

Original Article

The Impact of Inquiry-Based Teaching on Student Achievement in Science: An Action Research of Elementary Schools of District LarkanaRabel Kalhoro¹, Waseem Abbas Sarohi¹, Zaheer Ahmed Qadri¹, Ali Dost¹ & Muhsin Khan^{2*}¹ MS Scholar, SZABIST University Larkana Campus, Pakistan² Govt. of Sindh School Education & Literacy Department, Pakistan**Abstract**

The aim of present study was to analyze the impact inquiry-based teaching on learners' performance in science subject at elementary schools of District Larkana. Quantitative design of research was adopted to analyze the students' performance in science subject. The data gathering tool for current study was a teacher made pre and post-test questionnaire. It consisted of ten subject matter question in multiple choice questions (MCQs) type. The total marks were ten while passing were five. The results disclosed that students performed better when teacher utilized inquiry-based teaching method. Additionally, it was also found that the mean score of students in pre-test was 3.99 while, the mean score in post-test was 7.6. It was concluded from the results that the inquiry-based teaching is effective for enhancing the performance of students in science subject. However, it was recommended that concerned authorities should take such teaching method into consideration while, developing the curriculum.

Keywords: *Inquiry-Based Teaching, Student Achievement, Science Education, Elementary Schools, District Larkana*

INTRODUCTION

Inquiry-based learning is a process of teaching and learning that focuses on students' observation, inquisitiveness and ideas, in this approach, Teacher transforms traditional classroom into modern one where students are encouraged to learn with their peers to learn new things through hands-on activities like experimentation, Observation, Quizzes, gamification, simulation or dramatization (Song et al., 2022). In the interest of developing conceptual capabilities that can establish an experience and understanding of the economic organization in the twenty-first century and face the classical era, education must be administered effectively. Since they will deal with rapid and difficult developments in technological and scientific fields, learners ought to learn how to employ the strength of arguments, capacity for critical thinking, and moral standards (Hunaepi et al., 2020).

Cognitive abilities are a vital element of schooling that should be maintained concurrently. Education promotes the importance of pupils' total capacities and educational outcomes (Wriddle, 2015). A significant independent investigation education (CIBL) that has proven successful in enhancing learners' analytical reasoning is responsive to critical operations, wherein intellectual friction techniques are interfered with in the exposition and challenge presenting stages. Students use this instructional approach to record observations, discuss issues, look at references, collect, analyze, perceive, and synthesize information, offer predictions and clarifications, provide a comprehensive set of data via debate and contemplation, indicators suggest the reality, and follow up on any interesting questions that may come up during the learning process (Savery, J. R, 2015).

The analytical investigation into the matter learning (CIBL) emphasizes students' capacities to evaluate, query, and investigate multiple



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**How to cite:**

Kalhoro, R., Sarohi, W. A., Qadri, Z. A., Dost, A., & Khan, M. (2026). The Impact of Inquiry-Based Teaching on Student Achievement in Science: An Action Research of Elementary Schools of District Larkana. *Siazga Research Journal*, 5(1), 43–50. <https://doi.org/10.5281/zenodo.20029237>



viewpoints and ideas of practical life. It happens when a teacher supports students' learning, and then provides information and guideline to encourage learners to investigate, query, and explain their surroundings in a learner-centered learning atmosphere. According to Rejeki (2017), the Critical Inquiry-Based Learning (CIBL) approach helps encourage lifelong learning, which helps students to continue their pursuit of knowledge throughout their lives. Similarly, Lee (2014) claimed that the communicative approach and inquiry-based learning are comparable. Because it enables students to develop specialized skills, which are basic critical thinking skills, a critical inquiry-based learning (CIBL) is a learning that fosters students' critical thinking abilities. As long as the questioning yields fresh viewpoints, the degree of thinking rely on the amount of inquiry. Students are satisfied in developing self-regulation when they learn to pose their insightful questions within confines of the classroom and offer expressive responses (Espinoza et al., 2019).

The student in conventional methodologies typically appears to be a one-person show who is not much engaged. Direct and unilateral education is frequently the dominant component of conventional approaches. Proponents of the conventional approach presume that the learner must acquire a certain body of knowledge. Without challenging the lecturer, students are supposed to take the information they are given at face value. Little room is left for student-initiated inquiries, independent thought, or peer relationships as teachers try to convey ideas and interpretations to the passive learner (Irawan et al., 2018). Inquiry-based learning is primarily motivated by questions. Students are seen to pose important queries that direct their educational pursuits. They might ask these questions on their own because of natural inquisitiveness or because the teacher is trying to promote inquiry.

Exploration, research, and critical thinking are the main components of the educational strategy known as inquiry-based learning. The student are at the centre of the learning in the classroom, it encourages them to question, look for alternatives, and construct their own knowledge. Inquiry-based learning supports curiosity, problem-solving skills, and a deeper knowledge of subjects rather than just imparting facts and students sitting passively. Inquiry-based learning is primarily motivated by questions. Students are urged to pose important queries that direct their educational pursuits. They might

ask these questions on their own because of natural interest or because the teacher is trying to encourage inquiry. It frequently involves unfinished tasks. IBL approach emphasizes hands-on experiences, collaborative work, and real-world connections. Teacher becomes just a guide and support for students as they explore their questions and discover answers.

Even the activities-based subjects do not promote debate or study of the concepts involved, even though the activities are done in a group. This frequently ignores the critical thinking skills and overarching ideas required for genuine science literacy and appreciation. This teacher-centered approach to instruction also supposes that each student has a similar prior understanding of the subject. Developing knowledge and skills by seeking information is the critical inquiry-based learning (CIBL) (Sukini et al., 2018). Students' inquiry abilities are enhanced, their understanding of conducting a scientific investigation is increased, and they are more equipped to critically engage with scientific issues thanks to the adoption of the Critical Inquiry-Based Learning (CIBL). Additionally, this approach helps comprehend science's nature, obtain scientific information and process abilities, and establish scientific thinking, making it an effective learning tool for personal development (Hussain et al., 2011).

Inquiry is a term used to describe asking questions to acquire answers or information. In a critical inquiry-based learning (CIBL) approach, students are at the center of the learning process. They take responsibility for their learning by posing, looking into, and responding to questions. It is also seen as a type of self-directed learning where students are in charge of their education (Varnado, J, 2011). A method of education known as the critical inquiry-based learning (CIBL) is thought to enhance the growth of students' critical thinking and problem-solving abilities. Analysis, problem-solving, discovery, and creative thinking are all part of the Critical inquiry-based learning (CIBL), according to Saunders-Stewart, Gyles, and Shore's (2012) examination of the model's multiple variations. Although the inquiry is student-centered, Zangori, Forbes, and Biggers (2012) suggested that teachers occasionally guide students during the learning process since some beginning students may need additional guidance to improve their inquiry skills. In Pakistan, learning is dependent on memorizing of facts (Bekirova et al., 2021).

Boostrom (1991) states that more capable teachers who can embrace lecture style cannot be expected to follow activity-oriented education so quickly. It is due to teachers' confusion, lack of resources, material management issues, discomfort, lack of time, insufficient experience with experiential approaches to science instruction, and reliance on textbooks (Dzulkifli et al., 2021). Working in groups enhances confidence and communication skills. Performance of groups is measured instead of an individual that is why those who are good at studies help backward students in learning something new or in accomplishing Group goals. The constructivism theory that emerged in the early 20th century is the origin of inquiry-based learning. Individuals actively construct knowledge and meaning through their experiences and interactions with the world. Jean Piaget and Lev Vygotsky (IBL) made further contributions to the strategy.

The importance of students actively participating in the construction of knowledge was emphasized in Piaget's theory of cognitive development according to which Vygotsky's sociocultural theory placed a strong emphasis on the value of collaboration and social interaction in the classroom. Academic scholars and professionals started looking at its possible advantages in the 1980s and 1990s. Our understanding of and excitement for inquiry-based learning were impacted by the outstanding writings of well-known writers like Jerome Bruner and John Dewey. The United States' National Science Education Standards, which promoted the concept that students should actively engage in scientific practices including asking questions, designing investigations, and analyzing data, introduced inquiry-based learning techniques in the 1990s. This contributed to the inquiry-based learning model's success. In the 21st century, Teaching methodology based on IBL has remained evolving and moulding to changing educational landscapes. IBL has been thought of as an effective teaching strategy in many disciplines, like mathematics, social sciences, and the humanities.

Additionally, developments in technology have given new opportunities for inquiry-based learning, allowing students to access a vast array of resources and collaborate with others internationally. Today, inquiry-based learning is widely practiced in educational institutes around the world. Many schools and educators apply this approach as a means to

strengthen critical thinking skills, creativity, and a wide understanding of subjects. It goes with contemporary educational frameworks that embrace student-centered learning and the development of 21st-century skills.

The evolution of inquiry-based learning has been influenced by a growing body of research, educational reforms, and the recognition of its usefulness in promoting meaningful learning experiences. As education continues to evolve, inquiry-based learning remains an essential and relevant approach that empowers learners to become active participants in their own education. Activity-based learning requires students to be meaningful in listening, reading, writing and reflecting on learning something new for academic contents or solving problems. There are many different types of activity based teaching strategies. This learning should be based on the experiments or exercises (Mustapha et al., 2021).

Statement of the Problem

Learning, in Pakistan, is considered as memorization of facts and figures whether it is the subject of art or science (Bekirova et al., 2021). Even at elementary level learners are taught science by adopting the traditional method of teaching that is lecturer (Bakhru & Mehta, 2020). Such techniques lead students towards the rote learning instead of putting students into the situations where they could think scientifically and learn science as a concept (Zhou & Luh, 2021). It is believed by the researchers that lecturer method is beneficial when one has very limited resources (Rajabalee, Santally, & Rennie, 2020). According to a study by Mustapha et al. (2021) Science is a subject that could be learn through a variety of activities so called inquiry based teaching. Researcher while teaching science at public school noted that students were remembering the definitions and procedures of scientific terms. So, it was notable that inquiry-based teaching strategies could promote the scientific thinking among learner through which they learn the difficult concepts of science (Kurniasih et al., 2021). Therefore, there is need to conduct an action research on the impact of inquiry-based teaching on students' performance.

Objectives

- To assess the effect of the critical inquiry-based learning (CIBL) on students' academic performance of students at elementary school level.

Limitations

The limitations for this study are as under;

This study had limited number of participants, though the results of this study are very positive but the limited number of participants may vary the results and can affect it negatively. And this might not be generalized for the whole population. The other limitation for this study is that this study is only conducted in government boys higher secondary school Naudero.

LITERATURE REVIEW

A well-liked strategy for engaging students is the critical inquiry-based learning (CIBL), which enables students to get familiar with scientific procedures and build sophisticated thinking abilities. Because the critical inquiry-based learning technique enhances students' mental activity, it helps pupils build their critical thinking abilities. Past research has demonstrated that activity-based learning considerably improves students' cognitive skills compared to traditional learning techniques (Mariana, 2019). A preferred learning method to the act of teaching, which is characterized by teaching by force, is to have an environment where learners can exchange positive experiences through an exploration procedure, which is focused on curiousness.

According to Ewers (2002), learning science develops students' logical reasoning skills and helps them organize the concepts they have learnt so they may apply them to solving issues in the actual world. Therefore, the most important component of the curriculum and educational system is teaching science in a way that enables students to gain from it and use it for the good of humankind (Safdar, 2007). Because they actively choose the writing topics and shape the conclusions of the findings, students who employ the activity-oriented learning approach for their studies perform well academically. The critical inquiry-based learning approach influences the learning process to support students in developing additional skills necessary to comprehend this dynamic world. Students who engage in real-world activities are better able to refine their research techniques, adjust to change more effectively, and cultivate their critical thinking abilities.

In contrast to guided, structured, and open inquiry, Ahmad et al. (2014) found that students' preferred and performed much better with the confirmation inquiry because teachers set up all the necessary conditions and provided learner

the flexibility to learn freely at this level.

Similarly, Ghaemi and Mirsaed (2017) examined how the critical activity-based learning affected students' critical thinking abilities and found that engaging in activity-based activities in the class environment improved students' cognitive skills. Last but not least, Naryanti (2017) discovered that inquiry-based learning methods could enhance students' devoted abilities after conducting a study to determine how to enhance university graduates' capacity to write a descriptive paragraph (Chen et al., 2021). The kids actively participate in their education, especially when expressing their thoughts, asking and answering questions, and being enthusiastic about writing texts. According to recent studies, inquiry-based learning enhances students' cognitive abilities, prepares the students' to be lifelong learners (Mariana, M, 2019). Contrary to the current study, that used a single-group pretest-posttest design with time series design, most investigations executed on a two groups design called pretest and posttest.

On the other hand, these studies' findings, which excluded the parochial conditions in which the current study was done, demonstrate the benefits of employing inquiry-based learning. While writing skills, in particular, and inquiry-based learning, in general, need to be improved in the study area (Allen, 2011). The constructivist learning theory, which holds that people create their knowledge and meaning from their experiences, is the foundation of the critical inquiry-based learning (CIBL) approach. Consequently, knowledge is being built rather than being imparted by the teacher in this situation. According to John Dewey, a constructivist proponent of the critical inquiry-based learning (CIBL), students should actively participate in the learning process. If you have questions about how learning occurs, he advises, "engage in persistent inquiry: study, reflect, weigh your options, and come to a belief based on facts."

John Dewey was adamant that pupils should be self-reflective problem solvers (Lu, K., Pang, F., & Shadiey, 2021). Jerome Bruner is a constructivist who focuses on improving the relevance of education to students' needs at every stage. He thinks teachers could do this by letting students actively engage in learning. His critical inquiry-based learning (CIBL) hypothesis, known as "discovery learning," contends that pupils are more likely to comprehend and recall ideas they come across while interacting with

their surroundings. Lev Vygotsky, best known for his social constructivism theory, emphasizes that social contact and critical thinking are the two most essential components of the learning process (Espinoza et al., 2019).

METHODOLOGY

The research strategy is the most crucial component of the research methods, which governs the complete research approach. This study employed quasi-experimental design of research. A pre-test regarding the subject matter of the science was conducted from the participants. The pre-test was based on a suitable topic of science which was taught by integrating an inquiry-based lesson plan. Such practice was continued for eight weeks and then a post-test was conducted. The population of present study was all the public elementary schools of District Larkana. According to Creswell (2012) population is the number of participants to be considered a for particular study. Participants in a study population typically have one defining characteristic in common; in this case, the population consisted of elementary (from class 1-8) schools studying in the government schools of District Larkana. In addition, the present study utilized the Government (Boys) Higher Secondary School Naudero as the sample. Sample of this study selected 15 participants from the school.

Moreover, a teacher made Pre-test and Post-test was used for the data collection. The test comprised of ten question each question contained reward of one mark. The total marks were ten while, passing marks were five. The same tests were administered to measure the achievement of students' academic performance in science subject. Principal of the sample school was formally requested to give their consent at the beginning of the experimental process. The study participants are under 18, therefore their parents were required to read, understand, and sign the consent form after being given permission. The research participants' parents signed the consent forms after carefully reading them to show their willingness. The management of the school helped to conduct the experiment. The experiment was conducted according to the schedule given by the principal.

Quantitative data collected was analyzed using MS Excel sheet, pre-test and post-test were conducted in order to analyze results of the participants based on post-test score the data

was analyzed through MS Excel sheet in order to compare the difference of the means of pre and post-tests.

Ethical Research Issues

Many ethical considerations about honorable recognition were considered in the research review. The initial ethical factors in this study are the validity and dependability of the sources. Data was only gathered from the designated research sample. The results was presented in this study in their original format with the appropriate citation to guarantee that the information gathered is accurate and trustworthy. No information was copied and pasted from online resources throughout this study. It was ensured that almost all researchers mentioned in the information retrieval provide an accurate and comprehensive annotated bibliography following the data gathering and analysis.

Results and Discussion

The analyzed data showed two main findings of the present study. Firstly the importance of inquiry-based teaching and the other is the improved academic performance of learners in science subject. The table below clearly shows that eleven students secured less than required passing marks that means students were flexible in learning science using lecture method or any of the traditional method. Only four students were able to obtain the passing marks. So, it can be seen from the results of pre-test of students that majority students needed improvement in their learning. The overall mean score of students in pre-test is 3.99 which discloses that most of students lie under improve category.

After the intervening the inquire-based teaching strategy into science teaching at public schools students showed hundred percent satisfied results. The analyzed data given in the below table shows that all the students passed the same test after learning science by using inquiry-based teaching. Below table shows that the mean score of students' post-test is 7.6, which clearly shows that students' performance in learning science using inquiry-based learning is overall good.

However, overall this study shows that the inquiry-based teaching is an effective method for teaching students the science especially elementary level. Keeping in view the limitations and delimitations, this study only shows that

students improved their performance of Science, but the cycle of planning, action and result can

again and again be done to expertise all the students.

Table no. 1

Pre and Post-tests results

No.	Name of Student	Pre-test score	Category	Post-test score	Category
01	Student 1	4	Improve	8	Good
02	Student 2	3	Improve	7	Good
03	Student 3	3	Improve	8	Good
04	Student 4	3	Improve	9	Good
05	Student 5	6	Fair	7	Good
06	Student 6	4	Improve	8	Good
07	Student 7	4	Improve	6	Fair
08	Student 8	3	Improve	7	Good
09	Student 9	5	Improve	9	Good
10	Student 10	5	Improve	8	Good
11	Students 11	3	Improve	6	Fair
12	Students 12	6	Fair	8	Good
13	Students 13	4	Improve	9	Good
14	Students 14	3	Improve	7	Good
15	Students 15	3	Improve	8	Good
Mean score		3.99		7.6	

CONCLUSION

The results of present study showed that there is a positive impact of inquiry-based teaching strategy when teaching science. The findings of Hung et al. (2008) are similar to it. Their study disclosed that inquiry-based teaching positively influences the academic performance of students. Inquiry-based teaching is powerful tool for enhancing the critical thinking and problem solving skills of learners (Bakhrū & Mehta, 2020). The results of present study shown in the table number 01 show that before the intervention of inquiry-based teaching strategy students' performance were below the average of 4. But after intervention students showed high performance in Science subject. However, it clear that inquiry-based teaching method is positively influencing the performance of learners. The present study recommended that higher authorities should emphasize the integration of inquiry-based teaching.

Competing Interests

The authors did not declare any competing interest.

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