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EFFECTIVENESS OF INTERVENTION PROGRAMME BASED ON INQUIRY BASED LEARNING APPROACH TO ENHANCE SCIENCE PROCESS SKILLS OF 8TH GRADE STUDENTS

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Abstract:

The importance of inquiry has been firmly established and is increasingly pertinent in the current competitive, rapidly evolving, and intricate setting. The National Education Policy 2020 promotes the adoption of an Inquiry-Based Learning (IBL) approach, which can enhance student and teacher engagement by catering to the diverse needs of learners in the classroom. According to the National Curriculum Framework 2005, ensuring the effectiveness of the curriculum involves actively involving students in learning the techniques and procedures that result in creating and confirming scientific knowledge. It also aims to encourage the innate curiosity and inventive thinking of students in the field of science. Hence, the cultivation of Science Process Skills is crucial for enhancing the learning of science. In the realm of science education based on inquiry, students participate in various activities and cognitive procedures akin to those employed by scientists for the creation of fresh insights. The purpose of this study was to investigate the effectiveness of inquiry-based learning on students' science process skills. A total of 66 eighth grade students from two different classes were selected as experimental group and control group. The experimental group was instructed through inquiry-based learning approach whereas the control group was instructed using conventional method. For determining the effectiveness of the inquiry-based learning approach compared to conventional method, students of experimental group and control group were administered a pre-test and post-test evaluating Basic Science Process Skills. In the statistical analysis, Analysis of Covariance (ANCOVA) was utilized. The findings of the research revealed that students who received instruction via inquiry-based learning demonstrated improved Science Process Skills compared to those taught using the conventional method.

Keywords: *Inquiry-Based Learning (IBL), Conventional Method, Science Process Skills (SPS)*

Introduction:

Science is a systematic and organized body of knowledge that is built through observation, experimentation, and evidence. It is a way of seeking understanding about the natural world by asking questions, making predictions, and testing them. Science subject plays a crucial role in shaping our understanding of the world around us. By studying science, students develop critical thinking skills, learn to analyze data, and cultivate a curiosity for exploration.

Science holds a significant place in the Indian school system as it is a mandatory subject aimed at fostering open-minded individuals, an essential characteristic for any advanced nation. It offers a diverse array of specializations in higher education. Presently, the emphasis in science education lies on the practical application of scientific knowledge, underscoring its paramount importance.

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Studying science helps individuals develop problem-solving abilities that are applicable to real-life situations. Problem-solving in science relies on the systematic approach known as the scientific method, which involves observing, measuring, collecting data, making inferences, drawing conclusions, communicating findings, and making predictions. These processes are known as science process skills. These skills equip students with the necessary tools to explore their surroundings and build knowledge. Emphasizing science process skills in education is crucial as it enhances students' comprehension of scientific concepts beyond just theoretical knowledge. Implementing activity-based teaching methods in science significantly enhances students' proficiency in science process skills and boosts their overall achievement in the subject.

Thus, the incorporation of inquiry-based learning within the science classroom can lead to strong increase in student engagement with long- term knowledge retention as it emphasizes students' abilities to critically view, question, and explore various perspectives and concepts of the real world and hence it helps in enhancing basic process skills in science as well.

Implementing inquiry-based learning in the science classroom can significantly boost student engagement and long-term retention of knowledge. This approach focuses on fostering students' critical thinking, questioning, and exploration of different viewpoints and concepts in the real world. Consequently, it plays a vital role in improving basic process skills in science.

Inquiry-based learning involves acquiring knowledge and skills by seeking information (Lee, 2014). Inquiry-based learning is an approach that encourages students to actively participate in their learning process by making observations, asking questions, analyzing sources, and interpreting data. It involves synthesizing information, proposing explanations, and sharing findings through discussions and reflections. This approach also emphasizes critical thinking skills, encouraging students to explore different perspectives and concepts in the real world. Rather than simply providing facts, teachers support students in investigating, questioning, and explaining phenomena, creating a student-centered environment for learning.

Literature Review:

Research conducted in recent years has revealed a noticeable improvement in students' science process skills when taught through inquiry-based learning, in contrast to conventional teaching methods. The researcher came across several studies on inquiry based learning carried out in the past ten years.

A notable rise in students' science process skills was observed with the implementation of the Inquiry Based Learning Model. Students proficient in science process skills demonstrated an enhanced ability to engage in scientific creativity tasks, particularly those concerning temperature and heat materials (Panjaitan and Siagan, 2020). The basic science process skills showed improvement following the educational intervention. The utilization of worksheets, musical activities, and interactions with peers as well as teachers were identified as key factors contributing to the enhancement of basic science process skills through the inquiry-based science learning approach (Mulyeni, Jamaris, and Supriyati, 2019). Inquiry-based learning as an educational process of active learning encouraged students to discover new knowledge on their own and enhanced their problem-solving abilities. By generating their own questions and evidence-supported explanations, students are also able

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to engage in higher levels of cognitive reasoning in the classroom. (Kumar, 2013).Various types of inquiry-based learning exist (Bulbul, 2010). In structured inquiry, the teacher offers students a problem to explore along with the necessary tools and steps. This form of learning is utilized to impart a particular concept, information, or ability and sets the foundation for open inquiry, where students create their own questions to investigate.

Studies like those carried out by Rissing and Cogan (2009) and Marx et al. (2006) found that employing an inquiry-based or investigative teaching and learning approach in science can enhance students' science process skills by providing them with opportunities to actively apply these skills.

In summary, the above-mentioned research suggests that incorporating inquiry-based learning into the classroom enhances students' Science Process Skills and assists them in developing a curiosity-driven approach to learning that lasts a lifetime.

Objectives of the Study:

The research was conducted with the following objectives

- To study the Science Process Skills of 8th grade students.
- To develop a program based on Inquiry Based Learning approach.
- To study the effectiveness of program on Science Process Skills of students.

Variables of the Study:

Programme based on Inquiry-Based Learning approach, was considered the *independent variable*, while the Science Process Skills was the *dependent variable.*

Hypothesis of the Study:

H0: There is no significant difference in the pre-test and post-test scores on Science Process Skills of students of experimental and control group.

Methodology of the Study:

This study adopted the Quasi-experimental design where the experimental and control groups selected were non-equivalent. Both the groups were selected from one available school. The design used was pre-test post-test non-equivalent group design. It is indicated as follows:

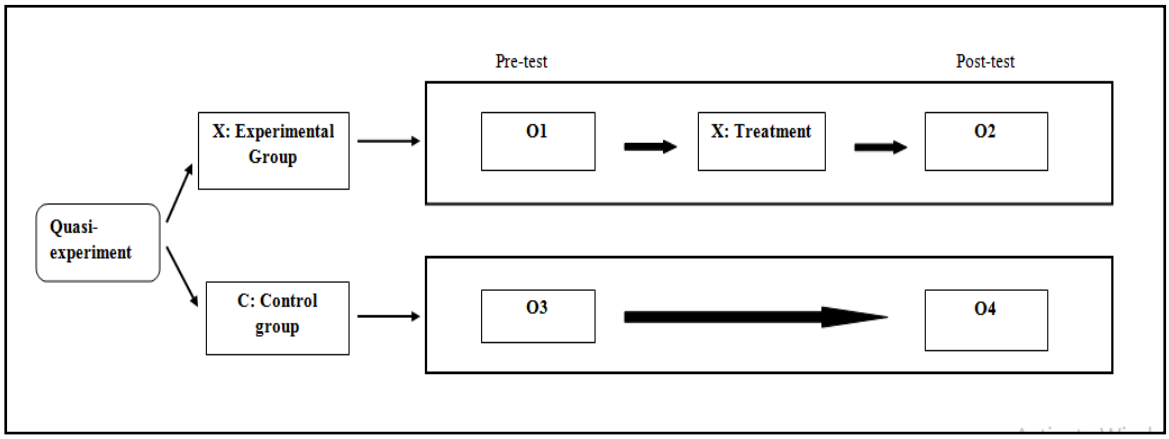

Figure 1 Quasi-experimental Design

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In this design, 'X' represents experimental group and 'C' represents control group of this study. 'O1' and 'O3' represent pre-tests of experimental group and control group respectively. 'O2' and 'O4' represent post-tests of experimental group and control group respectively.

Sample its size and nature:

The following sampling techniques were utilized to collect data for quantitative analysis. Sample was selected in the following manner.

School selection **-** Using an incidental sampling technique, the school was selected. The selected school is affiliated to the Maharashtra State Board of Secondary and Higher Secondary Education and is situated in the suburban region of Mira Road (East).

Class selection - Using random selection technique, two intact classes of 8th grade were selected as the control group and experimental group.

Student selection **–** From both intact classes, every student was included in the research. The selection of students was done using cluster sampling technique. Only those students who participated in the pre test and post test, as well as all sessions, were regarded as part of the final sample.

Tool of the study :

To gather data for quantitative analysis, the Test of Basic Science Process Skills (BAPS) was utilized. This test is prepared by Padilla M. Professor of Science Education, University of Georgia, Athens. The test consists of 36 items, each with a single correct answer. The items are designed around basic science processes including Observing, Inferring, Measuring, Communicating, Classifying, and Predicting. The maximum possible score is 36. The each correct response was scored by 1.

Procedure of the Study:

In this study, the researcher utilized the subsequent interventions:

a. Instructed through an inquiry-based learning approach (experimental group)

b. Instructed using conventional method (control group)

The researcher provided instructions to the experimental group, while the control group received instructions from the school's science teacher where the study took place.

In the experimental group, students were instructed through an inquiry-based learning approach. This approach involved designing teaching strategies, learning activities, and lesson plans to actively engage students in the learning process and provide them with opportunities for hands-on exploration. The lesson plans covered two chapters from the eighth-grade science textbook: 'Force and Pressure' and 'Current Electricity and Magnetism'. Activities were carried out by taking into account the steps of the cyclic inquiry model.

In the control group, the teacher followed a conventional approach by employing a strategy that involved direct instruction. This method included using direct teaching and the question-and-answer technique to educate students on relevant topics and fundamental concepts. The teaching methods utilized in this group primarily involved the explanation by the teacher along with the use of textbooks. Within this group, instruction was delivered through lectures and interactive discussions to convey the concepts effectively.

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Both conventional and inquiry-based classes made use of an identical textbook. The research was carried out over a total of eighteen hours, with twelve hours dedicated to instructional sessions and six hours allocated for administering both the pre-tests and post-tests.

Data Collection: In the present study, the quantitative data was collected in the following manner

1) Administration of the test of Science Process Skills (pre-test) on experimental and control group.
2) Exposing experimental group to a programme based on IBL approach.
3) Administration of the test of Science Process Skills (post-test) on experimental and control group.

Data Analysis:

In this study, the quantitative data has been analyzed using descriptive and inferential analysis.

For this study, the data was analyzed descriptively by:

- Measures of central tendency such as the mean, medianand mode.
- Measures of variability specifically standard deviation.
- Graphical Representation through a bar graph .

In this study, the Analysis of Covariance (ANCOVA) was utilized for the purpose of inferential analysis of the data.

Results and Discussion: Table 1 shows that the post-test mean for Science Process Skills is higher than the pre-test mean of experimental group.

Table 1

Descriptive statistics of the Pre test and Post test scores of SPS of Experimental group and control group

Variable	Test	Group	N	Mean	Median	Mode	SD
Science Process Skills (SPS)	Pre	Experimental	33	17.70	19	19	3.84
		Control	33	14.48	14	11	4.03
	Post	Experimental	33	26.12	27	28	3.97
		Control	33	18.76	20	20	4.38

Figure 2 shows a substantial increase in the SPS of students of experimental group compared to a slight increase in the SPS of students of control group.

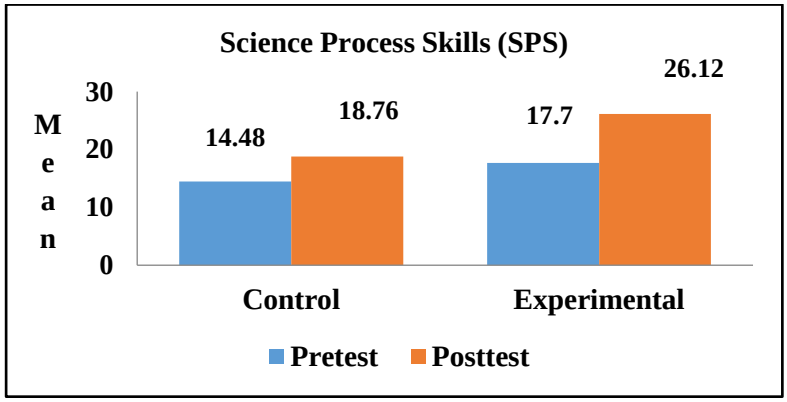

Figure 2. Mean scores of pre test and post test of SPS of experimental group and control group

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For testing the null hypothesis, the Analysis of Covariance (ANCOVA) was used.

Table 2 displays relevant statistics for the ANCOVA for Science Process Skills scores.

Table 2

Relevant statistics for the Analysis of Covariance for Science Process Skills scores

Source	SS	Df	MS	F	P
adjusted means	270.13	1	270.13	63.26	< 0.0001
adjusted error	269.34	63	4.27		
adjusted total	539.47	64			

The obtained F value for Science Process Skills is 63.26, exceeding the tabulated value of 7.08, indicating that F is significant at 0.01 level of significance. Therefore, the null hypothesis is rejected at the 0.01 level of significance.

There is a significant difference in the pretest and posttest scores of Science Process Skills of students of experimental and control group. The post test scores of experimental group is higher than the pretest scores of experimental group and post test scores of control group. This suggests that the intervention program has contributed to improving the Science Process Skills (SPS) of the students.

Conclusion and Implications:

The results of the research indicated that utilizing inquiry-based learning in science classrooms enhances students' science process skills. Implementing inquiry-based learning has beneficial effects on students' science process skills, such as Observation, Inference, Measurement, Communication, Classification, and Prediction.

Based on research findings, a notable contrast exists in the Science Process Skills of students taught through inquiry-based learning versus conventional teaching methods. Students taught using inquiry-based learning have demonstrated improved Science Process Skills compared to students taught using conventional teaching methods. This study aligns with previous research by Puspito, Supardi, Sulhadi (2020), and Sangeetha (2021).

Ergul et al. (2011) emphasized that adopting inquiry-based teaching significantly enriches students' science process skills and fosters positive attitudes toward science. Simsek and Kabapinar (2010) suggested that inquiry-based learning can not only improve students' conceptual understanding of matter but also develop scientific process skills.

Hence, educators should play a crucial role in inspiring students to connect concepts, analyze tasks, use various representations, communicate effectively, and engage in reasoning during their daily learning endeavors. To achieve this, teachers should implement the essential five steps of an inquiry-based learning approach. Motivating students by instilling the belief that they are capable of learning, creating, and sharing knowledge is essential.

School leaders should proactively integrate inquiry-based learning into daily school activities by structuring their teaching practices around this approach. Moreover, incorporating these methods will be beneficial for the training of future teachers.

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