CHAPTER-V

SUMMARY AND CONCLUSION

5.1 Introduction

This chapter brings out the findings of the study, the implications of the study and some suggestions for further research. The purpose of the study was to examine the Effectiveness of Inquiry-Based Instruction on Achievement in Science, Science Process Skills, Attitude towards Science and Metacognition of Higher Secondary School Students.

5.2 Conclusions based on the findings of the study

The major conclusion of the study is:

Conclusion-1: Inquiry-Based Instruction was found to enhance the Achievement in Science, Science Process Skills, develop positive Attitude towards Science and improve Metacognitive Awareness of higher secondary students when compared to Conventional method of teaching**.**

It was found from the t-test results that there is a significant difference in the Post-test scores of Experimental group and Control group studentson Achievement in Science, Science Process Skills,Attitude towards Science, and Metacognitive Awareness. The mean values obtained suggests that the Post-test scores are better for the Experimental group students on all the dependent variables, namely, Achievement in Science (t=19.54), Science Process Skills namely, Observation (t=47.29), Classification (t=25.37), Communicating (t=28.32), Experimenting (t=23.61), Interpretation of Data (t=39.31) and Formulating Model (40.43), Attitude towards Science (t=15.99), and Metacognitive Awareness (t=18.70) indicating that the Inquiry-Based Instruction is also better than the conventional method of teaching.

The otherconclusions of the study are given below:

Conclusion-2: Achievement in Science and Attitude towards Science were positively related.

The correlation coefficient between Achievement in Science and Attitude towards Sciencewas(.783**) which indicates that the two variables are positively correlated.

Conclusion -3: Achievement in Science and Science Process Skills were positively related.

Achievement in Science and the different Science Process Skills namely Observation (.901**),Classification (.840**), Communicating (.844*), Experimenting (.815**), Interpretation of Data (.839**),and Formulating Model (.883**) were statistically significant.

Conclusion–4: Achievement in Science and Metacognitive Awareness were positively related.

This Conclusion is supported by the following finding:

Statistical analysis of the relationship between academic achievement in science and Metacognitive Awareness yielded positive correlation in all components and subcomponents of Metacognitive Awareness, except for the sub component comprehension monitoring with procedural knowledge, conditional knowledge and evaluation.The correlation coefficient between Achievement in Science and Metacognitive Awareness,namely Knowledge about Cognition(.684**),Procedural Knowledge (.560**), Declarative Knowledge (.537**), Conditional Knowledge (.480**), Regulation of Cognition (.697**),Planning (.435**), Information Management Strategy (.432**), Comprehension Monitoring (.387**), Debugging Strategy (616**), Evaluation (484**) and Metacognitive Awareness (.745**) were statistically significant.

Conclusion–5: Science Process Skills and Attitude towards Science were positively related.

This conclusion is supported by the following finding:

The correlation coefficient between Attitude towards Science and the different Science Process Skills namely Observation (.835**), Classification (.791**), Communicating (.771**), Experimenting (.767**), Interpretation of Data (.831**), Formulating Model (.829**) indicates that the two variables were positively correlated.

Conclusion–6: Attitude towards Science and Metacognitive Awareness were positively related.

Statistical analysis of the relationship between Attitude towards Scienceand Metacognitive Awareness yielded positive correlation in all components and subcomponents of Metacognitive Awareness, except for the sub component

comprehension monitoring with procedural knowledge, conditional knowledge and evaluation.The correlation coefficient between Attitude towards Science and Metacognitive Awareness namelyKnowledge about Cognition (.673**), Procedural Knowledge (.505**), Declarative Knowledge (.553**), Conditional Knowledge (.472**), Regulation of Cognition (.650**), Planning (.400**), Information Management Strategy (.505**), Comprehension Monitoring (.267*), Debugging Strategy (.523**), Evaluation (.466**)and Metacognitive Awareness (.710**) were statistically significant and positively correlated.

Conclusion–7

Differential analysis using t-test revealed that there is no significant difference in the Pre-test scores of Experimental and Control group students on Achievement in Science, Science Process Skills, Attitude towards Science, and Metacognition.

Conclusion – 8

t-test results revealed that there is a highly significant difference in the Pre-test and Post-test scores of the Experimental group on Achievement in Science, Science Process Skills , Attitude towards Science, and Metacognition. The mean values obtained suggests that the Post-test scores are better for the Experimental group students on all the dependent variables, namely, Achievement in Science, Science Process Skills , Attitude towards Science, and Metacognition

Conclusion – 9

t-test results revealed that there is a highly significant difference in the Pre-test and Post- test scores of the Control group on Achievement in Science, Science Process Skills , Attitude towards Science, and Metacognition. The mean values obtained suggests that the Post-test scores are better for the Control group students on all the dependent variables, namely, Achievement in Science, Science Process Skills , Attitude towards Science, and Metacognition indicating that the conventional teaching method is also better.

Conclusion –10

Analysis of Covariance for the Pre-test, Post-test and AdjustedPost-test means on Achievement in Science, Science Process Skills ,Attitude towards Science, and Metacognition of Experimental group and Control group revealed that there is asignificant

difference in the Post-test and AdjustedPost-test mean scores of students of Inquiry-Based Instruction and Conventional method groups when their Pre-test scores on Achievement in Science, Science Process Skills ,Attitude towards Science, and Metacognition score were taken as Covariate.

Conclusion –11

When the Pre-test scores on Achievement in Science, Science Process Skills ,Attitude towards Science, and Metacognition ,of Boys and Girls of Control group and Experimental group were compared using t –test, the results revealed that there was no significant difference in the Pre-test scores on Achievement in Science of Boys and Girls, Science Process Skills , Attitude towards Science, and Metacognition of Control group and Experimental group.

Conclusion –12

Analysis of the pretest and post test scores obtained by Experimental group Boys and Girls on Achievement in Science, Science Process Skills, Attitude towards Science, and Metacognition revealed that there is a significant difference in the Pre-test and Post-test scores on all the four dependent variables of Boys and Girls and the mean values indicated that Post-test scores were better than the Pre-test scores in all the four dependent variables.

Conclusion –13

Analysis of the Pre-test and Post-test scores obtained by Control group Boys and Girls on Achievement in Science, Science Process Skills , Attitude towards Science, and Metacognition revealed that there is a significant difference in the Pre-test and Post-test scores on all the four dependent variables of Boys and Girls and the mean values indicated that Post-test scores were better than the Pre-test scores in all the four dependent variables.

Conclusion –14

Analysis of Posttest scores of Boys and Girls of Control group and Experimental group onAchievement in Science, Science Process Skills, Attitude towards Science, and Metacognition showed that there is a significant difference in the Post-test scores of Boys

and Girls and the mean values indicated that Post-test scores of students of Inquiry-Based Instruction group (both Boys and Girls) were better than the Post-test scores of students of Control group taught by conventional method.

Conclusion –15

Gender wise there is no significant difference in Achievement in Science of students in the Inquiry-Based Instruction group.

Gender-wise analysis ofachievement of students of experimental and control group revealed that there is no significant difference in the Post-test scores of Boys and Girls of Experimental group, but there was a significant difference in the Post-test scores of Boys and Girls of Control group(t=4.19). The mean scores showed that Post-test scores of Boys(41.05) of Control group is better than the Girls(35.85) of the Control group.

Conclusion –16

Girls of Inquiry-Based Instruction group possessed better Classification, Communicating, and Collection and Interpretation of data skills than Boys, whereas Boys had better observation skill.

Gender wise analysis of Post-test scores of Science Process Skills of Control group and Experimental grouprevealed that there was a significant difference in the Post-test scores of Boys and Girls of Experimental group on the Science Process Skills namely, Observation (t=3.15), Classification (t=11.01), Communicating (t=2.57), and Collection and Interpretation of data (t=10.18). The mean value indicated that boys of Experimental group had better Observation skill whereas girls of Experimental group possessed better Classification, Communicating, and Collection and Interpretation of data skills.

The t-test results revealed that there is a significant difference in the Post-test scores of Boys and Girls of Control group, for the Observation (t=2.76) and Collection and Interpretation of data skills (t=9.51) with the mean values indicating that Boys(4.47) possess better Observation skill and Girls possess better Collection and Interpretation of data skill.

Conclusion –17

Boys of both Control and Experimental group had better Attitude towards Science than the Girls.

Gender wise analysis of Post-test scores of Attitude towards Science of Control group and Experimental group brought out the finding that there was a significant difference in the Attitude towards Science of students of both Control (t=5.22)and Experimental group(t=2.40). The mean values suggested that Boys of both the groups (control group=6.23 and experimental group = 7.43) had better Attitude towards Science than the girls (control group=4.40 and experimental group =5.94).

Conclusion –18

Girls of Experimental group had better Metacognitive Awareness, Knowledge of Cognition, and Debugging Strategies than the Boys.

Gender wise analysis of Post-test scores on Metacognitive Awareness and its components of the Control group and Experimental group revealed that there is a significant difference in the total Metacognitive Awareness score (t= 2.68), Knowledge of Cognition (t = 3.47),and Debugging Strategies (t=5.33) of Boys and Girls of Experimental group and the Procedural knowledge(t=3.00) of Boys and Girls of Control group. The mean values suggest that Girls of Experimental group (mean scores-40.85, 14.85, 4.75) had better Metacognitive Awareness score, Knowledge of Cognition ,and Debugging Strategies than the Boys(mean scores-38.90, 13.65, 4.15).It was seen that the Procedural knowledge of Girls(mean score =4.50) of Control group was better than the Boys(mean score =3.75) in the Control group.

Conclusion –19

DelayedPost-test score on Achievement in Science and Attitude towards Science were better than the Post-test scores for the Inquiry-Based Instruction group

It was found from the t-test result(1.45) that there is no significant difference in the Post-test scores and DelayedPost-test scores of students of Control group, but there is a significant difference (t=10.22) in the Post-test scores and DelayedPost-test scores of students of Experimental group. The mean value obtained by the Experimental group

students in the DelayedPost-test (67.22) was better than the Post-test scores (60.57) indicating that the students were able to retain the concepts learned even after the intervention.

There was no significant difference in the Post-test scores and DelayedPost-test scores of students of Control group (t=1.31) , but there is a significant difference in the Post-test scores and DelayedPost-test scores of students of Experimental group(t=10.15). The mean value obtained forDelayedPost-test (77.33) was better than the Post-test mean (64.40) scores.

Conclusion –20

Majority of the students favored Inquiry-Based Instruction.

Qualitative analysis of data obtained from the semi structured interview revealed that 80 percent of Experimental group students liked the Inquiry-Based Instruction and the experiments and activities conducted while 20 per cent of students liked to do activities and experiment given in the lab and classrooms.89 percent of students felt that Peer learning is possible while learning through Inquiry- Based teaching. Ninety one per cent of students opined that they felt as if they were like scientists and all the students (100%) felt that they very active and there was no monotony during Inquiry-Based Instruction.

Conclusion – 21

Majority of the teacher were supporting the Inquiry-Based Instruction

It was opined by all the teachers of the school (100%) that Inquiry-Based Instruction method improved the achievement of the students, and agreed that due to implementation of Inquiry-Based Instruction, students were curious to learn new concepts. Eighty six percent of teachers believed that after implementation of IBI method students became disciplined and 72% of teachers agreed that Inquiry- Based Instruction method developed the self-confidence of their students. It was also observed by all the teachers(100%) that implementation of Inquiry- Based Instruction was the main reason for the school to get certified with ISO (International Organization for Standardization)

Figure 5.1 Media reports related the Intervention

5.3 Educational Implications of the study

The present study was aimed to find out the Effectiveness of Inquiry-Based Instruction onScience Process Skills, Achievement in Science, Attitude towards Science and Metacognitive Awareness of students of higher secondary school level. The findings of the study revealed that teaching based on Inquiry-Based Instruction has significant influence on Science Process Skills of higher secondary school students. The study also proved that instruction based on Inquiry- Based Instruction was not only effective for Science Process Skills and also effective for the enhancement of Metacognitive Awareness, Achievement in Science and develop a positive Attitude towards Science.

The Educational Implications of the study based on the findings are given below.

The 7E Inquiry-Based Instruction cycle is process oriented, learning through this method makes the students to use their Process Skills to learn scientific concepts. The method of teaching science needs to be modified as the teachers need to engage their students in the process of learning. For this, teachers themselves should have an

awareness on Science Process Skills and hence should be given in service training for process oriented teaching.

This model exposes students to problem situations like eliciting and engaging their thinking. It provides opportunities to explore, explain, elaborate and evaluate which in turn enhances the Achievement in Science, Science Process Skills, Attitude towards Science and Metacognition.

As students ask questions, and these questions lead to solution to the problem, it results in the beginning of exploration and hypothesis. These hypotheses will lead the students to investigate and test the hypothesis and find solutions to the problem and construction of knowledge based on the investigative findings.

7E Model emphasizes the constructivist concept of peer-peer interaction in learning. It also places greater emphasis on learner's prior experience rather than the teachers and on the active construction of knowledge than the passive reception of information. 7E students learn how to articulate their ideas clearly and effectively. As there is sharing of ideas in group discussions students can exchange and negotiate their ideas with others and evaluate their contribution in socially acceptable manner.

7E Model gives the teachers enough freedom to choose activities and materials of varying forms and this helps in planning the classroom activities according to the needs and interest of the students. This innovative planning will improve the creative level of the teachers and students.

The evaluation phase of the 7E Model provides best option for assessment and correction. As Science is a process oriented discipline, the assessment of Process Skills is inevitable and needs to be conducted periodically. Hence it becomes imperative to reframe the examination system in such a way that it facilitates the assessment of Process Skills along with the achievement in science. For this performance based tests need to be conducted.

5.4 Recommendations from the study

After successfully carrying out the intervention this studybrings out the following recommendations for different stakeholders.

- Curriculum planners should map the entire curriculum in all the discipline on the basis of Inquiry-Based Instruction Method to prepare students for lifelong learning.
- Regular seminars, trainings, workshops for principals, teachers and students should be arranged on Inquiry-Based Instructionmethod for it greater awareness and promotion.
- Head of the institutions should motivate teachers to conduct action research projects for the different dimensions of Inquiry-Based Instruction method.
- Teacherscan practice Inquiry-Based Instruction method for better academic results and for achieving short as well as long term educational goals.
- As this method will enhance Achievement in Science, Science Process Skills ,Attitude towards Science and Metacognitive Awareness of the students, teachers can plan to give different activities based on the content using Inquiry-Based Instruction method.
- The teachers of all disciplines can apply Inquiry-Based Instruction method to teach their subject.
- By using IBI Method, teachers can help students to meet future challenges in learning by developing inquiry skills , develop the habits like thinking divergently, observing and exploring the nature and surroundings
- Students can make use of Inquiry-Based Instruction to develop their discovery skills, which can help them to hypothesize and find solutions to different problems both in academics and in their life.
- Parents can provide an Inquiry-Based environment in their home to motivate their wards to be engaged in the experience oriented Inquiry-Based Instruction.

5.5. Suggestions for further Research

On the basis of the conclusions arrived, the following suggestions are proposed for further research.

- Studies can be conducted to explore the difficulties and challenges involved in the use of Inquiry-Based Instruction while learning in school.
- Studies can be conducted to explore the difference between classroom Inquiry and field Inquiry among higher secondary students.
- Studies can be conducted to explore the effect of IBI Methodin Achievement in Science, Attitude towards Science, Science Process Skills, and Metacognition of students of primary, and high school level and in higher education.

Research in the suggested areas can enrich students' Science Process Skills, Metacognitive Awarenes, Achievement in Science and Attitude towards Science.

Conclusion

The present study revealed that Inquiry-Based Instruction will enhance the Achievement in Science, develop Science Process Skills, inculcates positive Attitude towards Science and make students to be better aware of their own cognitive process. It is seen that Inquiry- Based Instruction is better for the adolescent students also and it makes learning permanent. Proper environment is essential and inevitable for appropriate development of Scientific Attitude and Science Process Skills. It is necessary to construct classrooms and environment that help to promotethe Science Process Skills and Metacognition which in turn brings out better Achievement in Science and a positive Attitude towards Science. The researcher would be grateful, if the findings of the present study could be considered for the development of Science in Schools.