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EFFECTIVENESS OF INTERVENTION PROGRAMME ESPOUSING INQUIRY TRAINING MODEL ON ACHIEVEMENT IN SCIENCE AND TECHNOLOGY OF STANDARD VIII STUDENTS OF JUNAGADH CITY

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Abstract:

Science forms an integral part of learning. It is studied to understand the world from a different perspective where we need not simply substitute many things just as God's work rather understand the wonders of the nature. Science helps to understand the working of the world. How things move around us? How things grow? It combines all observations and research and brings a general idea of each and every process which makes us understand the whole working. Essentially it has to be learnt mainly through concrete situations related to immediate environment. The main focus of imparting science education is on sharpening the senses of the learners and encouraging them to discover, observe and explore their environment and surroundings every small things can be explained by science. Every question has an answer through science. Though many certain things are still in research, science is truly the best field to understand the workings of the world. Whenever we come across anything which is unfamiliar, may it be an object, event or situation, our mind is stirred by questions which may help us in knowing more about the object of our curiosity. Nature has gifted us with the tool of curiosity for learning more and more. According to Singh (1995), "Whenever we are in a process of finding out or investigating through questions, we are in the process of inquiry. From a simple array of questions, if the inquiry takes the form of a disciplined and systematic approach, it becomes the spirit of scientific method". Therefore training the learners through their curiosity can be a way to orient their minds towards scientific inquiry. The present study was an attempt to find out the effectiveness of intervention programme espousing inquiry training model on achievement in science and technology of standard VIII students of Junagadh city. The programme was found to be effective in terms of the achievement of the students. Also the opinion of the students proved the programme to be effective. The results of the study shows that if regular classroom science teaching is made activity based and interactive then it will definitely positively affect the learning and achievement of the students. Inquiry training model is effective in terms of retention of the concepts as well as generating curiosity among learners.

Keywords: Inquiry training model, Achievement, Implementation, Syntax, Social System.

INTRODUCTION

Science forms an integral part of learning. Essentially it has to be learnt mainly through concrete situations related to immediate environment. The main focus of imparting science education is on sharpening the senses of the learners and encouraging them to discover, observe and explore their environment and surroundings. Instead of loading the students with scientific information, efforts should be made to help them learn key concepts which cut across all the disciplines of science. This would generate curiosity and would enhance awareness and understanding.

Whenever we come across anything which is unfamiliar, may it be an object, event or situation, our mind is stirred by questions which may help us in knowing more about the object of our curiosity. Nature has gifted us with the tool of curiosity for learning more and more about our environment. It is common to observe children asking a lot of questions about anything which arouses curiosity. According to Singh (1995), "Whenever we are in a process of finding out or investigating through questions, we are in the process of inquiry. From a simple array of questions, if the inquiry takes the form of a disciplined and systematic approach, it becomes the spirit of scientific method". Therefore training the learners for investigating a concept and explaining any type of puzzling problem, phenomena or event can be a way of orienting their minds towards scientific inquiry.

Nature of science is such that it demands the spirit of inquiry and science as school subject has a wide scope of scientific inquiry. There are various methods and models of teaching through which learners can be taught science through the process of inquiry. According to researcher Inquiry Training Model (I.T.M) is best suited to orient the minds of learners towards scientific inquiry ITM is a part of information processing family. In this model the process part is more important than the product part i.e. how the concept is learned is more important. This helps the students to strengthen their thinking and reasoning capacity.

In this study the researcher aims to develop spirit of inquiry in learners by teaching relevant concepts of science through ITM.

NATURE AND STRUCTURE OF SCIENCE

The word science finds its origin in the Latin words 'scientia' which means knowledge and 'scire' which means knowing. The most general definition one can think of is that science in any form is organized knowledge. It is not just a static body of already established facts but a living traditions of never finished explorations into secrets of nature. Sharma (1975) defines science as "an accumulated and systematized learning in general usage restricted to natural phenomena". Science is built on facts and logic which does not depend on historical reports, majority opinions, fashion or taste.

Sharma (2003) gave three basic principles of nature of science. These are:

a) An accumulated and systematized body of knowledge.
b) Scientific method and inquiry.

c) Scientific attitude

Thus the progress of science is marked not only by accumulation of facts but by the emergence of scientific method and attitude. In other words, science is a product in terms of accumulated and systematized body of knowledge, and it is a process in terms of method of inquiry and attitude. The style of inquiry which has been developed overages is known as scientific method.

NEED OF TEACHING SCIENCE THROUGH INQUIRY

To achieve the objectives of teaching science, it is imperative that teaching methods should be modified. According to NCERT (2006), "for any qualitative change from the present situation, science education in India must undergo a paradigm shift. Rote learning should be discouraged and inquiry skills should be strengthened and supported." According to Menon (1986), science teaching should depend on following premises:

» The essence of science is its process of inquiry and not the diverse information that form part of its substantive of product dimension.

» Teaching of science should not be taken to constitute merely of presenting the bits of information that have already been established as integral part of knowledge structure.

» Learning of a concept from learner's point of view and not memorizing the verbal statements of the concept. Hence science is best learnt and taught through an inquiry approach.

» Learning is acting upon the environment and solving his or her problems and making his or her own discoveries.

CONCEPT OF INQUIRY TRAINING MODEL (ITM):

The emphasis of ITM is upon making the learners aware of the inquiry process through structuring and re-structuring of questions and sequencing them appropriately. The learners are actively involved in data gathering and hypothesis verification but all this happens through questioning related to the problem presented by the teacher in the beginning. The teacher guides the students to frame such questions which can be answered in 'Yes' or 'No'.

OBJECTIVES OF ITM:

Singh (1995) and Joyce et.al. (2008) gave objectives of ITM in their respective books. Author has presented relevant objectives from both the books. These objectives are as follows:

a) To develop scientific process skills: observing, collecting and organizing data, identifying and controlling variables, formulating and testing hypothesis, explanations and inference.
b) To develop autonomous learning.
c) To develop ability to tolerate ambiguity.
d) To develop logical thinking.
e) To make students understand that all knowledge is tentative.

ITM CHART:

Joyce et.al. (2008) summarizes I.T.M in the following way:

(A) SYNTAX

Phase 1: Presentation of puzzling event and explanation of inquiry procedure.

In this phase the teacher demonstrates through an experiment or narrates a phenomenon which seems puzzling for students and triggers their thinking process.

Phase 2: Data gathering and verification

In this phase the students try to find out the variables associated with the given phenomena and their interrelationship.

Phase 3: Hypothesis and testing

Then the students try to find out the probable causes of that phenomenon. They formulate various hypotheses which are subjected to testing in the form of questions. If the answer of a particular question is 'no', then that particular hypothesis is rejected. Thus out of many hypotheses only few are not rejected which stands as the causes of that phenomena.

Phase 4: Formulating an explanation

After testing all hypotheses, students try to form an explanation considering the hypothesis which is not rejected. Thus they try to reason out the occurrence of that particular phenomenon.

Phase 5: Analysis of inquiry process

Finally, the teacher concludes by summarizing the concept to be taught. Also teacher analyse the entire process and point out the mistake made by students and also discusses the ways to rectify the mistakes.

B) SOCIAL SYSTEM

Co-operation, intellectual freedom and equality is must among students – students and teacher – students. Interaction among students should be encouraged.

C) PRINCIPLES OF REACTION:

a) Ensure that questions are phrased so they can be answered in 'yes' or 'no' and that substance does not require the teacher to do inquiry.

b) Ask the students to rephrase invalid questions.

c) Point out invalidated points.

d) If necessary, new information can be provided to keep the inquiry moving.

e) Try to provide a free intellectual environment by not evaluating student theories.

f) Encourage interaction among students.

D) SUPPORT SYSTEM:

The optimum support is a set of confronting materials, a teacher who has content mastery and understands the strategy of inquiry and resource materials bearing on the problem.

LIMITATIONS OF ITM:

Singh (1995) gave some limitations of ITM which are as follows:

» Helps in developing explanations on the basis of previous knowledge. So it is very necessary that students have some basic information which will guide them in the inquiry process.

» New concepts and formulae cannot be taught as students need some knowledge to start the inquiry process so if the concept is entirely alien to the students then it cannot be taught through ITM

» If the puzzling situation is not presented in the form of a problem requiring explanation, the student cannot effectively arrive at generalization through inquiry.

ROLE OF TEACHER:

» Should guide the students during the inquiry process, prevent them from going on wrong track and creating chaos in the class and have content mastery.

» Be flexible and provide free environment to the students and manage the time.

» Continuously keep a watch on student and stop them from moving out of track.

» Continuously motivate the students so they are inquisitive to know more.

» Help in inquiry but do not do inquiry for students.

» Before planning and implementation of ITM, the teacher should check the previous related knowledge of students.

» After students arrive at generalization, teacher should summarize in such a way that the concept clarity is attained by students.

» Teacher should have clear knowledge of all the related content matter.

» The hypotheses/questions having 'Yes' answers should be written on board so that it becomes easy for students to generalize.

» If questions are not framed properly, teacher should not ignore that question but ask the students to reframe them properly.

Reflecting on the objectives of teaching the subject science and technology and the advantages of using ITM the researcher thought of taking up a study to find the effectiveness of the intervention programme developed based on ITM on the achievement of the students of elementary school specifically at standard VIII in Junagadh City.

RATIONALE

Education is a very important factor for human life. Through education, attitude, character, personality and human skills will be formed to face a better future. Education is a future asset that determines the advancement of a nation. Improving the quality of education should be a top priority in development.

The present world is a world of science and technology. Everything or every event happening around us demands some knowledge of simple scientific facts and principles. Looking into the nature of science, it is both product and process and also the objectives of teaching science emphasize on development of scientific attitude. Moreover, almost all commissions and committees appointed by Govt. of India recommended the development of science attitude. According to NCF (2000), "science education should be such that it helps to generate and promote among the learners' scientific temper characterized by the spirit of inquiry, problem solving, courage to question and objectivity leading too elimination of superstition and fatalism." Thus science education if properly conceived should primarily be concerned with the education if properly conceived should primarily be concerned with the education of mind rather than the acquisition of violated pieces of scientific knowledge.

Science forms an integral part of learning. Essentially it has to be learnt mainly through concrete situations related to immediate environment. The main focus of imparting science education is on sharpening the senses of the learners and encouraging them to discover and explore their environment and surroundings. Instead of loading the students with scientific information, efforts should be made to help them learn key concepts which cut across all the disciplines of science. This would generate curiosity and would enhance awareness and understanding. Whenever we come across anything which is unfamiliar, may it be an object, event or situation, our mind is stirred by questions which may help us in knowing more about the object of our curiosity. Nature has gifted us with the tool of curiosity for learning more and more about environment. It is common to observe children asking lot of questions about anything which arouses curiosity.

An important purpose of science teaching in general education upto secondary stage is to familiarize the learners with various dimensions of scientific literacy. Scientific attitude, a very important attitude should be developed in the children who are the future citizens, if the objectives of teaching science are to be achieved.The reality in schools, especially in physics learning has not been much learning activities that are oriented toward habituation and improvement of science process skills. Students are expected to absorb information passively and then remember it during the test. This kind of learning resulted in students not having experience to observe, measure and experiment. Students' ability is limited to the memorization. One of the causes of the above problems is the weakness of the learning process. The learning process that is applied so far less empower the students to train the process skills in obtaining and understanding the material being studied. Learning should also be designed to train students' skills in the psychomotor domain. Learning students with SPS can improve students' psychomotor competence.Science teaching through the use of models of information processing family can prove to be very significant in the development of scientific attitude. The common objectives of all the models in this family are to help the students become more powerful learners.

Amin (2011) implemented ITM as one of the activity of science teaching on pre service student teachers. The findings reflect its effectiveness in terms of understanding, content clarity, attitude development, decision making, achievement and science process skills. Also the main focus of the present study is to make students pass through an inquiry process which probably will help in development of scientific

attitude and better learning. Thus according to the researcher ITM was appropriate for present study. The effectiveness of this model was founded in terms of the achievement of the students. One of the reasons to select school students for the present study was that the researcher wanted to find out how effective is the intervention programme based on ITM at elementary classes thus researcher took up the present study.

OBJECTIVES OF THE STUDY

1. To develop and implement the intervention programme, to teach the subject science and technology using inquiry training model for class VIII students of Junagadh city.
2. To measure the achievement of the students of class VIII in the subject science and technology of Junagadh city.
3. To find out the effectiveness of the developed intervention programme in terms of:
    a. achievement of students
    b. opinion of the students regarding the programme

HYPOTHESIS

H01) There will be no significant difference between the mean gain score on achievement of the experimental group and that of controlled group.

DELIMITATION OF THE STUDY

1. The present study was delimited to students of English medium schools of Junagadh city following CBSE syllabus.
2. Science concepts were delimited to concepts of combustion, properties of air, transfer of heat, depletion of ozone layer and static electricity.

STATEMENT OF THE PROBLEM:

Effectiveness of Intervention Programme Espousing Inquiry Training Model On achievement in Science and Technology of Standard VIII Students of Junagadh City.

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METHODOLOGY

The present study was quantitative in nature.

DESIGN OF THE STUDY

Design of the study was quasi – experimental. Pre test and post test was implemented on experimental and controlled groups. Implementation of ITM was independent variable and achievement of the students was dependent variable. Age was the controlled variable. Environmental factors like motivation level, exposure to other agencies of knowledge gaining were intervening variables which were thought to be equally affecting both the groups.

POPULATION

Approximately 240 students of standard VIII of 4 English medium schools of Junagadh city following CBSE syllabus was the population for the present study.

SAMPLE

Purposive sampling technique was used. Gyanbagh International School was selected as experimental group and Podar International School was selected as controlled group. Section A of both the schools participated in this study with 30 students in each class. Thus the sample size was 60 students.

PHASES OF THE PROGRAMME

PHASE I DEVELOPMENT OF THE PROGRAMME: content analysis was done of science textbook of standard VIII and six concepts were identified which could be taught through the ITM. These six concepts were: (i) oxygen is necessary for combustion, (ii) ignition temperature is necessary for combustion, (iii) transfer of heat, (iv) properties of air, (v) depletion of ozone layer and (vi) static electricity. The students do have a basic knowledge about these topics and there is a scope of inquiry for teaching these concepts.

Separate experiments were designed for each concept. The programme was validated bySharma, D., Rajpura, R., Pathak, J., Rathod, R., Joshi, D., Soni, D., Khanna, D. and Trivedi, N.(List of Experts is Appended in Appendix IV)The following table shows the designed experiments:

Table 1: Development of the Programme

Sr. No.	Concept	Experiment
1.	Oxygen is necessary for combustion	Light a candle and invert a glass on it. Observe and reason out.
2.	Ignition temperature is necessary for combustion	Take two papers. Make them conical in shape. Keep one cone empty and fill another cone with water. Bring both the cones near a candle flame. Observe and try to find out the reason.
3.	Transfer of heat	Take two beakers. Keep one empty beaker inside the refrigerator for some time. Light an incense stick inside another beaker and cover it with a piece of cardboard. After the beaker gets filled with smoke put the refrigerated beaker upside down on the beaker. Remove the cardboard slowly and observe.
4.	Properties of air	Place a glass. Keep a piece of paper inside it. Take a matchstick and burn the paper inside the glass. Blow a balloon and cover the glass with it. Observe.
5.	Depletion of ozone layer	Take two empty plastic bottles. Fill one bottle with boiling water to the top and another bottle to the halfway. Cover the top with chewing gum. Observe.
6.	Static electricity	Put some salt and pepper in a small dish. Mix it together. Give a plastic comb a static charge by running it through hair. Hold the statically charged comb over the dish, and observe.

PHASE 2 ADMINISTRATION OF PRE TEST:

An achievement test was administered on both experimental group and controlled group before implementation of the developed intervention programme. proper sitting arrangement of the students was ensured before administering the test. Two children on one bench were allowed to sit. Students were given 30 minutes for completion of the test. They had to write the answer in the question paper itself.

PHASE 3 IMPLEMENTATION OF THE PROGRAMME

The developed programme was implemented only on experimental group. The students were shown the experiment and then were given timefor inquiry and think of the probable causes of the phenomena. Then they had to present the probable causes in the form of question which can be answered only in 'YES' or 'NO'. Then at the end, suitable explanation was given by the students based on the positive hunches. The same method was followed for all the concepts.

PHASE 4 ADMINISTRATION OF THE POST TEST AND OPINIONNAIRE:

After the intervention programme on experimental group, again the same achievement test was administered on both the experimental as well as controlled group. An opinionnaire was implemented only on experimental group for knowing the reactions of the students regarding the programme.

TOOLS AND TECHNIQUES:

ACHIEVEMENT TEST: An achievement was constructed by the researcher. This test contained objective type questions and short answer questions covering all concepts. Each question was of one mark. The test contained total of 30 questions based on blueprint given below. The following table shows the distribution of the questions.

Table 2: Distribution of questions according to the level of objectives

Concepts/ level of objectives	Knowledge	Understanding	Application	Total
Combustion and oxygen	3	1	0	4
combustion and ignition temperature	4	1	1	6
Transfer of heat	2	3	1	6
Properties of air	2	2	2	6
Global warming	2	1	0	3
Static electricity	1	3	1	5
Total	14	11	5	30

OPINIONNAIRE: the opinionnaire was prepared by the researcher and validated by the experts. Only close ended statements and 5 point rating scale was prepared to determine the effectiveness of the programme after intervention of the experiment.

DATA COLLECTION:

For the purpose of data collection, researcher personally visited both the schools and took permission from the respected principals and explained them the purpose of the research. First pre test was administered on both the groups. Then ITM was implemented only on experimental group by the researcher. Controlled group followed their regular teaching by lecture method. Lately post test was administered on both the groups. Thus the achievement scores in pre and post test of the sample is the data for current study.

The duration of the data collection was of 8 days. 2 days for pre test and post test and 6 days for implementing ITM on experimental group.

DATA ANALYSIS

The data obtained was analyzed by using following statistical techniques such as frequency, percentage and t – test.

FINDINGS

- t – value calculated > t – value in table at 0.01 level of significance. So the null hypothesis "there will be no significant difference in the mean achievement scores of experimental group and that of controlled group" is rejected at 0.01 level of significance.

Table 3: t – value

N	Mean	SD	SEM	T
Experimental group 30	16.83	3.63	0.66	**3.86***
Controlled group 30	12.7	4.75	0.86	

- Thus there is a mean achievement score of the experimental group and the controlled group.
- The mean achievement score of experimental group which is 16.83 is significantly high than the mean achievement score of the controlled group which is 12.7
- Thus the implementation of the Inquiry Training Model to teach science standard VIII students is effective in terms of achievement of the students.
- Out of total 30 students, 29 (96.66%) students liked the new method of teaching and out of that 24 (80%) students strongly agreed to the statement.
- 23 (76.66%) students reported that they found the experiments performed interesting and 24 (80%) students found this new method of learning was fun.
- 24 (80%) students revealed that they had openly asked questions in the class and also enjoyed asking questions.
- 26 (86.66%) students agreed that this method aroused curiosity in them to know more and they also easily understood the concepts.
- 22 (73.33%) students agreed that this new method provoked them to think more,
- 22 (73.33%) students reported that they are satisfied with this new method and think that they remember more when taught through this new method.
- 23 (76.66%) students are of opinion that this new method of teaching is better than the regular lecture method.
- 26 (86.66%) also thought that the allotted time was not enough for learning through this new concept.
- Thus as per analyzed data and the results obtained by the opinionnaire, it can be concluded that implementation of Inquiry Training Model is effective in terms of arising curiosity in students, better retention of the concepts, generating interest in students and provoking them to ask questions and interact in class.
- During the whole span of the programme, researcher found that more than 90% of the students participated in the process and were asking questions.

DISCUSSION

The present study has drawn out the findings that teaching relevant concepts of science to standard VIII students through inquiry training model is effective in terms of achievement of the students. Also through opinion of the students it was found that it is also effective in generating curiosity and developing thinking ability in students. During the implementation period, the researcher observed that initially only few of the students participated in the interaction. So the researcher motivated all the students to participate and it was fruitful. Also as the students found the experiments very interesting they started participating in the interaction. Finally, as per the feedback given by the students and their teachers, the researcher could conclude that the students had very satisfactory and joyful learning experience. Also the findings reflect the effectiveness of the programme.

CONCLUSION

The present study was an attempt to implement the ITM on standard VIII students of Junagadh city to teach science. The programme was found to be effective in terms of the achievement of the students. Also the opinion of the students proved the programme to be effective. It was also a good learning experience for the students. The results reflect that if regular classroom science teaching is made activity based and interactive then it will definitely positively affect the learning and achievement of students.

REFERENCES:

Amin, J.A. (2011). *Development and implementation of an activity based science teaching programme for pre service student teachers.* Ph.D thesis published as a book, CASE, Vadodra.

Amore, Sister Jean Marie, *Instructional procedure using the Joyce Weil Inquiry Training Model of teaching with teacher candidates*. Education teacher training, Vol-37 No-02A P-921 1976.

Anderson, F.M. (1970). *The act of questioning in the classroom.* London, university of London press ltd.

Awodi, S. (1984) : "*Teaching Science (Biology) as inquiry versus traditional didactic approach in Nigerian secondary schools (Vol. I and II)"* Diss-. Ab. Int. (A), vol. 45, No. 6, 1984, p. 1707-A

Chauhan, S.S. (1985). *Innovation in teaching learning process.* New Delhi: vikas publishing house.

Collins K., (1969).“*The Importance of strong confrontation in an Inquiry Model of Teaching. School science and Mathematics*“V-69 No.-7 Oct-1969 P-615-617.

Dash, N.K. (1994). *A study of advance organizer model in relation to its instructional and nurturant effects.* Unpublished Ph.D thesis, CASE, Vadodra.

Dubey, A., (1985-86).“*A study on the Efficacy of Inquiry Training Model in Learning outcomes”,* M. Ed. Dissertation DAW. Indore-1986.

Haver. (2008). *A study of effects of traditional teaching vs multisensory instructional package on the achievement in science and attitude of English learners middle school students and English speaking middle school students.* Dissertation abstract international. 68(8)

Hendra, W. S., Sahyar, Mariati, P.S. (2017). “*The Effect of Inquiry Training Learning Model on Science Process Skills and Student Learning Outcomes”*. IOSR Journal of Research & Method in Education (IOSR-JRME) e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 7, Issue 6 Ver. III (Nov. – Dec. 2017), PP 46-51 www.iosrjournals.org

Joyce, A. (1988). *An experiment in mastery learning in science.* Ph.D. thesis, CASE, Vadodra.

Joyce, B., Weil, M., & Calhoun, E. (2008). *Models of teaching.*New Delhi: Prentice hall of India pvt. Ltd.

Katiyal S. (1985). “*How does Inquiry Training models Affect the Learning outcomes in comparision to Traditional method*?” M. Ed. Dissertation D A W Indore.

Khasnabis. (2009). *Developing scientific literacy through classroom instruction: investigating learning opportunities across three modes of inquiry based science instruction.* Dissertation abstract international. 70-A(1).

Malhotra S. P. (1986), "*Effectiveness of Inquiry Training Model with variations in Demonstration and peer practic in Terms of specific Teachings Competencies of Pre-Service Teacher-trainees*"..

Menon, S.B. (1986). *The study of system of science education in the perspective of the process of scientific inquiry.* Unpublished Ph.D thesis, CASE, Vadodra.

National Council of Educational Research and Training. (2006)., from www.ncert.nic.in.
NCF (2000). National Curriculum Framework. New Delhi: NCERT.

Patel, R.C. (1997). *A study of scientific attitude and its correlates among secondary school students of Baroda.* Unpublished Ph.D. thesis, CASE, Vadodra.

Pandey, S.N. (1986)."*Effectiveness of Advance Organizer Model and Inquiry Training Model for teaching Social Studies to Class VIII students*", Ph.D., Edu., BHU. Fourth Survey of Research in Education ,1983-88, Vol. II, , p. 1037. New Delhi, N.C.E.R.T

Rao, P. T. (1985). *Classroom teaching of effective science teachers – an analytical study.* Unpublished Ph.D. thesis, CASE, Vadodara.

Renee. (2008). *Project science inquiry: an exploration of elementary teachers perception of teaching and learning.* Dissertation abstract international. 69(6).

Sharma, M. K. (2013).*"A comparative study of effectiveness of inquiry training model concept attainment model and traditional teaching method in biology teaching at senior secondary level".* Ph.d. thesis, Institute of Advanced Studies in Education (IASE), Sardarshahar.

Sharma, R.C. (1975). *Modern science teaching.* 1st edition. New Delhi: Dhanpat Rai and sons.

Sharma, R.C. (2003). *Modern science teaching.* 5th edition. New Delhi: Dhanpat Rai and sons.
Shymansky, J.A. Kyle, W.C. and Alport, J.M. (1983)."*The effects of new science curricula on student performance".* Journal of Research in Science Teaching, 20, 387-404.

Sidney, A. H. (1989)."*The Effects of the Inquiry Method of Teaching Science on Critical Thinking Skills, Achievements and Attitude Towards Science",* Dissertation Abstracts International, 1989, 50, 5, 1205-A.

Singh, L. C. (1995). *Inquiry training model: teaching problem through discovery and questioning.* In L.C. Singh (Ed). *Multiple models of teaching for educators.* New Delhi: Vikas publishing house pvt. Ltd.

Sund, R.B., & Trowbridge, L.W. (1973). *Teaching science by inquiry in secondary school.* Ohio, Columbus: Charles E. Merrill Company.

Tosa. (2009). *A study of teaching science as inquiry in US and in Japan: a cross cultural comparison of science teachers.* Dissertation abstract international. 70-A (6).

Umasree, P.S. (1999). *Science curriculum and its transaction: an exploratory study in secondary schools of Baroda, Gujarat.* Unpublished Ph.D. thesis, CASE, Vadodra.

Varshney, A. K. (2017). "*Comparative study of effect of inquiry training model and conventional method of teaching on achievement in science of secondary school students*". Ph.D. Thesis, Aligarh Muslim University.