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Pedagogical Practices and Student Engagement in Science Education: Insights from Classroom Observations in Rural Schools

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ABSTRACT

Science education is crucial for helping learners understand the natural environment in a systematic and logical manner. However, rural students face challenges such as high dropout rates and poor academic performance due to a lack of resources, ineffective pedagogy, and the lack of relevance of science in their day-to-day lives. The present study documented the classroom activities of science teachers with the aim of understanding how science is taught in rural secondary schools and identifying the predominant teaching practices of science teachers. Two rural secondary schools from Bihar were selected for data collection. From each school, six classroom observations and a focus group discussion with students were undertaken, totalling 12 observations and two focus group discussions. The data gathered from classroom observations were analysed descriptively, while FGDs were transcribed to identify similar responses, which were then categorised to identify the underlying patterns within the data. Findings indicate that teachers predominantly relied on the lecture method with minimal use of brainstorming. While students participated and took notes, only a few asked questions. Also, the assessments were mainly based on questioning, indicating limited variety in evaluation methods. The study has implications for educators and stakeholders in addressing challenges and prioritising science teaching in the rural context. There is an impending need to shift from traditional, lecture-based, textbook-driven approaches in rural science education to a contemporary learner-centred approach.

Keywords: Rural science education, Teaching methods, Instructional orientation, Assessment practices, Students' activity

INTRODUCTION

Education is a socio-cultural activity; in any context, learning is influenced by the learner's background knowledge, life experiences, economic resources, interests, abilities, and cultural knowledge. The schools in urban areas have students from diverse cultural and racial backgrounds. However, in rural areas, the school remains a traditional, local social institution (Taylor and Sobel, 2011), with learners primarily limited to local customs and traditions. Despite the numerous recommendations of the Frameworks – National Curriculum Framework (NCF, 2005) and National Curriculum Framework for School Education (NCFSE, 2023) for the active learning of science in schools, the teaching and learning of science in rural schools is characterised by numerous inadequacies. Rural schools face numerous challenges, including teacher-centric cum textbook-driven instruction, lower funding, poor infrastructure, paucity of materials and curricular challenges.

In rural schools, science teaching-learning continues to be teacher-centric, reduced to a body of facts which is to be memorised and reproduced in examinations by students, coupled with a lack of opportunities to experience scientific phenomena during instruction (Menon *et al*., 2021), which in turn, hinders creativity (Mehra, 2021). Sarangapani (2014) argues that in India, teachers rely on science textbooks during teaching and adds,

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"Science classes are no different from history or geography or language. They are also taught by teachers from textbooks. The textbooks talk about things, experiments and processes and show pictures. They often take the route of not only describing the experiment but also telling children what they will observe and what they should conclude – an implicit acceptance by those designing the textbooks that children will not actually get to do or see the things that are to be learnt about" (pp.17).

Furthermore, limited funds in rural schools significantly constrain effective science teaching by limiting access to essential resources, infrastructure, and pedagogical support. Inadequate budgets often lead to poorly equipped laboratories, lack of scientific apparatus, and insufficient consumable materials, restricting hands-on and experiential learning (UNESCO, 2017; Zinger *et al.,* 2020). As a result, teachers tend to rely on textbook-based and lecture-oriented approaches, reducing opportunities for inquiry-based learning. Also, financial constraints hinder the integration of digital technologies and limit teachers' access to professional development, thereby affecting the adoption of innovative teaching practices (OECD, 2019; Darling-Hammond *et al.*, 2017).

Moreover, rural institutions face a critical shortage of qualified science teachers and lack essential facilities, including electricity, computers, and basic laboratory equipment such as microscopes, magnets, and biology kits (Santra and Basumallick, 2003). These infrastructural and human resource deficits directly affect students' academic achievement in science (Antony and Elangkumaran, 2020). However, educators in resource-constrained rural settings should prioritise optimising available resources rather than dwelling on limitations (Avery, 2013).

Besides resources, the effectiveness of science teaching in rural settings also depends on catering to the unique needs and circumstances of the rural students and communities (James and Riblett, 1981). Existing studies indicate that rural students often feel a disconnect between indigenous/local knowledge and formal academic content (Boyer, 2006), a gap that is particularly evident in STEM education contexts (Avery, 2013). This disjunction consequently leads to rural students feeling marginalised, stemming from cultural and socioeconomic differences (Semali and Kincheloe, 1999). However, teachers can engage rural students in ways that are both meaningful and relevant by facilitating a conducive and immersive environment that would help students establish the relevance of science in their daily lives and local contexts, connect classroom learning with real-world experiences, both in and out of school, through lived experiences (Avery, 2013, Morris *et al.,* 2019). Rural communities often have unique natural resources, ecosystems, and cultural practices that can be integrated into science lessons. This would also facilitate inquiry-based learning – an integral part of science teaching - by encouraging students to explore scientific concepts through hands-on, experiential learning, which can deepen their understanding of the natural world around them (Anharuddin and Fatonah, 2023). Beyond seeing and engaging with nature, students would also be able to investigate, analyse, and utilise local resources that relate to their science learning. According to Bihar Curriculum Framework (BCF-2008),

"*The vastness and openness of the serene rural environment, including its plants, forests, ponds, rivers, gardens, and animal-birds, provide a great source for science teaching and learning. The community can also provide services to individuals as well as persons with special skills, abilities, and interests through voluntary contributions."*

Thus, rural science education, despite its contextual richness, is shaped by multiple inequalities compared to urban settings, including infrastructural, resource, teacher-related, socio-economic, and digital disparities.

Review of Related Literature

Effective science education in rural secondary schools requires a comprehensive understanding of classroom practices across multiple interconnected dimensions. This review examines existing research on science teaching through three critical lenses: instructional orientation, which encompasses teaching methods and questioning practices; student activity and engagement patterns; and assessment practices. By synthesising findings across these dimensions, this review identifies pedagogical strengths, persistent challenges, and critical gaps in current research, thereby establishing the rationale for investigating classroom practices in rural secondary science education.

Instructional Orientation in Science Teaching

The existing literature reveals that teachers predominantly employ direct, teacher-centric methods in science classrooms (Maricic *et al.*, 2022; V.R and Chavan, 2022; Tufail and Mahmood, 2020; Karmakar, 2019; Hussain, 2018). Heavy reliance on such methods often leads to rote learning, which, coupled with a lack of resources, contributes to underperformance in science among rural students (Zinger *et al.,* 2020; Murphy, 2022; Zenda, 2016; Rao, 2010 as cited in Menon *et al.*, 2021). In contrast, use of innovative teaching strategies such as laboratory method, project method, activity-based method and technology integration has been shown to enhance student engagement and support their learning (Gericke *et al.,* 2022; Morphy, 2022; V.R. and Chavan, 2022; Menon *et al.,* 2021).

Questioning Practices, Students' Activity and Engagement

Furthermore, the literature provides that questioning is an essential pedagogical tool that directly shapes student engagement and cognitive development in science classrooms (Zerait *et al.*, 2023; Soysa, 2022). Although Chin (2007) emphasised the practical significance of using varied questioning strategies in science classrooms, research reveals a troubling pattern: teachers predominantly employ lower-order, closed-ended questions that elicit simple factual recall-type responses over application of knowledge that promotes use of higher-order thinking skills (Eliasson *et al.,* 2017; Ciascai *et al.,* 2014). These questions typically ask students to reproduce information, explain facts, or provide yes/no answers, thereby limiting opportunities for deep cognitive engagement.

In turn, this pedagogical approach raises concerns related to student engagement and classroom dynamics. Such approaches often reduce the attention span of students in science classrooms (Ali Cicekc and Sadik, 2019), thereby making the learning process mechanistic in nature (Hussain, 2018). Thus, the relationship between questioning practices and engagement becomes evident: when teachers rely on lower-order questions, students develop passive learning behaviours rather than active inquiry skills (Eliasson *et al.*, 2017).

Furthermore, the instructional method itself influences engagement levels. Kurti and Sezikill (2021) observed that student participation fluctuates significantly based on the teaching approach employed and explicit instruction scores over unassisted discover learning (Alfieri *et al.*, 2010). Gerick *et al.*, (2022) further provides that integrating writing into laboratory work, as in instructional method, increases student engagement. This interconnection suggests that improving questioning practices and diversifying instructional methods are not separate challenges but interrelated aspects of fostering meaningful student engagement in science education.

Assessment Practices

Studies examining assessment practices reveal both diversity and challenges in science classrooms. Teachers employ various assessment methods, including summative, formative, and portfolio assessments (Acheampong *et al.,* 2020), with oral questioning being particularly common (Rahman, 2018; Kaur, 2017). Feedback typically involves commenting on and correcting student answers or errors (Kaur, 2017). However, significant challenges persist: Kumar and Rao (2022) identified a lack of systematic evaluation in science classrooms, while Tariq *et al.* (2013) found that teachers possess limited knowledge about assessment practices. Sharma (2022) and Mishra (2014) attributed these challenges to time constraints, extensive syllabi, and inadequate training in assessment techniques.

Research Gaps and Present Study

Despite extensive research on science teaching across three dimensions, *viz.*, instructional orientation, questioning practice and students' engagement and assessment, most of the studies highlight the predominant use of direct methods, such as lecture-based teaching, in science classrooms (Maricic *et al.* 2022; V.R and Chavan, 2022; Tufail and Mahmood 2020; Karmakar, 2019; Hussain, 2018). However, there is a lack of exploration and utilization of innovative teaching strategies like laboratory methods, project-based learning, activity-based methods, and technology integration. This gap suggests that research should incorporate more engaging and student-centred instructional approaches. Secondly, although questioning is widely used for assessment (Tariq *et al.*, 2022; Sharma, 2022; Rahman, 2018), there is a lack of evaluation and variation in assessment techniques (Kumar and Rao, 2022) or strategies to promote higher-order thinking (Toplis, 2012). Teachers tend to focus on lower-order questions and closed-ended questions that assess factual knowledge rather than higher-order thinking skills. There are challenges in implementing effective assessment practices due to factors like limited time, a vast syllabus, and inadequate training (Mishra, 2014). Thirdly, existing studies on student engagement and pedagogical monotony (Hussain, 2018; Gericke *et al.,* 2022; Kurti and Sazakill, 2021) focus primarily on primary levels, leaving secondary science education underexplored. Ultimately, most research focuses on individual dimensions in isolation, rather than examining the interplay between instructional approaches, student activities, and assessment practices. These gaps underscore the need for a comprehensive study examining classroom activities in rural secondary schools. The present study addresses this need by investigating science teaching through three integrated dimensions: instructional orientation, student activities, and assessment practices.

Need of the Study

Science education aims to help learners understand the natural world by acquiring knowledge, skills, and thinking abilities. Students enter the science classroom with diverse backgrounds, varied experiences, and different views, as well as associated knowledge about the natural world. Therefore, situating the content of science education within the cultural context of students becomes pertinent. However, content and pedagogy often ignore these rich contexts, creating a disconnect between learners and subject matter (Zinger *et al.*, 2020, citing Biddle and Azano, 2016; Avery, 2013), especially noted in rural Indian schools,

Research has consistently shown that rural students in India underperform in science compared to their urban counterparts (Radhika, 2024). This gap stems from multiple pedagogical failures, including poor classroom management (Varghese, 2008), limited hands-on learning opportunities, and a failure to connect science with students' everyday life (Avery and Kassam, 2011). Rather than fostering curiosity, creativity, and inquiry-based learning, science teaching in rural settings often relies on memorisation of content, textbook-driven, teacher-centred, divorced from students lived realities, coupled with a lack of adequate laboratory resources (Sarangapani, 2014; Koul and Verma, 2015; Menon *et al.,* 2021). Inadequate laboratory resources further limit engagement and learning outcomes. Moreover, rural science teachers struggle to find and utilise techniques that help rural students acquire scientific knowledge and skills, and become functional in society, even if the students' education ends with basic education (Donkoh, 2016). Consequently, these underlying challenges lead to uneven concept formation between rural and urban learners (Chokkalingam, 2015) as students have limited opportunities for experiential learning to connect textbook knowledge with practical application and eventually become passive learners with low interest and unfavourable attitude towards learning science (Koul and Verma, 2015; Menon *et al.*, 2021).

Systemic constraints further compound these pedagogical challenges. Teachers face pressure to complete syllabi within a limited time, manage multiple administrative and extracurricular duties, and maintain classroom discipline – all of which limit their ability to nurture students' curiosity and self-expression (Kaptan and Timurlenk, 2012; Davis *et al.,* 2006). Consequently, instruction emphasises mechanical recall rather than self-explanation and questioning, and hence, students struggle to see the relevance of science in their daily lives (Avery and Kassam, 2011) as teaching fails to connect with their backgrounds, existing knowledge, experiences, and culture. This is further exacerbated by overlooking the needs of rural school students to acquire and apply scientific knowledge within a local context, as well as to engage in collaborative work and learning. Being a subject with immense potential to build students' sense of belonging, science is often transacted mechanically, with practical experiences relegated to extracurricular status rather than integrated into core instruction.

Paradoxically, rural schools possess untapped pedagogical assets. They are rich in natural resources - lakes, rivers, forests, and other bodies of water - that can be harnessed for contextual science learning. Students can learn through observation and manipulation of these resources, fostering connections with their immediate surroundings (Chokkalingam, 2015). Rather than viewing resource limitations as obstacles, teachers can utilise the available resources in rural areas (BCF, 2008). Teachers can incorporate familiar local examples to teach scientific concepts, such as observing animal behaviour, understanding the science behind fertiliser production, studying pollution caused by burning fossil fuels, learning about the water cycle, and observing phenomena like the Tyndall effect in a garden. Additionally, collaborating with parks, propagating native plants, raising animals, maintaining gardens, monitoring local ecosystems, and improving waterway health can be integrated into regular science lessons to enable students to explore, observe, manipulate, and analyse local natural resources. These resources offer opportunities for experiential learning, allowing students to connect theoretical knowledge with the world around them in meaningful ways. However, many teachers lack awareness of how to use these resources effectively or lack the training and institutional support to do so (Donkoh, 2016).

Despite extensive research documenting deficits in rural science education, few studies investigate how science is taught in rural secondary classrooms or explore opportunities for localised, context-based instruction. Understanding current teaching practices, the constraints teachers face, and the resources available is essential for moving beyond deficit narratives toward reimagining rural science education. By examining classroom-level practices in Bihar's rural secondary schools, the present study aimed to investigate how science is currently taught in rural secondary schools of Bihar. The findings are expected to contribute to the development of more equitable, inclusive, and effective science teaching strategies for Bihar and similar rural contexts.

Statement of the Problem and Research Question

Despite the vital role of science education in fostering critical thinking, problem-solving, and scientific literacy, the quality of science teaching in rural secondary schools in Bihar remains a significant concern. Understanding classroom practices is essential because pedagogical approaches directly impact how scientific knowledge is disseminated and acquired (Ciascai *et al.*, 2014). However, the critical question remains unanswered: How is science taught in rural secondary schools? To answer this, the present study sought to document the pedagogical practices of science teachers across three dimensions: instructional orientation, students' activity and assessment practices utilised by the teachers.

Research Objectives:

In tune with the research question, the present study was undertaken with the following research objectives:

1. To document classroom activities and teaching practices of science teachers.
2. To document the views of students related to how science is taught in the classroom.

METHODOLOGY

The present study was descriptive in nature and sought to document the teaching activities in rural secondary schools in Kishanganj district of Bihar, India. For this, two secondary schools were selected for data collection using convenience sampling. The researcher used an observation schedule to document the science teachers' classroom teaching activities. Six (6) classroom observations were made by the researcher in each school; thus, a total of 12 observations were undertaken. The observation schedule comprises 26 statements related to three dimensions: instructional orientation, students' activities, and assessment. Additionally, two focus group discussions with similar focus areas to those outlined in the observation schedule were conducted with students.

Data Analysis

Based on classroom observations, the teaching practices were classified as observed (O) and not observed (NO) for each dimension (instructional orientation, students' activities, and assessment) and then analysed based on frequency and percentage. Also, the responses obtained from focus group discussions were transcribed, followed by the identification and categorisation of similar responses under the dimensions considered for classroom observation.

RESULTS AND DISCUSSION

Instructional Orientation:

This dimension relates to the teaching approach used by science teachers in the teaching-learning process, as well as the opportunities created for students to express their thoughts, engage in activities, and ask questions.

Classroom observations revealed a predominant reliance on traditional teaching methods (Fig. 1). Traditional teacher-centred methods dominated science instruction, with the lecture method being universally employed (100%). In two-thirds of the observations (66.67%), teachers dictated or summarised key points and read directly from textbooks to explain science concepts. Despite this teacher-centred approach, most lessons (91.67%) provided some opportunity for students to express their thoughts, suggesting a modified lecture format rather than purely didactic instruction. However, none of the teachers use other teaching methods and approaches in the science classroom, such as cooperative learning techniques, discovery learning, and the guided inquiry approach.

Contextualization of science content was less frequent: only 41.67% of observed lessons connected scientific concepts to students' daily lives. Similarly,

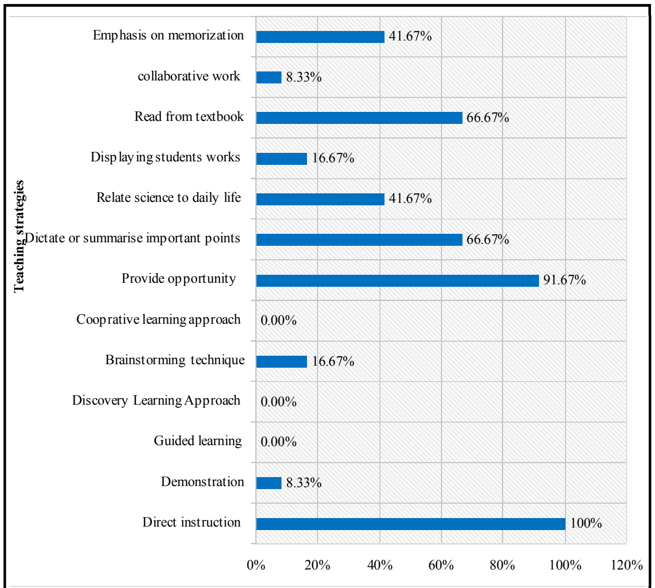

Fig. 1 : Instructional orientation of Science teachers during classroom teaching (12 observations)

teachers displayed students' work in 41.67% of classes, while the brainstorming method was rarely utilised (16.67%). This pattern suggests limited integration of constructivist or inquiry-based approaches, despite their documented effectiveness in various contexts.

These observational findings were corroborated by student focus group discussions. Students uniformly reported that teachers explain concepts, encourage note-taking, and rely primarily on the Bharti Bhawan science textbook as the instructional resource. Students quoted:

> *"सर टॉपिक को समझाते हैं और हम लोगों को उसे नोट करने को कहा जाता है । सर हमें पढ़ाने के लिए भारती भवन के साइंस का यूज़ करते है।"*
>
> *"The teacher explains the topic, and we are asked to take notes. The teacher uses Bharti Bhawan's science materials to teach us".*

This convergence of observational and self-report data confirms the predominance of teacher-centred, textbook-driven, expository instruction in rural secondary science classrooms, with limited incorporation of contextualised or experiential learning strategies. Similarly, Tufail and Mahmood (2020) found that science teachers are less interested in using the inquiry method and project-based learning in their classrooms, which is concerning as it reduces science education to mere transmission of facts rather than an active, inquiry-based learning process that builds competence of students to apply scientific concepts in their everyday life.

Students' Activities

This dimension focuses on various ways in which students engage with the content and undertake different activities in the science classroom. It involves students' active participation and individual or collaborative work.

As evident in Fig. 2, 83.33% observations demonstrate that the students actively participated in classroom discussions and took notes to retain information provided in the science class, but only one-third of observations (33.33%) show pupils asking questions related to the topic of science, indicating that students must be prompted and encouraged more often to ask questions. Also, in 16.67% of observed classes, students sought clarification from the instructor regarding science concepts. Additionally, no students were observed working independently on science-related activities, solving science problems in pairs or small groups, or discussing and learning from classmates during science-related activities. These findings emanating from classroom observations are further corroborated by students' responses during FGDs, which attest that students primarily take notes and post questions in science classrooms when they face confusion regarding the concept. One of the student iterated,

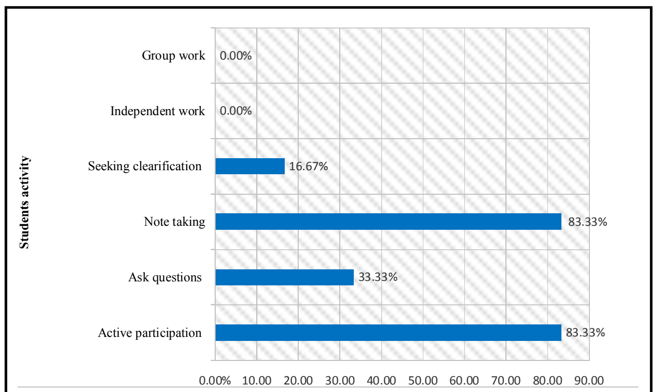

Fig. 2 : Students' activities in Science classroom (12 obsevations)

> *''सर हमें सवाल करने का मौका देते हैं, लेकिन सर कहते हैं कि पहले समझाने दो, फिर पूछना। जब सर पढ़ाते हैं, तो हम नोट्स बनाते हैं, और कभी–कभी किताब से भी लिखते हैं।''*
>
> *"The teacher gives us the opportunity to ask questions but says, 'Let me explain first, then*

ask.' When the teacher teaches, we take notes, and sometimes we also write from the book."

Assessment

This dimension captures the methods used by a science teacher to measure students' understanding of the concepts taught in the classroom. It focuses on teachers' use of various assessment methods such as formative and summative assessments, and level of questions (knowledge, understanding and application) posed to students.

As evident in Fig. 3, science teachers relied heavily on questioning as a method of assessing students' learning, indicating a lack of variety in the assessment methods (tests, worksheets, projects, activities, or mini presentations) used by the teachers. As evident in 75% of observations, teachers asked questions during or after the lesson that required students to elaborate on the "why" aspect, indicating teachers' focus on assessing students' understanding of the concepts taught. However, in 66.67% observations, the teachers limited themselves to posing mere factual-cum-recall based questions relating to science concepts, formulas, and definitions. Furthermore, students corroborated during the FGD that teachers merely use fact-based questions from the textbook, which was also observed in 25% classroom observations.

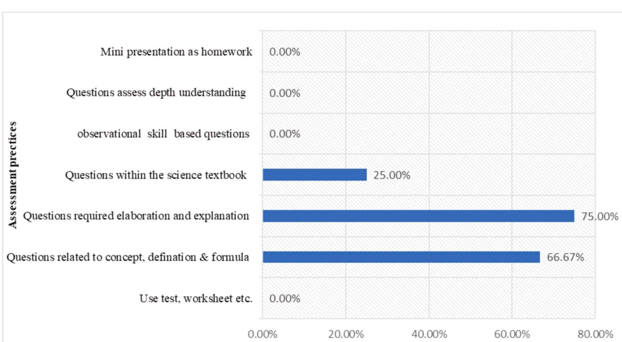

Fig. 2 : Students' activities in Science classroom (12 obsevations)

सर ज़्यादातर सवाल किताब से ही करते हैं। किताब के लास्ट में जो सवाल होते हैं, वही पूछते हैं। लेकिन बायो के टीचर किताब से सवाल नहीं पूछते हैं।

"*The teacher mostly asks questions from the book, specifically those at the end. However, the biology teacher does not ask questions from the book."*

Similarly, Kumar and Rao (2020) found that the assessment practices in rural schools primarily focused on content. This suggests a potential need for teachers to explore and incorporate alternative forms of assessment to ensure a more well-rounded evaluation of students' understanding of science concepts (Kumar and Rao, 2020, Zerai *et al.*, 2023).

Conclusion and Implications

Theme No. 1: Instructional Orientation

The findings underscore a dominant reliance on teachers' use lecture-based method, which often makes learning a passive act, and hence, it becomes indispensable for rural science teachers to intersperse the lecture-based method with a variety of teaching methods such as cooperative learning, discovery learning, guided inquiry etc., to create a more interactive and engaging classroom environment, thereby making students' science lessons more interesting (Kurt and Sezek, 2021; Najmonnisa and Saad, 2017). Furthermore, rural science teachers need to focus on improving their recapitulation skills to effectively summarise key concepts taught in the classroom rather than simply dictating them. By enhancing their recapitulation abilities, teachers can facilitate students' comprehension and make complex ideas more accessible (Maybodi and Maibodi, 2017). To recapitulate, science teachers can leverage multimodal scaffolds – such as concept maps, visual summaries, and community-embedded inquiry activities – that enable seamless translation of theory into practice and facilitate structured conceptual synthesis and retention. In turn, such pedagogical shifts toward contextually situated, learner-centric paradigms would make science learning more relevant to students' backgrounds and address NEP recommendation 4.5, which emphasises curricular reforms that facilitate active learning through inquiry, discovery, problem-solving, and dialectical analysis, and cultivate higher-order critical thinking. Consequently, such pedagogical delivery would transform the classroom into a dialogic, interactive interface, prioritising core conceptual understanding and collaborative problem-solving (Gleason *et al.*, 2011; Edwards, 2015), as well as experiential learning and holistic cognitive development (Hadzigeorgiou and Schulz, 2019). This will ultimately enhance the overall science learning experience and promote student ownership (Chan *et al.,* 2014).

Theme No. 2: Students' Activity

The findings reveal that students actively engage in notetaking. While note-taking can be a valuable learning strategy as it helps students organise and process information, reinforce their understanding, and serve as a reference for future review (Salame and Thompson, 2020), an over-reliance on verbatim transcription from blackboards or textbooks risks stunting higher-order critical and creative synthesis of scientific concepts (Chloeburroughs, 2023). Consequently, science teachers must encourage students to go beyond mere transcription and engage in active information processing through discussions, problem-solving activities, and hands-on experiences. By incorporating more interactive and inquiry-based approaches into the classroom, teachers can help students develop higher-order thinking skills and foster a genuine interest in science. This shift from a predominantly note-taking approach to more active and participatory learning strategies can enhance the overall quality of science education in rural secondary schools (Katopodis, 2020).

Theme No. 3: Assessment

Results indicate that most teachers use verbal questioning as the primary evaluative tool, predominantly targeting factual recall rather than the functional ability to synthesise and apply scientific information (Rohandi, 2017). This taxonomic limitation underscores the urgent need for a foundational shift away from the "culture of rote learning". A critical implication for rural science education is the need to adopt a pluralistic evaluative architecture. Teachers, especially in rural contexts, need to diversify their assessment methods by incorporating tests, worksheets, observation-based assessments, projects, and mini-presentations to evaluate students' understanding of science concepts from multiple perspectives. By doing so, teachers can assess students' abilities to analyse, synthesise, and evaluate scientific information (Snyder and Snyder, 2008). Teachers can actively incorporate practical activities, experiments, and scientific inquiry into their lessons to assess students' observational and prediction skills and experimental design abilities (National Research Council, 2001). Prioritising "process skills" through practical experiments and scientific inquiry allows for a more authentic assessment of students' predictive and experimental design abilities (National Research Council, 2001; Harlen, 1999). In turn, this would align and address NEP's recommendation 4.34, which emphasises a competency-based approach to assessment that evidences the development of higher-order cognitive skills, including conceptual clarity, dialectical analysis, and critical synthesis.

Hence, recalibrating assessment procedures to serve as a diagnostic tool for guiding instruction rather than the reproduction of factual knowledge is essential. Transitioning toward these participatory and multifaceted evaluative strategies is a fundamental prerequisite for enabling rural secondary students to thrive within the competitive rigour of the global scientific field.

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