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A Comparative Study of Science Inquiry Model and Conventional Method on the Achievement of Students in Biology

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Abstract

Science Inquiry Model lays stress on understanding the content and process of science and scientific investigations. Even today, lecture method is commonly used method of teaching in the classroom. Most teachers give lectures without understanding the cognitive structure of students which results in poor learning.This experimental study determined the Effectiveness of Science Enquiry Model and Conventional Method of teaching in achievement in Biology . In the research paper, pre-test, experimental treatment and post-test design was employed. It involved two groups of students, one experimental groups and one control group. The Experimental Group-I was taught Biology through Science Enquiry Model. and the Control Group was taught Biology through Conventional Method. The design comprised three stages. The first stage involved pre-testing of all the students of two groups on achievement in Biology, Intelligence and Socio-Economic Status . The second stage involved treatment of twenty weeks. The experimental treatment consisted of teaching of four units of Biology through Science Inquiry Model to Experimental Group-I, and through Conventional Method to Control Group. In the third stage, the students were post tested on Achievement in Biology. Purposive sampling was used for the research paper. D.A.V. Centenary Public School, Sirsa was selected. Four sections of IXth class were taken. These were divided in to Experimental Group - I and Control Group having 60 students in each group. The Experimental Group - I, and Control Group were equated on Mental Ability or Intelligence and Socio-Economic Status. After equating the groups there were 40 students in Each Experimental Group - I and Control Group. This study shows that the post-test achievement mean scores of the experimental and control groups, controlling for intelligence and Socio-Economic status, differ significantly in favor of the experimental groups. This implies that the students who were taught Biology through Science Inquiry Model have shown significant improvement in the Achievement in Biology than the students who were taught through Conventional Method. This suggests that Science Inquiry Model contributes in raising the achievement of students. The group of students taught Biology through Science Inquiry Model have shown significantly higher gain in achievement than the group of students taught Biology through Conventional Method

Keywords: Teaching Model, Science Inquiry Model, Conventional Method, Achievement, Gaim Score, Biology

Introduction

'Education' is generally conceived as a process or method of learning and training that moulds the whole of human personality in different dimension. It modifies man's experience, transforms his instinctive urges and impulses and determines his attitudes and beliefs. Education enables man to draw out his hidden talents. It trains him to increase his productivity and thus it helps him to render more effective service to society. The basic purpose lying at the very root of every plan and programme of education is evidently growth of the student into full-fledged responsible citizens. Education is evidently a process through which desirable changes in the behavior of a child in terms of knowledge, value, skills, attitudes etc. are expected to be brought about. In school desirable attitude, knowledge and beliefs are inculcated in him through the teaching of different subjects and a regular course of training.

Teaching is often thought of as something that comes rather naturally to people who know their subject. In general, it is thought that it is a simple process that produces simple outcomes. But teaching is an intriguing, important and complex process. It is true that teaching is a process by which teacher and students create a shared environment including sets of values and beliefs which in tern color their view of reality.

Model is a pattern of something to be made or reproduced and means of transferring a relationship or process from its actual setting to one in which it can be more conveniently studied. In the point of view of teaching, a model of teaching is to improve the instructional effectiveness in an interactive atmosphere and to improve or shape of curriculum. Model of teaching are the innovative practices which have drawn the attention of educational researchers and teachers since last few years.

Joyce and Weil (1980) have identified 23 models of teaching which are classified into four families – Information processing models, personal models, social Interaction models and behavioral modification models. Information processing may be defined as the ways people handle stimuli from the environment, organize data, sense problems etc. The goals of information processing models are to help individuals to acquire knowledge through an analysis of data from the world around us. They aim at intellectual growth of the individual. These models of teaching are inductive thinking model, inquiry training model, concept attainment model, cognitive growth model, biological Science Inquiry Model, Advance Organiser Model, memory and group investigation.

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.

Rationale of the Study

Change is a very important phenomenon of the present age and it affects the life of each and every individual. The world of today is changing rapidly because of the fast changes in the field of science and technology. Thus science is a compulsory subject in the schools has become the needs of the hour as also envisaged by different education commissions and committees right from Secondary Education Commission (1955) to National Education Policy (1986). This scientific revolution going at an ever accelerating pace for the past few decades that science teaching became inevitable. Thus for progress of the country, it is required that its citizens successfully understand and practice the concepts and principles of science. Thus emphasis should be laid on basic principles, concepts and generalizations rather than on information and facts.

Looking into the practical situation, the researcher felt that there is need to use such as teaching strategy which can motivate students to learn. Science Inquiry Model lays stress on understanding the content and process of science and scientific investigations. Through this model, open mindedness, independent thinking, cooperative skill, problem solving skill and interest in inquiry can be developed among students which are the dire needs of the present. Traditional method of teaching is just the transmission of knowledge but Science Inquiry Model of teaching provides scientific knowledge as well as inculcated habit of searching more knowledge through inquiry approach. Therefore researcher has planned to study the Effectiveness of Science Inquiry Model in attaining Mastery in Biology.

In India, research in the area of models of teaching has been gaining momentum since last decade. Researchers have compared Science Inquiry Model with other teaching strategies. An experimental study using Ausubel's and Burners strategy to ascertain their Comparative Effectiveness with Traditional Method for teaching of Mathematics was conducted by Chitrive (1983). Concept Attainment Model and traditional Method on conceptual learning efficiency and retention in relation to divergent thinking was investigated by Jaimini (1990). The effect of Advance Organiser Model and Concept Attainment Model on achievement of pupils was studied by Mujeeb (1991).

Ranjana (1992) conducted a study on the Effectiveness of Mastery Learning Strategy on VI graders in the subject of science and reported that students taught through Mastery Learning Strategy showed significant improvement in the achievement, Self-Concept and classroom trust behavior.

Studies were conducted to compare the Effectiveness of Concept Attainment Model and Biological Science Inquiry Model (Sushma Kumari, 1988), Concept Attainment Model, Inductive Thinking Model and Advance Organiser (Gupta, 1995) and Halda Taba's Inductive Thinking Model and Advance Organiser Model (Khare, 2000). It is evident from this brief survey of researches conducted in India on the use of Advance Organize Model and Science Inquiry Model that very little work has been done to test their effectiveness in Indian situations and to adapt them to our peculiar need Effectiveness of Science Inquiry and Conventional method in attaining Mastery in Biology particularly has not been attended to adequately. Since the subject is gaining importance

in school curriculum and has been made compulsory up to secondary level, research to use Advance Organiser Model and Science Inquiry Model to improve pupil's achievement in science needs to be conducted.

Statement of the Problem

"A Comparative Study of Science Inquiry Model And Conventional Method on the Achievement of Students in Biology"

Aim of the Study

1. To compare the mean achievement scores, on the criterion achievement test in Biology, of the two groups of students, to be taught Biology with the use of Science Inquiry Model and Conventional Method of teaching before the experimental treatment.
2. To compare the mean achievement scores, on the criterion Achievement Test in Biology, of the two groups of students, to be taught Biology with the use of Science Inquiry Model and Conventional Method of teaching after the experimental treatment.
3. To compare the mean gain scores , on the criterion Achievement Test in Biology, of the two groups of students, to be taught Biology with the use of Science Inquiry Model and Conventional Method of teaching after the experimental treatment.

Hypothesis

In order to realize the objectives of the research following hypothesis were tested.

H1

There is no significant difference in the mean score, on the criterion Achievement Test in Biology, of the two groups of students, to be taught Biology with the use of Science Inquiry Model and Conventional Method of teaching before the experimental treatment.

H2

There is a significant difference in the mean scores, on the criterion Achievement Test in Biology, of the two groups of students, to be taught Biology with the use of Science Inquiry Model and Conventional Method of teaching after the experimental treatment.

H3

There is a significant difference in the mean gain scores, on the criterion Achievement Test in Biology, of the two groups of students, to be taught Biology with the use of Science Inquiry Model and Conventional Method of teaching after the experimental treatment.

Delimitations

Keeping in view the constraints of time and resources, certain delimitations need to be imposed for conducting the study. Following were the delimitations of the present paper.

1. The study was confined to a single Centenary Public School at Sirsa in Haryana only.
2. The sample was chosen from IXth class only.
3. Only four units from Biology syllabus of IXth class have been selected for collecting the data.
4. The study was conducted in the subject of Biology only.
5. The experiment was limited to twenty weeks of the academic session.
6. Although there are various teaching models.the research paper was confined to Science Inquiry Model only.
7. The study can be conducted on a variety of other educational outcomes but it was conducted only on achievement

Design

In the research paper, pre-test, experimental treatment and post-test design was employed. It involved two groups of students, one experimental groups and one control group. The Experimental Group was taught Biology through Science Inquiry Model and the Control Group was taught through Conventional Method. The design comprised three stages. The first stage involved pre-testing of all the students of three groups on achievement in Biology, Intelligence, Socio-Economic Status and Self-concept.

The second stage involved treatment of twenty weeks. The experimental treatment consisted of teaching of four units of Biology through Science Inquiry Model to Experimental Group-I,and through Conventional Method to Control Group. In the third stage, the students were post tested on Achievement in Biology.

The Sample

Purposive sampling was used for the research paper. D.A.V. Centenary Public School, Sirsa was selected. Four sections of IXth class were taken. These were divided in to three Groups i.e. Experimental Group and Control Group having 60 students in each group.The Experimental Group and Control Group were equated on Mental Ability or Intelligence and Socio-Economic Status. After equating the groups, there were 40 students in Each Experimental and Control Group.

Variables

In the experimental researches the relationship between three types of variables namely independent, dependent and intervening variables are studied. All these three kinds of variables which were identified for the study are discussed below.

Independent Variables

Different methods of teaching which were used in the research paper to see their effect on achievement of pupils in Biology constitute the independent variables. The experimental Group was taught Biology through Science Inquiry Model and Conventional Method were the two independent variables for the research paper.

Dependent Variables

Achievement in Biology was the dependent variables. These variables were measure twice during the course of the study first before the experimental treatment which is pre-test stage and then after providing experimental treatment i.e. post-test stage.

Intervening variables

There are certain variables which have their effect on the learning outcome. These variables, known as intervening variables, can influence both. It

is necessary to control all those variables that may effect the dependent variables. Hence suitable: the independent and dependent variables. Different intervening variables in a research study can be nature of school, grade level, subject to be taught, intelligence of pupils, Socio-Economic Status of pupils, previous knowledge of pupils etc. These intervening variables were controlled either experimentally or statistically.

Control Employed

Control were employed for each such variables.

Nature of School

The sample was selected from a single school in Sirsa (Haryana). It was a D.A.V. Centenary Public School situated in Barnala Road, Sirsa.

Grade level

IXth class selected for the research paper and grade level was thus kept constant during the study.

Subject

All the two groups were taught same units of Biology.

Socio-Economic status

This variable was controlled experimentally.

Intelligence of pupils

This variable can greatly affect the achievement of pupils. It was also controlled by experimentally.

Tools Used

For the purpose of collecting data related to different variables covered in this study, following tools were used.

1. Biology Achievement Test (Developed by theinvestigator himself) to measure the achievement of pupils in Biology.
2. Raven's Progressive Matrices developed by J.C. Raven to measure the intelligence of students.
3. Socio-Economic Status Scale by Dr. Gyanendra P. Srivastva measure the Socio-Economic Status of the Student.

Experimental Procedure

It consisted of three stages:

(i) Pre-testing
(ii) Experimental treatment
(iii) Post-testing.

Pre-testing

Before the commencement of experiment, pre-tests were conducted. They were administered in all the two groups by the investigator himself. Cooperation of the class teacher was sought for conducting the tests properly. All the instructions were explained clearly to the students before administering the test.

Experimental Treatment

After pre-testing the experimental treatment of teaching Biology to Class IX students was started. All the two groups Control Group and Experimental Group were taught by the investigator himself. The Control Group was taught through Conventional Method of teaching. Experimental Group was taught through Science Inquiry Model. Content of the Biology was identified for the experiment. Four Chapters/Major concepts and twenty nine sub concepts were analyzed and arranged in proper sequence.

The treatment was of 20 weeks duration for both the groups. The researcher taught Control Group through Conventional Method of teaching and Experimental Group through Science Inquiry Model on the same day the same content. This was done to avoid carry over effects of one teaching strategy into other. The time was of one period (40 minutes) duration only so that schedule of schools was not disturbed.

Post- Testing

After teaching the contents to all the two groups, the students were given post – tests.

Statistical Analysis

Statistics has become an indispensable tool for research. It is fundamental to the proper analysis of data. In order to achieve the objectives of the study, the data collected was statistically analyzed using the following techniques.

1. Mean and Standard Deviations were used on pre-test, post-test and gain scores of Achievement Test in Biology.
2. "t" test was applied for testing the significance of difference between the Experimental Group and Control Group on means achievement scores and means gain scores of pre and post testing stage.

Interpretation of the Results

In the scheme of this study, students Achievement in Biology is the first outcome variable. This has been studied here focusing on the following objectives:

1. To compare the mean achievement scores, on the criterion Achievement Test in Biology, of the two groups of student, to be taught Biology with the use of Science Inquiry Model and Conventional Method of teaching, before the experimental treatment.
2. To compare the mean achievement scores, on the criterion Achievement Test in Biology, of the two groups of students, to be taught Biology with the use of Science Inquiry Model and Conventional Method of teaching, after the experimental treatment.
3. To compare the gain scores, on the criterion Achievement Test in Biology, of the two groups of students, to be taught Biology with the use of Science Inquiry Model and Conventional Method of teaching, after the experimental treatment.

Student's Achievement in Biology of the two groups have been compared by employing t' test . For this purpose, the Table: 1.1 to 1.3 provide the mean, standard deviation and 't' values in respect of pre-test ,post-test and gain scores of experimental and control groups of students.

Comparison of Mean Achievement Scores of Experimental Group and Control Group, before the Experimental Treatment.

Table 1.1

Difference in Pre-Test Mean Scores of the Students of Experimental Group and Control Group on Achievement in Biology

Treatment	N	Mean	S.D.	't' value	Level of Significance
Experimental Group – I	40	25.15	±5.84		Not Significant at 0.01
Control Group	40	24.65	±6.56	**0.89**	level of significance

From Table 1.1, it may be observed that the 't' value of 0.89 for the difference in the mean achievement scores, at the pre test stage, of the students of Experimental Group and Control Group is not significant at 0.01 level. This reveals that there is no significant difference in the pre-test mean achievement scores of Experimental Groups and Control Group.

Comparison of Mean Achievement Scores of the Experimental Group and Control Group After the Experimental Treatment .

Table 1.2

Difference in Post-Test Mean Scores of the Students of Experimental Group and Control Group on Achievement in Biology

Treatment	N	Mean	S.D.	't' value	Level of Significance
Experimental Group – I	40	29.95	±3.14		Significant at 0.01 level
Control Group	40	24.92	±4.77	**5.56**	of significance

From Table 1.2, it may be observed that the 't' value of 5.56 for the difference in the mean achievement scores, at the post test stage, of the students of Experimental Group - I and Control Group is significant at 0.01 level. This table also reveals that at the post-test stage, the mean score of 29.95 of the students of Experimental Group - I is higher than the mean score of the Control Group which is 24.92. This indicates that Achievement in Biology of the students of Experimental Group-I is higher than that of the Control Group after the treatment.

Table 1.3

Difference in the Mean Gain Scores of the Students of Experimental Group and Control Group on Achievement in Biology

Treatment	N	Mean	S.D.	t-value	Level of Significance
Experimental Group-I	40	13.07	±4.02		Significant At 0.01 level
Control Group	40	08.80	±4.52	**4.49**	of significance

Table: 1.3 indicates that the 't' value of 4.49 for df 78 for the difference in mean gain achievement scores in Biology of the students of Experimental Group and Control Groups is significant at 0.01 level. The mean, score of 13.07 of the student of Experimental Group have gained significantly higher than the students of Control Group on achievement in Biology

Discussion of the Results

The results obtained from Table: 1.1 to 1.3 indicate that the mean score and mean gain score on Achievement in Biology of the students of: **Experimental Group is significantly higher than that of Control Group.**

This finding is supported by following studies.

Aabassum Ahmed (1996) found that there was a significant gain in pupil's scholastic achievement when taught through Biological Science Inquiry Model.

The study done by Sushma (1987) provides support to the findings of the present investigation. She found that Biological Science Inquiry Model was more effective than Traditional Method of teaching in terms of achievement of students in Biology. Self-experimentation always creates interest among the students and supports the principle "learning by doing". Students solve the problem themselves and acquire the knowledge how do scientist work. These experiences may facilitate learning and enhance scholastic achievement.

Students are exercised and skilled in the process of inquiry. Formulation of hypothesis, collection of data and drawing conclusions are the essential tasks done by students when Biological Science Inquiry Model is used in the class room. While doing so, pupils acquire more knowledge about scientific processes which may result in better understanding.

Biological Science Inquiry Model helps in generating co-operative climate in the classroom. The results compare their observations and inferences with each other. In this way, they realize their own errors and select means to correct them. Owing to its inductive approach, Biological Science Inquiry Model is an effective way of teaching Biology.

On the basis of the results obtained from analysis of the data and the interpretation of the results done numerically, related to a students achievement in Biology the following hypotheses of the research paper are retained.

H1

There is no significant difference in the mean scores on the criterion Achievement Test in Biology, of the two groups of students taught Biology with the use of Science Inquiry Model and Conventional Method of teaching, before the experimental treatment.

H2

There is significant difference in the mean scores on the criterion Achievement Test in Biology of

the two groups of students taught Biology with the use of Science Inquiry Model and Conventional Method of teaching, after experimental treatment.

H3

There is a significant difference in the mean gain scores on the criterion Achievement Test in Biology of the two groups of students taught Biology with the use of Science Inquiry Model and Convention Method of teaching after experimental treatment.

Findings

The statistical data of the research paper reveal the following findings.

1. The group of students taught Biology through Science Inquiry Model have no significant difference on the criterion Achievement Test and gain on criterion Achievement test than the group of students taught Biology through conventional method.
2. The group of students taught Biology through Science Inquiry Model have scored significantly higher on the criterion Achievement Test than the group of students taught Biology through Conventional Method.
3. The group of student taught Biology through Science Inquiry Model have scored significantly higher gain on the criterion Achievement Test than the group of students taught Biology through Conventional Method.

Conclusion

This study shows that the post-test achievement mean scores of the experimental and control groups, controlling for intelligence and Socio-Economic status, differ significantly in favor of the experimental groups. This implies that the students who were taught Biology through Science Inquiry Model have shown significant improvement in the Achievement in Biology than the students who were taught through Conventional Method. This suggests that Science Inquiry Model contributes in raising the achievement of students. The group of students taught Biology through Science Inquiry Model have shown significantly higher gain in achievement than the group of students taught Biology through Conventional Method

Educational Implications

From the present experimental study, it has found that Science Inquiry Model is most effective over Traditional Method when the achievement is taken into consideration. From the results of the study, Model based teaching can be introduced in the Indian situation. The research paper has implications for teachers, teacher educators and curriculum and instructional material developers.

Implications for Teachers

The models of teaching serve as a repertoire of instructional approaches for teachers to tailor the teaching-learning environment to the pre-disposition of the learners to achieve a variety of educational objectives. By using Science Inquiry Model in classroom, teacher develops interest in the process of inquiry among students and motivate them to learn the process themselves. The teacher should help them at every stage of learning. Today, when there is an exponential increase in knowledge, it is impossible for teachers to teach everything in the classroom. However, if the students are trained in the skill of self learning, they would be able to acquire efficiently more knowledge with lesser dependence on their teacher. Science Inquiry Model help teachers to overcome this problem.

Implications for Teacher Educators

Science Inquiry Model is effective teaching strategies in enhancing scholastic achievement of learners as shown by results of the present study. Therefore teacher educators should analyze every activity of the models and attain competency in them. They should plan and implement training strategies based on these models of teaching to train teachers.

Teacher educators should provide theory of Science Inquiry Model to pre-service teachers, demonstrate lessons through this model and help student teachers to undergo practice in the use of this models. In this way, student-teachers should be trained in the application of Science Inquiry Model so that they may use these strategies in their classrooms for better teaching. Not only this, Science Inquiry Model is better transactional approaches for in-service teachers. These teachers need to be oriented time to time through these strategies for improvement of teaching skills.

Implications for curriculum and Instructional Material Developers

The use of Science Inquiry Model in teaching learning process helps in promoting self-learning and interest in inquiry skills on the part of learners which in turn enhances achievement . Designers of instructional material should develop the material in such a way that understanding of different concepts and principles takes place at a faster rate in students.

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