Effectiveness of Inquiry-Based Learning Strategy on Conceptual Understanding and Academic Achievement in Physical Science among secondary school Students of Jajpur districts

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***Abstract*—The present study was conducted to examine the effectiveness of inquiry-based learning strategy on conceptual understanding and academic achievement in physical science among Class IX students. The study adopted an experimental method with a pre-test and post-test equivalent group design. A sample of 50 students was selected and divided into an experimental group and a control group, each consisting of 25 students.**

The experimental group was taught through inquiry-based learning strategy, while the control group was taught through the traditional teaching method. Data were collected using a conceptual understanding test and an achievement test. The collected data were analyzed using mean, standard deviation, and t-test.

The results of the study revealed that students taught through inquiry-based learning strategy performed significantly better than those taught through the traditional method. The findings also indicated improvement in both conceptual understanding and academic achievement of students in the experimental group.

The study concludes that inquiry-based learning strategy is more effective than traditional teaching methods in teaching physical science at the secondary level.

I. INTRODUCTION

Science education brings not only changes in mind but also changes in behaviour. Science education inculcates logical thinking, reasoning, scientific attitude, and scientific aptitude. Science education brings drastic changes in human endeavours. However, in the teaching learning process the method of teaching plays a vital role. Traditional teaching methods promote route memorization but Sciences need most Conceptual Understanding, think logically, and investigate. So changes in method of teaching are necessary in science.

Inquiry-Based Learning is completely student centred, in which students actively participate, explore, investigate, perform experiments, drawing conclusions.

The present study attempts to examine the effectiveness of inquiry-based learning strategy in improving conceptual understanding and academic achievement of Class IX students in physical science.

II. REVIEW OF RELATED LITETATURE

John Dewey (1938**)** emphasized the importance of experiential learning in education. According to Dewey, students learn better when they actively participate in the learning process. He suggested that teaching should encourage students to ask questions, investigate problems, and discover knowledge through experience. This philosophy later became the foundation of inquiry-based learning in science education.

Michael Prince (2004) conducted research on active learning strategies and found that student-centered teaching approaches significantly improve students' academic performance and retention of knowledge.

Avi Hofstein and Vincent Lunetta (2004) examined the role of laboratory learning in science education and

concluded that inquiry-based laboratory activities improve students' scientific reasoning and conceptual understanding.

Cindy Hmelo-Silver (2007) found that inquiry-based learning promotes problem-solving skills, critical thinking, and collaborative learning among students.

Daphne Minner, Abigail Levy, and Jeanne Century (2010) reviewed several research studies on inquiry-based science instruction and concluded that inquiry-based teaching positively affects student achievement and engagement in science learning.

Erin Furtak et al. (2012) conducted a meta-analysis of inquiry-based science teaching and found that guided inquiry instruction significantly improves students' conceptual understanding and academic achievement.

III. RATIONALE OF THE STUDY

Many students rely on route memorization because of traditional teaching methods and lack conceptual understanding, whereas science education needs deeper conceptual understanding but inquiry-based learning provides opportunities for the students to explore, investigate, perform experiments, and draw conclusions. This approach involved students' active participation and making learning meaningful.
This approach helps students develop curiosity, scientific thinking, scientific attitude and inculcate problem solving ability.

IV. STATEMENT OF THE PROBLEM

Statement of problem is as follows "Effectiveness of Inquiry-Based Learning Strategy on Conceptual Understanding and Academic Achievement in Physical Science among secondary school Students of Jajpur districts "

OPERATIONAL DEFINATION OF THE TERMS

Inquiry-Based Learning Strategy - This learning strategy based on students centred, involved Students active participation in teaching. Students learn scientific concepts through questioning, Investigating, performing experiment, drawing conclusion

Academic Achievement -Academic achievement refers to the level of performance of students in a subject measured through tests or examinations.
Secondary School Students -Secondary school students refer to the students studying at the secondary level of education i.e class 9th and class 10.

V. OBJECTIVES OF THE STUDY

1.To study the effectiveness of the inquiry-based learning strategy in teaching physical science among Class IX students.
2.To compare the conceptual understanding of students taught through the inquiry-based learning strategy and those taught through the traditional teaching method.
3.To compare the academic achievement of students taught through the inquiry-based learning strategy and those taught through the traditional teaching method.

HYPOTHESES OF THE STUDY

H_{01} -There is no significant effect of the inquiry-based learning strategy on the teaching of physical science among Class IX students.
H_{02}-There is no significant difference in conceptual understanding between students taught through the inquiry-based learning strategy and those taught through the traditional teaching method.
H_{03}-There is no significant difference in academic achievement between students taught through the inquiry-based learning strategy and those taught through the traditional teaching method.

DELIMITATIONS OF THE STUDY

This study is delimited to secondary school of Jajpur districts, again delimited to Damodar Vidya pitha class IX Students only.

VI. METHODOLOGY OF THE STUDY

To examine the effectiveness of inquiry-based learning strategy on conceptual understanding and academic achievement in physical science among Class IX students, this present study adopted an experimental research method.
Among all the students were distributed into two groups i.e control group and another was an experimental group. Before treatment was given pretest was Conducted for both the group then control

group taught through traditional method but experimental group taught through inquiry-based learning strategy after that post-test was administered.

POPULATION OF THE STUDY

In research population means the entire set of individuals having some common characteristics to which research findings will be generalised. All the Secondary School Students of Damodar Vidya pitha's students comprised as the population of the study.

SAMPLE OF THE STUDY

Samples of the study are defined as Individuals that are taken from the population which represents all the population and the result of the research generalised to the whole population.

In this study 50 students from class IX were considered as samples, each group i.e control group and experimental group has 25 students each

TOOLS OF THE STUDY

Two types of tools were used for present study.

Instructional tool:- The lesson was plans based on inquiry-based learning strategies, it also included necessary TLM .

Measuring tool:- Teacher made achievement test prepared by the researcher which Contains mcq questions based on physical science.

PROCEDURE OF DATA COLLECTION

The researcher personally visited the school. The researcher considered 25 students as experimental group and 25 students as control Group. Before treatment was given pretest was Conducted for both the group then control group taught through traditional method but experimental group taught through inquiry-based learning strategy after that post-test was administered and data was collected.

STATISTICAL TECHNIQUES USED

In this present study, the statistical techniques mean, standard deviation (SD) and t test have been used for the analysis of the raw data and to find out the significance of mean differences for comparison

DATA ANALYSIS AND INTERPRETATION

INTRODUCTION -

Data analysis and interpretation is the process of assigning meaning to the collected data and determining conclusions, significance and implications of the findings. In this process data were collected, categorizing, manipulating data and summarizing data.

The present study attempts to understand the effect of inquiry-based teaching strategies on conceptual understanding and academic achievement in physical science among Class IX students.

A traditional lecture method was used for the control group whereas inquiry-based teaching methods for the experimental group. To measure students conceptual understanding and academic achievement pretest and post-test were conducted.

Analysis of Pre-Test Scores

Before implementing the teaching strategy, a pre-test was conducted to determine the initial knowledge level of students in both groups.

Pre-Test Scores of Experimental and Control Groups

Group	N	Mean	Standard deviation
Experimental	25	11.6	1.12
Control	25	11.6	1.15

The mean scores of the experimental and control groups are almost the same. This indicates that both groups had a similar level of knowledge before the teaching intervention.

Analysis of Post-Test Scores

A post-test was conducted to measure the academic achievement of students after the intervention of teaching was done.

Group	N	Mean	Standard deviation
Experimental	25	23.1	1.34
Control	25	16.5	1.12

The mean score of the experimental group is higher than that of the control group. This clearly shows that students score high who taught through inquiry-based

teaching methods in comparison to the students who Taught in a traditional way.

Objective 1

To study the effectiveness of the inquiry-based learning strategy in teaching physical science among Class IX students

To study the effectiveness of the inquiry-based learning strategy in teaching physical science among Class IX students. After the intervention post test score shows that the performance of students who were under the Experimental group taught through inquiry-based learning strategy significantly higher than the students who were under the control group. I,e 23.1 was the mean score for the experimental group whereas the mean score of the control groups was the 16.5 , mean score of experimental groups was higher than that of control group.

inquiry-based learning strategy is more effective in teaching physical science rather than traditional teaching methods. Thus, the Null hypothesis is rejected.

Objective 2

To compare the conceptual understanding of students taught through inquiry-based learning strategy and those taught through the traditional teaching method.

23.1 was the mean score for the experimental group whereas the mean score of the control groups was the 16.5. mean score of experimental group was higher than that of control group. This indicates that students who were taught through the inquiry-based learning strategy demonstrated better conceptual understanding than those taught through the traditional teaching method.

Group	N	Mean	SD	t-value	Table value (0.05 level)
Experimental	25	23.1	1.34	12.54	2.01
Control	25	16.5	1.12		

12.54 was the calculated t- value and 2.01 was the tabulated t- value at 0.05 level of significance, there for the Null hypothesis Is rejected.

The inquiry-based learning strategy was found to be more effective in improving conceptual understanding of physical science among Class IX students.

Objective 3

To compare the academic achievement of students taught through the inquiry-based learning strategy and those taught through the traditional teaching method.

The table shows that the mean score of the experimental group (23.1) is higher than that of the control group (16.5). This indicates that students taught through the inquiry-based learning strategy performed better in the achievement test than those taught through the traditional teaching method. Thus the Null hypothesis that reads There is no significant difference in academic achievement between students taught through the inquiry-based learning strategy and those taught through the traditional teaching method is rejected.

VII. SUMMARY AND CONCLUSION

MAJOR FINDINGS

The inquiry-based learning strategy in teaching physical science among Class IX students was most effective .

The conceptual understanding of students taught through the inquiry-based learning strategy was more than those taught through the traditional teaching method.

The academic achievement of students taught through the inquiry-based learning strategy was more than those taught through the traditional teaching method.

EDUCATIONAL IMPLICATION

Educational implications of the study are given below

Teachers should adopt inquiry-based learning instead of traditional lecture methods to make learning more effective.

The strategy helps in improving conceptual understanding, so teaching should focus on understanding rather than memorization.

Inquiry-based learning enhances academic achievement, so it should be used regularly in science classrooms.

It promotes scientific attitude, critical thinking, and problem-solving skills among students.
Curriculum planners should include more activity-based and inquiry-oriented content in physical science.
Teacher training programs should prepare teachers to use inquiry-based teaching methods effectively.

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