6.1 **Statement of the Problem**

The purpose of the study was to investigate the effectiveness of the Developmental Model in teaching geometrical theorems on higher cognitive abilities and achievement among IX grade pupils.

6.2 **Variables Considered in the Study**

**Independent Variables**

i. Developmental model, and

ii. Traditional model.

**Dependent Variables**

i. Inducto-deductive reasoning,

ii. Analytico-synthetic reasoning, and

iii. Achievement.
6.3 **Specific Objectives of the Study**

i. To compare the effectiveness of Developmental and Traditional models of teaching geometrical theorems in developing higher cognitive abilities/inducto-deductive reasoning among IX grade pupils;

ii. To compare the effectiveness of Developmental and Traditional models of teaching geometrical theorems in developing higher cognitive abilities/analytic-synthetic reasoning among IX grade pupils;

iii. To compare the effectiveness of Developmental and Traditional models of teaching geometrical theorems on achievement among IX grade pupils;

iv. To investigate the interaction between 'treatments' (aforesaid teaching models) and 'levels of pupils' (determined on the basis of general mental ability) with reference to development of inducto-deductive reasoning;

v. To investigate the interaction between 'treatments' and 'levels of pupils' with reference to development of analytic-synthetic reasoning;

vi. To investigate the interaction between 'treatments' and 'levels of pupils' with reference to achievement;
vii. To investigate if pupils retain inducto-deductive reasoning abilities developed through Developmental model of teaching the subject;

viii. To investigate if pupils retain analytico-synthetic reasoning abilities developed through Developmental model of teaching the subject; and

ix. To investigate if pupils retain achievement gained through Developmental model of teaching the subject.

6.4 Research Hypotheses

The following research hypotheses were set up:

i. Developmental model of teaching geometrical theorems is more effective than traditional model in terms of development of inducto-deductive reasoning among IX grade pupils.

ii. Developmental model of teaching geometrical theorems is more effective than traditional model in terms of development of analytico-synthetic reasoning among IX grade pupils.

iii. Developmental model of teaching geometrical theorems is more effective than traditional model in terms of achievement among IX grade pupils.
iv. There is interaction between 'treatments' and 'levels' with reference to development of inducto-deductive reasoning.

v. There is interaction between 'treatments' and 'levels' with reference to development of analytico-synthetic reasoning.

vi. There is interaction between 'treatments' and 'levels' with reference to improvement of pupils' achievement.

vii. Pupils retain inducto-deductive reasoning abilities developed through Developmental model of teaching the subject.

viii. Pupils retain analytico-synthetic reasoning abilities developed through Developmental model of teaching the subject.

ix. Pupils retain achievement gained through Developmental model of teaching the subject.

6.5 Scope of the Study

i. The study was confined to Kannada medium pupils only;

ii. The study was limited to theorems in geometry of IX grade prescribed by the Department of Public Instruction, Karnataka State for IX Standard; and
Out of the higher cognitive abilities, only inducto-deductive reasoning abilities and analytico-synthetic reasoning abilities were considered in evaluating the effectiveness of the Developmental model.

6.6 Design of the Study

6.6.1 Experimental Design

Pre-test and post-test parallel groups (TxL) experimental design was used in the study.

6.6.2 Tools Used/Constructed

The following standardized test was used in the study for obtaining matched groups:

Standard Progressive Matrices (SPM)

The following tests were used for measuring the dependent variables in the study:

1. Inducto-deductive reasoning test,

ii. Analytico-synthetic reasoning test, and

iii. Achievement test.

The researcher himself constructed all these tests following scientific procedure.
Inducto-deductive reasoning test consists of 12 content (Geometry) based and 12 content free items. Analytico-synthetic reasoning test consists of 12 content (Geometry) based and 12 content free items. Achievement test consists of 37 items in all.

Consistency reliability of inducto-deductive reasoning test was found to be 0.99 (n=60). The intrinsic validity of the test was found to be 0.99. In the opinion of the judges it has content validity. The concurrent validity (as against mathematics teacher's judgement) was found to be significant at 0.05 level.

Consistency reliability of analytico-synthetic reasoning test was found to be 0.998 (n=60). The intrinsic validity of the test was found to be 0.999. In the opinion of judges it has content validity. The concurrent validity (as against mathematics teacher's judgement) was found to be significant at 0.05 level.

Consistency reliability of achievement test was found to be 0.9989 (n=60). The intrinsic validity of the test was found to be 0.9994. In the opinion of the judges it has content validity. The concurrent validity was found to be 0.64 (n=60), which is significant at 0.05 level.
6.6.3 Obtaining the Parallel Groups and Constitution of Levels

Two parallel groups of 30 matched pairs (on SPM) were obtained and one of the two groups was randomly selected as the experimental group and the other as control group. The SPM scores of both the groups were arranged in descending order separately and the top 1/3rd cases formed 'Above-Average', the middle 1/3rd cases formed 'Average' and the bottom 1/3rd cases formed 'Below-Average' levels.

6.6.4 Conducting the Experiment

Both the groups were pre-tested on inducto-deductive reasoning and analytico-synthetic reasoning. It may be pointed out here that the two groups did not differ significantly on these abilities. The experimental group was taught through Developmental model for a period of 5 months at the rate of 2 periods per week. The control group was taught through traditional method during the same time and at the same rate. During this period 19 geometrical theorems were covered with related problems. After 5 months, immediate post-test was conducted on inducto-deductive reasoning, analytico-synthetic reasoning and pupils' achievement. Six weeks after the completion of experiment, delayed post-testing was done by using the same tests.
6.7 **Statistical Techniques Employed for the Analysis of Data**

In pursuance of the objectives of the study the following statistical techniques were employed.

i. Two-way analysis of variance (ANOVA),

ii. Scheffe's test, and

iii. 't' test.

6.8 **Findings**

i. Developmental model of teaching geometrical theorems is more effective than the traditional method in developing inducto-deductive reasoning among IX grade pupils.

ii. Developmental model of teaching geometrical theorems is more effective than traditional method in developing inducto-deductive reasoning for pupils belonging to average and below average groups.

iii. Both Developmental model of teaching geometrical theorems and traditional model of teaching the subject are equally effective for pupils belonging to above-average category in developing inducto-deductive reasoning abilities.

iv. Developmental model of teaching by itself is equally effective for pupils belonging to below-average and average groups.
v. Developmental model of teaching geometrical theorems is more effective than the traditional model in developing analytico-synthetic reasoning among IX grade pupils.

vi. Developmental model of teaching is more effective in terms of development of analytico-synthetic reasoning than the traditional model for pupils belonging to above-average, average and below-average groups.

vii. Developmental model of teaching by itself is more effective in terms of development of analytico-synthetic reasoning for pupils belonging to average and below-average groups. However, it is equally effective for the average and below-average groups.

viii. Developmental model of teaching geometrical theorems is more effective than the traditional method in terms of pupils' achievement in geometry.

ix. There is no significant interaction between treatments and levels with reference to pupils' achievement.

x. Pupils retain inducto-deductive reasoning abilities developed through Developmental model of teaching the geometrical theorems.

xi. Pupils retain analytico-synthetic reasoning abilities developed through Developmental model of teaching the geometrical theorems.
xii. Pupils retain achievement gained through Developmental model of teaching the geometrical theorems.

6.9 Conclusion

Based on the above findings the following conclusions may be drawn:

i. Developmental model of teaching geometrical theorems is more effective than the traditional model not only in developing inducto-deductive and analytico-synthetic reasoning abilities, but also in promoting achievement of IX grade pupils belonging to above-average, average and below-average groups.

ii. Developmental model of teaching geometrical theorems by itself does not indicate any definite trend in its effectiveness for IX grade pupils belonging to different levels.

6.10 Application to Teaching

Based on the above findings it is suggested that:

i. Developmental model of teaching geometry be used in secondary schools, not only
for promoting achievement of students in terms of knowledge, understanding, attainment of skills and application but also for the development of inducto-deductive and analytico-synthetic reasoning abilities.

ii. Secondary school teachers of mathematics be trained in the Developmental model of teaching geometry through seminar-cum-workshops.

These training programmes may be organised by College of Teacher Education (CTE's) and the resource persons of these training courses be trained by Institutes of Advanced Studies in Education to be established or by NCERT.

6.11 Suggestions for Further Research

While conducting the present study the researcher has identified some allied problems. They are listed below:

1. The effectiveness of Developmental model of teaching be investigated as applied to other branches of mathematics like arithmetic and algebra at the secondary school level.
ii. The effectiveness of this model of teaching be studied in terms of development of favourable attitude towards mathematics.

iii. Comparative effectiveness of Developmental Inductive-thinking and Concept-attainment models in terms of improvement of achievement, development of higher cognitive abilities and development of favourable attitude towards mathematics and science at the secondary level be investigated.

iv. The above stated study may be tried out at the college level in teaching mathematics and science - both physical and biological.

v. A question bank containing standard questions on analytical thinking ability in mathematics be prepared at the secondary level.

vi. An attempt be made to prepare students' text-books and teachers' hand books in geometry following Developmental model and their utility be evaluated by seeking the opinion of pupils, teachers and teacher-educators.