

## A COMPARATIVE STUDY OF SCIENCE INQUIRY MODEL AND CONVENTIONAL METHOD ON THE ACHIEVEMENT OF STUDENTS IN CHEMISTRY

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### Abstract

This study was taken by the researcher to accomplish greater good, and to develop lesson plans in various areas of XI Chemistry which are conceptually very important, and students feel difficult to understand & apply them in real situations. The present study was designed to examine the effect of Science Inquiry Model on Achievement in Chemistry of Class XI students. The methods used for the study was Randomized Groups pre-test post-test experimental design. The data collected was computed and analyzed using appropriate statistical techniques. The conclusions that emerged out of the analysis of data using different tools are:

The Science Inquiry Model is more effective than Conventional Method in teaching Chemistry in Standard XI. This conclusion was conformed from the following findings:

When the post-test scores of the pupils in the Experimental and Control groups were compared, the difference between their Means was found to be statistically significant ( $t = 5.866$   $p < 0.05$ ). The Experimental group was found to be superior to the Control group (Mean for Experimental Group,  $M_1 = 13.78$  and Mean for Control group  $M_2 = 8.68$ ).

The Science Inquiry Model is more effective than Conventional Method in enhancing the numerical solving capability of students. This conclusion was conformed from the following findings: The Experimental group is superior to the Control group. So the Science Inquiry Model is better than Traditional Method in realizing the objective. The following findings confirm this.

The t-value for pre-test and post-test scores of the pupils in the Experimental group and the Control group showed significant difference between the two groups. The Experimental group was found superior to the Control group.

The t-value obtained was significant at 0.05 level ( $t = 4.68$ ,  $p < 0.05$ ). The inference is that Science Inquiry Model is better than Conventional Method in developing the numerical solving capability of students.

**Key Words:** Teaching Model , Science Inquiry Model , Convention Method, Achievement , Chemistry, Pre-test, Post –test, Statistical technique, Variables .

### Introduction

A teaching model incorporates a complex array of learning/ instructional factors into a single working system. Hence, despite development the teacher does broadly remain the center point

around which the entire process revolves in the formal system. It is in this light that the National Policy on Education (1986) and its programme of Action make a policy statement, "Teachers should have the freedom to innovate, to devise appropriate methods of communication and activities". To achieve the continuing need of updating teaching methods with technological development, obsolete methods need replacement with introduction of 'Models of Teaching'. The world of tomorrow, which will be a door keeper in an information rich and technology intensive society calls for models of teaching as an approach of teaching. Joyce (1990) has stated, "To provide an all round development we need to design suitable instructional strategies which helps our students grow emotionally, physically, socially and intellectually. There still exists a big gap between theoretical knowledge and actual teaching in the classroom or schools. Models of Teaching as strategies need to be incorporated in our teaching practice." A variety of teaching approaches have been evolved to design instruction. In a study of **Mody A.K., Pradhan H.C.** (Problem based learning in basic Chemistry, 2012) a problem based learning course is presented in area of basic Chemistry. Problem based learning starts after students have been introduced to formal structure of Chemistry. **Benedict K.Y. (2010)** in Mutual comparison reception Model of concept development in Secondary Science learning proposed a variation to Brunarian theory. **Mukherjee Madhuchanda (2011)** investigated the effectiveness of SCIENCE INQUIRY MODEL in terms of achievement in science of class VIII. The researcher found the climate of classroom was open co-operative and encouraging SCIENCE INQUIRY MODEL provided wide opportunity to students for acquiring concepts, interpreting the data and applying the principles in new and differential situations.

**Ostad G.& Soleymanpour Javed (2014)** presented the impact of SCIENCE INQUIRY MODEL and Mastery Teaching Model (MTM) on female high school student's academic achievement and metacognitive skills. Results of this research showed that both methods SCIENCE INQUIRY MODEL & MTM with equal conditions affect academic achievement and metacognitive skills of students and these methods can be used to enhance student's academic achievement and skills in the classroom.

#### **Need & Significance of study:-**

Students of all ages and grade levels respond to the active learning encouraged by the inductive processes promoted by the Inquiry formation. In the Science Inquiry formation, students learn to organize discrete pieces of information into larger conceptual schemes. Students are also responsive to reflection on those thought processes used during Science Inquiry and this can understand to increase their learning. Both methods encourage the development of critical and creative thinking and promote independent learning at all grade levels. The **Science Inquiry Model** is an excellent evaluation tool when teachers want to determine whether important ideas introduced earlier have been mastered. It quickly reveals the depth of the students' understanding and reinforces their previous knowledge. The Science Inquiry strategies can accomplish several instructional goals, depending on the emphasis of the particular lesson. They designed for instruction on specific concepts and on the nature of concepts. They also provide practice in inductive reasoning and opportunities for altering and improving students' inquiry -building strategies.

#### **Statement of the Problem**

"A comparative study of Science Inquiry Model & Conventional Method on the achievement of students in Chemistry".

## Definitions of the Terms Used in Study

Definitions of the various terms used in the study are:

### Models of Teaching

Models of teaching are prescriptive teaching strategies having specific instructional objectives.

“A model of teaching is plan or pattern that can be used to shape curriculums, to design instructional materials and to guide instruction in classroom and other setting” (Joyce, 1990). “A model of teaching is a description of learning.” (Bruce Joyce, 1996). The models of teaching are structured logically consistent, cohesive and lucidly described alternative pattern of teaching”.

### Science Inquiry Model:

Science Inquiry is one of the learner centered approach propounded by J. Schwab (1965) to teach scientific knowledge and to develop interest in scientific inquiry. Not only can the nature of science but process of research in Biology also be introduced to students. They can also learn planning and execution of projects and self learning involving acquisition of knowledge through observation of phenomena, creative thinking and activities.

Science Inquiry Model is based on Science Curriculum Study. This approach emphasizes the need to teach students to process information using technique similar to those of research biologists (Joyce & Weil 1980). In this way, students are able to identify the problems and use a particular method to solve them. Science Curriculum Study stresses the need to understand content and processes. Generally people understand only products of science and not the process of science. It is however clear that understanding of products can't be attained adequately unless the process of science is understood.

### Conventional Method

The Conventional Method is the method adopted by a subject teacher under normal circumstances most of the time. Here, pupil participation is limited. The lecture is the main feature of this method and the 'elicitation process' is involved with the use of the black board.

### Chemistry

Chemistry is a branch of physical science that studies the composition, structure, properties and change of matter. Chemistry includes topics such as the properties of individual atoms, how atoms form chemical bonds to create chemical compounds, the interactions of substances through intermolecular forces that give matter its general properties, and the interactions between substances through chemical reactions to form different substances.

### Achievement

Achievement is a specified level of success on a learning task or a certain level of proficiency in scholastic or academic work. Educational or academic achievement is a specified level of attainment or proficiency in academic work as evaluated by teachers, by standardized tests or by a combination of both.

“A test of educational achievement is one designed to measure knowledge, understanding, application and skills in a specified subject or a group of subjects”.

## Objectives of the Study

The study was conducted to achieve the following objectives:

1. To study the difference in performance of class XI students taught through conventional method & Science Inquiry Model.
2. To study the effect on their numerical problem solving capability in when taught through conventional method & Science Inquiry Model.

## Hypotheses

1. There is a significant difference between achievement of students taught by conventional method & Science Inquiry Model.
2. There is a significant difference between numerical problem solving capacity of students taught through conventional method & Science Inquiry Model.

## Methodology

The details of the method adopted, variables of the study, tools used, sample selected, and procedure adopted in the administration of the tools and statistical techniques used for the analysis of data are given below.

## Method Adopted

The study is intended to test the effectiveness of Science Inquiry Model of teaching over the Conventional Method of teaching with special emphasis on concepts of Chemistry standard XI. Experimental design has been adopted for the study. Experimental design gives valid conclusions about relationship between independent and dependent variables (Best and Kohn, 1989).

In the present study, the experimental group and control group were naturally assembled groups. So the investigator decided to conduct the study using the pre test-post test controlled group design.

## Variables of the Study

Variables are the conditions or characteristics that the experimental group manipulates, controls, or observes. In the present study, the independent; dependent and the control variables play their own roles.

## Independent Variable

In experimentation, the manipulated variables are called independent variables. It is under direct control of the experiment that may vary it in any way desired (Sax, 1979). In this study, the method of teaching i.e. Science Inquiry Model and Conventional Method of teaching are the independent variables.

## Dependent Variable

The dependent variables are conditions or characteristics that appear, disappear or change as the experimenter introduces, removes or changes independent variables (Best, 1980). Here Achievement in Chemistry and Numerical problem solving Capability of students are dependent variables.

## Control Variable

The variables whose effects must be controlled are called Control variables. The Control variable considered for the present study are previous achievement in Chemistry, which are pre-

requisites for mastering the new topic, teacher factor, time of data collection, length of instruction, etc.

### **Tools used in the Study**

Tools are the techniques which are appropriate for the collection of certain type of evidence or information for conducting the research. The tools used for the present study are given below.

- (a) Lesson transcripts based on Science Inquiry Model
- (b) Achievement Test in Chemistry (used as pre-test and post-test)

### **Achievement Test (used as pre-test and post-test)**

An achievement test was conducted as pre-test and post-test to compare the previous knowledge and post academic ability of students. The test contained objective type questions based on conceptual knowledge and numerical problems. One Mark was assigned for each correct answer.

### **Sample of the Study**

Sampling means the procedure in which a subject is selected from a large number of observations. A sample represents a broader population.

The present study was conducted on a total sample of 60 XI standard students of DAV Centenary Public School, Barnala Road, Sirsa. The students of two sections of standard XI were selected. One group was considered as the Experimental group and the other as Control group. Each group comprised 30 students.

### **Procedure Adopted in Experimentation**

The procedure adopted for conducting the experiment is as follows.

#### **Pre-test Conducted**

The investigator made necessary arrangements with the Principal of the school selected for the experiment. The Achievement Test was administered to both the groups before teaching them the concepts. The scores that were collected from the answer sheets comprised the pre-test scores.

#### **Learning by the Experimental Group**

The Experimental group was taught with the help of the lesson transcripts based on Science Inquiry Model. There were 10 lesson transcripts. Two weeks time was used for teaching the topic. Simple demonstrations, diagrams and verbal examples were used for presenting the selected concepts.

#### **Learning by the Control Group**

The Control group was taught the same topic in the conventional way by the investigator herself. Equal time was used for teaching the Control group.

#### **Post-test Conducted**

Prior information regarding the concepts on which Post-test will be conducted was given to both Experimental and Control groups. The Post-test was administered to both the groups simultaneously. There was complete supervision by the class teacher and the investigator. Answer sheets were collected and scored. The scores obtained comprised the post-test scores.

#### **Statistical techniques employed**

The Pre-test scores and the Post-test scores of the Experimental and Control groups were consolidated for statistical analysis. Since the Experiment was conducted using random selection t-test was applied for analyzing the data.

### **Analysis and Interpretation**

The data pertaining to various objectives and corresponding hypothesis of the study were obtained . These data would have remained merely a meaningless heap of facts unless it had not been statistically processed and analyzed, so in order to give the present study a meaning and a scientific hue, a desired shape & direction, the data was subjected to appropriate statistical procedure. The inter-relation of results related to different variables of the study and their discussion have also been included .

The variable studied in the present study is achievement in Chemistry. The study was conducted with the help of two groups, in which one group was assigned as control group and the other one was assigned as experimental group. The pupils of experimental group were taught certain lessons of Chemistry through Science Inquiry model and the pupils of control group were taught through conventional method.

For this study, the hypotheses were formulated as

- (1) There is a significant difference between achievement of students taught by conventional method and Science Inquiry model.
- (2) There is a significant difference between Numerical problem solving ability of students taught through conventional method and Science Inquiry Model.

To assert the hypotheses, significance of difference was to be found to determine the relation effectiveness of Science Inquiry Model and conventional method. The t-test is considered a suitable technique for statistical analysis under these conditions, Developed by Walker and Lev (1953), Edwards (1960) and Garret (1966). It is a reliable technique to determine whether difference between the means of two groups is significant or not. Usually a difference is marked significant when the gap between two sample means signifies a real difference between the parameters of population from which sample is drawn. In order to reject or retain the hypotheses, the values of t- are compared with the t-value from t-tables obtained.

### **ANALYSIS AND INTERPRETATION**

In the scheme of this study, pupil's achievement in Chemistry & the effect on their numerical solving capability are the outcome variables. This has been studied here focusing on the following objectives.

1. To compare the mean scores on achievement test in Chemistry, of the two groups of pupils i.e. experimental group and control group.
2. The compare the numerical solving capability, the score of students was taken from the given achievement test.

The two groups had been compared by using t-test. For this purpose, the tables 1.1 and 1.2 provide the mean, standard deviation & 't' values in respect of scores on achievement test of experimental and control groups. t-test has been applied to test the significance of difference

between the mean of experimental group and control group with respect to (a) performance in achievement test (b) Numerical solving capability. These have been discussed below:

### Comparison of Pre-test Scores of pupils in Experimental & Control groups

The mean & standard deviation of pre-test scores of pupils in the two groups, taught with Science Inquiry model and conventional model were computed. The critical ratio was also found out and tested for significance.

**Table 1.1**

**The difference between the means of pre-test scores of pupils in experimental & control groups**

Group	No. of Pupils	Mean	S.D.	t-value	Level of Significance
Experimental Group	30	3.87	1.77	0.32	0.05
Control Group	30	3.67	1.56		

The above table shows that there is no significant difference between the means of pre-test scores of pupils in experimental and control groups. This means that the two groups are more or less of the same ability.

### Comparison of post-test scores of pupils

The mean & standard deviation of post test scores of pupils in the experimental & control group were computed. The data and result of test of significance are given in table 1.2.

**Table 1.2**

**Data & result of test of significance of difference between mean of post test scores of pupils in experimental and control groups.**

Group	No. of Pupils	Mean	S.D.	t-value	Level of Significance
Experimental Group	30	13.78	3.76	5.866	0.05
Control Group	30	8.68	2.45		

The table value shows that there is a significant difference between the means of post test scores of pupils in experimental & control groups. This means that the two groups differ significantly in their post academic ability. Since the mean score of experimental group is greater than those of control group. The experimental group is superior to the control group in achievement so it can be concluded that Science Inquiry Model is more effective than conventional method in teaching Chemistry in Senior Secondary classes.

### Comparison of effectiveness of Science Inquiry Model over conventional method in enhancing the Numerical problem solving capability:-

The mean & standard deviation of post-test scores of pupils in Numerical problems in both the group were computed. The data analysis of test of significance are given in table: 1.3.

**Table :1.3**

Group	No. of Pupils	Mean	S.D.	t-value	Level of Significance
Experimental Group	30	6.8	1.67	4.68	0.05
Control Group	30	4.8	1.60		

The table value shows that there is a significant difference between the means of post test scores of pupils in experimental & control groups in numerical section . This means that the two groups differ significantly in their numerical solving capability. Since the mean score of experimental group is greater than those of control group. The experimental group is superior to the control group in solving numerals so it can be concluded that Science Inquiry Model is more effective than conventional method in developing application skills in Senior Secondary classes.

### Study in Retrospect

The present study was designed to examine the effect of Science Inquiry Model on Achievement in Chemistry of Class XI students. The methods used for the study was Randomized Groups pre-test post-test experimental design. The data collected was computed and analyzed using appropriate statistical techniques.

### Conclusions Based on the findings

The conclusions that emerged out of the analysis of data using different tools are:

1. The Science Inquiry Model is more effective than Conventional Method in teaching Chemistry in Standard XI. This conclusion was deduced from the following findings:

When the post-test scores of the pupils in the Experimental and Control groups were compared, the difference between their Means was found to be statistically significant ( $t = 5.866$   $p < 0.05$ ). The Experimental group was found to be superior to the Control group (Mean for Experimental Group,  $M_1 = 13.78$  and Mean for Control group  $M_2 = 8.68$ )

The Science Inquiry Model is more effective than Conventional Method in enhancing the numerical solving capability of students. This conclusion was deduced from the following findings:

As the Numerical problem solving capability is concerned, the Experimental group is superior to the Control group. So the Science Inquiry Model is better than Traditional Method in realizing the objective. The following findings confirm this.

The t-value for pre-test and post-test scores of the pupils in the Experimental group and the Control group showed significant difference between the two groups. The Experimental group was found superior to the Control group.

The t-value obtained was significant at 0.05 level ( $t=4.68$ ,  $p<0.05$ ). The inference is that Science Inquiry Model is better than Conventional Method in developing the numerical solving capability of students.

### Educational Implications

The Science Inquiry Model will encourage the students to engage in learning activities with maximum enthusiasm and this will help them to understand the subject matter more vividly. The Method also helps to correlate the theoretical concepts and its application, which is not so effective



in the Conventional Method.

The Science Inquiry Model will help the students to learn the theory and apply the newly acquired knowledge simultaneously. The conclusions of the study prove that the Science Inquiry Model has helped the students to score better in the Achievement Test.

The teachers also were encouraged to learn more and test their knowledge when Science Inquiry Model is used. The teachers should have a thorough knowledge in the subject to conduct such classes. The teacher should be also to clear all the doubts of students. The classes will be lively and there will be good teacher-pupil interaction.

Since the results of the present study prove the effectiveness of the Science Inquiry Model in teaching Chemistry in XI standard, it can be applied in the teaching of more concepts in other subjects. The study may help in selecting suitable activities to attain objectives.

### **Suggestions for Improvement**

The findings of the study reveal that Science Inquiry Model is definitely better than the Conventional Method for student achievement. A few suggestions are put forth for improving the effectiveness of teaching.

1. The students should be made aware of the necessity of concept attainment. They should be made familiar with different strategies of Science Inquiry and the hierarchical structuring of knowledge.
2. Since the application of Models of Teaching in the classroom will facilitate better learning and retention, these Models should be introduced in all classes.
3. The teachers should be given an orientation to the theoretical bases of Model and their practical utilities in classrooms.
4. Teachers should be encouraged to use the Models in the classrooms.
5. Ideas regarding Models of Teaching should be given to the students, teachers, and parents to improve teaching learning conditions.
6. The curriculum designers should also develop awareness on Models of Teaching so that they can implement them in the curriculum.

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