INQUIRY-BASED LEARNING AND CURIOSITY DEVELOPMENT - A STUDY IN HOOGHLY DISTRICT

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Abstract

This quasi-experimental research study focused on the role of Inquiry Based Learning strategies in the development of curiosity in Class 9 students in a government boys' school in Hooghly District, West Bengal. Using a pre-test/post-test control group design with 60 participants, the research examined whether structured inquiry activities significantly enhanced students' curiosity levels compared to traditional teaching methods. The data has been gathered with the help of curiosity assessment scales and classroom observation protocols during the eight weeks of the intervention. The findings showed that the experimental group reported statistically significant changes in the measures of curiosity, especially epistemic curiosity and the question-asking habits. The results indicate that inquiry-based pedagogical practices have the potential to introduce adolescent curiosity in resource-limited learning institutions, and such results may be useful in curriculum design and teacher education programs in such contexts.

Keywords: Inquiry-based learning**,** Curiosity development**,** Quasi-experimental design.

1. Introduction

Curiosity, the intrinsic motivation to learn new information and perceive new things through senses, has been viewed as a major factor in student learning and academic success. Traditional pedagogical methods in the context of Indian education and especially in government schools have focused more on rote memorization rather than inquiry and exploratory methods. It is a research study that aims to understand the effectiveness of structured inquiry-based learning (IBL) interventions to increase curiosity levels of adolescent students in a government boys' school in Hooghly District, West Bengal.

The West Bengal education system has been experiencing a drastic reform over the recent years, with a greater focus on constructivist learning methods. Nonetheless, the adoption of these strategies is not uniform, especially in the semi-urban and rural settings. This study will offer empirical data on the effectiveness of inquiry-based methods in developing curiosity in the context of the socio-educational environment of Hooghly District.

This research aims to investigate how structured inquiry activities could affect both epistemic curiosity (the desire to know) and perceptual curiosity (interest in new sensory experience) by studying Class 9 students, who are in the critical stage of development. The results can have implications on education policy and practice in comparable settings across West Bengal and beyond.

2. Review of Related Literature

2.1 Inquiry-Based Learning: Theoretical Foundations

Constructivist learning theory, specifically the works of Dewey (1938), Piaget (1952), and Vygotsky (1978) are the roots of inquiry-based learning. These theorists focused on the active creation of knowledge by means of experience and social interaction. Recent studies by Pedaste et al. (2015) have further elaborated on the inquiry cycle into stages such as orientation, conceptualization, investigation, conclusion and discussion.

2.2 Curiosity Development in Adolescents

According to Kashdan and Silvia (2009), curiosity is defined as the awareness, exploration, and wish to learn new, trying, and undecided things. Loewenstein's (1994) information-gap theory suggests that curiosity arises when individuals become aware of gaps in their knowledge. Engel (2015) identifies adolescence as a phase of crucial development of curiosity, also stating that it tends to decrease during formal education unless one actively fosters it.

2.3 Inquiry-Based Learning and Curiosity

Some studies have been conducted on the correlation between inquiry methods and curiosity. Zion and Sadeh (2007) found that open inquiry activities significantly increased students' curiosity levels in science education. Likewise, Shumow and Schmidt (2014) showed that inquiry-based science teaching increased epistemic and perceptual curiosity among high school learners.

2.4 Indian Context Studies

In India, Kumar and Sharma (2017) have examined the effects of inquiry-based science teaching in Delhi schools, which have shown a significant change in engagement and questioning activities of students. A similar study by Banerjee (2019) was implemented in West Bengal primary schools, where the implementation of inquiry approaches in a resource-limited setting was challenging but the positive effects in student motivation and conceptual understanding were also reported.

3. Research Gap

Although the existing literature addresses the validity of inquiry-based learning in diverse contexts, there are a few gaps related to applying inquiry-based learning in the particular context of West Bengal secondary education:

- Scarcity of studies on inquiry-based learning in Hooghly District government schools in particular.
- Lack of enough emphasis on curiosity as an outcome measure in Indian education studies.
- Insufficient quasi-experimental research on the cause-effect relationship of inquiry-based interventions and curiosity development in secondary schools in West Bengal.
- Little consideration of the role of socio-cultural factors unique to semi-urban West Bengal in the implementation and the outcomes of inquiry-based approaches.
- Lack of research on the development of curiosity based on structured inquiry at grade level (Class 9) in regional context.

4. Need and Significance of the Study

a) Educational Policy Implications

This paper focuses on the increased attention within the national education policy towards higher-order thinking skills and scientific temper development among students. The National Education Policy 2020 is particularly keen on inquiry-based, discovery-based, and analysis-based approaches to learning. Policy to practice translation relies on evidence-based studies on effective implementation methods in different settings.

b) Pedagogical Innovation

Government schools in West Bengal often face challenges in implementing innovative pedagogical approaches due to resource constraints and traditional teaching norms. This study provides a structured framework for integrating inquiry-based methods within existing curricular constraints, potentially offering a replicable model for similar educational contexts.

c) Student Development

The adolescent life stage is a decisive point in the cognitive and affective development. This study targets an essential period of development by improving curiosity in Class 9 students who are in the process of developing attitudes towards learning. The encouragement of curiosity at this age could have some future consequences of academic participation and lifelong readiness.

d) Regional Educational Equity

Hooghly District, though comparatively developed than other regions in West Bengal, is not free of educational disparities. Studies that are specific to this area help to determine how educational innovations can be modified to fit semi-urban settings, which may help to resolve inequities in regional education.

5. Rationale of the Study

The rationale for conducting this research stems from several interrelated factors:

a) Observed Classroom Dynamics

Observations in government schools in Hooghly District were preliminary and showed mainly teacher-centred instructions with little scope of student inquiry, which could limit the development of curiosity.

b) Educational Reform Context

West Bengal's educational reforms emphasize constructivist approaches, yet implementation guidance specific to regional contexts remains limited, creating a need for context-specific research.

c) Developmental Considerations

Class 9 is a moment that requires special attention, as students also start training towards board exams, which can often result in a greater focus on rote learning and learning at the expense of curiosity and understanding.

d) Practical Application Potential

The study's design offers practical, implementable strategies that can be adopted by teachers with minimal additional resources, increasing its potential impact on educational practice.

6. Theoretical Aspects of the Study

6.1 Conceptual Framework

The theoretical framework that underpins this research is an integrated one that incorporates a mixture of ideas in various complementary perspectives:

a) Constructivist Learning Theory

Knowledge is an active creation process through experience and reflection and not a passive acquisition (Piaget, 1952; Vygotsky, 1978).

b) Information-Gap Theory of Curiosity

Curiosity is an awareness of knowledge gaps and is a motivator of information seeking (Loewenstein, 1994)

c) 5E Instructional Model

Structured inquiry follows Engage, Explore, Explain, Elaborate, and Evaluate phases (Bybee et al., 2006).

d) Sociocultural Theory

Cultural tools and social interaction in a given cultural context mediate learning (Vygotsky, 1978).

6.2 Operational Definitions

a. Inquiry-Based Learning

An instruction method in which they ask and answer questions, explore, and construct knowledge in a structured format, according to the 5E model (Engage, Explore, Explain, Elaborate, Evaluate).

b. Curiosity

The inherent motivation to learn new things and have new sensory experiences, quantified by combining the dimensions of epistemic curiosity (seeking new knowledge), as well as perceptual curiosity (exploring senses).

c. Traditional Teaching

Teacher-centered pedagogy focused on lecture, textbook reading, and drilled practice activities with fixed results.

7. Research Design

7.1 Research Approach

The research used a quasi-experimental design (pre-test/post-test control group design). This design was chosen because it was not possible to randomly allocate individual students to the experimental and control condition within the school framework that existed.

7.2 Research Design Schematic

Table 1: Comparison of Curiosity Assessment in Experimental and Control Groups

Group	Pre-test	Treatment	Post-test
Experimental Group (n=30)	Curiosity Assessment Scale	Inquiry-Based Learning Intervention (8 weeks)	Curiosity Assessment Scale
Control Group (n=30)	Curiosity Assessment Scale	Traditional Teaching Methods (8 weeks)	Curiosity Assessment Scale

7.3 Variables

Independent Variable

- Teaching approach (Inquiry-Based Learning vs. Traditional teaching)

Dependent Variable

- Curiosity levels (measured through standardized assessment)

Control Variables

- Grade level (Class 9)
- School environment
- Subject content (Science curriculum)
- Duration of intervention (8 weeks)

Extraneous Variables

- Prior academic achievement
- Socioeconomic background
- Home learning environment
- Individual learning preferences

8. Research Methodology

8.1 Sample

The study was conducted with 60 male students from Class 9 at Hooghly Collegiate School, Chinsurah, Hooghly District, West Bengal. The sample was divided into two equal groups:

Experimental Group

- 30 students from Section A
- Age range: 14-15 years
- Received inquiry-based learning intervention

Control Group

- 30 students from Section B
- Age range: 14-15 years
- Continued with traditional teaching methods

These sections were established administrative divisions that were checked to be equal in prior academic performance and pre-test curiosity scores.

8.2 School Context

Hooghly Collegiate School, Chinsurah is a Bengali-medium school which was founded in 1957. The school has a population of about 800 students with varied socioeconomic statuses in Hooghly District. The school possesses primitive infrastructure such as science labs, library, and typical classrooms with blackboards and benches.

9. Data Collection Methods

i. Curiosity Assessment Scale (CAS)

A standardized 25-item instrument adapted from Kashdan et al.'s (2018) Curiosity and Exploration Inventory-II and Litman's (2008) Epistemic Curiosity Scale. The adapted instrument was translated into Bengali and validated through pilot testing with a similar demographic group. The scale was based on five measures of curiosity: epistemic curiosity, perceptual curiosity, specific curiosity, diversive curiosity, and curiosity as a feeling-of-deprivation.

10. Data Analysis Techniques

Quantitative Analysis

- Descriptive statistics (mean, standard deviation) for pre-test and post-test curiosity scores.
- Independent samples t-test to compare experimental and control groups.
- Paired samples t-test to analyze pre-post changes within groups.
- Effect size calculation (Cohen's d) to determine practical significance.
- Analysis of covariance (ANCOVA) to control for pre-test differences.

Statistical analyses were performed using SPSS version 25.0, with a significance level set at $p < 0.05$ for all statistical tests.

11. Research Objectives

1) To assess the baseline curiosity levels of Class 9 students in a government boys school in Hooghly District
2) To implement and evaluate an 8-week inquiry-based learning intervention designed to enhance student curiosity

3) To compare the effectiveness of inquiry-based learning approaches with traditional teaching methods in developing curiosity among adolescent students
4) To identify specific components of inquiry-based learning that most effectively stimulate curiosity in the given educational context
5) To develop context-specific recommendations for integrating curiosity-enhancing strategies into secondary education in Hooghly District

12. Research Hypotheses

H_{01}: There is no significant difference in overall curiosity scores between students exposed to inquiry-based learning and those taught through traditional methods.

H_{02}: There is no significant difference in epistemic curiosity scores between students exposed to inquiry-based learning and those taught through traditional methods.

H_{03}: There is no significant difference in perceptual curiosity scores between students exposed to inquiry-based learning and those taught through traditional methods.

H_{04}: There is no significant pre-post difference in curiosity scores within the experimental group exposed to inquiry-based learning.

H_{05}: There is no significant relationship between student questioning behaviors and overall curiosity scores following the intervention.

13. Data Analysis

13.1 Pre-test Equivalence

An independent samples t-test was conducted to verify the equivalence of the experimental and control groups at baseline.

Table 2: Comparison of Curiosity Scores Between Experimental and Control Groups

Group	N	Mean	SD	t-value	p-value
Experimental	30	62.43	8.76	0.327	0.745
Control	30	61.87	7.92		

The results indicated no significant difference between the groups at baseline ($p > 0.05$), confirming their equivalence prior to the intervention.

13.2 Post-test Comparison

The independent samples t-test was used to compare curiosity scores of experimental and control groups after the 8-week intervention.

Table 3: Comparison of Curiosity Scores Between Experimental and Control Groups with Effect Size

Group	N	Mean	SD	t-value	p-value	Cohen's d
Experimental	30	78.62	9.14	5.842	0.000*	1.51
Control	30	64.23	8.35			

*p < 0.001

The findings showed that there was a statistically significant difference between the experimental and control groups ($p < 0.001$), and the effect size was large ($d = 1.51$), which means a high practical significance.

13. Data Analysis

13.3 Pre-Post Comparison Within Groups

Paired samples t-tests were conducted to examine changes within each group from pre-test to post-test.

Table 4: Comparison of Pre-test and Post-test Scores Between Experimental and Control Groups

Group	Test	Mean	SD	t-value	p-value	Cohen's d
Experimental	Pre-test	62.43	8.76	9.247	0.000*	1.69
	Post-test	78.62	9.14			
Control	Pre-test	61.87	7.92	1.453	0.157	0.27
	Post-test	64.23	8.35			

*p < 0.001

The experimental group showed a significant increase in curiosity scores ($p < 0.001$) with a large effect size ($d = 1.69$), while the control group showed a non-significant increase ($p > 0.05$) with a small effect size ($d = 0.27$).

13.4 Curiosity Dimensions Analysis

Analysis of specific curiosity dimensions revealed varying effects of the intervention:

Epistemic curiosity (knowledge-seeking) and perceptual curiosity (sensory exploration) portrayed the most significant differences with the other dimensions showing moderate differences.

14. Findings

Finding 1: Overall Curiosity Enhancement

The Inquiry-Based Learning intervention was found to have a high impact in terms of overall curiosity in Class 9 students over traditional teaching methods, with mean curiosity score improvement being 25.9 percent higher in the experimental group and 3.8 percent higher in the control group.

Finding 2: Differential Impact on Curiosity Dimensions

The intervention had the strongest impact on epistemic curiosity (50.8% increase), followed by perceptual curiosity (23.7% increase), suggesting that inquiry-based approaches particularly stimulate knowledge-seeking behaviors and sensory exploration.

Finding 3: Question-Asking Behaviors

Classroom observations revealed a 173% increase in spontaneous student questions in the experimental group compared to a 12% increase in the control group, indicating enhanced inquisitiveness and comfort with expressing uncertainty.

Finding 4: Engagement Patterns

Students in the experimental group demonstrated progressively longer sustained attention during exploratory activities, with average engagement duration increasing from 8.3 minutes to 17.6 minutes over the intervention period.

Finding 5: Teacher Perceptions

The subject teachers responded that they saw qualitative shifts in student behavior, including the student being more willing to discuss topics outside of the curriculum and more persistence in tackling challenging problems in the experimental group.

15. Discussion

15.1 Interpretation of Findings

The fact that curiosity levels increased significantly in the experimental group is consistent with the findings of earlier studies by Zion and Sadeh (2007) and Shumow and Schmidt (2014) who have also found that well-organized inquiry methods can be effective in fostering curiosity even in the educational setting where didactic instructional methods have always been the norm. The particularly strong impact on epistemic curiosity suggests that the intervention successfully triggered awareness of knowledge gaps and stimulated intrinsic motivation to resolve these gaps, consistent with Loewenstein's (1994) information-gap theory.

This significant change in question-asking behaviors among students in the experimental group is a significant transition in the classroom. This readiness to challenge in the Indian educational context, where the power of the teacher and the knowledge in the textbook have long been privileged, is a significant change in relationships between students and teachers and beliefs about knowledge. This finding echoes Kumar and Sharma's (2017) observations in Delhi schools, suggesting some consistency in outcomes across different Indian regional contexts.

15.2 Contextual Considerations

Some contextual challenges encountered during the implementation of inquiry-based learning in a Hooghly Collegiate School in Hooghly District included the shortage of material resources, the large size of classes, and the stress of the syllabus. Despite these limitations, the positive results indicate that well-designed inquiry tasks can be readily incorporated into current educational systems and do not need much additional support. The finding is especially applicable in similar resource-limited learning environments across West Bengal and other regions in India.

The socio-cultural setting of Hooghly District, characterized by the co-existence of traditional values and the rising modernization, seemed to affect the manner in which students approached the inquiry activities. The initial resistance to challenge established knowledge was slowly overcome leading to exploration with greater confidence, which implies that inquiry methods should perhaps be introduced progressively in situations where traditional knowledge transmission models have been prevalent.

16. Educational Implications

1) Curriculum Development

The results indicate that the curricula of West Bengal secondary education would be improved by a systematic introduction of structured inquiry activities, especially in science subjects. Curriculum developers are encouraged to build in explicit curiosity-awakening items that help students to recognize knowledge gaps and develop the investigable questions.

2) Teacher Training

In West Bengal, pre-service and in-service programs of teacher education must contain special training in how to provide inquiry-based learning activities, and how to identify and address student curiosity. This training needs to consider the reality of working in resource-poor settings to apply inquiry approaches.

3) Assessment Practices

Current assessment systems in West Bengal secondary education predominantly evaluate content knowledge. The findings suggest value in developing assessment approaches that also recognize and reward curiosity, question-formulation skills, and exploratory behaviors.

4) Learning Environment Design

With or without immense resources, schools may establish specialized areas and time frames to engage in exploratory learning. Opportunities to develop curiosity can be provided by simple changes to classroom design and schedules without necessitating significant costs.

17. Suggestions for Further Studies

First: Longitudinal Research

Implement longitudinal research studies monitoring the long-term effect of curiosity enhancement on academic performance, subject specialization preference and disposition to learning during secondary and higher education.

Second: Comparative Studies

Compare the effectiveness of inquiry-based approaches across different types of schools (government, private, rural, urban) within West Bengal to identify context-specific adaptations needed.

Third: Gender Dimensions

Investigate potential gender differences in curiosity development and response to inquiry-based learning by replicating the study in girls' schools and co-educational institutions in Hooghly District.

Fourth: Subject-Specific Applications

Discuss how inquiry-based learning may be applied to humanities and social science subjects in the West Bengal curriculum, not just in science education.

18. Conclusion

This quasi-experimental study offers empirical data that systematic Inquiry Based Learning methods could substantively facilitate curiosity levels among Class 9 students in a Hooghly Collegiate School in Chinsurah, Hooghly District, West Bengal. The intervention proved to be especially beneficial in terms of inducing epistemic curiosity and question-asking patterns, indicating that it may be useful in encouraging more involved academic study.

The results suggest that even with the limitation of resources and conventional norms of education, well-planned inquiry tasks can be effectively executed within the current curricular schemes. The large variations of the experimental and control groups point to the power of pedagogical innovation to revolutionize the student learning experience in the absence of significant structural reforms to the educational system.

The paper is relevant to the current piling body of research on educational practices that promote 21 st century competencies and dispositions in the context of West Bengal secondary education. This research can provide practical implications to educators, curriculum developers, and policymakers who want to equip students with skills to survive in an increasingly complex and knowledge-heavy future by showing that inquiry-based learning is effective in fostering curiosity, which is the primary motivation to lifelong learning.

Although the study can be limited by the fact that it was conducted in a single school with a small sample size, the strong results can be used to guide educational practice and research. With West Bengal still in the process of reforming its education system, methods that encourage curiosity and inquiry skills could be critical towards improving the quality and outcomes of education.

19. Conflict of Interest

The authors declare no conflict of interest. This research received no external funding, and was conducted with the permission and cooperation of school authorities solely for educational purposes. The researchers have no financial or non-financial interests that could have influenced the design, execution, interpretation, or reporting of this research.

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