken from nine institutions.

DEVELOPING THE GEOMETRIC CONCEPTS TEST

Since the standardized Geometric Concept Test relevant to the syllabus at the Junior Secondary Stage in Chandigarh was not available therefore, it was thought by the investigator to develop Geometric Concepts Test in order to evaluate the understanding of geometric concepts in pupils of the junior secondary stage. The preliminary draft of the test comprised of 51 multiple choice items corresponding to eleven concepts of plane geometry. The tryout of the preliminary test was conducted on a sample of eight students drawn from three institutions. Five items were dropped and the final tryout of the test consisted of 46 items arranged according to difficulty level. The test was administered for final tryout to 217 students of Chandigarh taken from seven institutions. Item difficulty and item discrimination were used for analyzing the items. Selection of an item for the final form of the GC Test was guided by the criteria that it discriminated between
upper and lower 27 per cent cases and had item-difficulty values exceeding the minimum proportion indicating knowledge beyond chance success. Lastly, 35 items were included in the final form of the Geometric Concepts Test. The test was prepared in Hindi and it had all multiple-choice items. Time limit for completing the GC Test was found to be 40 minutes. Scoring of items was done on "All or None", basis.

RELIABILITY OF THE GC TEST

The reliability of the GC Test was worked out with the help of test-retest technique of reliability which was established over a sample of 60 pupils (42 boys and 18 girls) taken from two institutions. The second administration of the test was given after ten days. The co-efficients of correlation between two test scores was found to be .79 which was fairly high and testifies the soundness of the GC Test. The measures of central tendency, skewness, kurtosis and S.D. were computed for the two administration of the test.

VALIDITY OF THE GC TEST

Content and predictive validities were established for the GC Test. Content validation was done during the process of test-development and predictive validity was established over a sample of 80 students (35 girls and 45 boys). The co-efficient of predictive validity was found to be .62, which was quite significant and indicated the soundness of the GC Test as predictor of success in Mathematics in the future examination of 8th standard.
ADMINISTRATION OF TOOLS FOR FINAL DATA COLLECTION

Raven's Standard Progressive Matrices, Jalota (1972) Group Test of General Mental Ability (72), Numerical Ability Test, Algebraic Concept Test, Geometric Concepts Test, Socio-Economic Status Scale, Student Information Proforma and School Characteristic Index were administered one after the other, with a suitable break to the sample of 510 students. Teacher Attitude Scale and Teacher Information Proforma were given to 16 mathematics teachers, whose students had been taken for the final phase of the study. Informations on the School Information Proforma were recorded from the school authorities.

ANALYSIS OF THE RESULTS

Descriptive statistics, namely, mean, median, SD, Skewness and Kurtosis were worked out so as to ascertain the nature of score distribution pertaining to fourteen continuous variable under consideration. In addition to the above-mentioned statistical techniques, factor analysis of these variables was obtained to study the factorial unity. Eight multivariate regression equations by stepping up one variable at a time in case of each of the criterion variable, were set up by involving eight variable as independent predictor. Eight regression models were framed by entering student, school characteristics and home variables.
in different blocks. Analysis of variance for discrete variables was employed. Further the use of t-ratios was made for examining the position of different groups identified on the basis of F-ratios.

On the basis of analysis of data and discussion of results the following conclusions may be enumerated:

CONCLUSIONS ON THE BASIS OF STUDENT VARIABLES:

1. The results of the present study indicated, that intelligence affects acquisition of mathematical concepts significantly. Intelligence emerged as a significant predictor of criterion variance from the conclusions of regression equations and regression models I and II. The results of factor analysis lend empirical support to obtaining intellectual correlates of achievement in mathematics, as the third original and varimax factor loadings led to identify factor III as a 'Group Factor of Verbal and Non-Verbal Intelligence'. Also intelligence (Verbal + Non-Verbal) shared a significant correlation of the order of .500, .516, .489 and .538 with the criterion variables. The results lead to support the first hypothesis on student variable that intelligence is significantly correlated with the acquisition of mathematical concepts individually and in unique constellation with other variables. That is, high intelligence tends to account for higher scores and low intelligence account for lower scores on the acquisition of mathematical concepts.
2. The variables: students who devote more time to study mathematics, and have the advantage of additional help, do not significantly influence acquisition of mathematical concepts. Hence the second hypothesis namely, students who devote more time to study mathematics and have the advantage of additional help, show superior performance on the MC Tests is not accepted.

3. The effect of student's participation in co-curricular activities was found to be independent of the acquisition of mathematical concepts due to its insignificant F-ratios. Thus the third hypothesis that students participation in co-curricular activities and acquisition of mathematical concepts are independent of each other stood tenable.

4. The results clearly showed that the groups identified on the basis of interest of the student in mathematics did not differ among themselves in the performance on acquisition of mathematical concepts. Therefore the hypothesis that interest of the student in mathematics is significantly related with the acquisition of mathematical concepts was rejected.

5. The contribution to variance due to sex was again found to be insignificant at .05 level in the two away classification of analysis of variance which
indicated insignificant sex-differences in the acquisition of mathematical concepts by the students at the junior secondary stage. In the context of these findings the fifth hypothesis that sex difference is significantly related with the achievement on MC Tests could be safely rejected.

CONCLUSIONS ON THE BASIS OF SOME VARIABLES:

1. It was found that in the sample studied, the high SES students had higher scores than those of the low SES students. There was statistically significant difference in the achievement of three groups classified on the basis of their socio-economic status as was evident from the F-ratio and t-ratios. SES scores shared an 'r' of .352, .374, .288 and .403 with the criterion variables namely, arithmetic, algebraic, geometric and mathematical concepts respectively, which were significant at .01 level. As a result of this, first hypothesis socio-economic status of the parents is significantly correlated with the acquisition of mathematical concepts was accepted.

Similar trend was also noted in regard to the relationship of SES with the achievement in mathematics on the basis of factor analysis. Fourth varimax factor was identified as a 'Factor of Socio-Economic Status' which contributed 8.80 per cent common factor variance and 6.29 per cent of total
variance. Conclusions of regression equations and model
VIII also supported the findings of the present study
as SES had turned out to be a good predictor of achieve-
ment of criterion variance in terms of its significant
F-ratios.

(2) The second hypothesis that Father's presence or absence,
size of the family, ordinal position of the child in the
family and acquisition of mathematical concepts are
independent of each other was tested and this hypothesis
was accepted in the present study due to their insigni-
ficant F-ratios.

(3) Four groups of students as classified on the basis of
their father's income differed significantly in respect
of their achievement in mathematics and when identified
on the basis of t-ratios, the results showed superiority
of the G1V group (income of father above Rs. 1200/-) over
that of other three groups. It appeared that greater the
income of the father, the more would be the performance
of the child in mathematics. The third hypothesis that
'father's income' is significantly related with the
acquisition of mathematical concepts was, therefore,
confirmed.

(4) The study has indicated that effect of working or non-
working mothers and encouragement given by the parents
on the achievement of the child in mathematics seemed to
be almost non-existent. None of the F-ratios was significant.
The results presented, therefore, confirmed the fourth
hypothesis that working or non-working mothers and the
encouragement given by the parents are independent of the achievement on the MC Tests.

(5) The findings of this study provide ample evidence in support of the fifth hypothesis that education of the parents is significantly related with the acquisition of mathematical concepts. Due to the significant differences in F-ratio (vide Table 6.20) and t-ratio (vide Table 6.23), the present study has yielded the results that there exist variations in the achievement of the child in mathematics due to the variation in educational experience of the parents. The tendencies reflected by mean scores also supported that students whose parents were more educated scored higher than the students whose parents were less educated.

CONCLUSIONS ON THE BASIS OF TEACHERS' VARIABLES :

(1) From the discussion of the results of the present investigation, it may be concluded that there exist significant differences among the students with regards to the acquisition of mathematical concepts as classified on the basis of academic and professional qualification of the teachers. Children belonging to schools where postgraduate teachers and M.Ed. teachers were teaching tended to perform better on the conceptual tests than their counterparts from other schools where graduate and B.Ed. teachers were teaching. Therefore, results obtained in the
present study, confirmed the first hypothesis that teachers' qualification both academic and professional and achievement on the MC Tests are significantly related with each other.

(2) Class size had significant effect on the acquisition of mathematical concepts. In the present investigation class size of 35 to 45 students demonstrated best results by gaining more scores as compared to other two groups namely class size below 35 students and class size above 45 students. The findings confirmed the second hypothesis that significant relation is expected due to size of the class on achievement of the students on the MC Tests and further was suggestive of the fact that large sized class did not favour better performance on the MC Tests.

(3) The reported results of this study found no significant differences in the acquisition of mathematical concepts by the students due to differences in the amount of home work given by the teacher, teaching experience and in-service training received by the teacher. The present study observed no significant differences in the responses of two groups of students - one given the less home work and the other more. Likewise the two groups identified on the basis of experience of the teacher proved to be ineffective in accounting for significant variance with regard to the acquisition of mathematical concepts. In the same way the difference between means of the two-groups : one which was taught by the teacher who received
inservice training and other group by the teachers who did not receive inservice training, was found to be insignificant. It showed that inservice training received by the teacher was not influencing the acquisition of mathematical concepts by the students. Thus, the third hypothesis on teachers' variable that amount of home work given by the teacher, teaching experience and inservice training received by the teacher shows no difference in respect of the acquisition of mathematical concepts had been confirmed by the present results.

(4) The present study confirms the hypothesis that encouragement given by the head of the institution to the teacher is significantly related with the acquisition of mathematical concepts as the F-ratio was significant at .01 level. In the present investigation mean scores of subjects under the encouragement given by the head to the teacher (Group I) were superior to subjects under no encouragement by head to the teacher (Group II).

(5) The variables of 'use of aids by the teacher', 'nature of test given by the teacher' and 'feedback', were found to be significantly influencing acquisition of mathematical concepts which led to the acceptance of fifth hypothesis. It was seen that the mean scores of subjects under use of aids group was higher than that of no use of aids group. For the second variable of this hypothesis, results led to infer that in case of arithmetic and algebraic concepts weekly tests were better than the fortnightly and monthly
test whereas in case of geometric concepts the achievements of the students were superior by taking fortnightly tests than the weekly or monthly tests. Similarly, the performance under feedback condition was significantly superior on the acquisition of mathematical concepts as compared to the performance under no feedback conditions. Positive feedback resulted into better achievement on the acquisition of mathematical concepts as compared to no feedback.

(6) When the joint effect of teachers' variables, i.e., qualification, professional qualification, class size, amount of homework given by the teacher, teaching experience, inservice training received by the teacher, encouragement given by the head, use of A.V. aids by the teacher and feedback were considered jointly after giving the weightage to different aspects, it was found that there existed significant differences among the three groups—high, average and low. The difference between the means of high and average groups were found to be significant at .01 level. Also mean scores of high group were higher, than that of other groups, which showed that the high group was more effective than other two groups in the acquisition of mathematical concepts. This led to the acceptance of the sixth hypothesis on teacher variable that when the qualification, class size, teaching experience, feedback and other variables of teacher considered
jointly, they produce significant variance in the acquisition of mathematical concepts.

(7) The seventh hypothesis on teachers' variables that attitude of the teacher towards teaching profession (ATP), professional growth (APG), students (ASS), method of teaching (AMT), school discipline (ASD), curricular activities (ACA), self-concept (ASC) is significantly correlated with the acquisition of mathematical concepts, was confirmed partially. Out of the seven sub-dimensions of teacher attitude scale, four of them namely AMT, ASS, ASD, ASC, yielded insignificant F-ratios. However, teachers attitude towards teaching profession, interaction of professional growth x mathematical concepts, attitude towards students x mathematical concepts, and total attitude of the teachers' were found highly significant. Further t-test was employed to identify the true nature and direction of differences and was seen that except teachers' attitude towards students, significant differences exist between the two groups (high and low attitude) of ATP, APG. In case of total attitude of the teachers significant differences existed between the three groups (i.e., high positive attitude, average and low attitude). In all the cases mean scores of group I (high attitude of the teacher) was higher than that of group II (average attitude). The significant values and higher mean scores of group I, suggested that teachers in those schools were characterised by better attitude towards teaching profession, professional growth and students. Also the
results were indicative of the fact that total attitude score of the teacher on seven sub-dimensions effects the acquisition of mathematical concepts.

CONCLUSIONS ON THE BASIS OF SCHOOL STRUCTURE VARIABLES:

(1) A significant F-ratio in case of size of the school confirmed the hypothesis that a significant relation exists between the size of the school and students achievement on the MC Tests. From the results of t-ratios, it could be concluded that performance of the students in large sized schools leads to better performance as compared to students in the small sized schools.

(2) It had been recognised by the findings of this study that acquisition of mathematical concepts in pupils depend on the teacher pupils ratio and mathematics teacher pupils ratio, since the F-ratios were significant for these variables. This testified the second hypothesis on school structure variables. This study revealed that less the teacher pupils ratio and mathematics teacher-pupils ratio greater would be the understanding of mathematical concepts among the pupils.

(3) When the effects of the variables - expenditure on the salary of the teachers, non-recurring expenditure and non-recurring expenditure per student on the understanding of mathematical concepts were studied, high significant F-ratios were obtained. This supported the hypothesis that significant
differences in the acquisition of mathematical concepts emerge due to the expenditure on salary, non-recurring expenditure and non-recurring expenditure per student. That is, understanding of mathematical concepts among the pupils can be effectively increased by spending more on the recurring expenditure, non-recurring expenditure and non-recurring expenditure per student.

(4) Type of the school (i.e., Govt.boys, Private boys, Govt. Co-educational, Private Co-educational, and Govt. Girls Schools) interacted significantly with the acquisition of mathematical concepts at .01 level. From the mean scores of five groups, it could be concluded that the performance of private boys and private co-educational schools were higher than the Govt.boys, Govt. Co-educational and Govt. Girls schools. These results supported the fourth hypothesis on school structure variables that type of the school namely, Govt. boys, Private boys, Govt. Co-educational, Private Co-educational and Govt. Girls contribute to significant differences in relation to the acquisition of mathematical concepts among children.

(5) Total index of the school structure variables, i.e., size of the school, teacher pupils ratio, expenditure and type of the school, when considered jointly were not found to be significantly influencing acquisition of mathematical concepts. This led to the rejection of the hypothesis that
the size of the school, teacher pupils ratio, mathematics teacher pupils ratio, recurring and non-recurring expenditure and type of the school when considered jointly account for significant differences in the acquisition of mathematical concepts.

CONCLUSIONS ON THE BASIS OF SCHOOL CHARACTERISTICS VARIABLES:

Five variables of school characteristics were studied by formulating five hypotheses. The conclusions were drawn as follows:

(1) The obtained results of this investigation clearly showed that the variable of curriculum press SCI ($C_1$) had neither emerged as a correlate of the criterion variables nor it has proved to be a significant predictor of criterion variance. Therefore, the first hypothesis that curriculum press ($C_1$) and achievement on the MC Tests are significantly correlated with each other was rejected.

(2) The results indicated that the press of teaching method, student and teacher interaction in the class room SCI ($C_2$) and performance on the Mathematical Concepts Tests share a significant correlation with each other. The second hypothesis was also supported by the findings of regression equation and regression model IV, which conclude that the teacher press of teaching method and student/interaction in the class room SCI ($C_2$) is a good predictor of achievement in mathematics, due to its significant F-ratios.
The significant 'rs' between the press of rules, regulations and policies SCI(C3) and achievement on the criterion variables supported the third hypothesis that SCI (C3) is a correlate of achievement on the MC Tests. However, in a multivariate analysis SCI (C3) was unable to predict any significant criterion variance.

There was significant 'rs' between the press of curricular activities SCI (C4) and achievement on the criterion tests, which led to the rejection of the fourth hypothesis on school characteristics variables that no significant correlation exists between press of curricular activities and performance on the MC Tests. So far as prediction of criterion variance was concerned, this variable failed to predict any significant criterion variance.

Further, from the significant F-values between model VI, VII and significant 'rs' of SCI (C5) with the criterion variables, fifth hypothesis that press of school traditions SCI (C5) contributes to significant differences with regard to the understanding of mathematical concepts has been accepted and also it has been concluded that press of school tradition is a good predictor of achievement in mathematics.
It was also found that high and positive loadings in original and varimax matrices on Total School Characteristics Index led to identify factor II as a 'Factor of School Characteristics'. This factor in its original form accounted for 22.04 per cent of common factor variance and 18.03 per cent of total variance. In the varimax form, this factor explained 13.20 per cent of common factor variance and 10.02 per cent of total variance.

The last hypothesis that in a multivariate analysis, the variables of educational environment as related to student, home, and school conjointly predict significant variance in respect of acquisition of mathematical concepts was confirmed as the variables of student, home and school conjointly contributed greater variance in accounting for acquisition of mathematical concepts as compared to their respective contribution respectively. However, the variables of student, home and school did not share common factor structure with the criterion variables in the factor analytical results.