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# TEACHERS' NARRATIVES ON STRATEGIES FOR ENHANCING SCIENTIFIC CURIOSITY IN A PUBLIC SECONDARY SCHOOL

**J. M. S. Nerio*[1], J. D. Linaugo[2], N. F. Sulaeman[3]**

[1]Buenavista National High School, Escalante City, Negros Occidental, Philippines
[2]Carlos Hilado Memorial State University, Talisay City, Negros Occidental, Philippines
[3]Mulawarman University, Samarinda, East Borneo, Indonesia

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**ABSTRACT**

Teachers' narratives on strategies for enhancing scientific curiosity in secondary public schools are significant, particularly for uncovering the different approaches science teachers use to cultivate students' curiosity in science education. This research aimed to uncover teachers' narratives about strategies to enhance students' scientific curiosity. This study also examined science teachers' perspectives on scientific curiosity. It utilized a qualitative research design, specifically a narrative inquiry approach. The data were obtained from four junior secondary school science teachers at one school in the central Philippines using a triangulation method: one-on-one interviews, essays, and focus group discussions. The involved conversation partners were determined using a purposeful sampling. Four themes were forwarded based on the original statements of the conversation partners: pedagogical approaches to enhance curiosity, including fostering an active learning environment and resilient instruction to meet students' needs; instructional challenges and difficulties; and scientific curiosity as a curiosity-driven inquiry. This study highlights integrating pedagogical strategies that enhance students' scientific curiosity into daily instruction. Schools should design professional development programs that emphasize curiosity-enhancing teaching methods. The research findings have major consequences for how teachers implement and use pedagogical approaches that cultivate scientific curiosity and for how students engage in the lesson based on the strategies teachers use.



Keywords: Science education; scientific curiosity; narrative inquiry; central Philippines

## INTRODUCTION

Curiosity is closely associated with cognition, serving as an important motivating force that drives information-seeking and enhances cognitive capacity, memory, and information processing (Vogl et al., 2020). Conceptualized as "wanting to know," curiosity encourages active information-seeking, often prompted by awareness of a knowledge gap or the strategic use of mystery in interventions (Wright et al., 2018; Metcalfe et al., 2020). Curiosity strengthens memory formation and serves as an internal motivation for learning (Gruber & Ranganath, 2019). Student curiosity should be characterized by both internal thought processes and external behaviors, such as seeking truth and information integrity, while factoring in school context and parental feedback (Nurishlah et al., 2020). Indicators of scientific curiosity include stretching (seeking new information), embracing (novel everyday experiences), and engaging in scientific practices (Weible & Zimmerman, 2016).

Inquiry-based learning repeatedly aligns with formalized evaluation frameworks that center on defining structured outcomes. Kapici et al. (2022) argue that educators tend to prioritize inquiry-based methods over those that cultivate curiosity-driven strategies. However, Shin (2024) states that students may misplace their sense of

***Correspondence Address**
E-mail: josemarie.nerio@deped.gov.ph

ownership in the learning process if inquiry-based learning takes precedence, resulting in an experience that conforms to instructions rather than being authentic. According to Kibga et al. (2021), collaborative lessons unleash students' curiosity and initiative through hands-on activities.

The 2022 PISA results show that the Philippines ranked low in science (OECD, 2023a, OECD 2023b). Aside from the perennial factors like reading proficiency and mathematical ability (Bernardo, et al, 2023), this result can be attributed to the lack of instructional materials such as laboratories, facilities, and equipment in science indicating minimal support and focus on how to strengthen performance of the students (Pacadlejen, 2024; Briones 2025) leading teachers to depend on experiential and active learning engagement which may partially develop students' natural curiosity and stimulate their eagerness to delve into scientific concepts beyond structured experiments. Additional factors also include curriculum changes and competency focus (Cabacungan & Calzada, 2025).

Currently, fostering intellectual inquisitiveness explicitly aligns with the United Nations' Sustainable Development Goal (SDG) 4, which aims to ensure inclusive and equitable quality education and to foster continuous learning opportunities for all (Wang et al., 2025). Furthermore, the competence and proficiency cultivated are vital for achieving higher-level targets, such as SDG 9: Industry, Innovation, and Infrastructure, which is achieved through scientific inquisitiveness, critical analysis, and innovation (Sanchez-García et al., 2024).

Vygotsky's Sociocultural Learning Theory serves as the anchor for this research. The theory claims that the acquisition of knowledge is a collaborative endeavor and that cognitive ability is enhanced through engagement with historical and cultural contexts (Burner & Svendsen, 2025). In the classroom, this is carried out and works through engagement, partnership, and facilitated education. Intricate cognitive processes, particularly those related to the scientific method and nurturing inquisitiveness, can be internalized through socialization with students and educators (Taber, 2025). In accordance with the theory, learning is transmitted through tools and cultural artifacts, and in science instruction, instructional materials, language, lectures, and practical examples are incorporated. The unavailability of instructional materials and limited proficiency may be considered challenges to the effective communication of principles, indicating the practical relevance of the theory.

The goal and purpose of this study are to pinpoint the educational practices that are significant to an excellent, sustainable education. By scrutinizing teachers' narratives on their accomplished and resilient schemes, this research will go beyond theoretical discussions to provide a vigorous, evidence-based framework. Specifically, this study answers the following questions: (i) What pedagogical strategies do science teachers employ to enhance students' scientific curiosity?; (ii) What challenges do teachers face in implementing curiosity-enhancing strategies?; and (iii) how do science teachers conceptualize scientific curiosity? This evidence-based framework will serve as a crucial resource for professional growth and development by supporting teachers in their significant role of enhancing and developing students' academic involvement and analytical reasoning, thereby contributing to the learning needs and demands of the Philippines. In the last decade, initial research on curiosity has focused on the neural underpinnings of curiosity elicitation (Oosterwijk et al., 2020; Poh et al., 2022), but the literature still lacks findings on the specific processes that occur during the satisfaction of curiosity. There is a gap in existing studies on student-centered strategies that increase motivation and engagement in science for junior high school students in regular classroom settings, particularly regarding how teachers facilitate self-directed scientific curiosity, how they are trained to foster this curiosity, and the strategies they use to enhance student learning. In scientific teaching, a handful of investigations have scrutinized the educators' lived experiences and storylines in light of the limited resources in the Philippine setting.

## METHODS

This study employed a qualitative research design using the narrative inquiry approach (Parks, 2023). This is particularly effective for capturing the narratives and personal strategies of junior high school science teachers aimed at enhancing scientific curiosity. Narrative inquiry enables the collection of rich, contextually grounded stories that reflect authentic classroom practices. To foster an extensive and comprehensive evaluation, four (4) public secondary school science teachers were selected based on their credentials and expertise.

The inclusion criteria were used to determine participants. The criteria prescribed that the participant must (i) be a public junior high school science teacher, (ii) be a teacher for at least three years, and (iii) have teaching loads in science subjects. An approach prioritizing comprehensiveness over scope, achieving saturation of data through multiple interviews and participants' evaluations (Creswell & Poth, 2018). The researchers used pseudonyms to conceal participants' identities. First, we have Andres, 39 years old, who started his teaching career in 2009 as a volunteer teacher and transferred to a far-flung school as a permanent teacher. He has 15 years of teaching experience. The second participant, Jun, 35 years old, has a Bachelor of Secondary Education degree majoring in physical science and five years of teaching experience as a volunteer and eight years as a regular teacher. Sam, 32 years old, the third participant, holds a master's degree in teaching science and has been a regular teacher since 2017. He has a Bachelor of Secondary Education degree with a major in physical science. Lastly, Lucy, 31, also holds a master's degree in teaching science. She has 12 years of teaching experience. All teachers teach across all grade levels in the junior secondary school.

Data were gathered through (i) semi-structured interviews, used to capture in-depth, personal narratives. (ii) focus group discussions, used to explore shared experiences and validate common strategies (iii) narrative essays, used to capture reflective and structured accounts of their practices, enabling triangulation by method and depth of understanding of science teachers of what are the pedagogical strategies being employed and utilized in science education to foster scientific curiosity and enhance the scientific curiosity of the students. Data were collected over three months, from March to May 2025. The original statements from the one-on-one interview, essay writing, and focus group discussion were encoded verbatim to capture every detail and participant statement. Ethical considerations such as informed consent, social value, vulnerability of research participants, risks and benefits, privacy and confidentiality, transparency, qualifications of the researcher, justice, adequacy of facilities, and community involvement were strictly observed, with participants provided with information about the study's purpose and confidentiality. The researcher used smartphones to record the process, took notes, and engaged in social conversations to establish rapport and ensure participant comfort.

In exploring the teacher narratives, a thematic analysis is used to stimulate scientific curiosity in public secondary schools. The study included interviews, focus group discussions, and written essays, which ensured data saturation through a series of interviews and respondent validation. This study followed the protocols of Braun & Clarke (2021a, 2021b) and the six-phase framework to ensure an exhaustive approach to data analytics and interpretation. The thematic analysis process began with familiarization, which involves engaging with the data through repeated recording and reading to develop a deeper understanding and grasp the meaning fully, while noting initial ideas. The researchers then generated initial codes by grouping the data and logically labeling and coding interesting elements. This process led to the third phase, which involved identifying pivotal themes to compile codes into more extensive, unifying concepts and using visual aids for sorting. The researchers reviewed themes after the implicit ones were determined. Verification for coherence at the level of the coded data extracts (Level 1) and against the entire data set (Level 2), improving the necessary themes needed. Fifthly, defining and naming themes in which the researcher finds the substance and particular focus of each theme. It creates a distinct definition and fosters a well-ordered narrative. Producing the report is the final phase, which encompasses the final analysis, selection of convincing data, connecting the findings to the research question, and writing a brief, rational, and persuasive academic account of the data narratives until final themes emerge. A thematic analysis encompasses structuring information from a well-reasoned account, recognizing compelling perspectives, and creating a scholarly exposition that persuasively demonstrates the analysis's merit and validity. Trustworthiness of the study was ensured through credibility, transferability, dependability, and confirmability measures, with the triangulation method, member checking, the code-recode strategy, and thick descriptions supporting the rigor of the research process.

## RESULTS AND DISCUSSION

The study revealed four (4) major key findings that underscore teachers' narratives on strategies in enhancing scientific curiosity. These findings emphasize the significance of pedagogical approaches in igniting students' scientific curiosity and ensuring an active learning environment that supports better learning, not just rote memorization, but also lifelong learning. The themes highlight the following pedagogical strategies: (i) pedagogical approaches in enhancing scientific curiosity; (ii) fostering active learning environments and resilient instruction for students' needs; (iii) instructional challenges and difficulties; and (iv) scientific curiosity as curiosity-driven inquiry. The themes identified in the study demonstrate the strategies employed and how these strategies enhance students' scientific curiosity in secondary public schools. Given major challenges such as insufficient learning materials and limited English proficiency, these strategies aim to foster a curiosity-driven educational environment. Cultivating curiosity for seeking out knowledge drives the teachers' approaches, particularly in problem-based learning and the utilization of real-world circumstances in line with the literature. Despite this, an enormous gap between ideal and realistic execution emerged; even though educators recognize the necessity of organized inquiry, insufficient resources motivate teachers to implement resilient and adaptable teaching approaches, such as using household items for demonstrations, which ensure education continues regardless of structural limitations. This surprising outcome indicates that curiosity in these contexts is fueled by cognitive adaptability rather than by quantitative accessibility. Structured on Sociocultural Learning Theory (SCLT), the results imply that insufficient serves as an obstacle, and teachers' flexible and adaptable strategies function as a limited arbitration method. Conceptually, resiliency transcends structural barriers in the educational setting, thereby enhancing SCLT. This research affirms the efficiency of these inexpensive yet effective techniques, including tactical questioning and straightforward examples. This firmly suggests that regulations must address insufficient resources while offering specialized education to lessen the challenge of language, ensuring adequate opportunities for scientific study.

**Pedagogical Approaches in Enhancing Scientific Curiosity**

Pedagogical Approaches in Enhancing Curiosity focuses on instructional strategies science teachers use to foster students' curiosity, including the inquiry-based approach, real-life applications, multimedia presentations, curiosity-sparking demonstrations, and curiosity-sparking in the motivation phase. This shows how knowledgeable teachers are in implementing effective strategies that spark students' curiosity, leading to more engaging lessons. Sparking curiosity in the Motivation Phase highlights that, in this phase, most teachers ignite students' curiosity. Inquiry-based approaches play a crucial role in maintaining student engagement and fostering curiosity, as narrated by Jun: first, ask scientific questions that pique learners' curiosity; then use an inquiry-based approach; and, after that, proceed to the project method to address learners' scientific curiosity.

The use of multimedia presentations captures students' attention and promotes engagement. This was shared by Sam: "Short videos, video clips, multimedia, and audiovisuals because that is where they are engaged. Wherein, if they watch a video, they might become more curious and see even more things. Alternatively, if they look at a picture, they get curious, and from there, they start searching for more."

Lucy narrated about the use of demonstration to fuel students' scientific curiosity: "I let them bring materials like shampoo for colloids, or before, I would distribute to them shampoo, fish sauce, and cooking oil to mix with water. Moreover, they would ask how they would do it. They would probably be curious about it, so the next day, they would be more interested in what would happen."

It plays a significant role in maintaining student engagement and participation throughout the lesson and should start in the motivation phase. Andres mentioned this aspect. "For me, it really starts at the very beginning of the lesson, which is the motivation. In the first place, if we are at the part of the lesson plan where we discuss something, then naturally we need to ask questions of the student, and it is through asking those questions that the students become curious about what the correct answer really is."

Curiosity is the desire for knowledge that leads to exploration to answer any questions that arise from observations. In line with this opinion, Nasrullah et al. (2021) state that curiosity is the desire to acquire new knowledge through exploration to grow and expand understanding, which refers to students' tendency to ask questions, investigate, and discover new knowledge from their environment. Meanwhile, Kendra (2020) states that curiosity is the foundation of a student's cognitive processes regarding thoughts about the surrounding environment. In addition, explicit promotion (Lindholm, 2018) focuses on the broader educational goal of promoting curiosity in the classroom. It provides a theoretical and instructional context for the strategies used in the initial motivation phase, confirming that cultivating this intellectual drive is a deliberate pedagogical goal. Aligning with the findings of Wu et al. (2021), which emphasize the effectiveness of inquiry-based learning in stimulating scientific interest, and with Ardianto & Rubini (2016), science learning in junior high school should provide students with inquiry skills.

Using inquiry-based approaches as a primary strategy for deepening understanding and sustaining interest in science fosters a lifelong learning environment. Visual aids and multimedia better develop students' curiosity, motivation, and interests and create a consequential environment. Creating a real-world setting and providing real-life, hands-on applications will encourage students to construct their knowledge and ignite their curiosity. Much of the literature demonstrates the efficacy of this strategy in developing academic accomplishments and achieving learning outcomes. It involves students becoming active discoverers from passive observers and encourages them to actively participate in sharing knowledge and in material processing. When students are curious, they are more interested and motivated to learn new science lessons, allowing them to engage in class through participation. From passive learning, students become actively motivated to uncover answers and create meaning around them.

**Table 1.** Comparison Table of Teachers Strategies

| Pedagogical Strategies | Participants | | | | Literature Support |
|---|---|---|---|---|---|
| | Andres | Jun | Sam | Lucy | |
| Inquiry-based approach (Uses questions) | | √ | | | Inquiry fosters a curious learning cycle (Morris, 2025). IBL teaches how to think through queries, not what to think, which sparks curiosity and supports the concept of curiosity as driven inquiry and innovative scientific thinking (Qablan et al., 2024). |
| Real-life applications (Integrates real-life application) | | √ | | | Culture-based curriculum contextualizes learning resources (Dewi et al., 2019). Real-life connections and hands-on demonstrations deepen conceptual understanding and enhance student motivation (Ozuho et al., 2021). This directly supports existing literature on the efficacy of experiential learning in science education (Shanmugam & Balakrishan, 2019). |
| Multimedia presentations/Videos (Short videos, video clips, audio-visuals) | | | √ | | Audiovisual materials increase student interaction and engagement, leading to more effective information retrieval (Kleemola et al., 2023). Multimedia boosts student interest, enhances comprehension, and aids memory retention. (Ye, 2024). Also, Problem-based media enhances learning outcomes (Wibawa et al., 2024) |
| Demonstration that sparks curiosity (Uses household materials like shampoo, fish sauce, cooking oil) | | | √ | | Investigative experiences provide excitement, satisfaction, and achievement, which boost motivation (Sutiani et al., 2021). Motivation-Sensitive Teaching (MST) uses three strategies: promoting learner involvement, ensuring a safe class atmosphere, and making the learning process (especially language acquisition) pleasurable and interesting (Abrar-ul-Hassan, 2024). |
| Sparking curiosity in the motivation phase (begins the class by asking questions) | √ | | | | Motivated students become independent, self-regulated learners (Zajda, 2018). Effective classroom management enhances motivation and student learning. (Habbah & Husna, 2024). |

The primary practical implication derived from Theme 1, Pedagogical Approaches in Enhancing Scientific Curiosity, is the need for a Training Module on Inquiry-Centered Lesson Design. This module would focus on formalizing key teacher strategies, specifically: mandating a "Curiosity Hook" at the start of every lesson (like a puzzling question or demonstration) to trigger a knowledge gap intentionally; shifting the default instruction mode to Inquiry-Based Learning for student-led discovery; requiring teachers to embed real-world relevance to ensure conceptual understanding is immediately applicable; and training on the strategic use of both multimedia and low-cost, household materials to ensure hands-on experimentation is possible despite material shortages. This systematic integration ensures curiosity is not merely acknowledged but actively used as the foundation of the science learning process.

**Foster an Active Learning Environment and Resilient Instruction for Students' Needs**

This theme focuses on the outcomes of enhancing students' scientific curiosity in delivering lessons amid their diversity. Responding to students' interests to foster resilient instruction emphasizes teachers' flexibility and upholds education while supporting students' interests and needs in all corners of a classroom. The strategies deepen students' curiosity and, by promoting it, make them actively engaged and involved in the teaching and learning process; this was shared by Andres. "We can really see it in their performance and in the outcome of the assessment or evaluation, and through the activities you have given them, where they perform well. The student's participation will reflect on their report card, and you can really tell when a student is excelling."

Since the students have different learning styles, teachers should be flexible. This was shared by Jun: "Since each student has a different learning style, we should also have different teaching styles. If it is not effective, we automatically erase it, and we go back to the blackboard and chalk, to spoon-feeding. However, since you have proven that the inquiry-based approach works and you can integrate real-life applications throughout, and the results in the post-assessment and their outputs are good, then we just continue with that approach."

Establishing an experiential, hands-on, and collaborative learning environment is crucial for fostering engagement and igniting students' curiosity. Moreover, students become inquisitive when they are immersed in the learning process. The participants' narratives show how flexible they are despite the challenges. Teachers should be resilient in finding the best and most effective strategies to cater to students' backgrounds, learning styles, and needs, given the diversity of students. Despite the difficulties they encounter while delivering the lessons, participants are doing their best to impart knowledge, and their resilience shows that they are committed, creative, and centered amidst these difficulties in the educational realm.

Engagement is crucial for nurturing and fostering the connection between learners and instructors to intellectual prowess and for enhancing the esteem of esteemed educational institutions. The review highlights that promoting student involvement in the learning environment is essential to developing educational accomplishments and creating a thriving environment. Educators play a vital role in creating classroom environments that encourage participation. To accommodate diverse backgrounds, learning preferences, and demands, teachers must relentlessly seek efficient teaching methods. Participants strive to convey information despite difficulties with the lecture. Resilience demonstrates focus, dedication, and innovation in the face of educational challenges. The existing literature supports the importance of student involvement, empowering students to take charge of their education and actively participate in class discussions, thereby improving academic performance.

**Table 2.** Results of Enhancing Scientific Curiosity

| Results of Enhancing Scientific Curiosity | Literature Support |
|---|---|
| Foster an active learning environment. | Student involvement is the fundamental element that fosters understanding and plays a pivotal role in enriching educational performance and curriculum development (Sajib, 2024). Student engagement is a crucial element of learning that fosters understanding and promotes responsible community membership. It plays a pivotal function in curriculum development and is essential for achieving academic excellence (Nyika & Mwema, 2021). Student engagement involves many interactions (Morsches & Matthews, 2021). Student engagement affects academic success. (Nguyen, 2019). Teacher support influences student engagement. (Hu & Abu Talib, 2023). The findings of Ehirim et al. (2020) indicate that inadequate materials obstruct teaching and readiness. In the accomplishment of the profession, experiential knowledge and profound understanding are vital (Kerekes, 2024). The English language is the primary medium for teaching science.<br>A particular approach is adaptive learning, which offers revolutionary potential (Hayani et al., 2021). Adaptive learning revolutionizes personalized education. This approach means that students are no longer bound to the curriculum (Qasim et al., 2020). Adaptive learning accommodates everyone, enabling learning at the best individual level and path. (Adeel et al., 2020). |
| Resilient/Flexible instruction | Diversity demands varied pedagogical skills. (Farooqi et al., 2024). Effective teaching strategies optimize adaptive instruction and feedback, improving classroom efficiency (Chen & Li, 2025). |

The practical implication of Theme 2, Fostering an Active Learning Environment and Resilient Instruction for Students' Needs, is the need for teacher training in Inclusive and Adaptive Pedagogy. This training requires a shift in focus to: Cultivating Autonomy, where teachers provide students with choices in their learning process to boost ownership and sustained curiosity; Modeling resilience by demonstrating resourceful, flexible teaching (especially given material shortages); and effectively Implementing Differentiated Instruction to ensure all diverse learners, including those with language challenges, are catered to, thereby making the classroom a safe, collaborative space where all students are empowered to engage in scientific inquiry.

**Instructional Challenges and Difficulties**

The theme focuses on the uncertainties science teachers face when implementing effective strategies, given evident gaps in the academe. The study's results emphasize that instructional materials, such as equipment in science education, can foster a greater understanding of complex concepts and better student retention, creating a more meaningful learning environment. However, participants' narratives revealed problems in science education due to a lack of funds and other factors. Andres shared his stories about the shortage of materials: "There are even times during class discussions when there is a lack of equipment, or the students cannot really perform the activities because we do not have the materials, and we also cannot localize them due to lack of resources or availability."

In the Philippine context, literacy skills were at their lowest. Students are non-readers and cannot even understand English. Jun pointed out this statement: "The language barrier is a major factor. It is hard for students to read, and now you are making them understand English: the language barrier, sir. The medium of instruction is English, so we are mandated to use it. We must speak in English all the time, but when we are speaking English all the time, you have 40 students in the classroom, and some are below average, who cannot understand."

In science education, English is the primary medium. In the Philippine context, literacy skills were at their lowest. Students are non-readers and cannot even understand English. The participants express their frustration about how to implement the expected learning outcomes for students. The results indicate that poor reading comprehension is influenced by three key factors: students' lack of motivation, limited prior knowledge, and limited English vocabulary.

**Table 3.** Teacher Challenges

| Challenges | Literature Support |
|---|---|
| Shortage of instructional material | Material shortages and weak English literacy reduce the effectiveness of scientific education. Sharpe & Abrahams (2020) mention that experiments and the laboratory are essential for motivating science learning and effective practice. |
| Low language proficiency | Low language proficiency and poor reading awareness predict low science literacy and poor national performance on international assessments. (Calleja et al., 2023). COVID-19 distance learning increased reading comprehension problems (Caasi & Pentang, 2022). Moreover, this issue leads to three main adverse impacts: reduced learning achievement, hindered problem-solving skills, and inhibited future studies and careers (Nanda & Azmy, 2020). |

The practical implications of Theme 3, Instructional Challenges and Difficulties, highlight the urgent need for a Training Module and an Institutional Policy on Resource Management and Linguistic Scaffolding. This requires a systemic commitment to overcome the two major barriers identified: material shortage and low language proficiency. To address the former, it needs a policy supporting the development of a sustainable, low-cost experiment library and a shared resource system to reduce reliance on expensive equipment. To address the latter, it requires a mandatory program that trains teachers in Explicit Linguistic Scaffolding techniques, empowering them to teach both science content and the necessary technical language, while also creating a supportive environment where the students' native language can be temporarily used to clarify complex scientific ideas, ensuring that a language barrier never suppresses curiosity.

**Scientific Curiosity as Curiosity-Driven Inquiry**

Scientific Curiosity as Curiosity-Driven Inquiry encapsulates the participant's understanding of scientific curiosity. Andres shared this. "For me, scientific curiosity is about wanting to learn more, especially for the new things that you wish to discover and explore. It is the questions that lead you to find an answer by investigating and experimenting." Sam shared the same ideas and understanding about scientific curiosity. "Scientific curiosity, to me, is the drive to explore, ask questions, and understand the world through observation and experimentation. It is the mindset that pushes students/people to ask "how" and "why" about the reality of existence—everything, from small to complex things. It is not just about gathering facts but seeking deeper explanations, often leading to more questions than answers."

Participants' descriptions of their understanding of scientific curiosity aligned with the study's definition, suggesting that science teachers are aware of what scientific curiosity entails: the pursuit of knowledge through inquiry and investigation. Curiosity, the drive for information that motivates investigation to find answers to observations, is the propensity of students to inquire, research, and uncover new information from their surroundings. It is the desire to learn through investigation to develop and broaden understanding.

**Table 4.** Teacher's Perspective

| Teacher's perspective | Literature Support |
|---|---|
| Scientific Curiosity as Curiosity-Driven Inquiry | Exploring the presence of scientific curiosity among prospective biology education teachers is important because it can help lecturers direct and mobilize students' motivation and interest in the learning process, both in the classroom and in the laboratory. The presence of curiosity among students can serve as intrinsic motivation for understanding the material concepts presented by lecturers; in addition, it can encourage students to explore their surroundings (Hunaepi et al., 2021). |

The practical implication of Theme 4, Scientific Curiosity as Curiosity-Driven Inquiry, is the crucial need for a Training Module on Metacognitive Assessment and Scientific Identity to formalize inquiry as the primary learning mechanism. This requires a systemic shift in how learning is measured and valued: the curriculum needs to reframe learning objectives to explicitly include behavioral indicators of curiosity (such as question formulation); the institution must implement process-oriented assessment tools that evaluate the quality of a student's investigation and argumentation, not just the final answer; and teachers need training in metacognitive skill development (like curiosity journaling) to empower students to consciously reflect on their own "how" and "why" driven exploration. This ensures that the culture recognizes scientific curiosity as the powerful, investigative force driving the pursuit of knowledge.

The thematic map shown in Figure 1 illustrates the relationships among teachers' pedagogical strategies, the challenges they encounter, and students' development of scientific curiosity.

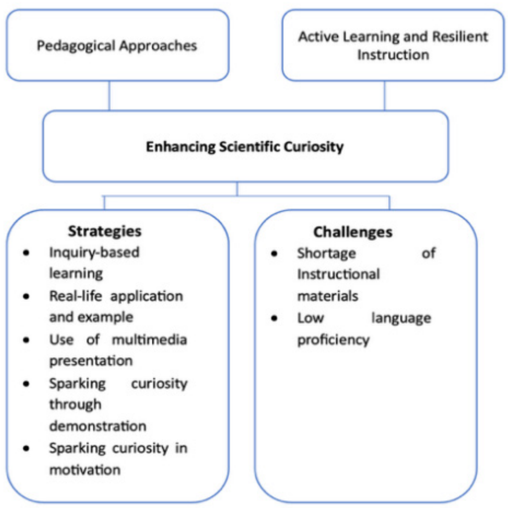


**Figure 1.** Map Showing Thematic Relationships Drawn from the Study

Figure 1 illustrates how teachers enhance scientific curiosity by balancing effective pedagogical approaches with the realities of instructional challenges. Strategies such as inquiry-based learning, real-world applications, multimedia use, and demonstrations are key drivers of students' curiosity. However, these efforts operate within constraints such as limited instructional materials and students' low language proficiency. Through active learning and resilient instruction, teachers adapt their methods to overcome these barriers. Ultimately, the framework shows that scientific curiosity emerges from the dynamic interaction between supportive teaching strategies and the challenges present in the learning environment.

## CONCLUSION

The narratives from the science teachers underscore the vital role of strategic Pedagogical Programs in achieving Sustainable Development Goal 4 (SDG 4): Quality Education. The findings demonstrate that enhancing scientific curiosity directly contributes to the targets of SDG 4, particularly ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all. The four themes revealed Pedagogical Approaches, Active Learning Environment, Instructional Challenges, and Curiosity as Inquiry collectively point to a need for systematic professional development focused on student-centered methodologies. By integrating training modules on the Curiosity Cycle, Inclusive and Adaptive Pedagogy, and Metacognitive Assessment, the education system can address the systemic barriers and effectively cultivate the critical thinking and scientific literacy necessary for lifelong learning. This focused teacher training is the most direct pathway to translating the global ambition of SDG 4 into local classroom practice, ensuring that every secondary student gains the investigative skills and knowledge required to participate fully in a world that is scientifically and technologically evolving.

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