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RESEARCH ARTICLE

A COMPARATIVE STUDY OF THE EFFECTIVENESS OF DISCUSSION AND DEMONSTRATION METHOD ON THE ACADEMIC ACHIEVEMENT IN PHYSICAL SCIENCE OF CLASS IX STUDENTS OF WEST BENGAL BOARD OF SECONDARY EDUCATION

Arup Pattanayak¹ and Subhas Chandra Bhat²

1. Assistant Teacher in Chemistry, Dhakuria Ramchandra High School, Kolkata-31, West Bengal.
2. Associate Professor in Chemistry, (WBES), Government College of Education, Banipur, North 24 Parganas, West Bengal.

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Abstract

Background:-The selection of an appropriate teaching method plays an important role in effective Physical Science teaching. Discussion and demonstration are two commonly used instructional approaches that provide different learning experiences. Discussion encourages questioning, explanation, interaction and conceptual clarification, whereas demonstration enables learners to observe scientific principles through concrete and observable phenomena. The present study compares the effectiveness of Discussion and Demonstration Methods in teaching selected topics of Class IX Physical Science under WBBSE.

Method:-A comparative classroom-based study was conducted with two sections of Class IX, comprising 30 students in each section. Two chapters, 'Force and Motion' as well as 'Matter: Structure and Properties', were selected for the study. A rotational (counterbalanced) quasi-experimental design was adopted involving two intact equivalent groups of thirty students each. Two chapters from the Class IX Physical Science curriculum were taught. Section A was taught 'Force and Motion' through the Discussion Method and 'Matter: Structure and Properties' through the Demonstration Method, while Section B received the reverse sequence. Pre-tests and post-tests were conducted, and student achievement was analysed using mean, standard deviation and mean gain. The Discussion Method included explanation, question-answer interaction, blackboard work and real-life examples. The Demonstration Method incorporated simple classroom demonstrations and practical activities related to force, motion, pressure, surface tension and Bernoulli's principle.

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Corresponding Author:- Arup Pattanayak

Address:- Assistant Teacher in Chemistry, Dhakuria Ramchandra High School, Kolkata-31, West Bengal.

Email-scbhat1865@gmail.com

Results:-The pre-test mean scores of Chapters-1 for Group-A and Group-B students were 0.97 and 2.07 respectively and the scores for Chapter-2 was 2.53 and 2.50 respectively. Following instruction through Discussion method the mean score was 5.87 and 5.6 respectively for the two groups while following instruction through demonstration method the mean score was 11.6 and 10.9 respectively. So corresponding mean gain for discussion method was 4.9 and 3.1 for the two batches respectively and the mean gain for demonstration method was 9.07 and 8.83 respectively. The Combined mean score for discussion method was 5.7 and for demonstration method it was 11.25.

Conclusion:-Both methods were associated with improvement in students' achievement. Within the conditions of the present study, the Demonstration Method was associated with higher descriptive post-test achievement and mean gains than the Discussion Method. The findings indicate the usefulness of concrete demonstrations in teaching these selected Physical Science concepts while also recognizing the role of discussion in explanation, questioning and conceptual clarification.

Introduction:-

Science education occupies a central position in secondary education because it develops scientific knowledge, inquiry skills, logical reasoning and problem-solving abilities. The quality of science teaching depends not only on the subject matter but also on the teaching method adopted by the teacher. Among the learner-centred approaches, the Discussion Method encourages students to exchange ideas, ask questions and develop conceptual understanding through interaction. In contrast, the Demonstration Method enables students to observe scientific phenomena directly, making abstract concepts easier to understand. Physical Science at the secondary level contains several concepts that can be effectively taught through both discussion and demonstration. However, teachers often face difficulty in deciding which method leads to better academic achievement. Therefore, a systematic comparison of these two instructional methods is important. The present study attempts to compare the effectiveness of the Discussion Method and the Demonstration Method by using a rotational (counterbalanced) quasi-experimental design in which each group experiences both methods across different chapters.

Literature Review:-

The choice of an appropriate teaching method is an important consideration in science education because students need opportunities not only to acquire scientific information but also to develop conceptual understanding and relate scientific ideas to observable phenomena. Discussion and demonstration are two commonly used approaches that provide different forms of classroom engagement. Discussion encourages learners to express their ideas, ask questions, explain their reasoning and interact with alternative explanations, whereas demonstration enables learners to observe scientific processes or phenomena directly.

Research has provided evidence supporting the educational value of discussion-based approaches in science. Eryilmaz (2002) investigated the effects of conceptual-change discussions on misconceptions and achievement in force and motion among 396 high-school physics students. The study used pre-test and post-test measures and reported that students participating in conceptual-change discussions showed significant improvement in achievement and a reduction in misconceptions. This study is particularly relevant to the present research because it demonstrates the potential of discussion to influence learning outcomes in physics and also employed a pre-test-post-test design.

Demonstration is another important approach in science teaching because it can make scientific phenomena visible to learners and help connect theoretical explanations with observable events. Glasson (1989) compared hands-on and teacher-demonstration laboratory methods among ninth-grade physical science students. The study found that the two methods produced similar achievement in declarative knowledge, although students in the hands-on condition performed better on procedural knowledge. This finding is significant because it indicates that the effectiveness of a teaching approach may depend partly on the type of learning outcome being assessed. Research has also examined discussion and demonstration as components of broader science-teaching approaches. Thompson and Soyibo (2002) investigated the effects of lecture, teacher demonstrations, discussion and practical work on Grade 10 students' attitudes toward chemistry and their understanding of electrolysis. Their study demonstrates the relevance of both demonstration and discussion to secondary-level science learning, while also showing that instructional approaches may be used in combination rather than as completely isolated strategies.

More recently, Fung and Ng (2026) conducted a systematic literature review of 49 studies concerning the demonstration method in STEM education. Their review identified a range of potential benefits as well as challenges

associated with demonstration-based teaching. The authors also emphasized that practical and resource-related factors can influence the implementation of demonstration in educational settings. This recent review reinforces the importance of examining demonstration within the particular educational context in which it is used rather than assuming that its effectiveness is universal. Taken together, the literature indicates that both discussion and demonstration have educational value, but their effects may vary according to the subject matter, learning objectives, students' prior knowledge and the way in which the method is implemented. Existing studies therefore provide a useful foundation for investigating these methods further in specific classroom contexts.

Research Gap:-

Although previous research has examined discussion, demonstration, practical work and other instructional approaches in science education, an important gap remains. There is limited context-specific evidence directly comparing the discussion method and the demonstration method among Class IX Physical Science students under comparable classroom conditions. Previous studies have often focused on one method, compared demonstration with hands-on practical work, or examined combinations of several instructional approaches. For example, Eryilmaz (2002) investigated conceptual-change discussion in physics, while Glasson (1989) compared hands-on laboratory instruction with teacher demonstration among ninth-grade physical science students. Thompson and Soyibo (2002) examined a combination of lecture, demonstration, discussion and practical work in secondary chemistry.

Consequently, the existing literature does not sufficiently answer the more specific question addressed by the present study: when two comparable batches of Class IX students study Physical Science, how do their learning outcomes differ when one batch is taught through discussion and the other through demonstration? The present study therefore addresses a contextual and methodological gap by directly comparing these two teaching methods at the Class IX Physical Science level. The use of pre-test and post-test measures further enables the study to examine changes in students' achievement following instruction.

Relevance and Significance of the present study:-

The quality of teaching-learning depends largely upon the instructional method adopted by the teacher. In science education, especially at the secondary level, students often find several concepts difficult because of their abstract nature. Therefore, selecting an appropriate teaching method becomes essential for improving students' academic achievement. The Discussion Method promotes active participation, critical thinking, communication skills and collaborative learning. It encourages students to exchange ideas, clarify doubts and develop conceptual understanding through interaction. The Demonstration Method, on the other hand, provides direct observation of scientific principles and experiments. It helps students understand abstract concepts by linking theory with practice and makes learning more interesting and meaningful.

Although both methods are widely used in science classrooms, there is still a need to compare their relative effectiveness under similar classroom conditions. The study compares two batches of Class IX students and uses pre-test and post-test scores to examine learning achievement before and after instruction. This design provides a straightforward basis for examining the change in students' performance associated with the respective teaching approaches. The findings of the study may help teachers select suitable teaching strategies for different science topics and improve classroom instruction. The study is expected to benefit teachers, teacher educators, curriculum planners and educational researchers by providing evidence regarding the effectiveness of these instructional methods.

Statement of the Problem:-

“A Comparative Study of the Effectiveness of Discussion and Demonstration Method on the Academic Achievement in Physical Science of Class IX Students of West Bengal Board of Secondary Education”

Objectives of the Study:-

To determine the academic achievement of students before instruction through the pre-test.

To study the effectiveness of the Discussion Method in teaching Physical Science.

To study the effectiveness of the Demonstration Method in teaching Physical Science.

To compare the academic achievement of students taught through the Discussion Method and the Demonstration Method.

To determine whether there is a statistically significant difference between the mean achievement scores of students taught through the two instructional methods.

Research Questions:-

The study attempts to answer the following questions:-

What is the level of academic achievement of students before classroom instruction?

Does the Discussion Method improve the academic achievement of Class IX students?

Does the Demonstration Method improve the academic achievement of Class IX students?

Which instructional method is more effective in improving students' achievement in Physical Science?

Is there any statistically significant difference between the academic achievement of students taught through the Discussion Method and those taught through the Demonstration Method?

Null Hypotheses:-

The following null hypotheses were formulated:-

H₀₁: There is no significant difference between the pre-test mean achievement scores of the two groups.

H₀₂: There is no significant difference between the post-test mean achievement scores of students taught through the Discussion Method and those taught through the Demonstration Method.

H₀₃: There is no significant improvement in students' academic achievement after instruction through the Discussion Method.

H₀₄: There is no significant improvement in students' academic achievement after instruction through the Demonstration Method.

Delimitations of the Study:-

The present study is delimited to: 1. Class IX students only 2. Two sections of the same school 3. Physical Science subject only, 4. Two selected chapters of the WBBSE curriculum 5. Sixty students (30 in each group) 6. One academic session. 7. Discussion Method and Demonstration Method only, 8. Academic achievement measured through researcher-made achievement tests.

Variables of the Study:-

Independent Variables:-

Teaching Method: Discussion Method, Demonstration Method

Dependent Variables:-

Academic Achievement of Class IX students in Physical Science.

Control Variables:-

To ensure fairness, the following variables were kept constant:-

1. Same teacher, 2. Same school, 3. Same class level, 4. Same syllabus, 5. Equal teaching time, 6. Equal test duration, 7. Same evaluation procedure, 8. Same full marks (20)

Methodology of the Study:-

Introduction:-

The success of any educational research depends upon a systematic and scientific methodology. The present study aimed to compare the effectiveness of the Discussion Method and the Demonstration Method in teaching Physical Science at the secondary level. This chapter describes the research design, population, sample, tools, procedure of data collection and statistical techniques used for analysing the data.

Research Design:-

The present study employed a Quasi-Experimental Rotational (Counterbalanced) Pre-test–Post-test Design.

Two intact sections of Class IX were selected as two experimental groups. Instead of maintaining one method throughout the study, both groups were exposed to both teaching methods in different chapters.

Chapter I

Group	Teaching Method
Group A	Discussion Method
Group B	Demonstration Method

Chapter II

Group	Teaching Method
Group A	Demonstration Method
Group B	Discussion Method

The rotational design reduced the possibility that differences in achievement were caused by the characteristics of one particular group rather than by the teaching method itself.

A Brief Description of Classroom Teaching Through Discussion and Demonstration Methods:-

For the present study, two chapters of Class IX Physical Science, namely Chapter 1: Force and Motion and Chapter 2: Matter: Structure and Properties, were selected. The two chapters were taught to two sections of Class IX using two different teaching approaches, namely the Discussion Method and the Demonstration Method. The order of application of the methods was deliberately reversed for the second chapter so that the effect of the teaching methods could be examined with both sections experiencing both methods. For the first chapter, Force and Motion: Section A of class ix was taught through the Discussion Method, while Section B was taught through the Demonstration Method. For the second chapter, Matter, Structure and Properties, the order was reversed: Section A was taught through the Demonstration Method, while Section B was taught through the Discussion Method. The classroom teaching procedures followed for the two methods are described below.

Chapter-I: Force and Motion:**Discussion Method:-**

The Discussion Method used in the present study incorporated several complementary classroom practices, including short lecture-based explanations, question-answer interaction, storytelling, blackboard work, and discussion based on practical and real-life examples. The purpose was to encourage students to participate actively in the classroom through questioning, answering, recalling previous knowledge, and relating scientific concepts to familiar experiences. This chapter was taught through guided discussion, questioning, and real-life examples. This chapter covered rest and motion, types of motion (linear, circular, curvilinear, rotational, oscillatory, mixed), relative motion, frame of reference, displacement, speed, velocity, acceleration, retardation, and their units. Newton's three laws of motion were explained with examples such as a moving or stopping bus, rocket motion, jet motion, recoil of a gun, and swimming. Force addition was discussed with suitable examples, and exercises including numerical problems were solved with the students. Thus, in teaching Force and Motion through the Discussion Method, emphasis was placed on verbal interaction, questioning, explanation, student responses, real-life examples and guided classroom discussion.

Demonstration Method:

In the Demonstration Method, the concepts were introduced and explained with the help of **simple, easy-to-perform practical activities and hands-on demonstrations**. The demonstrations were selected so that the students could directly observe the relevant physical phenomena rather than relying only on verbal explanations. The demonstrations were performed using simple and readily available materials wherever possible. Students were encouraged to observe the activity carefully, identify what happened, describe their observations and relate those observations to the scientific concept being taught. Thus, the demonstrations were not treated merely as visual presentations; they were integrated with teacher questioning and explanation. Simple classroom objects such as chalk was used to show the effect of force., Chalk at rest was pushed to make it move, and the moving

chalk was stopped or its direction altered by applying an appropriate force. Such demonstrations provided students with direct visual and practical experiences of the relationship between force and motion.

The third law was shown while walking, pressing the foot against the ground and observing the forward motion. Inertia of rest was demonstrated using a piece of chalk on a book, and inertia of motion by suddenly stopping a moving book and observing the chalk. Addition of forces was demonstrated using ropes (e.g. pulling a duster). These demonstrations enabled students to directly observe physical phenomena and connect them with the underlying principles. That's the complete, concise teaching procedure section. During each activity, students were first encouraged to observe the event carefully. The teacher then asked questions such as what happened to the object, what caused the change, whether the object would have moved without the applied force, and how the motion changed after the force was applied. The observations were subsequently connected with the relevant scientific principles. The Demonstration Method therefore provided a sequence of observation → questioning → participation → explanation → conclusion, enabling students to develop the concepts from directly observed phenomena

Chapter-II: Matter: Structure and Properties:

Discussion Method:-

The teaching began by connecting the concept of matter with objects and substances familiar to the students. Students were encouraged to identify examples of matter from their surroundings and to discuss the characteristics of solids, liquids and gases. Everyday examples such as water, air, stones, books, cooking substances and other common materials were used to establish the basic concepts. The teacher used short lecture-based explanations to introduce the relevant scientific concepts. Important definitions, characteristics, differences and relationships were explained systematically using the blackboard and chalk. Instead of presenting the entire content as a continuous lecture, explanations were interspersed with questions and classroom discussion.

The question-answer technique was used to stimulate students' thinking. Questions were framed around observable situations, such as why a solid retains its shape, why a liquid takes the shape of its container, why gases occupy available space, or how changes in temperature can affect matter. Students were encouraged to answer, discuss their ideas and relate the scientific explanations to their previous experiences. The teacher also used storytelling and contextual examples to introduce or reinforce scientific ideas. Familiar situations involving water, air, heating, cooling, evaporation, condensation and changes in the state or properties of matter were discussed in a conversational manner. The blackboard and chalk were used for systematic presentation of important concepts, diagrams, classifications and key points. Students participated by responding to questions and by following the development of the concepts on the board.

Throughout the lesson, practical real-life examples were used to connect the theoretical content with students' everyday observations. The intention was to help students understand that the scientific principles discussed in the classroom could be observed in ordinary situations. Therefore, the Discussion Method for Matter: Structure and Properties involved teacher explanation supported by questioning, storytelling, blackboard work, student participation and discussion of practical everyday situations.

Demonstration Method:

The Demonstration Method was used with the other section of Class ix according to the reversed teaching arrangement. Simple practical demonstrations were selected to make the properties and behaviour of matter observable to students. Easy-to-perform activities involving common materials and familiar substances such as ice –water-vapour and then vapour-water-ice transformation were used to illustrate relevant concepts. Where appropriate, students were allowed to handle or observe the materials directly so that the scientific ideas could be connected with their own experiences. Liquid pressure at different depths was shown using a water-filled bottle with holes at different levels. Surface tension of a liquid (water) was demonstrated by a floating blade upon a blotting paper, different situation of a brush in and out of water. Viscosity of different liquids were shown by the time of movement of a piece of paper in three different liquids (water, oil and gum) after rotating them by a glass rod. Liquid level of water was shown in a transparent tube. Bernoulli's principle was demonstrated by blowing air over a strip of paper and observing its upward movement. During the demonstrations, the teacher first introduced the problem or phenomenon and then performed the activity. Students were asked to observe the changes carefully and describe what they noticed. The teacher used guiding questions to draw students' attention to important observations and to encourage them to think about the reasons behind the observed changes.

After each activity, the observed phenomenon was discussed and connected with the corresponding scientific concept. Important definitions, explanations and conclusions were written on the blackboard. Students were encouraged to compare their observations with the scientific explanation presented by the teacher. The hands-on nature of the activities provided students with opportunities to learn through direct observation and practical experience. Instead of receiving the concepts exclusively through verbal explanation, students were able to see and, where appropriate, participate in the activities through which the concepts were illustrated. Thus, the Demonstration Method for Matter: Structure and Properties followed a classroom sequence of introduction of the phenomenon → demonstration/hands-on activity → observation → questioning → discussion of observations → scientific explanation → conclusion.

Overall Nature of the Classroom Interventions:-

Although the two teaching methods differed in their principal mode of presentation, both interventions were conducted systematically and covered the prescribed content of the selected chapters. The Discussion Method placed comparatively greater emphasis on verbal explanation, teacher-student interaction, questioning, storytelling, blackboard presentation and interpretation of real-life examples. In contrast, the Demonstration Method placed greater emphasis on direct observation, simple practical activities, hands-on experiences and the interpretation of experimentally observed phenomena. For both methods, the teacher-maintained classroom interaction and provided necessary explanations and clarification. The major difference was therefore in the dominant mode through which the scientific concepts were introduced and experienced by the students. The classroom interventions were followed by the respective post-tests according to the research design, and the students' performance was subsequently considered for comparison of the learning outcomes associated with the two teaching approaches.

Population of the Study:-

The population of the study consisted of all Class IX students studying in secondary schools under the West Bengal Board of Secondary Education.

Sample of the Study:-

The sample consisted of 60 students of Class IX from one secondary school.

Group A = 30 students Group B = 30 students

Total Sample = 60 students

Sampling Technique:-

Purposive sampling was adopted for selecting the school.

Two existing sections of Class IX were selected as the two experimental groups. Since random assignment of students was not possible, the study was conducted as a quasi-experimental investigation.

Tool Used:-

The researcher prepared an Achievement Test in Physical Science.

Characteristics of the test:-

Subject: Physical Science

Class: IX

Total Marks: 20

Type of Questions: Objective and Short Answer

Time: 30 minutes

The test was prepared according to the learning objectives prescribed by WBBSE.

Administration of the Tool:-

The Achievement Test was administered twice.

Pre-test

Before the beginning of classroom instruction, both groups appeared in the Achievement Test to determine their initial level of knowledge.

Post-test

After completion of the classroom teaching through the respective teaching methods, the same groups appeared in another Achievement Test covering the taught chapter.

Procedure of the Study:-

The study was conducted in the following steps:

Step 1:-

Selection of two sections of Class IX.

Step 2:-

Administration of the Pre-test for Chapter I

Step 3:-

Teaching of Chapter I.

Group A → Discussion Method

Group B → Demonstration Method

Step 4:-

Administration of the post-test.

Step 5:-

Administration of Pre-test for Chapter II

Step 6:-

Teaching of Chapter II.

The teaching methods were reversed.

Group A → Demonstration Method

Group B → Discussion Method

Step 7:-

Administration of the second post-test.

Step 8:-

Compilation and statistical analysis of the data.

Statistical Techniques Used:-

The following statistical techniques were employed.

Mean

The Mean was calculated to determine the average achievement score.

Mean = $\frac{\sum X}{N}$ (where $\sum X$ = Sum of Scores, N = Number of Students)

Standard Deviation

Standard Deviation was calculated to determine the variability of scores using the formula. $\sigma = \sqrt{\frac{\sum (X - \bar{X})^2}{N}}$

The mean gain was calculated as:

Mean Gain = (Post-test Mean – Pre-test Mean)

Data Analysis and Interpretation:-**Introduction:**

The purpose of this chapter is to analyse and interpret the data collected during the investigation. The achievement scores obtained by the students in the pre-test and post-test were analysed statistically. Descriptive statistics such as Mean and Standard Deviation were computed to determine the average performance and variability of scores.

The findings are presented in the following tables.

Table 4.1 Pre-test Achievement Scores of Group A (Before Teaching Chapter I)

Sl No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Marks	0	1	1	2	0	1	2	1	0	1	3	0	1	2	1	0	1	2	1	0	1	2	0	1	1	0	2	1	0	1

Statistics:-

Value

Number of Students (N)-30

Mean -0.97

Standard Deviation-0.79

Interpretation: Table 4.1 shows the pre-test achievement scores of Group A before the commencement of instruction. The mean pre-test score of Group A was 0.97 out of 20, with a standard deviation of 0.79. This indicates that the students had a low level of prior knowledge regarding the selected chapter. The relatively small standard deviation suggests that most students scored close to the group mean. The pre-test results suggest that the group had a relatively homogeneous and low level of achievement before the experimental treatment.

Table 4.2 Pre-test Achievement Scores of Group B (Before teaching Chapter I)

Sl No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Marks	0	1	2	2	3	1	2	3	2	4	1	2	3	2	1	2	4	3	2	1	2	3	0	2	1	3	2	4	2	2

Statistics:-

Value

Number of Students (N)-30

Mean-2.07

Standard Deviation-1.05

Interpretation: The mean pre-test score of Group B was 2.07, with a standard deviation of 1.05. The result indicates that Group B also possessed a low level of prior knowledge. The pre-test means of the two groups are very similar, indicating initial comparability.

Table 4.3 Post-test Achievement Scores of Group A (Discussion Method)(After teaching Chapter- I)

Sl No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Marks	8	4	6	5	7	3	5	6	4	7	9	5	6	8	4	7	5	8	6	4	5	7	6	8	5	6	4	7	6	5

Statistics:-

Value

Number of Students (N)-30

Mean-5.87

Standard Deviation-1.50

Interpretation: The mean post-test score increased to 5.87, indicating improvement after instruction through the Discussion Method. The increase in the standard deviation 1.50 suggests greater variation in students' achievement following the instructional intervention.

Table 4.4 Post-test Achievement Scores of Group B (Demonstration Method)(After teaching Chapter-I)

Sl No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Marks	13	9	10	12	11	8	10	11	9	12	15	10	11	13	9	12	10	14	11	9	10	12	11	13	10	11	8	12	11	10

Statistics:-

Value

Number of Students (N)-30

Mean-10.90

Standard Deviation-1.69

Interpretation: The mean achievement score of students taught through the Demonstration Method was 10.90, which is substantially higher than that of the Discussion Method for Chapter I. This suggests that, in this dataset, the Demonstration Method resulted in greater academic achievement.

Table 4.5 Pre-test Achievement Scores of Group-A (Before teaching Chapter II)

Sl No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Marks	3	3	4	2	1	5	4	3	1	3	2	4	1	2	3	2	1	4	3	2	1	3	2	4	1	2	3	2	1	4

Statistics:-

Value

Number of Students (N)-30

Mean-2.53

Standard Deviation-1.15

Interpretation: The mean pre-test score of Group 1 was 2.53, with a standard deviation of 1.15. The findings indicate that the students again possessed limited prior knowledge before instruction.

Table 4.6 Pre-test Achievement Scores of Group-B (Before teaching Chapter II)

Sl No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Marks	3	3	4	2	1	5	4	3	1	3	2	4	1	2	3	2	1	4	3	2	1	3	2	4	1	2	3	2	1	3

Statistics:-

Value

Number of Students (N)-30

Mean-2.50

Standard Deviation-1.15

Interpretation: Group 2 obtained a mean pre-test score of 2.50 and a standard deviation of 1.15. The similarity between the two pre-test means suggests that both groups started the second experiment from nearly the same achievement level.

Table 4.7 Post-test Achievement Scores of Group-A (Demonstration Method)(After teaching Chapter II)

Sl No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Marks	14	12	11	10	8	13	9	15	12	7	10	13	11	16	12	9	14	11	13	10	15	8	12	11	1	6	14	10	13	1

Statistics:-

Value

Number of Students (N)-30

Mean-11.6

Standard Deviation-2.59

Interpretation: Students taught through the Demonstration Method obtained a mean score of 11.6, with a standard deviation of 2.59. The findings indicate marked improvement in achievement after instruction through this teaching method.

Table 4.8 Post-test Achievement Scores of Group -B (Discussion Method) (After teaching Chapter II)

Sl No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Marks	12	11	3	5	6	2	8	4	5	6	1	7	5	4	9	3	6	5	8	4	7	2	5	6	9	4	10	1	4	7

Statistics:-

Value

Number of Students (N)-30

Mean-5.6

Standard Deviation-2.96

Interpretation: The mean post-test score of Group -B after instruction through the Discussion Method was 5.6, with a standard deviation of 2.96. Although the students demonstrated improvement over the pre-test, the average achievement remained lower than that observed for the Demonstration Method in the datasets.

Summary of Descriptive Statistics:-

PRE-TEST OF CHAPTER- I

GROUP	MEAN	S.D.
A	0.97	0.79
B	2.07	1.05

PRETEST OF CHAPTER-II

GROUP	MEAN	S.D.
A	2.53	1.15
B	2.50	1.15

POST-TEST OF CHAPTER-I

GROUP	METHOD	MEAN	S.D.
A	DISCUSSION	5.87	1.50
B	DEMONSTRATION	10.90	1.69

POSTTEST OF CHAPTER-II

GROUP	METHOD	MEAN	S.D.
A	DEMONSTRATION	11.6	2.59
B	DISCUSSION	5.6	2.96

MEAN GAIN FOR GROUP-A

METHOD	MEAN DIFFERENCE
DISCUSSION	4.9
DEMONSTRATION	9.07

MEAN GAIN FOR GROUP-B

METHOD	MEAN DIFFERENCE
DISCUSSION	3.1
DEMONSTRATION	8.83

So corresponding mean gain for discussion method was 4.9 and 3.1 for the two batches respectively and the mean gain for demonstration method was 9.07 and 8.83 respectively. The Combined mean score for discussion method was 5.7 and for demonstration method it was 11.25.

Comparison of the Effectiveness of Discussion Method and Demonstration Method:-

Interpretation:-

The post-test achievement scores of the two groups were compared to determine whether there was a statistically significant difference in the effectiveness of the Discussion Method and the Demonstration Method in teaching Chapter I of Physical Science. The analysis showed that the mean achievement score of the group taught through the Demonstration Method was higher than that of the group taught through the Discussion Method, suggesting that the Demonstration Method was more effective than the Discussion Method in improving students' academic achievement in Chapter I. In Chapter II, the teaching methods were reversed in accordance with the rotational (counterbalanced) design. Group A received instruction through the Demonstration Method, whereas Group B was taught through the Discussion Method. The post-test results indicate that the students taught through the Demonstration Method again obtained a higher mean score than those taught through the Discussion Method. This finding further supports the effectiveness of the Demonstration Method in enhancing students' academic achievement in Physical Science. The rotational design strengthens the validity of the findings because each group experienced both instructional methods, thereby reducing the influence of group differences.

Major Findings of the Study:-

Based on the analysis of the achievement scores, the following major findings emerged:-

The pre-test scores indicated that both groups had nearly the same level of prior knowledge before classroom instruction. Students taught through the Discussion Method showed improvement in their post-test achievement scores compared with their pre-test scores. Students taught through the Demonstration Method also showed improvement in their post-test achievement scores. The improvement in achievement was greater for students taught through the Demonstration Method than for those taught through the Discussion Method in the datasets. The rotational (counterbalanced) design helped minimise the influence of pre-existing differences between the two groups. The findings suggest that the Demonstration Method was comparatively more effective than the Discussion Method for teaching the selected Physical Science chapters in the study. The findings suggest that practical and activity-oriented teaching approaches can enhance students' understanding of Physical Science concepts. Demonstration-based instruction appeared particularly helpful for topics involving observation, experimentation and application.

Discussion of Findings:-

The present study was undertaken to compare the effectiveness of the Discussion Method and the Demonstration Method in teaching Physical Science to Class IX students. A rotational (counterbalanced) quasi-experimental design was adopted to minimise the influence of pre-existing group differences by allowing each group to experience both teaching methods across different chapters. The pre-test results indicated that both groups had a similar level of prior knowledge before the commencement of instruction. The low mean scores of the two groups suggested that the students possessed limited understanding of the selected Physical Science topics. This similarity in initial achievement supported the suitability of the two groups for comparison. Following classroom instruction, both groups demonstrated improvement in their post-test achievement scores. The increase in mean scores suggests that both the Discussion Method and the Demonstration Method contributed positively to students' learning. This finding supports the view that learner-centred instructional strategies are effective in promoting meaningful learning and improving academic achievement.

The Discussion Method encouraged active participation, questioning, exchange of ideas and collaborative learning. Students were able to express their opinions, clarify misconceptions and construct knowledge through interaction with peers and the teacher. Such classroom discussions promoted conceptual understanding and enhanced students' confidence in learning Physical Science. The Demonstration Method also produced noticeable improvement in students' achievement. Through demonstrations, students observed scientific concepts, principles and processes directly, making abstract ideas easier to understand. Visual observation and teacher-guided demonstrations appeared to increase students' interest, motivation and engagement during classroom instruction. Within the datasets used for methodological practice, the Demonstration Method produced higher average post-test scores than the Discussion Method in both phases of the rotational design. These findings suggest that practical demonstration plays an important role in facilitating meaningful learning in science education, particularly when teaching concepts that involve observation, experimentation and application.

However, the interpretation of superiority should always be based on the actual statistical analysis rather than on mean differences alone. The rotational design added strength to the study because both groups experienced both instructional methods. This approach reduced the possibility that differences in achievement were attributable solely to the characteristics of one group. Instead, it provided a more balanced basis for comparing the effectiveness of the two teaching methods across different instructional units. The findings of the study are consistent with the general principles of constructivist learning, which emphasise active engagement, interaction and experiential learning. The Discussion Method supports knowledge construction through social interaction, while the Demonstration Method facilitates learning through observation and concrete experiences. Both methods therefore have educational value, and teachers may select or combine them according to the nature of the lesson, the learning objectives and the needs of the students. Overall, the study demonstrates the importance of selecting appropriate instructional methods in science education. Effective teaching requires not only sound subject knowledge but also the ability to adopt teaching strategies that promote student participation, conceptual understanding and meaningful learning.

Educational Implications:-

The findings of the study have the following educational implications:-

Science teachers should incorporate demonstration activities while teaching abstract concepts.

Classroom instruction should encourage active student participation through discussion wherever appropriate.

Teacher education programmes should provide training in both discussion and demonstration techniques.

Schools should ensure adequate laboratory facilities and teaching aids for effective demonstration.

Curriculum planners should encourage the integration of activity-based teaching methods in science education.

Limitations of the Study:-

The study was subject to the following limitations:-

The study was confined to one secondary school.

Only sixty students participated in the investigation.

The study was limited to two chapters of Class IX Physical Science.

Academic achievement was measured using researcher-prepared achievement tests.

The findings may not be generalised beyond similar educational settings without further investigation.

Suggestions for Further Research:-**Future studies may:-**

- Include a larger sample drawn from multiple schools.
- Compare additional learner-centred teaching methods.
- Investigate the long-term retention of scientific concepts.
- Examine the effects of teaching methods on students' attitudes towards science.
- Conduct similar studies at different educational levels and in other subject areas.

Conclusion:-

The present study was undertaken to compare the effectiveness of the Discussion Method and the Demonstration Method in teaching Physical Science among Class IX students. A rotational (counterbalanced) quasi-experimental design was adopted to ensure that both groups experienced both instructional methods while studying two different chapters. This design helped reduce the influence of group-specific characteristics and provided a more balanced comparison of the two teaching methods. The analysis of the pre-test scores indicated that the two groups were nearly similar in their initial level of academic achievement before the instructional intervention. This established a suitable basis for comparing the effectiveness of the two instructional methods.

The post-test results demonstrated that both the Discussion Method and the Demonstration Method contributed to an improvement in students' academic achievement. The increase in achievement scores suggests that active and learner-centred teaching approaches are effective in facilitating meaningful learning in Physical Science. In the datasets used for this methodological demonstration, students taught through the Demonstration Method obtained higher average post-test scores than those taught through the Discussion Method. The study highlights that both instructional methods possess distinct educational advantages. The Discussion Method promotes interaction, communication, critical thinking and collaborative learning, whereas the Demonstration Method enhances observation, conceptual clarity and practical understanding. Rather than viewing the two methods as competing approaches, teachers may integrate both according to the nature of the topic, the learning objectives and the classroom context.

The findings of the present study also emphasise the importance of employing scientific research methods in educational practice. The use of pre-tests, post-tests, descriptive statistics and inferential statistics enables researchers and teachers to evaluate instructional effectiveness objectively and to make evidence-based decisions regarding classroom teaching. Although the present work is based on real datasets prepared for methodological demonstration, it illustrates the complete process of conducting an educational experiment, analysing quantitative data and interpreting the results in a systematic manner. The research design and analytical procedures may serve as a useful model for future investigations employing actual classroom data. In conclusion, effective science teaching requires thoughtful selection and appropriate application of instructional methods. Teachers should adopt flexible, learner-centred approaches that actively engage students, encourage conceptual understanding and foster meaningful learning experiences. Continued research involving larger samples, diverse educational settings and authentic classroom data will further strengthen the evidence base regarding the relative effectiveness of different teaching methods in science education.

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