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THE STUDY OF THE EFFECTIVENESS OF THE INQUIRY BASED LEARNING METHOD IN CHEMISTRY TEACHING LEARNING PROCESS

Jogendra Singh, Ph.D Scholar, Department of Education, Suresh Gyan Vihar University, Jaipur, India, sjogendra745@gmail.com
Dr. Vibha Kaushik, Assistant professor, Department of Education, Suresh Gyan Vihar University, Jaipur, India, vibha.kaushika@mygyanvihar.com

Abstract:- This research is a quantitative study in which traditional method is used in a limited way as compare to modern teaching method like inquiry based learning. The aim of this study was to find out effectiveness of inquiry-based learning method on student's achievement in chemistry lessons.A total of 80 students are selected in which 60 are rural and the other 60 are urban in Jhunjhunu district. They were selected through purposive sampling methods, the group which was assigned as an experimental group was instructed through inquiry-based learning methods and another group was traditionally instructed. This research is an experimental study with non-proportional groups. In which the pre and post-test will be done with the control group and the classes will be in the form of control and experimental groups. It is concluded from research that inquiry based method is much more effective than traditional teaching method in both urban and rural students.

Keywords: - Inquiry based learning, chemistry, traditional method, purposive sampling method.

I. INTRODUCTION:-

The term inquiry, in general, refers to an act of asking for information or investigates something. During the 1960s, the discovery learning movement was developed in response to traditional forms of teaching where people were required to memorize data or information from lectures. Hence inquiry-based learning is a form of modern learning methods and hasan active learning process that starts by asking questions, scenarios, and problems. This learning method contrasts with the traditional type of teaching method, which relies on the fact that instructor or teacher presented before them and there was no further any queries from both teachers and student but inquiry-based learning is appears differently by a facilitator rather than a teacher. Inquirers, for example, students will identify and examine issues and queries to develop knowledge or solutions. They might research to discover answers, engage in activities that will help them to pursue answers and find a new way to detect answers regardless the same way to search out it. By engaging in such type of learning method, students come to understand that they can take responsibility for their learning.

Inquiry-based learning strategies include the principles of creative learning such as Pieget, Dewey, the work of Wagowski and Freier. Marshall Heron in 1971 formally formulated in which a special laboratory developed the scale to evaluate the amount of questioning in practice. Heather bani and Randy Bell graphically outlines four levels of scrutiny of the headline of many levels of investigation.

Scientific information in the current information and technological era increases day- today. Technologies became more and more advance and play a major role in development for the future of society. The main goal of science education is to develop scientific literacy among students. In the inquiry-based learning of science process students are engaged in many activities. Use scientific processes to create new knowledge. Encourage the science faculty to change traditional academics- centered practices such as lecturers, textbooks and scientific facts.

There is an oriented approach to investigating-

1. Science involves the students' interest.
2. Provide opportunities for students to use fairly collect evidence.
3. Encourage students to further study to develop a more detailed explanation.

4. Emphasizing the importance of writing the scientific interpretation.

Students will act as scientists in inquiry-based activities. Experience the process of knowing and also experience the rationality of knowledge.

II. REVIEW LITERATURE: -

Edelson et al. (1999) presented a design history covering four peers of software and curriculum to display how these challenges ascend in classrooms and how the design strategies reply to them. They had been reconnoitering these challenges through a program of exploration on the consumption of scientific visualization technologies to upkeep inquiry-based learning in the geosciences. In this paper, they described five momentous challenges to employing inquiry-based learning and presented the strategies for lecturing them through the design of technology and curriculum.

Garcia et al. (2003) shown that an inquiry based, pro-active method was the superlative way to demonstrate science in an ecosphere where facts modification repeatedly and the difficulty of the issues confronted would only growth with time. In reaction to this need, numerous higher school districts in the U.S. had implemented innovative science series in which the emphasis was on inquiry type instruction. Yet still, science literacy had been relaxed to illustration improvement in undeveloped children. This research was showed to see how considerable of a role teacher's attitudes towards science itself, and science instruction in specific, played in determining to practice an inquiry approach to teaching science. Surveys concerning science upbringing, science training and instruction, and teacher attitude towards science were directed to teachers presently in elementary classrooms teaching science. Replies were gathered and investigated, and the results were really amazing. Read on to discover how teachers actually felt roughly teaching science in today's Schoolrooms.

Balaban et al. (2007) discussed the sanction on the consequence of inquiry learning in the sciences. She serrated out that although people might expected different things/practices when they referred to inquiry-based learning, there were decisive characteristics that required being nearby, including an integrated prospectus across regulation, a problem based teaching room, and deliberation to skills enlargement.

Tsai et al. (2007) investigated the consequence of inquiry-based teaching on 8th graders' impulses in learning physical science. Total 295 students were involved in this reading. The experimental group (EG) enclosed of 5 classes (n=155), the nested inquiry-based instruction model was conceded out in three units: "The basic structures of matter", "The structure of element" and "Temperature and Heat" over the phase of four months. The control group (TTM) contained 5 classes of students (n=140). Students' discernments on the fundamental inspiration were steadfast using the students' motivation towards science learning (SMTSL) questionnaire, composed from both groups before and after the tentative period.

Courtade et al. (2010) determined if teachers of students with judicious and undecorated intellectual incapacities could acquire to practice a task analysis for inquiry-based science instruction and if this training increased student responding. The conclusions of this study confirmed a practical association between the inquiry-based science teaching preparation and teacher's capability to teach students with reasonable and simple incapacities in science.

Alkaher et al. (2011) described the progression of three faculties employing inquiry based learning (IBL) in their surroundings. The focus of the article was on in what way the instructors made conclusions related to expending IBL in their classes. They provided a stimulating representation of their conclusions and their discernments of the usefulness of their decisions. Observations from the teachers provided a frame into how they were thoughtful about using the IBL attitude in their classrooms.

Pandey et al. (2011) investigated the efficiency of Inquiry Training Model over conservative teaching technique in teaching physical science at the secondary level of science students. A total of 100 students contributed in the study. The author designated the randomized groups, pre-test post-test enterprise in true untried design. Results exposed a statistically noteworthy consequence of Inquiry Training Model (ITM) over conservative teaching method on Academic accomplishment of students. Based upon the achievement test in physical science (ATPS), schooling of physical science through Inquiry Training Model

was additional operational than the teaching through the Predictable Method at the subordinate level. The ITM model might be encouraged as a better tool than the conventional method for teaching Physical Science. However, the work carried out was having certain limitations such as the unit of lesson-plans based on Physical Science was specified only 4 sub-units.

Spencer et al. (2012) explored inquiry-based instructional approaches as a technique for producing student attention in science. Inquiry was a procedure that students used to decide indecision. Grounded in the work of John Dewey, inquiry was compulsory a person to practice philosophical and perilous thinking assistances. Inquiry-based teaching was student centered and the teacher was watched as the implementer of knowledge and learning. The paper engrossed on two inquiry-based instructional approaches: The 5E model and Concept accomplishment. The 5E model used five stages: engage, explore, explain, elaborate, and evaluate. The concept accomplishment model was suitable for teaching ideas that had a vibrant set of characteristics. This approach used a procedure that agreed students to generate their own descriptions and considerate.

Abdi et al. (2014) investigated the belongings of inquiry-based learning method on students' academic accomplishment in sciences class. A total of 40 fifth grade students from two different classes were convoluted in the study. They were selected through purposive sampling technique. The group which was allocated as tentative group was 47 initiated through inquiry-based learning technique whereas the supplementary group was conventionally educated. This experimental study persisted eight weeks. To determine the efficiency of inquiry-based learning method over outdated teaching, an achievement test about sciences which entailed of 30 items was directed as pre-test and post-test to students both in the investigational and control groups. For the numerical analysis, Analysis of Covariance (ANCOVA) was used. The results exhibited that students who were instructed through inquiry-based learning were accomplished greater score than the ones which were inculcated through the outmoded method.

Treagust et al. (2014) discussed the nature of inquiry learning and how this related to inquiry teaching and the kinds of evidence needed to ascertain that this mode of learning and teaching was operational. First, he measured what was meant by inquiry learning and teaching, and then examined particular curriculum backgrounds based on inquiry learning, such as Primary Influences, Model-based Education, and Process-Oriented Guided Inquiry Learning.

Alkaher et al. (2011) depicted the movement of three resources using inquiry based learning (IBL) in their environment. The focal point of the article was on how the teachers made ends identified with consuming IBL in their classes. They gave an invigorating portrayal of their decisions and their perceptions of the helpfulness of their choices. Perceptions from the teachers gave a frame into how they were keen about utilizing the IBL mentality in their classrooms.

Hypothesis:-

1. There is no significance difference between the academic achievements of 11th class students in chemistry taught by Inquiry-based teaching method and traditional teaching method.
2. There is no significance difference between the academic achievements of 11th class urban students &rural students in chemistry taught by Inquiry-based teaching method.
3. There is no significance difference between the academic achievements of 11^{th} class urban student and rural students taught by traditional teaching method.

III. METHODOLOGY:-

(a) Research design:

This examination was a quasi-experimental investigation with non-proportionate groups, which includes pre and post-test plans with the control group. Since the classes started toward the start of the new semester by school organization, it was impractical to assign out students randomly to both experimental and control groups. In any case, the classes were randomly assigned out as control and experimental group.

The experiment design pattern, O1 is experiment group while O2 is control group. "X" represents treatment i.e. Inquiry-Based teaching approach (learning cycle model).The table represents experimental design pattern clearly-

Group	Pre-test	Experiment test	Post-test
Experimental group	01	X	01
Control group	02	-	02

(b) Sampling:

The researcher decided to select the sample from the senior secondary school of jhunjhunu district of rajasthan state. The study was done on basis of experimental method. The survey had consisted of following as given below:

- Total 120 students
- 60 students from the rural area
- Other 60 students from the urban area.
- 30 boy students belonged to rural area
- 30 girl students belonged to rural area
- 30 boy students belonged to urban area
- 30 girl students belonged to urban area.

(c) Research procedure:-

The researcher used the following two groups in the present study:

A. Taught by using inquiry based learning method (5E learning cycle) represents experimental group.

B. Taught by using traditional method represents control group.

Both groups were instructed by the same sciences teacher and before the implementation of treatment the teacher was informed about the purpose of the study and 5E learning cycle based instruction.

In the *experimental group* students were instructed with inquiry-based teaching method supported 5E learning cycle. In 5E learning cycle method, lesson plans were made in such a way that student's interaction with teacher increases. An active role was played by teacher to maximize student's interest and involvement in different concepts and topics. Lesson plans were implemented by considering stages of 5E learning cycle model are described as follows-

Engagement phase: in this phase teacher establish a good connection with students. Some random questions are asked to ascertain students' knowledge about the topic on the basis of their previous knowledge. In the engagement phase, teacher tried to increase student's attention, get them interested and ready to learn. So that students had opportunities to make some connections between prior knowledge and present learning experiences. So that further lesson plan will base on students learning outcome. Students had previous knowledge about the concepts like oxidation, reduction, hydrogen and also know some elements of s-block. This lasts for about 15 to 20 minutes.

Exploration phase: In this phase, the aim of teacher was to create learning environment for students so that they could design and plan experiments, create graphs, record data, observe scientific processes, develop hypotheses, finding results and organize their findings. Teacher only provided related approaches to understand the concept, gave feedbacks to them and assessed understandings. Some major topics of the chapters were introduced to students.

*Explanation phase:*in this phase is teacher-centered phase. Students need proper guidance and direction. It enables students to understand concepts; they describe the topics and raises questions. Teacher clarifies the doubt of students. Teacher basically used textbook as primary source of lecturing and other reference book was also used to clarify topics in more detail. This phase took more time than other phases.

*Elaborate phase:*in this phase, some activities were given to students for understanding their implementation ability for the particular chapter in different ways. It helps teacher to understand that how much student's caught the topic. How they utilize the knowledge in practical life. Two activities from three chapters- oxidation reduction reaction, hydrogen and s-block were done.

Evaluation phase: in this phase, student asked questions from students related to chapter or any other queries from topics. Teacher gave them worksheet for evaluating their knowledge. The activities in evaluation phases were also used by teacher for both formative and summative evaluations of student learning.

In the *control group*, a teacher use traditional lecture method. The teacher directly asks question and answers from students. Students learn basic concepts and topic from their textbook. Three chapters were chosen from chemistry textbook of class 11th were taught to both groups are as follows-

1. Oxidation reduction reaction.
2. Hydrogen.
3. S-block.

Other reference methods have used rarely. In this process students are completely passive, were used while teaching the hidden strangles unit. In the process of control group the teacher have instruction to students through lecture and discussion method. During this lecturing process teacher considers that all the concepts was understood by all students. Teacher wrote notes on the chalkboard and later passed out worksheets for student to complete. After the teacher's explanations, some topics were discussed, prompted by teacher-directed questions. Worksheets were developed specifically for each lesson included mostly same textbook exercises. These required written responses. Worksheets were later checked by teacher and mistakes were highlighted in front of that students and ask them for further improvement in academics.

Both traditional (control group) and inquiry classes (experimental group) used the same textbook and handouts. The instruction took 10 weeks, one week for the evaluation of result using the post-tests.

(d) Statistics:

The entire data is collected to study the effectiveness of inquiry based learning method in chemistry 11th class in compare to traditional method with respect to gender, area in which school is situated. The statistics used to analyze data are mean, standard deviation and t-test. Self made test is used to design pre-test and post- test.

IV. RESULT:

These hypothesis were tested.

Hypothesis 1-There is no significance difference between the academic achievements of 11th class students in chemistry taught by Inquiry-based teaching method and traditional teaching method.

Mean differences in teaching chemistry through inquiry based teaching method and traditional teaching method are analyzed through t-tests under the Hypothesis.

Table: 01

Teaching method	N	Mean	S.D.	t- value	Hypothesis
IBLM	60	23.6	2.586	10.450	Rejected
TTM	60	19.1	2.106		

❖ Significance level: 0.05

In the above table the analysis of data is signifies that mean score in teaching chemistry through inquiry based teaching method and traditional teaching method are analyzed through t- tests under the hypothesis H00 are 23.6 and 19.1 and S.D. is 2.586 and 2.106. The table value of't' at 0.05 level is 1.98. The obtained value of't' is more than the significance level. So we can say that academic achievement of chemistry students of 11th class students is more in inquiry based learning method than traditional method. Hence the null hypothesis is **rejected**.

Hypothesis 2-There is no significance difference between the academic achievements of 11th class urban students &rural students in chemistry taught by Inquiry-based teaching method.

Mean difference between academic achievements of urban and rural students taught by inquiry based teaching method are analyzed through t test under the Hypothesis 2.

Table: 02

Teaching method	N		Mean	S.D.	t- value	Hypothesis
IBLM	Urban students	30	24.366	2.370	2.281	Rejected
	Rural students	30	22.833	2.816		

- Significance level: 0.05

From the results of the above table, the mean and SD of urban students taught by inquiry based learning method is 24.366 and 2.370 and the mean and SD score of rural students taught by inquiry based learning method is 22.833 and 2.816. The t-table value at 0.05 is 2.00 are analyzed under hypothesis H01 (a). The obtained value of't' is more than significant value. So here we can say that null hypothesis is rejected.

Hypothesis3-There is no significance difference between the academic achievements of 11th class urban students and rural students in chemistry taught by traditional teaching method.

Mean difference between academic achievements of urban and rural students taught by traditional teaching method are analyzed through t test under the Hypothesis.

Table: 03

Teaching method	N		Mean	S.D.	t- value	Hypothesis
TTM	Urban student	30	19.233	1.851	0.488	Accepted
	Rural student	30	18.966	2.355		

- Significance value: 0.05

The above table represents the mean and SD of urban students taught by traditional teaching method is 19.233and 1.851 and the mean and SD score of rural students taught by traditional teaching method is 18.966 and 2.355. The t-table value at 0.05 is 2.00 are analyzed under hypothesis H01 (b). The obtained value of t -table is less than of significance value 0.05 so there is no significant mean difference between urban and rural students. Hence null hypothesis is accepted.

Educational implications –

The existing education system is limited. Book academic and students study facts and principles only. Current education learning strategies are far from social and actual contexts.

1. Teacher must have to understand what is meant by inquiry based learning method and also knowing the advantages and disadvantages for inquiry.
2. In schools, there is need to provide material and research labs for students and teachers.
3. Providing a coordinate support system that maximizes the staff's opportunity to put more efforts in teaching through inquiry.
4. Teachers should think in new ways, which takes the form of new skills, instructional activities, behaviors, and so on.
5. Standards of both rural and urban area school need to be increased.
6. Government agencies provide financial and other help to institutions.
7. Need to make study student centered, so students take interest in it.

V. CONCLUSION:-

From the research 'The Study of the effectiveness of the inquiry- based learning method in chemistry teaching learning process' it may be concluded that students of 11th class who taught by inquiry based learning method shows more effective results as compare to students who taught by traditional method. The findings of the study suggest to improve in academics inquiry based method must be implemented. Inquiry method is beneficial for both urban and rural area schools. Both male and female students performed very well.

REFERENCES

1. Ali Iran (2014) - Inquiry Based Learning Mode Achievement in the study of science text.
2. Anandan , a region , N.(2008) - creative Jisitii Journal education Expansion off- shore research.
3. Alam , MS (1997) The Effectiveness of Motivational Thinking and Testing tutorials and the student of secondary schools are trained in biology science.
4. Anderson, R. (1997). The research on teaching as inquiry. Paper presented for the Center for Science, Mathematics and Engineering Education. National Research Council, Washington D.C.[3].
5. Anderson, R. (2002). Reforming Science Teaching: What research says about inquiry. Journal of Science Teacher Education, 13, 1-2.
6. Balaban, Marie T.(2007) "Implementing Inquiry- or Problem-Based Learning the Undergraduate Science Curriculum: Ideals, Examples, and Concerns. Developing & Sustaining a Research-Supportive Curriculum: A Compendium of Successful Practices", eds. Kerry K. Karukstis and Timothy E. Elgren. Washington, DC: Council on Undergraduate Research.
7. Bybee, R. W. (2000) Teaching Science as Inquiry. In J. minstrell& E. H. van Zee (Eds.), *Inquiry into inquiry learning and teaching in science* (pp. 20–46). Washington, DC:American Association for the Advancement of Science .
8. Carroll, J (1963). "A model of school learning", Teachers College Record, Volume 64.
9. D.C. Edelson, D.N. Gordin, and R.D.Pea, "Addressing the Challenges of Inquiry-Based Learning Through Technology and Curriculum Design," Journal of the Learning Sciences, Volume 8 [33].
10. Genie Black (2002), "A Comparison of Traditional, Online and Hybrid Methods of Course Delivery", Journal of Business Administration online, Vol. 1 No. 1.
11. Hsiao-Lin Tuan, Chi-Chin Chin(2005), Investigating The Effectiveness Of Inquiry Instruction On The Motivation Of Different Learning Styles Students, International Journal Of Science And Mathematics Education , Vol. 3.
12. M. Herron (1971), "The nature of scientific enquiry". School Review, Vol. 79 Issue 2.
13. Michelle, J. Barthlow, Scott B. Watson(2014)- the effectiveness of process oriented guided inquiry learning to reduce alternative conceptions in secondary chemistry; school science and mathematics, volume 114, issue 5, published 11 may 2014.
14. Pandey. A, Nanda. G. K. and Ranjan. V (2011) "Effectiveness of Inquiry Training Model over Conventional Teaching Method on Academic Achievement of Science Students in India," Journal of Innovative Research in Education, vol.1(1), pp. 7-20.
15. Peggy Brickman(2006), "Effects of Inquiry-based Learning on Students' Science Literacy Skills and Confidence", International Journal for the Scholarship of Teaching and Learning, Vol. 3, No. 2, pp. 1-26.

16. Ruth Fairbanks and Catherine Andrew(2020)-Inquiry learning in the primary social science classroom .Differentiating practice to meet student needs , ISSN -2329-5929 EISSN:2329-5937, inclusive theory and practice in special education (31).
17. Secker.v.c(2002) Effects of Inquiry-Based Teacher Practices on Science Excellence and Equity .The Journal of Educational Research [Vol. 95(No. 3)]
18.Stephen Twumasi Annan, Francis Adarkwah, Albert Abaka-Yawson, Pious Akwasi Sarpong and Prince K. Santiago(2019) Assessment of the Inquiry Teaching Method on Academic Achievements of Students in Biology Education at Mawuko Girls School, Ho, Ghana*American Journal of Educational Research*. **2019**, 7(3), 219-223.
19. TSAI, Chih-Chung TUAN, Hsiao-Lin(2006), "Investigating the inquiry-based instruction effects the 8th graders' perceptions about learning environments in the physical science" in proceeding of APERA Conference.
20. Umesh Ramnarian (2016)- Understanding the influence of intrinsic and extrinsic factor on inquiry based and science education at township schools in south Africa , published -5 February 2016, https://doi.org/10.1002/tea.21315, Wiley periodicats ,Inc.J Res Sci Tech 53:598-619 .