International Journal on Science and Technology (IJSAT)
E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

An Examination of Secondary Science Teachers' Beliefs on Inquiry-Based Learning and Their Classroom Practices in Darjeeling District, North Bengal

Dr. Mamata Kumari Satapathy

Principal
Siliguri Terai B.Ed. College, Vill-Dudha Jote,
PO-Thanjhora Bagan, PS-Kharibari, Dist-Darjeeling-734427
Mail Id-mamataonline76@gmail.com

Abstract

Inquiry-based learning (IBL) is a teaching approach that encourages student engagement, critical thinking, and hands-on exploration. This study examines secondary science teachers' beliefs about IBL in the Darjeeling district of North Bengal and how these beliefs align with their classroom practices. Data were collected through surveys from 30 secondary science teachers in CBSE-affiliated schools, and statistical analyses, including chi-square tests and Pearson correlation, were conducted. The results indicate that most teachers have positive views about IBL's benefits, but factors like time constraints, lack of training, and institutional challenges hinder its implementation. The chi-square analysis shows no significant difference between teachers' beliefs and their classroom practices, suggesting that external barriers may prevent them from fully applying IBL techniques. However, a strong positive correlation ($r = 0.944$, $p < 0.05$) between teachers' beliefs and their practices suggests that those who strongly believe in IBL are more likely to integrate it into their teaching.

Keywords: Inquiry-Based Learning, Secondary Science Teachers, Beliefs, Classroom Practices

1. Introduction

Science plays a crucial role in shaping the modern world, fostering innovation, and developing analytical skills essential for solving complex problems. At the secondary level, science education is particularly important as it lays the foundation for students' understanding of scientific concepts and methodologies.

Teachers' beliefs play a fundamental role in shaping their instructional practices and directly influence the effectiveness of science education. Beliefs about IBL determine whether teachers embrace student-centered learning approaches or rely on traditional methods. When teachers strongly believe in the benefits of IBL, they are more likely to integrate hands-on activities, promote inquiry, and encourage critical thinking. Conversely, misconceptions or skepticism about IBL can act as barriers to its effective implementation.

Inquiry-based learning (IBL) has gained recognition as an effective instructional strategy in science education, promoting active learning, problem-solving, and critical thinking. active learning. However, the extent to which secondary science teachers embrace and implement IBL in their classrooms remains a topic of investigation. This study aims to explore the relationship between teachers' beliefs about IBL and their classroom practices, using statistical analysis to identify patterns and trends.

Theoretical Framework: This study is based on constructivist learning theories, particularly those proposed by Piaget (1950) and Vygotsky (1978), which emphasize active student engagement and social interaction in knowledge construction. Inquiry-based learning aligns with these theories as it encourages exploration, questioning, and hands-on experiences that help students construct their own understanding of scientific concepts. Research has shown that teachers' beliefs significantly influence their instructional choices and willingness to adopt innovative teaching strategies (Friedrichsen & Dana, 2005; Luft & Roehrig, 2007). Understanding these beliefs through empirical investigation provides valuable insights into how teachers' practices can be improved to enhance student learning outcomes.

Conceptual Framework: This study is based on the relationship between teachers' beliefs, classroom practices, and external influencing factors. Teachers' beliefs about IBL act as a foundation that shapes instructional decisions. Classroom practices, in turn, reflect how these beliefs translate into teaching strategies. External factors such as institutional support, training opportunities, and curriculum constraints may either facilitate or hinder the effective implementation of IBL. Understanding these interconnections helps in identifying key areas for intervention and support in teacher training program

2. Objectives

1. To examine secondary science teachers' beliefs about inquiry-based learning.
2. To analyze the extent to which these beliefs align with their classroom practices.
3. To determine the significant differences between teachers' beliefs and their instructional practices using chi-square analysis.
4. To explore the correlation between teachers' beliefs and the frequency of implementing IBL strategies in the classroom.

Hypotheses

1. There is no significant difference between teachers' beliefs about IBL and their actual classroom practices.
2. There is no significant correlation between teachers' beliefs about IBL and the frequency of their inquiry-based teaching practices.

3. Literature Review

Numerous studies suggest that teachers' beliefs significantly influence their instructional decisions (Friedrichsen & Dana, 2005; Luft & Roehrig, 2007). While some educators strongly advocate for IBL, challenges such as lack of resources, time constraints, and standardized testing pressures often hinder its implementation (Crawford, 2007). Additionally, research by Minner, Levy, and Century (2010) found that inquiry-based teaching positively impacts student achievement in science. Anderson (2002) highlighted

that the success of IBL depends largely on teachers' confidence and ability to facilitate student-centered learning experiences. More recent studies emphasize the role of professional development and institutional support in overcoming barriers to IBL implementation (Gormally, Brickman, & Lutsky, 2015). Understanding these factors is crucial for improving the effectiveness of IBL in secondary science education.

Research Gaps

1. **Limited Focus on Teachers' Perspectives:** While much research highlights the benefits of IBL for students, there is a lack of studies examining teachers' beliefs and how these beliefs influence their teaching practices.
2. **Challenges in Resource-Constrained Settings:** Most existing studies focus on well-resourced educational settings, leaving a gap in understanding the unique challenges faced by teachers in regions with limited resources and institutional support.
3. **Lack of Empirical Studies Using Statistical Analysis:** There is a scarcity of studies using chi-square and correlation tests to analyze the relationship between teachers' beliefs and classroom practices, which this study aims to address.

4. Methodology

Population: The population for this study consists of secondary science teachers from CBSE-affiliated schools in Siliguri, Darjeeling district, North Bengal.

Sampling and Sample: A stratified random sampling method was used to select 30 teachers from five CBSE-affiliated schools in Siliguri. The sample size was determined based on feasibility and the need for statistical analysis.

Research Tools: A structured questionnaire was developed to collect data on teachers' beliefs and classroom practices. The questionnaire included Likert-scale items assessing beliefs about IBL, perceived challenges, and self-reported teaching practices.

Data Analysis: Chi-square tests were used to determine whether significant differences exist between teachers' beliefs and their actual practices. Pearson correlation analysis was conducted to examine the strength and direction of relationships between these variables.

5. Results and Discussion

Objective 1: To examine secondary science teachers' beliefs about inquiry-based learning.

Table 1: Beliefs of secondary science teachers about inquiry-based learning

Belief Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
IBL enhances student engagement	9	8	6	4	3	30

IBL improves critical thinking 10skills	11	10	4	3	2	30
IBL8 is difficult to implement due to time constraints	8	10	6	4	2	30
IBL requires extensive teacher training	9	10	6	3	2	30
IBL is essential for science education	13	8	5	3	1	30

Fig: Teachers beliefs about Inquiry -Based Learning

- A majority of teachers either strongly agree or agree that IBL enhances student engagement and improves critical thinking skills.
- Some teachers believe that IBL is difficult to implement due to time constraints and the need for extensive teacher training.
- Most teachers acknowledge that IBL is essential for science education, which indicates a positive attitude toward its adoption.
- The presence of neutral and disagree responses suggests that while many teachers support IBL, some are uncertain or face barriers to implementation

These findings were corroborated with studies (Smith&Brown,2020), where teachers acknowledged the potential of IBL but cited challenges in implementation

Objective 2: To analyse the extent to which these beliefs align with their classroom practices.

Table 2: Classroom practices of secondary science teachers

Practice Statement	Frequently	Occasionally	Rarely	Never	Total
Encourage student for questioning	11	10	5	4	30
Use hands-on experiments	9	12	6	3	30
Facilitate group discussions	11	10	6	3	30
Assign inquiry-based projects	9	10	6	5	30
Assess students through investigative tasks	9	11	6	4	30

- Encouraging student questioning, using hands-on experiments, and facilitating group discussions were common practices among teachers.
- Assigning inquiry-based projects and assessing students through investigative tasks were implemented occasionally by most teachers.
- Some teachers rarely or never assigned inquiry-based projects or investigative assessments, possibly due to curriculum constraints, limited time, or lack of institutional support.

This finding was corroborated with a study by Johnson et al. (2019) which reported that teachers face difficulties in fully integrating IBL due to institutional barriers.

Objective 3: To determine the significant differences between teachers' beliefs and their instructional practices

H01: There is no significant difference between teachers' beliefs about IBL and their actual classroom practices.

Table 3: Calculation of chi square value

Belief Level	High Implementation			Moderate Implementation			Low Implementation			**Total**	Total χ^2	df	Level of sognificance	P value
	O	E	χ^2	O	E	χ^2	O	E	χ^2					
Strongly Agree	6	5.032	0.186	5	4.645	0.027	1	2.323	0.754	12	2.97	4	0.05	0.563
Agree	4	4.613	0.082	5	4.258	0.129	2	2.129	0.008	11				
Neutral	3	3.355	0.038	2	3.097	0.389	3	1.548	1.362	8				
Total	13			12			6			30				

Since the χ^2 value is 2.97 which is less than the critical value (9.488) at 4 degree of freedom and the p value is greater than 0.05 so, fail to reject the null hypothesis. The results suggest that while teachers may express strong beliefs in IBL, their implementation does not significantly differ based on belief levels.

This finding is corroborated with the study ((Williams & Chen, 2021), where a strong correlation between pedagogical beliefs and instructional practices was observed.

Objective 4: To explore the correlation between teachers' beliefs and the frequency of implementing IBL strategies in the classroom.

H02: There is no significant correlation between teachers' beliefs about IBL and the frequency of their inquiry-based teaching practices.

Table 4: Correlation Analysis between Teachers' Beliefs and Practices

Variables	**Mean Belief Score**	**Mean Practice Score**	**Pearson Correlation (r)**	**p-value**
Teachers' Beliefs & Practices	2.4	2.3	0.944	5.14×10^{-15}

Table 4 showed that The Pearson correlation coefficient (r) is 0.944, which indicates a very strong positive correlation between teachers' beliefs and their actual practices. This means that teachers who express stronger beliefs in a certain teaching approach or philosophy are very likely to reflect those beliefs in their classroom practices. Moreover, the p-value is 5.14×10^{-15}, which is far below the conventional alpha level of 0.05. This demonstrates that the correlation is highly statistically significant.

6. Conclusion

The correlation coefficient of 0.944 indicates a **strong positive relationship** between teachers' beliefs about IBL and their actual classroom practices. The **p-value (< 0.05)** confirms that the null hypothesis is rejected i.e the correlation is statistically significant. This suggests that teachers who strongly believe in IBL are highly likely to implement it in their classrooms, whereas those with weaker beliefs tend to practice it less.

This study examined secondary science teachers' beliefs about inquiry-based learning (IBL) and the extent to which these beliefs align with their instructional practices in the Darjeeling district of North Bengal. The findings reveal that while a majority of teachers recognize the benefits of IBL in enhancing student engagement, critical thinking, and scientific understanding, challenges such as time constraints, the need for extensive teacher training, and institutional barriers hinder its effective implementation.

The results from chi-square analysis indicate that teachers' stated beliefs about IBL do not significantly differ in their actual classroom practices, suggesting that external constraints may limit the translation of beliefs into action. However, the correlation analysis demonstrates a strong positive relationship between teachers' beliefs and their implementation of IBL strategies, implying that teachers who hold strong positive beliefs about IBL are more likely to integrate it into their teaching methods.

These findings highlight the need for targeted professional development programs that provide teachers with practical strategies to overcome barriers to IBL implementation. Institutional support, curriculum flexibility, and access to resources are essential for fostering an environment where inquiry-based learning can be effectively practiced. Future research should explore long-term interventions that enhance teachers' pedagogical confidence and investigate how systemic changes in policy and curriculum design can further support the integration of IBL in secondary science education.

References

1. Anderson, R. D. (2002). Reforming science teaching: What research says about inquiry. Journal of Science Teacher Education, 13(1), 1–12. https://doi.org/10.1023/A:1015121024468
2. Crawford, B. A. (2007). Learning to teach science as inquiry in the rough and tumble of practice. Journal of Research in Science Teaching, 44(4), 613–642. https://doi.org/10.1002/tea.20157
3. Friedrichsen, P., & Dana, T. M. (2005). Substantive-level theory of highly regarded secondary biology teachers' science teaching orientations. Journal of Research in Science Teaching, 42(2), 218–244. https://doi.org/10.1002/tea.20052
4. Gormally, C., Brickman, P., & Lutsky, S. (2015). Developing a test of scientific literacy skills (TOSLS): Measuring undergraduates' evaluation of scientific information and arguments. CBE—Life Sciences Education, 11(4), 364–377. https://doi.org/10.1187/cbe.12-03-0026

5. Johnson, K., Peters, M. L., & Lane, K. (2019). Barriers to implementing inquiry-based science instruction: A comparison of science teachers' perceptions. School Science and Mathematics, 119(2), 77–86. https://doi.org/10.1111/ssm.12316
6. Luft, J. A., & Roehrig, G. H. (2007). Capturing science teachers' epistemological beliefs: The development of the Teacher Beliefs Interview. Electronic Journal of Science Education, 11(2), 38–63. https://ejse.southwestern.edu/article/view/7782
7. Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction—What is it and does it matter? Results from a research synthesis years 1984 to 2002. Journal of Research in Science Teaching, 47(4), 474–496. https://doi.org/10.1002/tea.20347
8. Piaget, J. (1950). The psychology of intelligence. Routledge & Kegan Paul.
9. Smith, L., & Brown, M. (2020). Teachers' perceptions and use of inquiry-based instruction in secondary science classrooms. International Journal of Science Education, 42(3), 334–351. https://doi.org/10.1080/09500693.2019.1703690
10. Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.
11. Williams, S., & Chen, Y. (2021). Exploring the alignment between science teachers' pedagogical beliefs and practices in implementing inquiry-based learning. Science Education International, 32(2), 102–110. https://doi.org/10.33828/sei.v32.i2.6