CHAPTER VI
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SUMMARY AND CONCLUSIONS

The main objective of the present study was to find out the effectiveness of an Instructional Strategy based on Path-Smoothing Model on Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics of students at Secondary Level. This chapter deals with the major findings that emerged from the study and its educational implications, an overview of the procedure followed in the study, conclusions of the study and recommendations for further improvement and some suggestions for further research.

6.1 THE STUDY IN RETROSPECT

The different aspects of the various stages of the present study are given under the following heads

6.1.1 Restatement of the Problem

The present study was undertaken to develop and to find the effect of Instructional Strategy based on Path-Smoothing Model on Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics of Students at Secondary Level. Hence the study is entitled ‘THE EFFECTIVENESS OF AN INSTRUCTIONAL STRATEGY BASED ON PATH-SMOOTHING MODEL ON CREATIVE PROBLEM SOLVING ABILITY, PERCEPTUAL SPEED AND ACHIEVEMENT IN MATHEMATICS OF STUDENTS AT SECONDARY LEVEL’.

6.1.2 Objectives of the Study

The objectives of the study are:

1. To analyse the present status of Mathematics Teaching at Secondary Level
2. To develop an Instructional Strategy based on Path – Smoothing Model.
3. To find out the Effectiveness of the Instructional Strategy based on Path-Smoothing model and Activity Oriented Method on Creative Problem Solving Ability of students at Secondary Level for total sample and relevant subsamples.

4. To compare the Effectiveness of the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method on Creative Problem Solving Ability of students at Secondary Level for total sample and relevant subsamples.

5. To find out the Effectiveness of the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method on Perceptual Speed of students at Secondary Level for total sample and relevant subsamples.

6. To compare the Effectiveness of the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method on Perceptual Speed of students at Secondary Level for total sample and relevant subsamples.

7. To find out the Effectiveness of the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method on Achievement in Mathematics of students at Secondary Level for total sample and relevant subsamples.

8. To compare the Effectiveness of the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method on Achievement in Mathematics of students at Secondary Level for total sample and relevant subsamples.

9. To assess the retention effect of the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method on Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics of students at Secondary Level.
6.1.3 Hypotheses of the Study

The hypotheses formulated for the study are:

- H(1) There will be significant difference in Creative Problem Solving Ability of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the total sample.

- H(2) There will be significant difference in Creative Problem Solving Ability of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the sub samples based on Gender and Type of Management.

- H(3) There will be significant difference in Perceptual Speed of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the total sample.

- H(4) There will be significant difference in the Categories of Perceptual Speed of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method.

- H(5) There will be significant difference in Perceptual Speed of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the sub samples based on Gender and Type of Management.

- H(6) There will be significant difference in Achievement in Mathematics of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the total sample.

- H(7) There will be significant difference in Achievement in Mathematics based on the Objectives of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method.
There will be significant difference in Achievement in Mathematics of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the sub samples based on Gender and Type of Management.

There will be significant difference in the Retention of Creative Problem Solving Ability of the students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method

There will be significant difference in the Retention of Perceptual Speed of the students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method

There will be significant difference in the Retention of Achievement in Mathematics of the students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method

6.1.4 Methodology in Brief

The present study is intended to find out the Effectiveness of an Instructional Strategy based on Path-Smoothing Model on Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics of students at Secondary Level. So Experimental method was adopted for the study.

6.1.4.1 Experimental Design of the Study

For the Experiment, the Design selected was Pre-test Post-test non equivalent group design.

6.1.4.2 Variables of the Study

The variables are the conditions or characteristics the experimenter manipulates controls or observes. The variables involved in this study are,
a) **Independent variables**: The Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method of teaching were the two independent variables selected for this study.

b) **Dependent Variables**: Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics were selected as the dependent variables of the study.

c) **Extraneous Variables**: General Mental Ability, Previous Achievement in Mathematics, Age level of students, Teacher factors, Time of Instruction were considered as extraneous variables for this study.

### 6.1.4.3 Sample Selected for the Study

A sample of 296 students from four schools at Secondary Level in Thrissur district following Kerala State syllabus were selected for the study.

### 6.1.4.4 Tools Used for the Study

Tools are the instruments employed for collecting the necessary data.

1. Questionnaire on the present status of teaching Mathematics.

2. Lesson Transcripts on Instructional Strategy based on Path-Smoothing Model (Prepared by the investigator)

3. Lesson Transcripts on Activity Oriented Method. (Prepared by the investigator)

4. Creative Problem Solving Ability test (Prepared and Standardized by the Investigator)

5. Perceptual Speed test (Prepared and Standardized by the Investigator) including the following subtests.
   
   i) Perceptual Speed Sub Test- I (Number Comparison Test)

   ii) Perceptual Speed Sub Test-II (Word Comparison Test)
iii) Perceptual Speed Sub Test-III (Alpha Numeral Comparison Test)

iv) Perceptual Speed Sub Test-IV (Mathematical Operation Comparison Test)

v) Perceptual Speed Sub Test-V (Figure Comparison Test)

vi) Perceptual Speed Sub Test -VI (Formulae Comparison Test)

vii) Perceptual Speed Sub Test -VII (Roman Numeral Comparison Test)

viii) Perceptual Speed Sub Test-VIII (Figure Identification Test)

6 Achievement test in Mathematics (Prepared and Standardized by the Investigator)

7 Raven’s Standard Progressive matrices.

**6.1.4.5 Procedure Adopted for the Study**

A preliminary survey was conducted to collect information from Secondary school Mathematics teachers about the present status of teaching Mathematics at Secondary Level.

For conducting the experiment, investigator selected 296 Secondary School Students following Kerala State Syllabus from 4 schools of Thrissur district. The students of Eighth standard were selected for the study. From the population, sufficient sample for the experimental study was taken using Random Sampling technique, giving due importance to Gender and Type of school Management. Both the experimental group and control group consisted of 148 students each. The experimental group was taught using the
Instructional Strategy based on Path-Smoothing Model and control group was taught using Activity Oriented Method.

In order to understand the retention of these groups on the variables, these same post-tests were administered one month after the administration of post-test i.e the Delayed Post-test. The investigator tried to maintain same conditions with regard to the time allotted, instructions given during the test etc, for all the groups. The response sheets were collected back and scored.

6.1.4.6 Statistical Techniques Used

In order to find out the Effectiveness of an Instructional Strategy based on Path-Smoothing Model on Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics of Students at Secondary Level, t-test is done using Pre-test Post-test scores. The classroom intact groups may be similar, but they are non equivalent groups. Since the experiment is conducted using class room intact groups, Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) is applied for analyzing the final scores.

6.2 MAJOR FINDINGS OF THE STUDY

The findings that obtained from the analysis of data lead to absolute answers to research questions outlined by the investigator. The major findings are:

6.2.1 Findings based on Present Status of Teaching Mathematics: Analysis of responses of Mathematics Teachers at Secondary Level

Despite so many instructional strategies and different models of teaching, present context is inappropriate for Mathematics learning at Secondary Level. Majority of students feels difficulty in relating Mathematics concepts with daily life situations.
Teachers believe that poor performance of most of the students in Mathematics examination is due to lack of interest in Mathematics learning and also majority of students feels difficulty in relating Mathematics concepts with daily life situations. Very few teachers gives activities in school to students to improve their Creative Problem Solving Ability. Even though some of the teachers are using some of the available resources for teaching Mathematics and some of them encourage students in using other models to assist Mathematics learning and thereby improve the performance of students. Some teachers do not realize that the interest in learning Mathematics helps to improve the Perceptual Speed among students. Majority of teachers thought that the implementation of new teaching method in Mathematics class rooms will make Mathematics teaching-learning more effective

6.2.2 Findings based on Initial comparison of Experimental and Control groups

6.2.2.1 The analysis of the scores before starting the experimental treatment revealed that there is no significant difference between the Experimental and Control groups with respect to their Previous Achievement in Mathematics (\( t = 0.34, \ p > 0.05 \)), General Mental Ability (\( t = 0.059, \ p > 0.05 \)), Creative Problem Solving Ability (\( t = 0.66, \ p > 0.05 \)), Perceptual Speed (\( t=0.38, p>0.05 \)) and Achievement in Mathematics (\( t = 0.62, \ p > 0.05 \)). Also there is no significant difference in the Perceptual Speed (Category Wise) and Achievement test based on Objectives among Experimental and Control groups.

6.2.3 Findings based on Comparative analysis on Creative Problem Solving Ability

6.2.3.1 Comparison of Creative Problem Solving Ability (Total)

6.2.3.1.1 The comparison of the Post-test scores of the Experimental and Control groups with respect to Creative Problem Solving Ability (\( t = 15.81 \)) revealed that the Experimental and Control groups differ significantly at 0.01
level. Thus it is interpreted that the Experimental group taught using Instructional Strategy based on Path-Smoothing Model achieved better Creative Problem Solving Ability than the Control group taught using the Present Activity Oriented Method.

6.2.3.1.2 The Analysis of Variance of the Pre-test and Post-test scores showed that there is no significant difference between the means of Pre-test scores of the Experimental and Control groups with respect to the Creative Problem Solving Ability (Fx=0.44). But there is significant difference between the means of post-test score of the two groups (Fy=249.94).

6.2.3.1.3 Analysis of Covariance of the pre-test and post-test scores showed that there is significant difference between the means of the post-test scores of the Experimental and Control groups (Fyx = 256.12, p < 0.01).

6.2.3.1.4 The adjusted means of the post-test scores of the Experimental and Control groups were compared, the obtained ‘t’ value (t = 16.02) was found to be statistically significant at 0.01 level. Since the adjusted mean of the Experimental group is higher than that of the Control group, the students in the experimental group are found superior on Creative Problem Solving Ability than the students in the Control group.

6.2.3.2 Comparison of Creative Problem Solving Ability based on Gender and Type of Management

6.2.3.2.1 When the Post-test scores are compared by considering the sub samples Gender and Type of Management, it is revealed that the experimental group scored significantly better than the control group on Creative Problem Solving Ability among Boys (t = 10.99), Girls (t = 11.3), students of Government (t = 10.73) and Aided (t = 11.58). The mean post-test score of the experimental group is greater than that of the Control group. Thus it is interpreted that the Experimental group taught using Instructional Strategy based on Path-Smoothing Model achieved better Creative Problem Solving Ability than the Control group based on Gender and Type of School.
6.2.3.2.2 The Analysis of Variance of the Pre-test and Post-test scores showed that there is no significant difference between the means of Pre-test scores of the Experimental and Control groups on Creative Problem Solving Ability based on Gender and Type of Management. (Boys \( F_x = 0.57 \), Girls \( F_x = 0.04 \), Government \( F_x = 0.53 \) and Aided \( F_x = 0.05 \)). The obtained \( F_y \) values on Creative Problem Solving Ability based on Gender and Type of Management of the Experimental group and the Control group are significant at 0.01 level. (Boys \( F_y = 120.76 \), Girls \( F_y = 127.78 \), Government \( F_y = 115.2 \) and Aided \( F_y = 134.17 \)). This shows that the Experimental and Control groups differ significantly on the Post-test scores on Creative Problem Solving Ability scores based on Gender and Type of Management.

6.2.3.2.3 From the analysis using ANCOVA, the \( F_{yx} \) ratio is greater than the table value for Creative Problem Solving Ability based on Gender and Type of Management of the Experimental group and the Control group. So Creative Problem Solving Ability based on Gender and Type of Management of the Experimental group and the Control group is significant at 0.01 levels. (Boys \( F_{yx} = 137.04 \), Girls \( F_{yx} = 126.87 \), Government \( F_{yx} = 133.85 \) and Aided \( F_{yx} = 133.21 \)). The scores of students in the Experimental group and Control group differ significantly after they were adjusted for the difference in the Pre-test scores.

6.2.3.2.4 The difference in adjusted means for post-test scores of the Experimental and Control groups were tested for significance. The obtained ‘\( t \)’ values for Creative Problem Solving Ability based on Gender and Type of Management of the Experimental group and the Control group are significant at 0.01 level. (Boys \( t = 11.73 \), Girls \( t = 11.27 \), Government \( t = 11.59 \) and Aided \( t = 11.54 \)). This shows that the experimental group is superior to the control group with respect to Creative Problem Solving Ability based on Gender and Type of Management.
So it can be concluded that Instructional Strategy based on Path-Smoothing Model is more effective than Activity Oriented Method in enhancing Creative Problem Solving Ability of Students at Secondary Level.

6.2.4 Findings based on Comparative analysis on Perceptual Speed

6.2.4.1 Comparison on Perceptual Speed (Total)

6.2.4.1.1 The comparison of the post-test scores of the Experimental and Control groups with respect to Perceptual Speed (t = 23.81) revealed that the Experimental and Control groups differ significantly at 0.01 levels. Thus it is interpreted that the Experimental group taught using Instructional Strategy based on Path-Smoothing Model achieved better than the Control group taught using the Present Activity Oriented Method.

6.2.4.1.2 From the Analysis of Variance of the Pre-test and Post-test scores showed that there is no significant difference between the means of Pre-test scores of the Experimental and Control groups with respect to the Perceptual Speed (Fx=0.14). But there is significant difference between the means of post-test score of the two groups (Fy=567.03).

6.2.4.1.3 Analysis of Covariance of the pre-test and post-test scores showed that there is significant difference between the means of the Post-test scores of the Experimental and Control groups (Fyx = 570.38, p < 0.01).

6.2.4.1.4 When the adjusted means of the post-test scores of the Experimental and Control groups were compared, the obtained‘t’ value (t = 23.89) was found to be statistically significant at 0.01 level. Since the adjusted mean of the Experimental group is higher than that of the Control group, the students in the experimental group are found superior on Perceptual Speed than the students in the Control group.

6.2.4.2 Comparison on Perceptual Speed (based on Categories)

6.2.4.2.1 While comparing with respect to the categories of Perceptual Speed, it is evident that Experimental group is superior to that of control group( Number Comparison t=20.27, Word Comparison t=25.52, Alpha Numeral Comparison t=22.54, Mathematics Operation Comparison t=26.3, Figure
6.2.4.2 From the Analysis of Variance of the Pre-test and Post-test scores showed that there is no significant difference between the means of Pre-test scores of the Experimental and Control groups with respect to the Categories of Perceptual Speed (Number Comparison Fx = 0.01, Word Comparison Fx = 0.75, Alpha Numeral Comparison Fx = 0.04, Mathematics Operation Comparison Fx = 0, Figure Comparison Fx = -1.21, Formulae Comparison Fx = 0.43, Roman Numeral Comparison t = Fx = 0.15, Figure Identification Fx = 1.28). But there is significant difference between the means of post-test scores of the two groups, (Number Comparison Fy = 410.68, Word Comparison Fy = 651.29, Alpha Numeral Comparison Fy = 508.04, Mathematics Operation Comparison Fy = 691.46, Figure Comparison Fy = 769.7, Formulae Comparison Fy = 778.94, Roman Numeral Comparison Fy = 471.72, Figure Identification Fy = 655.49).

6.2.4.2.3 Analysis of Covariance of the pre-test and post-test scores showed that there is significant difference between the means of the Post-test scores of the Experimental and Control groups (Number Comparison Fyx = 409.89, Word Comparison Fyx = 719.88, Alpha Numeral Comparison Fyx = 507.2, Mathematics Operation Comparison Fyx = 690.29, Figure Comparison Fyx = 763.47, Formulae Comparison Fyx = 780.56, Roman Numeral Comparison Fyx = 479.04, Figure Identification Fyx = 671) (p < 0.01).

6.2.4.2.4 When the adjusted means of the post-test scores of the Experimental and Control groups were compared, the obtained ‘t’ value (Number Comparison t = 20.25, Word Comparison t = 26.87, Alpha Numeral Comparison t = 22.52, Mathematics Operation Comparison t = 26.27, Figure Comparison t = 27.69, Formulae Comparison t = 27.96, Roman Numeral Comparison t = 21.89, Figure Identification t = 25.96) was found to be statistically significant at 0.01 level. Since the adjusted mean of the Experimental group is higher than that of the Control group, the students in the
experimental group are found superior on Perceptual Speed than the students in the Control group with respect to the categories of Perceptual Speed.

6.2.4.3 Comparison of Perceptual Speed based on Gender and Type of Management

6.2.4.3.1 In comparison with the post-test scores based on Gender and Type of Management it is revealed that the experimental group scored significantly better than the control group on Perceptual Speed among Boys and Girls and students of Government and Aided School, (Boys $t=16.27$, Girls $t=17.32$, Govt $t=15.89$, Aided $t=17.67$). The mean post-test score of the Experimental group is greater than that of the Control group. Thus it can be tentatively interpreted that the Experimental group taught using Instructional Strategy based on Path-Smoothing Model achieved better Perceptual Speed than the Control group based on Gender and Type of Management.

6.2.4.3.2 The Analysis of Variance of the pre-test and post-test scores showed that there is no significant difference between the means of Pre-test scores of the Experimental and Control groups on Perceptual Speed based on Gender and Type of Management (Boys $F_x = 0.79$, Girls $F_x = 0.09$, Govt $F_x = 0.49$ and Aided $F_x = 0.01$) and $F_y$ values on Perceptual Speed based on Gender and Type of Management of the Experimental group and the Control group (Boys $F_y = 264.85$, Girls $F_y = 299.81$, Govt $F_y = 252.56$ and Aided $F_y = 312.14$) is significant at 0.05 level. This shows that the Experimental and Control groups differ significantly on the post-test scores on Perceptual Speed based on Gender and Type of Management.

6.2.4.3.3 From the analysis using ANCOVA, the $F_y$ ratio is greater than the table value for Perceptual Speed of the Experimental and Control groups based on Gender and Type of Management (Boys $F_y = 261.46$, Girls $F_y = 303.25$, Govt $F_y = 249.85$, Aided $F_y = 316.68$). So Perceptual Speed scores based on Gender and Type of Management of the Experimental group and the Control group is significant at 0.01 levels. The scores of students in the
Experimental group and Control group differ significantly after they were adjusted for the difference in the Pre-test scores.

6.2.4.3.4 The difference in adjusted means for post-test scores of the Experimental and Control groups were tested for significance. The obtained ‘t’ values for Perceptual Speed based on Gender and Type of Management of the Experimental group and the Control group are significant at 0.01 level (Boys t = 16.21, Girls t = 17.42, Govt t = 15.83 and Aided t = 17.8). This shows that the Experimental group is superior to the control group with respect to Perceptual Speed based on Gender and Type of Management.

So it can be concluded that Instructional Strategy based on Path-Smoothing Model is more effective than Activity Oriented Method with respect to Perceptual Speed of Students at Secondary Level.

6.2.5 Findings based on Comparative analysis on Achievement in Mathematics

6.2.5.1 Comparison on Achievement in Mathematics (Total)

6.2.5.1.1 The comparison of the Post-test scores of the Experimental and Control groups with respect to Achievement in Mathematics (t = 34.79) revealed that the Experimental and Control groups differ significantly at 0.01 level. Thus it can be interpreted that the Experimental group taught using Instructional Strategy based on Path-Smoothing Model achieved better than the Control group taught using the Present Activity Oriented Method.

6.2.5.1.2 From the Analysis of Variance of the Pre-test and Post-test scores showed that there is no significant difference between the means of Pre-test scores of the Experimental and Control groups with respect to the Achievement in Mathematics (Fx = 0.39). But there is significant difference between the means of post-test score of the two groups (Fy = 1210.32).

6.2.5.1.3 Analysis of Covariance of the pre-test and post-test scores showed that there is significant difference between the means of the post-test scores of the Experimental and Control groups (Fyx = 1226.13, p < 0.01).
When the adjusted means of the post-test scores of the Experimental and Control groups were compared, the obtained ‘t’ value ($t = 35.04$) was found to be statistically significant at 0.01 levels. Since the adjusted mean of the Experimental group is higher than that of the Control group, the students in the experimental group are found superior on Achievement in Mathematics than the students in the Control group.

**6.2.5.2 Comparison on Achievement in Mathematics (Based on Objectives)**

**6.2.5.2.1** The comparison of the Post-test scores of the Experimental and Control groups with respect to Achievement in Mathematics (based on Objectives) revealed that the Experimental and Control group differ significantly at 0.01 level. (Knowledge $t = 12.49$, Understanding $t = 20.91$, Application $t = 21.52$, Analysis $t = 5.96$, Synthesis $t = 44.08$, Evaluation $t = 42.44$). Thus it can be interpreted that the Experimental group taught using Instructional Strategy based on Path-Smoothing Model have better Achievement in Mathematics than the Control group taught using the Present Activity Oriented Method.

**6.2.5.2.2** From the Analysis of Variance of the Pre-test and Post-test scores showed that there is no significant difference between the means of Pre-test scores of the Experimental and Control groups with respect to the Achievement in Mathematics (based on Objectives) (Knowledge $F_x = 1.54$, Understanding $F_x = 1.02$, Application $F_x = 0.19$, Analysis $F_x = 0.38$, Synthesis $F_x = 1.92$, Evaluation $F_x = 0$). But there is significant difference between the means of post-test score of the two groups (Knowledge $F_y = 155.92$, Understanding $F_y = 437.29$, Application $F_y = 463.3$, Analysis $F_y = 35.54$, Synthesis $F_y = 1943.3$, Evaluation $F_y = 1801.06$).

**6.2.5.2.3** Analysis of Covariance of the pre-test and post-test scores showed that there is significant difference between the means of the post-test scores of the Experimental and Control groups (Knowledge $F_{yx} = 152.86$, Understanding $F_{yx} = 431.67$, Application $F_{yx} = 440.46$, Analysis $F_{yx} = 35.41$, Synthesis $F_{yx} = 1908.78$, Evaluation $F_{yx} = 1797.15$), ($p < 0.01$).
6.2.5.2.4 When the adjusted means of the post-test scores of the Experimental and Control groups were compared, the obtained ‘t’ value (Knowledge $t = 12.46$, Understanding $t = 20.94$, Application $t = 21.32$, Analysis $t = 5.95$, Synthesis $t = 43.97$, Evaluation $t = 42.39$) was found to be statistically significant at 0.01 level. Since the adjusted mean of the Experimental group is higher than that of the Control group, the students in the experimental group are found superior on Achievement in Mathematics than the students in the Control group.

6.2.5.3 Comparison of Achievement in Mathematics based on Gender and Type of Management

6.2.5.3.1 In comparison of the Post-test scores with respect to Gender and Type of Management it is revealed that the Experimental group scored significantly better than the control group on Achievement in Mathematics among Boys ($t = 22.26$) and Girls ($t = 27.27$) and students of Government ($t = 21.5$) and Aided ($t = 28.1$). The mean post-test score of the experimental group is greater than that of the Control group. Thus it can be interpreted that the Experimental group taught using Instructional Strategy based on Path-Smoothing Model have better Achievement in Mathematics than the Control group with respect to Gender and Type of Management.

6.2.5.3.2 The Analysis of Variance of the pre-test and post-test scores showed that there is no significant difference between the means of pre-test scores of the Experimental and Control groups on Achievement in Mathematics based on Gender and Type of Management. (Boys $Fx = 0.13$, Girls $Fx = 1.62$, Government $Fx = 0.02$ and Aided $Fx = 1.0$). The obtained $Fy$ values on Achievement in Mathematics based on Gender and Type of Management of the Experimental group and the Control group are significant at 0.01 level. (Boys $Fy = 495.44$, Girls $Fy = 743.61$, Government $Fy = 462.28$ and Aided $Fy = 789.51$). This shows that the Experimental and Control groups differ significantly on the post-test scores on Achievement in Mathematics based on Gender and Type of Management.
6.2.5.3.3 From the analysis using ANCOVA, the Fyx ratio is greater than the table value for Achievement in Mathematics based on Gender and Type of School of the Experimental group and the Control group. So Achievement in Mathematics based on Gender and Type of Management of the Experimental group and the Control group is significant at 0.01 level. (Boys Fyx = 545.01, Girls Fyx = 730.95, Government Fyx = 510.46 and Aided School Fyx = 780.28). The scores of students in the Experimental group and Control group differ significantly after they were adjusted for the difference in the pre-test scores.

6.2.5.3.4 The difference in adjusted means for post-test scores of the Experimental and Control groups were tested for significance. The obtained ‘t’ values for Achievement in Mathematics based on Gender and Type of Management of the Experimental group and the Control group are significant at 0.01 level. (Boys t = 23.36, Girls t = 27.18, Government t = 22.59 and Aided t = 28.02). This shows that the experimental group is superior to the control group with respect to Achievement in Mathematics based on Gender and Type of Management.

So it can be concluded that Instructional Strategy based on Path-Smoothing Model is more effective than Activity Oriented Method with respect to Achievement in Mathematics of Students at Secondary Level.

6.2.6 Retention in Creative Problem Solving Ability of Students at Secondary Level

In comparison of the delayed Post-test scores on Creative Problem Solving Ability of the Experimental and Control groups, it is found that the t value obtained is significant at 0.01 level (t=34.40). The mean value of the experimental group is higher than that of the control group. So the experimental group is having more retention in Creative Problem Solving Ability than the control groups.
When compared the Post-test scores and the delayed Post-test scores of the experimental and control groups, it is revealed that t value obtained with respect to the experimental group is not significant at 0.05 level. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for retaining Creative Problem Solving Ability on students at secondary level.

### 6.2.7 Retention in Perceptual Speed of Students at Secondary Level

In comparison of the delayed Post-test scores on Perceptual Speed of the Experimental and Control groups, it is found that the t value obtained is significant at 0.01 level (t=39.71). The mean value of the experimental group is higher than that of the control group. So the experimental group is having more retention in Perceptual Speed than the control groups.

When compared the Post-test scores and the delayed Post-test scores of the experimental and control groups, it is revealed that t value obtained with respect to the experimental group is not significant at 0.05 level. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for retaining Perceptual Speed on students at secondary level.

### 6.2.8 Retention in Achievement in Mathematics of Students at Secondary Level

In comparison of the delayed Post-test scores on Achievement in Mathematics of the Experimental and Control groups, it is found that the t value obtained is significant at 0.01 level (t=16.53). The mean value of the experimental group is higher than that of the control group. So the experimental group is having more retention in Achievement in Mathematics than the control groups.

When compared the Post-test scores and the delayed Post-test scores of the experimental and control groups, it is revealed that t value obtained with
respect to the experimental group is not significant at 0.05 level. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for retaining Achievement in Mathematics on students at secondary level.

6.3 TENABILITY OF THE HYPOTHESES

The tenability of the hypotheses formulated was tested by the veracity of the findings obtained from the experimental study conducted and are stated below:

\[ H_{(1)} \] There will be significant difference in Creative Problem Solving Ability of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the total sample

The findings 6.2.3.1.1 to 6.2.3.1.4 show that the Creative Problem Solving Ability of students taught through an Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught through existing Activity Oriented Method for the total sample.

Hence the hypothesis \( H_{(1)} \) is substantiated.

\[ H_{(2)} \] There will be significant difference in Creative Problem Solving Ability of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the subsamples based on Gender and Type of Management

The findings 6.2.3.2.1 to 6.2.3.2.4 show that by considering the subsamples Gender and Type of Management, Creative Problem Solving Ability of students who were treated with the Instructional Strategy based on Path-Smoothing Model is reliably superior to those with existing Activity Oriented Method.

Hence the hypothesis \( H_{(2)} \) is substantiated.
Summary and Conclusions

$H(3)$ There will be significant difference in Perceptual Speed of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the total sample

The findings 6.2.4.1.1 to 6.2.4.1.4 show that the Perceptual Speed of students (total) taught through an Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught through existing Activity Oriented Method for the total sample.

Hence the hypothesis $H(3)$ is substantiated.

$H(4)$ There will be significant difference in the Categories of Perceptual Speed of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method.

The findings 6.2.4.2.1 to 6.2.4.2.4 show that the Perceptual Speed (based on Categories) of students taught through an Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught through existing Activity Oriented Method for the total sample.

Hence the hypothesis $H(4)$ is substantiated.

$H(5)$ There will be significant difference in Perceptual Speed of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the sub samples based on Gender and Type of Management

The findings 6.2.4.3.1 to 6.2.4.3.4 show that by considering the subsamples Gender and Type of Management, Perceptual Speed of students who were treated with the Instructional Strategy based on Path-Smoothing Model is reliably superior to those with existing Activity Oriented Method.

Hence the hypothesis $H(5)$ is substantiated.
Summary and Conclusions

$H_6$ There will be significant difference in Achievement in Mathematics of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the total sample.

The findings 6.2.5.1.1 to 6.2.5.1.4 show that the Achievement in Mathematics of students taught through an Instructional Strategy based on Path-smoothing Model is significantly higher than that of those taught through existing Activity Oriented Method for the total sample.

Hence the hypothesis $H_6$ is substantiated.

$H_7$ There will be significant difference in Achievement in Mathematics based on the Objectives of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method.

The findings 6.2.5.2.1 to 6.2.5.2.4 show that the Achievement in Mathematics (based on Objectives) of students taught through an Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught through existing Activity Oriented Method for the total sample.

Hence the hypothesis $H_7$ is substantiated.

$H_8$ There will be significant difference in Achievement in Mathematics of students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method for the sub samples based on Gender and Type of Management.

The findings 6.2.5.3.1 to 6.2.5.3.4 show that by considering the subsample Gender and Type of Management, Achievement in Mathematics of students who were treated with the Instructional Strategy based on Path-Smoothing Model is reliably superior to those with existing Activity Oriented Method.

Hence the hypothesis $H_8$ is substantiated.
There will be significant difference in the Retention of Creative Problem Solving Ability of the students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method

The finding 6.2.6 shows that the retention of Creative Problem Solving Ability of students taught through an Instructional Strategy based on Path-smoothing Model is significantly higher than that of those taught through existing Activity Oriented Method for the total sample.

Hence the hypothesis $H_{(9)}$ is substantiated.

There will be significant difference in the Retention of Perceptual Speed of the students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method

The finding 6.2.7 shows that the retention of Perceptual Speed of students taught through an Instructional Strategy based on Path-smoothing Model is significantly higher than that of those taught through existing Activity Oriented Method for the total sample.

Hence the hypothesis $H_{(10)}$ is substantiated.

There will be significant difference in the Retention of Achievement in Mathematics of the students at Secondary Level taught through the Instructional Strategy based on Path-Smoothing Model and Activity Oriented Method

The finding 6.2.8 shows that the retention of Achievement in Mathematics of students taught through an Instructional Strategy based on Path-smoothing Model is significantly higher than that of those taught through existing Activity Oriented Method for the total sample.

Hence the hypothesis $H_{(11)}$ is substantiated.
6.4 CONCLUSIONS OF THE STUDY

The major conclusions arrived from the study after the analysis and summarization are noted below:

1. The Creative Problem Solving Ability of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method for total sample. So it can be concluded that Instructional Strategy based on Path-Smoothing model is better than existing Activity Oriented Method for improving Creative Problem Solving Ability of students at Secondary Level.

2. With respect to Gender and Type of Management, the Creative Problem Solving Ability of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for improving Creative Problem Solving Ability of students with respect to the Gender and Type of Management of school.

3. The Perceptual Speed of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method for total sample. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for improving Perceptual Speed of students at Secondary Level.

4. The Perceptual Speed (based on its categories) of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method. So it can be concluded that Instructional Strategy based on Path-
Smoothing Model is better than existing Activity Oriented Method for improving Perceptual Speed (based on Categories) of students at Secondary Level.

5 With respect to Gender and Type of Management, the Perceptual Speed of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method. So it can be concluded that Instructional Strategy based on Path-Smoothing model is better than existing Activity Oriented Method for improving Perceptual Speed of students with respect to the Gender and Type of Management of school.

6 The Achievement in Mathematics of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method for total sample. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for improving Achievement in Mathematics of students at Secondary Level.

7 The Achievement in Mathematics (based on Objectives) of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for improving Achievement in Mathematics (based on Objectives) of students at Secondary Level.

8 With respect to Gender and Type of Management, the Achievement in Mathematics (based on the Objectives) of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for improving
Achievement in Mathematics with respect to Gender and Type of Management of school.

8 The Retention in Creative Problem Solving Ability of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for retaining Creative Problem Solving Ability on students at Secondary Level.

9 The Retention in Perceptual Speed of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method. So it can be concluded that Instructional Strategy based on Path-Smoothing Model is better than existing Activity Oriented Method for retaining Perceptual Speed of students at Secondary Level.

10 The Retention in Achievement in Mathematics of students taught using the Instructional Strategy based on Path-Smoothing Model is significantly higher than that of those taught using existing Activity Oriented Method. So it can be concluded that Instructional Strategy based on Path-Smoothing model is better than existing Activity Oriented Method for retaining Achievement in Mathematics of students at Secondary Level.

6.5 EDUCATIONAL IMPLICATIONS OF THE STUDY

The main objective of the study was to find out the Effectiveness of an Instructional Strategy based on Path-Smoothing model on Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics of students at Secondary Level. The findings revealed that the strategy based on Path-Smoothing Model is effective and the major implications are outlined below.
1. The findings of the study revealed that The Instructional Strategy based on Path-Smoothing Model help to improve Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics of students at Secondary Level. Teaching Creative Problem Solving through Path-Smoothing Model helps the students learn independently. Success in Creative Problem Solving requires both specific content knowledge and general skills. Learning through Path-Smoothing Model helps the students to establish a method for Creative Problem Solving and improving Perceptual Speed, which helps them to become better problem solvers.

2. Teaching through Path-Smoothing Model develops the creative thinking power, which leads to the reconstruction of some knowledge or capability which the learner did not have before. Learning through Path-Smoothing Model helps the students to understand the processes involved than the product. Learning through Path-Smoothing Model helps the child to learn how to learn.

3. Learning through this Instructional Strategy based on Path-Smoothing Model helps in posing problems which in turn develops the Creative Problem Solving Ability and improves Perceptual Speed of the Students.

4. Since the Instructional Strategy based on Path-Smoothing Model is more effective than existing Activity Oriented Method in Teaching Mathematics at Secondary Level, faculty improvement programmes namely Orientation classes, Refresher courses, Seminars and Workshops should be organized for the teachers to familiarize with various instructional strategies. This helps the secondary school teachers to develop novel strategies.

5. Knowledge is actively constructed by the learner, not passively received from the environment. Emphasis is placed on situations where pupils explore and discuss in an active and creative way. This type of strategy
helps the teacher to provide the scaffolding which allows the students to progress.

6. This model helps the students to develop the ability to understand the generalities associated with Creative Problem Solving. Teaching Creative Problem Solving through Path-Smoothing Model helps the child learn independently. Creative Problem Solving Ability can be developed through the flexible learning atmosphere provided through Path-Smoothing Model.

7. The most important contribution of the study is that it has come out with a set of standardized instruments for measuring the variables of the study such as tests for Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics. These tools can be further used widely in the field of Education, especially Mathematics Education.

8. The importance of learning models should be emphasized in the teacher education curriculum and teacher educators should be equipped to translate the importance of learning models in their practice.

9. This study revealed that the Instructional Strategy based on Path-Smoothing Model is more effective than that of the existing Activity Oriented Method in enhancing Creative Problem Solving, Perceptual Speed and Achievement in Mathematics of Students at Secondary Level irrespective of Gender and Type of Management. So the curriculum planners should take this into account while preparing instructional materials and learning packages for learning Mathematics.

10. This study revealed that the Instructional Strategy based on Path-Smoothing Model is found to have more effect on the retention of Creative Problem Solving Ability, Perceptual Speed and Achievement in Mathematics than the existing Activity Oriented Method. The application of different teaching models requires different instructional materials and sufficient expertise. Model lesson transcripts based on different models of teaching on selected units in Mathematics may be
prepared. The preparation of such materials by teachers themselves is neither possible nor practicable. Hence it is essential that the curriculum developers should take efforts to prepare such materials which the teachers can utilize with minor adaptations to specific needs of learners.

The results of the study will contribute towards new learning strategies and will help all those who are concerned with the field of Mathematics. Our educational system and higher education establishments have to utilize the immense potentials of our students by including these types of innovative learning strategies in the curriculum.

**6.6 SUGGESTIONS FOR FURTHER RESEARCH**

In the light of the present study the investigator presents certain suggestions which can help others to think about the possibilities of further research related to this study and are given below

1. The present study is conducted at Secondary Level to find the effectiveness of an Instructional Strategy based on Path-Smoothing Model. The study can be conducted at higher secondary and degree levels.
2. To get the complete picture of the effectiveness of the Instructional Strategy based on Path-Smoothing Model, similar studies can be conducted at different districts using larger sample
3. The present study can be conducted on students with different learning as well as cognitive styles.
4. These types of strategies are helpful for the effective development of the communication and co-operation among students.
5. Many research findings show the difficulty in teaching and learning Mathematics subject. So using this Instructional Strategy helps the Teaching and learning easier.
6. An experimental study can be conducted to find out the effectiveness of Path-Smoothing Model on fast learners, slow learners, gifted children, learners of short concentration span, and learners with learning difficulty.

7. Experimental studies can be conducted to compare the effectiveness of the Instructional Strategy based on Path-Smoothing Model with other innovative teaching learning strategies.

8. A survey on the Attitude of educational practitioners, administrators, curriculum planners, teachers and students towards the inclusion of these innovative instructional strategies in school curriculum can be studied.