CHAPTER 5
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SUMMARY AND CONCLUSIONS

Mathematics is an important subject in secondary school because it is associated with many academic and career opportunities. This subject is the basis for scientific, industrial and technological advancement of any country. Mathematization of the child’s thought process is the main goal of Mathematics education. The characteristics of this process are clarity of thought, the ability to arrive at logical conclusions, the ability to handle abstract ideas and the capacity to analyse facts systematically (NCF, 2005).

One of the observation on school education is that the performance of the school students in Mathematics is not upto the mark. For the proper development of Mathematics education the method adopted to teach Mathematics and its effectiveness in Achievement must be taken into account. Learning of Mathematics can be made easier and enjoyable through the coordinated efforts of teachers, students, parents, educational researchers, psychologists and mathematicians. In our present scenario there is a movement for recognising the need for inventing and investigating new models for teaching Mathematics. One of such model is Cognitive Apprenticeship Model (Brown, Collins, & Dugid, 1989).

Cognitive Apprenticeship Model enables a less experienced learner to acquire knowledge and skills under the guidance of an expert. In this model knowledgeable teachers provide model, demonstrations, coaching and corrections as well as personal bond with the learners that motivate them to study. Learning along with an experienced master leads them to learn different skills and knowledge. Thus Cognitive Apprenticeship Model focuses on the process of learning and on developing more cognitive and Metacognitive skills. The present study attempts to find the effectiveness of the Cognitive Apprenticeship Model to make the teaching learning process more meaningful and interesting. As this model enhances healthy relationship between the teacher and the student and among students themselves, it is presumed that the Cognitive Apprenticeship Model influences Achievement in Mathematics, Metacognitive Outcomes and Social Skills.
5.1 Study in Retrospect

The investigator conducted the study to find out the effectiveness of Cognitive Apprenticeship Model on Achievement in Mathematics, Metacognitive Outcomes, and Social Skills among the secondary school students. For this purpose experimental method was adopted. The study was conducted on a sample of 76 students comprising two groups - experimental and control, each consisting of 38 students. The brief summary of the study is presented below.

5.1.1 Statement of the Problem

The present study is entitled “Effectiveness of Cognitive Apprenticeship Model on Achievement in Mathematics, Metacognitive Outcomes and Social Skills”.

5.1.2 Operational Definitions of the Key Terms

1. Effectiveness: Oxford Dictionary (2008) defines effectiveness as ‘the degree to which something is successful in producing a desired result’. In the present study, ‘effectiveness’ means the potential of a teaching method or model to produce desired result in the Achievement in Mathematics, Metacognitive Outcomes and Social Skills of secondary school students.

2. Cognitive Apprenticeship Model: Cognitive Apprenticeship Model was developed by Brown, Collins, and Dugid (1989) based on the situated cognition theory. This Model suggests that cognitive skills can be acquired in authentic contexts and by communicating with peers and experts. It is a model designed to improve students’ thinking and problem-solving skills through the learning of school subjects. It involves six steps, namely, Modelling, Coaching, Scaffolding, Articulation, Reflection and Exploration.

3. Achievement in Mathematics: Achievement in Mathematics refers to the behavioural evidence of cognitive outcomes in the discipline of Mathematics which is measured by scores obtained on the Achievement Test in Mathematics constructed by the investigator.

4. Metacognitive Outcomes: Metacognition refers to the higher order thinking which involves active control over the cognitive processes. Paris and Winograd (1990) emphasised two aspects of Metacognition as Knowledge of Cognition
and Regulation of Cognition. In the present study, Metacognitive Outcomes refer to behavioural evidence in the context of mathematical problem solving which reveals Knowledge of Cognition and Regulation of Cognition. The components of Knowledge of Cognition were Declarative Knowledge, Procedural Knowledge and Conditional Knowledge and the components of Regulation of Cognition selected were Prediction, Planning, Monitoring and Evaluation.

5. **Social Skills:** Social Skills are defined as those social, interpersonal and task-related behaviours that produce positive consequences in the school classroom settings (Cartledge & Melburn, 1980). In the present study, Social Skills refer to social, interpersonal and task related behaviours that produce positive consequences in the classroom settings. It is measured in terms of Cooperation, Interpersonal Relationship, Communicative Ability and Concern for Others.

5.1.3 **Variables of the Study**

In the study, the investigator had selected the following variables namely independent, dependent and extraneous variables.

**Independent Variable**

In the present study, the independent variable was the treatment variable which had two levels – the experimental treatment using the Cognitive Apprenticeship Model and the routine treatment using the Existing activity oriented method.

**Dependent Variables**

The three dependent variables selected for the study were:

1. Achievement in Mathematics
2. Metacognitive Outcomes

   The selected components of Metacognitive Outcomes were:
   a) Knowledge of Cognition
   b) Regulation of Cognition

   a. Knowledge of Cognition includes the following components:
      i) Declarative Knowledge
      ii) Procedural Knowledge
      iii) Conditional Knowledge
b. Regulation of Cognition includes the following components:
   i) Prediction
   ii) Planning
   iii) Monitoring
   iv) Evaluation

3. Social Skills
   The selected components of Social Skills were:
   a) Cooperation
   b) Interpersonal Relationship
   c) Communicative Ability
   d) Concern for Others

**Extraneous variable**

The extraneous variable selected for the study was Intelligence, since Intelligence may affect the Achievement, Metacognitive Outcomes and Social Skills irrespective of other learning conditions.

5.1.4 Objectives of the Study

1. To prepare instructional materials based on the Cognitive Apprenticeship Model for teaching Mathematics to the students of standard eight

2. To prepare and validate the tools, namely, a) Achievement Test in Mathematics to measure Achievement b) Scale of Metacognitive Outcomes to measure the Metacognitive Outcomes in mathematical problem solving and c) Social Skills Rating Scale to measure the Social Skills of the students of standard eight

3. To analyse the scores on (a) Intelligence (b) Achievement in Mathematics (c) Metacognitive Outcomes and (d) Social Skills of the students in the experimental and control groups

4. To find out the relationship among Intelligence and the pretest scores on the dependent variables, namely, Achievement in Mathematics, Metacognitive Outcomes and Social Skills of the students of standard eight
5. To find out whether there is any significant difference between the pretest scores of the students in the experimental and control groups on (a) Intelligence (b) Achievement in Mathematics (c) Metacognitive Outcomes and (d) Social Skills

6. To find out whether there is any significant difference between the pretest and posttest scores of the students in the experimental group on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills

7. To find out whether there is any significant difference between the pretest and posttest scores of the students in the control group on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills

8. To find out whether there is any significant difference between the posttest scores of the students in the experimental and control groups on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills

9. To find out whether there is any significant difference between the gain scores of the students in the experimental and control groups on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills

10. To find out the effectiveness of the Cognitive Apprenticeship Model over the existing method on Achievement in Mathematics, Metacognitive Outcomes and Social Skills, by controlling the influence of Intelligence and pretest scores on the dependent variables

11. To find out whether there is any significant difference between the gain scores of boys and girls in the experimental group on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills

### 5.1.5 Hypotheses of the Study

1. There is significant relationship among Intelligence and the pretest scores on the dependent variables, namely, Achievement in Mathematics, Metacognitive Outcomes and Social Skills of the students of standard eight.

2. There is no significant difference between the pretest scores of the students in the experimental and control groups on (a) Intelligence (b) Achievement in Mathematics (c) Metacognitive Outcomes and (d) Social Skills.
3. There is significant difference between the pretest and posttest scores of the students in the experimental group on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills.

4. There is significant difference between the pretest and posttest scores of the students in the control group on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills.

5. There is significant difference between the posttest scores of the students in the experimental and control groups on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills.

6. There is significant difference between the gain scores of the students in the experimental and control groups on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills.

7. There is significant effect of the Cognitive Apprenticeship Model over the Existing method on Achievement in Mathematics, Metacognitive Outcomes and Social Skills, by controlling the influence of Intelligence and pretest scores on the dependent variables.

8. There is significant difference between the gain scores of boys and girls in the experimental group on (a) Achievement in Mathematics (b) Metacognitive Outcomes and (c) Social Skills.

**5.1.6 Methodology in Brief**

The investigator intended to find out the effectiveness of the Cognitive Apprenticeship Model over the Existing method on Achievement in Mathematics, Metacognitive Outcomes and Social Skills. The design selected for the present study was pretest-posttest nonequivalent-groups design, where there were one experimental group and one control group. The experimental group was taught through the Cognitive Apprenticeship Model and the control group through the Existing activity oriented method practiced in the schools which follow the curriculum designed by the Board of Secondary Education in Kerala State. To compensate for the lack of equivalence among the groups, the technique of MANCOVA and ANCOVA were applied. For the preparation of the instructional material the investigator selected suitable contents from Mathematics textbook of standard eight.
For the study, the investigator randomly selected two intact classes from four divisions of standard eight of St. Mary’s Higher Secondary School, Kidangoor of Kottayam district, Kerala State. Of the two selected classes, one was randomly assigned as experimental group and the other as control group, each consisting of 38 students. Thus a group of 76 students from two classes was treated as sample. The experimental group was taught through the Cognitive Apprenticeship Model and the control group was taught through the Existing method.

For the purpose of the present study the investigator used the following tools.

1. Achievement Test in Mathematics (ATM) constructed by the investigator to test Achievement in Mathematics of the students of standard eight

2. Scale of Metacognitive Outcomes (SMO) constructed by the investigator to measure the Metacognitive Outcomes in mathematical problem solving of the students

3. Social Skills Rating Scale (SSRS) constructed by the investigator to measure the Social Skills of the students

4. Raven’s Standard Progressive Matrices (1996) to measure Intelligence

In order to find out the effectiveness of the Cognitive Apprenticeship Model over the Existing method, the investigator adopted the following procedure. Before conducting the experiment, Raven’s Progressive Matrices test in Intelligence was administered to obtain the scores on Intelligence, the extraneous variable. The investigator administered the Achievement Test in Mathematics (ATM), the Scale of Metacognitive Outcomes (SMO) and the Social Skills Rating Scale (SSRS) before and after the experiment in order to measure Achievement in Mathematics, Metacognitive Outcomes in mathematical problem solving and Social Skills respectively of the students in the experimental and control groups. The experimental group was taught through Cognitive Apprenticeship Model and the control group through the Existing method practiced in the schools which follow the curriculum designed by the Board of Secondary Education in Kerala State. The two groups were given equal attention during the course of the experiment.

The collected data were analysed using the statistical techniques such as mean, median, mode, standard deviation, skewness, Pearson’s product-moment correlation,
test of significance of correlation, test of significance of difference between the means
of two independent groups, test of significance of difference between means of two
correlated groups, Analysis of Co-variance (ANCOVA) and Multivariate Analysis of
Co-variance (MANCOVA).

5.2 Major Findings and Conclusions of the Study

The major conclusions obtained from the analysis of the comparison of
effectiveness of the Cognitive Apprenticeship Model over the Existing Method are
synthesised under the following subheadings.

1. Cognitive Apprenticeship Model is Effective for Fostering Achievement in
Mathematics and its Components

This conclusion is substantiated by the following findings of the study.

The mean posttest score on Achievement in Mathematics (27.87) of the
experimental group, taught through the Cognitive Apprenticeship Model is found to
be higher than the mean pretest score (14.92). When compared the mean posttest and
pretest scores of the components of Achievement in Mathematics, namely, Knowledge (8.37 and 4.34), Understanding (12.84 and 7.89) and Application
(6.66 and 2.89), the posttest scores are higher than that of the pretest scores.

The t-values obtained by the test of significance of difference between the
means of pretest and posttest scores of the experimental group on Achievement in
Mathematics ($t_{(37)} = 24.59$, $p < .05$) and the components of Achievement in
Mathematics, namely, Knowledge ($t_{(37)} = 16.57$, $p < .05$), Understanding ($t_{(37)} = 14.15$, $p < .05$)
and Application ($t_{(37)} = 12.43$, $p < .05$) indicate a significant improvement in
Achievement in Mathematics as a result of instruction through the Cognitive
Apprenticeship Model. This proved that the Cognitive Apprenticeship Model is
effective for fostering Achievement in Mathematics and its components.

2. Cognitive Apprenticeship Model is Effective for Enhancing Metacognitive
Outcomes and its Components

This conclusion is substantiated by the following findings of the study.

The mean posttest score on Metacognitive Outcomes (99.24) of the
experimental group, taught through the Cognitive Apprenticeship Model is found to
be higher than the mean pretest score (79.55). When compared the mean posttest and pretest scores of the components of Metacognitive Outcomes, namely, Declarative Knowledge (14.87 and 11.66), Procedural Knowledge (14.34 and 11.26), Conditional Knowledge (15.13 and 12.13), Prediction (11.95 and 9.71), Planning (14.37 and 11.79), Monitoring (14.02 and 11.55) and Evaluation (14.55 and 11.45), the posttest scores are higher than that of the pretest scores.

The t-values obtained by the test of significance of difference between the means of pretest and posttest scores of the experimental group on Metacognitive Outcomes ($t_{(37)} = 14.20, p < .05$) and the components of Metacognitive Outcomes, namely, Declarative Knowledge ($t_{(37)} = 13.78, p < .05$), Procedural Knowledge ($t_{(37)} = 9.53, p < .05$), Conditional Knowledge ($t_{(37)} = 8.53, p < .05$), Prediction ($t_{(37)} = 6.20, p < .05$), Planning ($t_{(37)} = 9.09, p < .05$), Monitoring ($t_{(37)} = 6.81, p < .05$) and Evaluation ($t_{(37)} = 8.69, p < .05$) show a significant improvement in Metacognitive Outcomes as a result of instruction through the Cognitive Apprenticeship Model. This proved that the Cognitive Apprenticeship Model is effective for enhancing Metacognitive Outcomes and its components.

3. **Cognitive Apprenticeship Model is Effective for Enhancing Social Skills and its Components**

This conclusion is substantiated by the following findings of the study.

The mean posttest score on Social Skills (115.45) of the experimental group, taught through the Cognitive Apprenticeship Model is found to be higher than the mean pretest score (97.95). When compared the mean posttest and pretest scores of the components of Social Skills, namely, Cooperation (28.13 and 24.37), Interpersonal Relationship (29.42 and 24.74), Communicative Ability (28.71 and 23.58) and Concern for Others (29.18 and 25.26), the posttest scores are higher than that of the pretest scores.

The t-values obtained by the test of significance of difference between the means of pretest and posttest scores of the experimental group on Social Skills ($t_{(37)} = 13.13, p < .05$) and the components of Social Skills, namely, Cooperation ($t_{(37)} = 6.26, p < .05$), Interpersonal Relationship ($t_{(37)} = 11.68 p < .05$) Communicative Ability ($t_{(37)} = 10.82, p < .05$) and Concern for Others ($t_{(37)} = 8.84 p < .05$) reveal a significant improvement in Social Skills as a result of instruction through the
Cognitive Apprenticeship Model. This proved that the Cognitive Apprenticeship Model is effective for enhancing Social Skills and its components.

4. **Existing Activity Oriented Method is Effective for Fostering Achievement in Mathematics and its Components**

This conclusion is substantiated by the following findings of the study.

The mean posttest score on Achievement in Mathematics (23.89) of the control group, taught through the Existing method is found to be higher than the mean pretest score (14.63). When compared the mean posttest and pretest scores of the components of Achievement in Mathematics, namely, Knowledge (7.55 and 4.45), Understanding (11.16 and 6.97) and Application (5.18 and 3.21), the posttest scores are higher than that of the pretest scores.

The t-values obtained by the test of significance of difference between the means of pretest and posttest scores of the control group on Achievement in Mathematics ($t_{(37)} = 26.08, p < .05$) and the components of Achievement in Mathematics, namely, Knowledge ($t_{(37)} = 14.16, p < .05$), Understanding ($t_{(37)} = 11.51, p < .05$) and Application ($t_{(37)} = 7.94, p < .05$) show a significant improvement in Achievement in Mathematics as a result of instruction through the Existing method. This proved that the Existing method is effective for fostering Achievement in Mathematics and its components.

5. **Existing Activity Oriented Method is Effective for Enhancing Metacognitive Outcomes and the Components - Declarative Knowledge, Procedural Knowledge, Conditional Knowledge and Monitoring**

This conclusion is substantiated by the following findings of the study.

The mean posttest score on Metacognitive Outcomes (85.34) of the control group, taught through the Existing method is found to be higher than the mean pretest score (81.05). When compared the mean posttest and pretest scores of the components of Metacognitive Outcomes, namely, Declarative knowledge (12.55 and 11.95), Procedural knowledge (12.61 and 11.74), Conditional knowledge (13.20 and 12.37) and Monitoring (12.50 and 11.74), the posttest scores are higher than that of the pretest scores. But in the case of the mean posttest and pretest scores of Prediction (10.00 and 9.97), Planning (12.68 and 12.00) and Evaluation (11.74 and 11.29), the posttest scores are slightly higher than the pretest scores.
The t-values obtained by the test of significance of difference between the means of pretest and posttest scores of the control group on Metacognitive Outcomes ($t_{(37)} = 2.93$, $p < .05$) and the components of Metacognitive Outcomes, namely, Declarative Knowledge ($t_{(37)} = 2.28$, $p < .05$), Procedural Knowledge ($t_{(37)} = 2.36$, $p < .05$), Conditional Knowledge ($t_{(37)} = 2.23$, $p < .05$) and Monitoring ($t_{(37)} = 2.54$, $p < .05$) reveal a significant improvement in Metacognitive Outcomes and its components, namely, Declarative Knowledge, Procedural Knowledge, Conditional Knowledge and Monitoring as a result of the Existing method. But there is no significant difference between the pretest and posttest scores of the students in the control group on Prediction ($t_{(37)} = 0.09$, $p > .05$), Planning ($t_{(37)} = 1.73$, $p > .05$) and Evaluation ($t_{(37)} = 1.15$, $p > .05$). This proved that the Existing method is effective for enhancing Metacognitive Outcomes and the components of Knowledge of Cognition (lower level), namely, Declarative Knowledge, Procedural Knowledge and Conditional Knowledge. But the Existing method is not effective for the components of Regulation of Cognition (higher level), namely, Prediction, Planning and Evaluation except for Monitoring.

6. **Existing Activity Oriented Method is Effective for Enhancing Social Skills and the Components – Cooperation, Communicative Ability and Concern for Others**

This conclusion is substantiated by the following findings of the study.

The mean posttest score on Social Skills (103.24) of the control group, taught through the Existing method is found to be higher than the mean pretest score (100.21). When compared the mean posttest and pretest scores of the components of Social Skills, namely, Cooperation (27.26 and 24.24), Communicative Ability (25.68 and 24.10) and Concern for Others (27.11 and 22.53), the posttest scores are higher than that of the pretest scores. But the mean posttest and pretest scores of the Interpersonal Relationship (26.21 and 26.32) do not show difference.

The t-values obtained by the test of significance of difference between the means of pretest and posttest scores of the control group on Social Skills ($t_{(37)} = 3.38$, $p < .05$) and the components of Social Skills, namely, Cooperation ($t_{(37)} = 6.48$, $p < .05$), Communicative Ability ($t_{(37)} = 4.55$, $p < .05$) and Concern for Others ($t_{(37)} = 8.75$, $p < .05$) reveal a significant improvement in Social Skills as a
result of the Existing method. But there is no significant difference between the pretest and posttest scores of the students in the control group on Interpersonal Relationship ($t_{(37)} = 0.25 \ p > .05$). This proved that the Existing method is effective for enhancing Social Skills and the components – Cooperation, Communicative Ability and Concern for Others.

7. Cognitive Apprenticeship Model is more Effective for Enhancing the Dependent Variables - Achievement in Mathematics, Metacognitive Outcomes and Social Skills

The results of the Multivariate Analysis of Covariance (MANCOVA) to find the effectiveness of the Cognitive Apprenticeship Model over the Existing method on the dependent variables ($F_{(3,68)} = 61.06, \ p < .05$) show that there is significant difference between the two groups when the effects of Intelligence and pretest on all the dependent variables were controlled. This proved that there is significant effect of the Cognitive Apprenticeship Model over the Existing method for enhancing the dependent variables, namely, Achievement in Mathematics, Metacognitive Outcomes and Social Skills.

8. Cognitive Apprenticeship Model is more Effective than the Existing Method in Raising Achievement in Mathematics and its Components

This conclusion is substantiated by the following findings of the study.

The mean posttest score on Achievement in Mathematics of the experimental group (27.87), taught through the Cognitive Apprenticeship Model is found to be higher than that of the control group (23.89), taught through the Existing method. Moreover the mean posttest scores on the components of Achievement in Mathematics, namely, Knowledge (8.37), Understanding (12.84) and Application (6.66) of the experimental group are higher than that of the control group (Knowledge (7.55), Understanding (11.16) and Application (5.18)).

The t-values obtained by the test of significance of difference between the means of posttest scores of the experimental and control groups on Achievement in Mathematics ($t_{(74)} = 5.45, \ p < .05$) and the components of Achievement in Mathematics, namely, Knowledge ($t_{(74)} = 2.27, \ p < .05$), Understanding ($t_{(74)} = 3.03, \ p < .05$) and Application ($t_{(74)} = 4.84, \ p < .05$) reveal that the experimental group has
significant improvement in Achievement in Mathematics when compared with the control group after the experiment. This proved the advantage of the Cognitive Apprenticeship Model on Achievement in Mathematics over the Existing method.

The gain scores of the experimental and control groups when subjected to the test of significance of difference between the means of scores on Achievement in Mathematics ($t_{(74)} = 5.88$, $p < .05$), Knowledge ($t_{(74)} = 2.82$, $p < .05$) and Application ($t_{(74)} = 4.57$, $p < .05$) show that there is significant difference between the gain scores of the experimental and control groups. But there is no significant difference between the gain scores of experimental and control groups on Understanding ($t_{(74)} = 1.51$, $p > .05$).

The results of the Analysis of Covariance to find the effectiveness of the Cognitive Apprenticeship Model over the Existing method on Achievement in Mathematics ($F_{(1,70)} = 51.07$, $p < .05$) show that there is significant difference between the experimental and control groups when the effects of Intelligence and pretest on all the dependent variables were controlled. Moreover the results of the Analysis of Covariance for the components of Achievement in Mathematics, namely, Knowledge ($F_{(1,72)} = 4.09$, $p < .05$), Understanding ($F_{(1,72)} = 8.29$, $p < .05$) and Application ($F_{(1,72)} = 25.67$, $p < .05$) reveal the significant effect of the Cognitive Apprenticeship Model over the Existing method. This proved that the experimental group excels control group on Achievement in Mathematics.

The above all results proved the effectiveness of the Cognitive Apprenticeship Model over the Existing method on Achievement in Mathematics and its components.

9. **Cognitive Apprenticeship Model is more Effective than the Existing Method for Enhancing Metacognitive Outcomes and its Components**

This conclusion is substantiated by the following findings of the study.

The mean posttest score on Metacognitive Outcomes of the experimental group (99.24), taught through the Cognitive Apprenticeship Model is found to be higher than that of the control group (85.34), taught through the Existing method. Moreover the mean posttest scores on the components of Metacognitive Outcomes, namely, Declarative Knowledge (14.87), Procedural Knowledge (14.34), Conditional Knowledge (15.13), Prediction (11.95), Planning (14.37), Monitoring (14.02) and
Evaluation (14.55) of the experimental group are higher than that of the control group (Declarative Knowledge (12.55), Procedural Knowledge (12.61), Conditional Knowledge (13.26), Prediction (10.00), Planning (12.68), Monitoring (12.50) and Evaluation (11.74)).

The t-values obtained by the test of significance of difference between the means of posttest scores of the experimental and control groups on Metacognitive Outcomes ($t_{(74)} = 5.23, p < .05$) and the components of Metacognitive Outcomes, namely, Declarative Knowledge ($t_{(74)} = 4.71, p < .05$), Procedural Knowledge ($t_{(74)} = 3.17, p < .05$), Conditional Knowledge ($t_{(74)} = 2.92, p < .05$), Prediction ($t_{(74)} = 3.15, p < .05$), Planning ($t_{(74)} = 2.74, p < .05$), Monitoring ($t_{(74)} = 2.60, p < .05$) and Evaluation ($t_{(74)} = 4.99, p < .05$) reveal that the experimental group has significant improvement in Metacognitive Outcomes when compared with the control group after the experiment. This proved that the Cognitive Apprenticeship Model is superior to the Existing method in improving Metacognitive Outcomes.

The gain scores of the experimental and control groups when subjected to the test of significance of difference between the means of Metacognitive Outcomes ($t_{(74)} = 7.64, p < .05$) and the components of Metacognitive Outcomes, namely, Declarative Knowledge ($t_{(74)} = 7.38, p < .05$), Procedural Knowledge ($t_{(72)} = 4.51, p < .05$), Conditional Knowledge ($t_{(74)} = 3.95, p < .05$), Prediction ($t_{(74)} = 4.80, p < .05$), Planning ($t_{(74)} = 3.90, p < .05$), Monitoring ($t_{(74)} = 3.63, p < .05$) and Evaluation ($t_{(74)} = 5.04, p < .05$) reveal that there is significant difference between the gain scores of the experimental and control groups.

The results of the Analysis of Covariance to find the effectiveness of the Cognitive Apprenticeship Model over the Existing method on Metacognitive Outcomes ($F_{(1, 70)} = 52.45, p < .05$) indicate that there is a significant difference between the experimental and control groups when the effects of Intelligence and pretest on all the dependent variables were controlled. Moreover the results of the Analysis of Covariance for the components of Metacognitive Outcomes, namely, Declarative Knowledge ($F_{(1, 72)} = 24.99, p < .05$), Procedural Knowledge ($F_{(1, 72)} = 11.36, p < .05$), Conditional Knowledge ($F_{(1, 72)} = 10.65, p < .05$), Prediction ($F_{(1, 72)} = 10.57, p < .05$), Planning ($F_{(1, 72)} = 8.49, p < .05$), Monitoring ($F_{(1, 72)} = 9.75, p < .05$) and Evaluation ($F_{(1, 72)} = 35.31, p < .05$) reveal the significant effect of the Cognitive
Apprenticeship Model over the Existing method on the components of Metacognitive Outcomes.

The above all results proved that the Cognitive Apprenticeship Model is more effective than the Existing method on Metacognitive Outcomes.

10. **Cognitive Apprenticeship Model is more Effective than the Existing Method for Enhancing Social Skills and its Components**

This conclusion is substantiated by the following findings of the study.

The mean posttest score on Social Skills of the experimental group (115.45), taught through the Cognitive Apprenticeship Model is found to be higher than that of the control group (103.24), taught through the Existing method. Moreover the mean posttest scores on the components of Social Skills, namely, Cooperation (28.13), Interpersonal Relationship (29.42), Communicative Ability (28.71) and Concern for Others (29.18) of the experimental group are higher than that of the control group (Cooperation (24.23), Interpersonal Relationship (26.21), Communicative Ability (25.68) and Concern for Others (27.10)).

The t-values obtained by the test of significance of difference between the means of posttest scores of the experimental and control groups on Social Skills ($t_{(74)} = 3.84$, $p < .05$) and the components of Social Skills, namely, Cooperation ($t_{(74)} = 4.37$, $p < .05$), Interpersonal Relationship ($t_{(74)} = 3.15$, $p < .05$) and Communicative Ability ($t_{(74)} = 2.75$, $p < .05$) reveal that the experimental group has significant improvement in Social Skills and its components except for Concern for Others ($t_{(74)} = 1.99$, $p > .05$) when compared with the control group after the experiment.

The gain scores of the experimental and control groups when subjected to the test of significance of difference between the means on Social Skills ($t_{(74)} = 9.02$, $p < .05$), Cooperation ($t_{(74)} = 8.91$, $p < .05$), Interpersonal Relationship ($t_{(74)} = 8.29$, $p < .05$) and Communicative Ability ($t_{(74)} = 6.05$, $p < .05$) reveal that there is significant difference between the gain scores of the experimental and control groups. But there is no significant difference between the gain scores of the students in the experimental and control groups for the component, Concern for Others ($t_{(74)} = 0.96$, $p > .05$).
These two results proved that the Cognitive Apprenticeship Model is effective over the Existing method in fostering Social Skills and its components except for the component Concern for others.

The results of the Analysis of Covariance to find the effectiveness of the Cognitive Apprenticeship Model over the Existing method on Social Skills ($F_{(1,70)} = 74.41, p < .05$) indicate that there is significant difference between the experimental and control groups when the effects of Intelligence and pretest on all the dependent variables were controlled. Moreover the results of the Analysis of Covariance for the components of Social Skills namely, Cooperation ($F_{(1,72)} = 27.90, p < .05$), Interpersonal Relationship ($F_{(1,72)} = 21.17, p < .05$), Communicative Ability ($F_{(1,72)} = 18.65, p < .05$) and Concern for Others ($F_{(1,72)} = 14.86, p < .05$) show the significant effect of the Cognitive Apprenticeship Model over the Existing method on the components of Social Skills.

The above all results proved that the Cognitive Apprenticeship Model is more effective than the Existing method for enhancing Social Skills.

11. Performance of Boys and Girls in the Experimental Group on Achievement in Mathematics, Metacognitive Outcomes and Social Skills does not differ

This conclusion is supported by the following findings.

The mean gain scores on Achievement in Mathematics of the boys (12.82) and the girls (13.05) of the experimental group, Metacognitive Outcomes of the boys (19.94) and the girls (19.48) of the experimental group and Social Skills of the boys (17.18) and the girls (17.76) of the experimental group did not differ.

The t-values obtained by the test of significance of difference between the means of gain scores of boys and girls of the experimental group on Achievement in Mathematics ($t_{(36)} = 0.21, p > .05$), Metacognitive Outcomes ($t_{(36)} = 0.17, p > .05$) and Social Skills ($t_{(36)} = 0.22, p > .05$) indicate that there is no significant difference between the performance of boys and girls in the experimental group. This proved that the performance of boys and girls on Achievement in Mathematics, Metacognitive Outcomes and Social Skills are almost equal and there is no significant influence of gender on the performance of the experimental group.
5.3 Educational Implications of the Study

1. The results of the study revealed that the Cognitive Apprenticeship Model enhances Achievement in Mathematics, Metacognitive Outcomes and Social Skills in comparison to the Existing method. Owing to the need and importance of developing these outcomes, teachers should find ways to implement the Cognitive Apprenticeship Model in classroom teaching.

2. The instructional materials based on the Cognitive Apprenticeship Model evolved out of the research can be used by teachers for teaching Mathematics. Keeping the result of the study in mind, the agencies responsible to improve the quality of education should take up the task of developing instructional materials based on the Cognitive Apprenticeship Model for all the subjects.

3. The school curriculum can be modified to suit the Cognitive Apprenticeship Model. Curriculum should provide opportunities to the students to articulate, reflect and explore themselves so that the students will develop Metacognitive Skills.

4. Curriculum construction committee can revise the curriculum by incorporating the Cognitive Apprenticeship Model in order to develop the content knowledge, Metacognition and Social Skills among the students. National and State level curriculum frame workers should take measures to make educators aware of the potential of the Cognitive Apprenticeship Model by arranging seminars and workshops.

5. The existing teachers and teacher trainees can be given orientation and training on the development of instructional materials to teach through the Cognitive Apprenticeship Model at different levels. The NCERT, SCERT and DIET’s should take up the responsibility of developing instructional material adopting Cognitive Apprenticeship Model.

6. Pre-service and in-service teacher training programmes should focus on the importance of the Cognitive Apprenticeship Model in order to make the students develop Metacognitive and Social Skills.

7. Existing teacher training institutions can incorporate the steps involved in the Cognitive Apprenticeship Model in teacher training so that prospective teachers can develop Metacognitive Outcomes and Social Skills.
8. Tools constructed for this study especially the Scale of Metacognitive Outcomes and the Social Skills Rating Scale can be used for further related studies. Those tools can be widely used in other parts of India and the World to measure the Metacognitive Outcomes and the Social Skills of the secondary school students.

9. Introducing the Cognitive Apprenticeship Model in faculty improvement programmes, namely, orientation classes, refresher courses, seminars and workshops will give positive outlook on this model and teachers should try to practice that in the school.

5.4 Suggestions for Further Research

1. Further research studies can be done in other subject areas like Science, Commerce and Languages. Similar experimental studies may be conducted for secondary and primary students selecting different topics so that they can experience this new method of teaching learning process.

2. Similar experimental studies can be conducted on a wide range of school/college students at different levels.

3. Study can be conducted to find out the comparative effect of Cognitive Apprenticeship Model and other strategies.

4. Similar studies can be conducted to find out the external validity of the method specially based on different demographic variables. Studies can be conducted with different experimental designs to collect more reliable data.

5. Similar studies can be conducted for longer period under carefully controlled conditions.

6. Similar studies can be conducted with larger samples comprising students from different States of India.

7. Instead of using a rating scale, researchers can use the observational technique to measure Metacognitive Outcomes and Social Skills.

8. A survey can be carried out to find out the level of Metacognitive Outcomes and Social Skills among students at different levels and among learning disabled children.
9. A survey can be carried out to find out Metacognitive Outcomes and Social Skills among teachers of different educational field.

5.5 Delimitations of the Study

1. The study was confined to the students of standard eight from Kottayam District of Kerala State.

2. Only important components of the Metacognitive Outcomes and the Social Skills were included in the study.

3. Study was conducted in a school which follows the curriculum designed by the Board of Secondary Education in Kerala State.

4. The content selected for the preparation of the instructional material was delimited to only certain portions prescribed in the Mathematics textbook of standard eight.

5.6 Conclusion

The study persuasively revealed that the Cognitive Apprenticeship Model is effective in fostering Achievement in Mathematics, Metacognitive Outcomes and Social Skills among the secondary school students. Based on the findings, it is suggested that the Cognitive Apprenticeship Model should be encouraged in schools. The investigator hopes that the present study will pave way to make the teaching learning process more meaningful and interesting through such constructivist approaches in education.