Teacher Engagement And Institutional Facilities In Promoting Students' Interest In Science: A Case Study Of Rural Secondary Schools In Bangladesh

Most Rumana Aktar and Juliana Rosmidah Binti Jaafar

Abstract- **This qualitative single-case study examined how teacher involvement and institutional facilities influence secondary students' interest in science in a rural area of Bangladesh. Amid global emphasis on STEM education as a driver of innovation and development, many low-resource contexts face declining student engagement in science. Rural Bangladeshi secondary schools frequently contend with inadequate infrastructure, limited teaching materials, and shortages of qualified teachers, which foster teacher-centred instruction and low student engagement. Data were collected through purposive sampling and consisted of semi-structured interviews with three science teachers, one headteacher, and six students, as well as classroom observations. Thematic analysis, informed by Vygotsky's socio-cultural theory and Hidi & Renninger's work on interest development, revealed that teacher involvement especially interactive pedagogy, emotional support, and real-life contextualization substantially shapes students' interest in science learning. Findings also indicate that effective teaching practices depend on institutional support to sustain deeper student engagement. The study recommends that policy and practice prioritize interactive teaching approaches alongside improvements in institutional resources to foster long-term student interest in science.**

Keywords- **Science Interest, Teacher Engagement, Institutional Facilities, Rural Bangladesh**

I. INTRODUCTION

In the modern world, science education is crucial for national development, particularly in emerging economies such as Bangladesh, as it builds human capital and drives socio-economic progress (Ahmed et al., 2025). The secondary education stage plays a significant role, as it consolidates academic learning, prepares students for tertiary education, and enhances their prospects for future employment (de Vries et al., 2024).

A large proportion of students attend rural secondary schools; however, these institutions frequently face structural and institutional constraints insufficient facilities, a shortage of trained teachers, and limited access to teaching materials (Kibria & Hasan, 2024; Ahmed et al., 2025). These constraints are compounded by prevailing classroom practices that often fail to adopt student-centred pedagogies, thereby restricting meaningful participation and diminishing students' interest and motivation in science (Miju & Arif, 2024; Tonni et al., 2024).

In this context, teacher engagement is critical in shaping how students interact with science and develop motivation.

Engaged teachers are more likely to foster dynamic, inquiry-based learning environments that support students' conceptual development and sustain their interest in science (Wang et al., 2022). Although many teachers express positive attitudes toward interactive, student-centred approaches, rural schools in Bangladesh struggle to implement these strategies effectively (Tonni et al., 2024). This gap between intended pedagogy and classroom practice underscores the need for research that addresses both pedagogical and institutional dimensions.

Accordingly, this qualitative research explores how teacher engagement functions in rural secondary settings and how it interacts with institutional resources to shape students' interest in science. By examining these interactions, this study aims to provide a contextually grounded understanding of science education in rural Bangladesh and to inform improvements in educational practice and policy. The study addresses the following research questions:

RQ1. What role do teacher engagement practices play in shaping students' interest in science in rural secondary schools in Bangladesh?

RQ2. How do institutional factors interact with teacher instructional practices to influence students' interest in science?

II. PROBLEM STATEMENT

There is a growing emphasis on Science, Technology, Engineering, and Mathematics (STEM) education worldwide, which is important for promoting innovation, economic growth, and sustainable development. Despite this increased focus, student disengagement in science remains a critical concern, particularly in resource-constrained contexts (UNESCO, 2024). Recent research demonstrates that student interest is a key driver of engagement, persistence, and academic achievement in science-related disciplines (Woreta et al., 2024).

A critical factor in enhancing student motivation and engagement is teacher-related practices. Instructional quality—such as interactive teaching strategies, emotional support, and relevance-based pedagogy-has been shown to promote greater student participation in learning (Reeve & Cheon, 2024).

Dialogic and student-centred instructional practices also facilitate higher-order thinking and engagement, particularly in science education (Wang & Chen, 2025). However, much of this evidence is derived from well-resourced or urban educational environments, limiting its applicability to rural or under-resourced contexts.

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In addition, institutional elements (infrastructure, teaching resources, organizational support) significantly shape the effectiveness of teaching and learning processes. Empirical evidence indicates that insufficient school facilities, poor infrastructure, and limited teaching resources are significant barriers to the implementation of appropriate pedagogic practices and opportunities for meaningful student interaction (World Bank, 2023).

However, most existing studies examine teacher practices and institutional conditions separately, with limited attention to their combined influence on students' learning experiences.

In the context of Bangladesh, these challenges are particularly pronounced. Many secondary schools, especially in rural areas, face persistent constraints including inadequate resources, limited infrastructure, and variability in teaching quality. Although policy reports acknowledge these inequalities, there remains a lack of context-specific empirical research examining how these factors jointly influence students' interest in science (UNESCO, 2024).

Furthermore, contemporary theoretical perspectives emphasize that the development of interest occurs through continuous interactions among individual motivation, instructional practices, and contextual support systems (Kehle & Urhahne, 2025). However, these dynamics have received limited empirical attention in rural, resource-constrained educational settings.

Therefore, a key gap in the literature is the limited understanding of how teacher engagement and institutional conditions interact to shape students' interest in science in rural secondary schools in Bangladesh.

Addressing this gap is essential for developing context-responsive pedagogical and policy interventions aimed at enhancing student engagement and sustaining interest in science education.

III. LITERATURE REVIEW

The landscape of science education has shifted from a content-based to a competency-based model emphasizing critical thinking, inquiry, and innovation (OECD, 2019; UNESCO, 2023). This shift reflects the growing importance of STEM education in preparing students for knowledge-based economies and global challenges (Sellami et al., 2023). However, despite ongoing reforms, a persistent decline in students' interest in science remains evident (Steidtmann et al., 2022), suggesting that structural changes alone are insufficient without understanding how interest develops and is sustained.

Students' interest in science can be explained through Hidi and Renninger's Four-Phase Model of Interest Development and Vygotsky's Sociocultural Theory. Interest evolves from situational to individual levels through meaningful, relevant, and cognitively engaging experiences. At the same time, learning is socially constructed through interaction, language, and scaffolding within the Zone of Proximal Development (ZPD). Together, these perspectives highlight that interest is shaped through the interaction of instructional practices, social mediation, and contextual support.

Traditional lecture-based instruction remains a key contributor to declining interest, as it limits active learning and inquiry (Zang et al., 2024). In contrast, student-centred and inquiry-based approaches such as discussion, experimentation, and problem-based learning enhance motivation and sustain engagement by making learning more meaningful (Othman & Wardat, 2025; Sellami et al., 2023).

Teacher engagement plays a central role in this process. Teachers act as facilitators by providing scaffolding and guiding interaction within students' ZPD. Research shows that strong pedagogical and content knowledge enables teachers to implement interactive strategies that support sustained engagement (Wang et al., 2022). Additionally, positive teacher-student interactions, including feedback, encouragement, and dialogic teaching, are essential for fostering confidence and deeper engagement (OECD, 2019).

Institutional conditions further shape teaching and learning. Access to laboratories, instructional materials, and technology supports experiential and inquiry-based learning (OECD, 2023; Zang et al., 2024). Conversely, limited resources in low-resource settings restrict hands-on learning and reinforce lecture-based instruction (UNESCO, 2024).

In rural Bangladesh, science education faces persistent challenges, including inadequate infrastructure, limited laboratory facilities, shortages of teaching materials, and variability in teacher quality (UNESCO, 2023; Ahmed et al., 2025). Teaching remains largely examination-oriented and lecture-based, resulting in passive student engagement and limited interest development. These conditions reflect a gap between intended curriculum reforms and classroom practice.

Despite growing international literature, context-specific research on rural secondary schools in Bangladesh remains limited (Sato, 2024). Most studies adopt quantitative approaches and examine factors in isolation, limiting understanding of how teacher engagement, instructional practices, and institutional conditions interact.

This highlights a key research gap: limited qualitative research examining how these factors collectively shape students' interest in science in rural secondary school contexts in Bangladesh.

Conceptual Framework

This study adopts an integrated framework combining Hidi and Renninger's Interest Development Theory with Vygotsky's Sociocultural Theory. It proposes that students' interest develops through dynamic interactions among instructional practices, teacher engagement, and institutional conditions, with social interaction playing a central role.

Using a qualitative approach, this study examines how these factors interact to influence students' interest in science and provides contextually grounded insights for improving engagement in resource-constrained settings.

IV. METHODOLOGY

Research Design

This research employed a qualitative single-case study design to examine the role of teacher engagement and institutional facilities in shaping students' interest in science in a secondary school in rural Bangladesh. A qualitative

research design is appropriate because it focuses on the experiences of the participants, perceptions, and contextual realities rather than numerical measurement.

An interpretive stance was adopted to enable an in-depth exploration of teachers' and students' experiences in science education. This approach is well suited to examining complex educational processes in natural settings (Guetterman, 2015). The single-case design enabled a contextualized, detailed examination of teacher practices and institutional conditions that influence students' interest in science.

Research Setting

The study was conducted in one selected secondary school in rural Bangladesh. The school was characterized by relatively limited infrastructure and lower teacher qualifications, and is situated within a rural context. These contextual realities provide a meaningful background for examining how institutional and pedagogical factors influence students' engagement with science.

Participants and Sampling

Participants included three science teachers, one headteacher, and six students from grades 9-10. Purposive sampling was used to select participants with relevant experience in science teaching and learning. Teachers were chosen for instructional roles, the headteacher for institutional insight, and students for classroom experience.

Sample size was guided by the concept of information power, in which small samples are sufficient for rich data (Malterud et al., 2016), consistent with the qualitative emphasis on depth over breadth (Revelo & Ramírez Román, 2024). Data collection continued until saturation was reached (Vasileiou et al., 2018).

Data Collection Method

Data were collected through semi-structured interviews and classroom observations. Interviews were conducted via WhatsApp voice calls, lasting 30-40 minutes for teachers and the headteacher, and 15-20 minutes for students. All interviews were conducted in Bangla, recorded with consent, and transcribed verbatim.

Classroom observations included recorded and live online sessions, focusing on teaching strategies, interaction patterns, and student participation. Field notes supported triangulation.

Data Analysis

Thematic analysis followed Braun and Clarke's (2006) six-step framework. Both inductive and deductive approaches were used to identify themes related to teacher engagement, institutional constraints, classroom interaction, and student interest.

Trustworthiness of the Study

Credibility was ensured through triangulation, member checking, and detailed field notes, supporting dependability and transparency.

Ethical Considerations

Ethical approval procedures were followed. Informed consent was obtained, confidentiality ensured, and participation remained voluntary with the right to withdraw. Data were securely stored and used solely for research purposes.

V. FINDINGS

The qualitative data for this study were collected through semi-structured interviews with three science teachers, one headteacher, and six science students from a secondary school in rural Bangladesh. The data were analyzed using thematic analysis, generating two major themes: (1) Teacher Engagement in Science Teaching and (2) Institutional Facilities and Learning Environment. Findings are presented using narrative explanation and direct quotations to ensure credibility and authenticity.

Theme 1: Teacher Engagement in Science Teaching

Subtheme 1.1: Interactive Teaching and Student Engagement

Teachers play a central role in shaping students' interest in science. Participants consistently emphasized that interactive, enthusiastic, and student-centered teaching increases curiosity and motivation.

Student engagement improves when lessons include questioning, discussion, and real-life applications rather than lecture-based instruction. One teacher stated:

"When I ask students questions and interact with them, they are naturally interested in science. If I'm only lecturing, they get distracted fast." (Teacher 3)

This shows that active teaching strategies enhance both cognitive and emotional engagement. Students also confirmed this view:

"When the teacher asks questions and explains slowly, I feel more interested in science." (Student 5)

This indicates that teacher-student interaction is a key factor in sustaining interest.

Subtheme 1.2: Use of Real-Life Examples

"Another important factor is contextual teaching through real-life examples, which makes science more meaningful and understandable."

"One teacher explained: "Science becomes more interesting when students can relate it to real life. Even without laboratory facilities, I try to give practical examples." (Teacher 1)"

"Students supported this perspective: "We understand science better when teachers explain with examples. If it is only reading from the book, it becomes boring." (Student 2)"

This suggests that textbook-based instruction alone is insufficient to maintain engagement.

Subtheme 1.3: Teacher Motivation and Challenges

The headteacher emphasized teacher commitment as essential for student motivation:

"Students' enthusiasm to learn depends mostly on how carefully teachers teach their lessons." (Headteacher)"

However, teachers reported challenges in applying interactive methods due to workload and structural constraints:

"We want to conduct practical lessons, but we are limited by large class sizes and time constraints." (Teacher 2)"

This shows that teacher engagement is influenced by both individual effort and institutional conditions.

Theme 2: Institutional Facilities and Learning Environment

Subtheme 2.1: Lack of Laboratory Facilities

Participants consistently reported that limited laboratory facilities and inadequate resources negatively affect science learning.

"We have a lab, but it lacks the necessary equipment for routine experiments." (Teacher 2)"

"Students are much more engaged with science when they can see experiments." (Teacher 1)"

Students also confirmed this limitation:

"We rarely do experiments. That is why science feels difficult and less interesting." (Student 1)"

"If we had more lab work, science would be easier to understand." (Student 4)"

This shows that lack of practical learning reduces both understanding and interest.

Subtheme 2.2: Overcrowded Classrooms and Limited Resources

Overcrowded classrooms were identified as another major barrier to effective teaching and participation.

"In a large class, making sure every student participates is difficult." (Teacher 3)"

"In big classes, teachers cannot help everyone properly." (Student 6)"

This results in reduced individual attention and limited student participation, often leading to teacher-centered instruction.

Although some teachers used alternative strategies:

"We use charts, models, and demonstrations to sustain students' interest." (Teacher 1)"

Their effectiveness remained limited due to structural constraints.

Findings from Classroom Observation

Classroom observations revealed that science teaching was predominantly lecture-based, with minimal student participation and limited opportunities for inquiry or discussion. Interaction was largely teacher-dominated, with brief student responses indicating low engagement.

From a sociocultural perspective (Vygotsky), this reflects limited scaffolding within the Zone of Proximal Development (ZPD), as opportunities for guided interaction were minimal. Teaching remained mostly transmission-oriented despite occasional use of questions and visual aids.

Institutional constraints such as overcrowding and lack of laboratory facilities further restricted experiential and individualized learning, shaping instruction toward lecture-based methods.

In terms of Hidi and Renninger's Interest Development Theory, these conditions rarely triggered or sustained situational interest, limiting progression toward deeper engagement in science.

Overall Interpretation of Findings

Overall, students' interest in science is shaped by the interaction of teacher engagement and institutional conditions. While teacher practices are crucial for motivation, their effectiveness is constrained by limited resources and overcrowded classrooms.

This highlights that improving science learning requires both enhanced pedagogical practices and strengthened institutional support, as both factors are interdependent in shaping student engagement.

VI. DISCUSSION

This study examined the influence of teacher engagement and institutional facilities on students' interest in science in rural secondary schools in Bangladesh. The findings reveal a contextually constrained relationship among pedagogical practices, institutional conditions, and student engagement.

Teacher engagement particularly interactive pedagogy and contextualization emerged as a key driver of students' cognitive and emotional involvement. This aligns with Vygotsky's Sociocultural Theory, which emphasizes learning through interaction and guided participation. Classrooms characterized by dialogue and inquiry showed higher levels of engagement, consistent with prior research on dialogic teaching (Tao et al., 2025). However, the effectiveness of these approaches remains limited in resource-constrained settings.

Teacher enthusiasm and emotional support also contributed to sustaining students' interest. In line with Interest Development Theory (Hidi and Renninger), meaningful and supportive learning environments help

trigger and maintain situational interest. The use of real-life examples further enhanced relevance and motivation.

Despite these strengths, institutional constraints significantly restricted effective implementation. Limited laboratory facilities, overcrowded classrooms, and insufficient teaching resources constrained opportunities for inquiry-based and experiential learning. This finding aligns with OECD (2023), which highlights the negative impact of inadequate resources on classroom interaction and participation, particularly in rural contexts.

Classroom observations reinforced these patterns, revealing predominantly lecture-based instruction with minimal student participation. Although teachers attempted to sustain engagement through demonstrations and visual aids, such strategies were insufficient to replace hands-on learning experiences.

The results also suggest that sustained engagement is essential for developing individual interest over time (Renninger & Hidi, 2006). In resource-limited environments, restricted opportunities for continuous inquiry hinder progression beyond situational interest.

Overall, students' interest in science is shaped by the interaction of teacher engagement, instructional practices, and institutional conditions. Improving science education in rural contexts therefore requires coordinated and integrated efforts. Policy initiatives should prioritize teacher professional development in interactive pedagogies alongside investments in laboratory facilities and classroom resources to support meaningful and sustained student engagement.

VII. CONCLUSION

The study examined the impact that teacher engagement and institutional facilities have on students' interest in science within rural secondary schools-in Bangladesh. The results show that active and supportive teaching significantly enhance student motivation.

However, insufficient infrastructure and resources prevent effective science learning, limiting this positive impact. The findings indicate an interdependent relationship: dedicated but poorly equipped educators have a hard time involving students. Long-term interest in science is sustained not only through effective teaching practices but also through adequate institutional support and resources. Limitations are the small sample size, the use of qualitative methods, and restrictions of generalizability. Future studies should collect larger, diverse, and longitudinal sample sizes. Policymakers must focus on both teacher training and infrastructure in order to move science education in rural settings forward.

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