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Article

Developing Life Sciences Competencies: Lived Experiences of Junior High School Students in Science Education at Guina-ang National High School

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Abstract

Science education plays a pivotal role in developing learners' competencies in the life sciences by cultivating scientific literacy, critical thinking, problem-solving skills, and environmental responsibility. As educational reforms increasingly emphasize competency-based learning, junior high school students are expected not only to acquire scientific knowledge but also to apply scientific concepts to real-life situations that promote health, environmental sustainability, and community well-being. Despite continuous improvements in science curricula and teaching approaches, limited qualitative studies have explored how students personally experience the development of life sciences competencies within the context of public secondary schools in rural and mountainous communities. This study explored the lived experiences of Junior High School students at Guina-ang National High School in developing life sciences competencies through science education. Employing a descriptive phenomenological research design, the study purposively selected fifteen (15) students from Grades 7 to 10 who demonstrated active participation in science learning activities. Data were collected through semi-structured, in-depth interviews and analyzed using Colaizzi's Seven-Step Phenomenological Method. The analysis generated five essential themes: (1) Cultivating Scientific Curiosity Through Experiential Learning; (2) Developing Scientific Literacy and Critical Thinking; (3) Applying Life Sciences Knowledge to Everyday Living; (4) Overcoming Learning Challenges in Science Education; and (5) Envisioning Future Careers Through Life Sciences Competencies. The findings revealed that authentic learning experiences, inquiry-based instruction, collaborative activities, and contextualized science lessons significantly strengthened students' understanding of biological concepts and enhanced their appreciation of science as an essential component of daily life. The study proposes a Life Sciences Competency Development Framework that may guide curriculum enhancement, instructional innovation, and learner-centered science education in secondary schools. The findings contribute to the growing body of literature on life sciences education, competency-based science instruction, and phenomenological research within the Philippine educational context.

Keywords: *life sciences, science education, scientific literacy, life sciences competencies, phenomenology, junior high school students, inquiry-based learning, competency-based education*

Introduction

Science education has become one of the most significant pillars of educational development because it equips learners with the knowledge, skills, and values necessary to understand the natural world, solve complex societal problems, and contribute to sustainable development. Among its major disciplines, life sciences provide learners with essential understanding of living organisms, biodiversity, ecology, genetics, human health, and environmental sustainability. As scientific discoveries continue to influence agriculture, medicine, biotechnology, environmental conservation, and public health, developing life sciences competencies has become increasingly important in preparing learners to become scientifically literate citizens capable of addressing global and local challenges (UNESCO, 2021).

Globally, educational systems have shifted from traditional content-based instruction toward competency-based learning that emphasizes the development of scientific inquiry, critical thinking, collaboration, creativity, and problem-solving skills. The Organisation for Economic Co-operation and Development (OECD, 2019) emphasizes that science education should enable learners to explain scientific phenomena, evaluate scientific evidence, and apply scientific knowledge to real-world situations. Likewise, the Programme for International Student Assessment (PISA) identifies scientific literacy as an essential competency that empowers individuals to make informed decisions concerning health, environmental sustainability, technological advancement, and responsible citizenship (OECD, 2023). These global perspectives highlight the need for science classrooms to move beyond memorization toward meaningful learning experiences that encourage learners to investigate, analyze, and solve authentic problems.

The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2021) further recognizes science education as an important driver in achieving the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 3 (Good Health and Well-being), SDG 13 (Climate Action), and SDG 15 (Life on Land). Through quality science education, learners acquire competencies that enable them to understand ecological relationships, promote environmental stewardship, conserve biodiversity, and participate in sustainable community development. Consequently, life sciences education has expanded beyond classroom instruction to include inquiry-based learning, experiential activities, environmental investigations, community engagement, and interdisciplinary learning experiences that foster lifelong scientific literacy.

Within the Philippine educational context, science education occupies a central position in the K to 12 Basic Education Curriculum, which seeks to develop scientifically, technologically, and environmentally literate learners capable of making informed decisions that improve their quality of life (Department of Education [DepEd], 2016). The curriculum emphasizes inquiry-based learning, contextualization, scientific investigation, and the application of scientific knowledge to everyday situations. Specifically, Junior High School Science integrates biology, chemistry, physics, and earth science through spiral progression, allowing learners to continuously build and deepen their scientific understanding across grade levels. The curriculum also encourages students to engage in laboratory investigations, field activities, collaborative learning, and community-based environmental projects that strengthen their life sciences competencies.

Life sciences competencies encompass not only mastery of biological concepts but also the ability to observe, investigate, analyze evidence, communicate scientific ideas, solve environmental and health-related problems, and demonstrate responsible attitudes toward nature and society. These competencies enable learners to understand the interconnectedness of humans and ecosystems while promoting informed decision-making concerning nutrition, disease prevention, biodiversity conservation, climate change adaptation, and sustainable resource management. Consequently, science education has become an essential avenue for preparing future citizens who can contribute to national development through scientific innovation and environmental responsibility.

At Guina-ang National High School in Guina-ang, Bontoc, Mountain Province, science education plays an important role in developing learners' understanding of life sciences within a unique geographical and cultural context. Situated within a mountainous community characterized by rich biodiversity, indigenous ecological knowledge, and close interaction with the natural environment, the school provides opportunities for students to experience science beyond textbooks. Through classroom instruction, laboratory activities, environmental projects, school gardening, ecological conservation initiatives, and community-based learning, students encounter authentic situations that strengthen their scientific competencies while fostering appreciation for the natural resources surrounding them. Such contextualized learning experiences enable students to connect scientific theories with local environmental realities, thereby making science education more meaningful and relevant.

Despite significant curricular reforms and instructional innovations, several studies continue to report that many students experience difficulties in understanding abstract scientific concepts, conducting scientific investigations, interpreting scientific evidence, and applying classroom learning to real-life situations (OECD, 2023). While quantitative investigations have measured science achievement, scientific literacy, and academic performance, relatively few studies have explored how students personally experience the process of developing life sciences competencies through science education, particularly within rural secondary schools in geographically isolated communities. Existing research has focused primarily on learning outcomes, standardized assessments, or instructional effectiveness, leaving limited understanding of the meanings, motivations, challenges, and transformative experiences that shape students' scientific learning journeys.

Moreover, studies specifically examining the lived experiences of Junior High School students in developing life sciences competencies within the Philippine context remain scarce. Understanding students' experiences is essential because scientific competence develops not only through cognitive learning but also through meaningful interactions, authentic investigations, reflective learning, and contextualized educational experiences. Such insights may guide educators in designing learner-centered instructional strategies that promote deeper scientific understanding, lifelong learning, and environmental responsibility.

Recognizing these research gaps, the present study explored the lived experiences of Junior High School students at Guina-ang National High School in developing life sciences competencies through science education. By examining how learners acquire, apply, and internalize scientific knowledge within their educational and community contexts, the study seeks to contribute to the improvement of science instruction, curriculum development, competency-based education, and life sciences learning in Philippine secondary schools. Furthermore, the findings are expected to provide empirical evidence that may assist science teachers, school administrators, curriculum planners, and educational policymakers in strengthening instructional practices that cultivate scientifically literate, environmentally responsible, and globally competitive learners.

Research Gap

Although numerous studies have investigated science achievement, scientific literacy, inquiry-based instruction, and competency-based education, the majority have utilized quantitative methodologies that measure students' academic performance, conceptual understanding, or attitudes toward science. Comparatively little attention has been given to exploring how learners personally experience the development of life sciences competencies within authentic educational settings. Existing literature rarely examines the lived experiences of Junior High School students in rural and mountainous schools where contextual factors such as indigenous ecological knowledge, environmental interaction, and community experiences may shape science learning differently. Furthermore, limited qualitative research has explored how inquiry-based instruction, experiential learning, and contextualized science education contribute to the development of scientific literacy, critical thinking, and life sciences competencies among Filipino secondary school learners. Addressing these gaps, the present phenomenological study provides an in-depth understanding of students' lived experiences in developing life sciences competencies through science education at Guina-ang National High School, thereby contributing context-specific evidence for curriculum enhancement and learner-centered science instruction.

Theoretical Foundation

This study is anchored on Kolb's Experiential Learning Theory (1984), which posits that learning occurs through a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. The theory suggests that learners develop deeper scientific understanding when they actively engage in authentic investigations, laboratory activities, field experiences, and reflective learning. In the context of life sciences education, experiential learning enables students to construct scientific knowledge by directly interacting with biological phenomena and environmental systems.

The study is further grounded in Vygotsky's Social Constructivist Theory (1978), which emphasizes that learning is socially constructed through interaction, collaboration, and guided participation. Classroom discussions, collaborative experiments, inquiry-based activities, and teacher facilitation allow students to co-construct scientific knowledge while strengthening higher-order thinking skills. This perspective supports learner-centered science instruction that encourages active participation, dialogue, and problem-solving.

Additionally, the investigation is informed by the framework of Scientific Literacy advanced by the Organisation for Economic Co-operation and Development (OECD, 2023), which emphasizes learners' ability to explain scientific phenomena, evaluate scientific evidence, and apply scientific knowledge in addressing real-world issues related to health, environmental sustainability, and community development. Collectively, these theoretical perspectives explain how authentic learning experiences, social interaction, and competency-based instruction contribute to the development of life sciences competencies among Junior High School students.

Research Questions

This study sought to explore the lived experiences of Junior High School students at Guina-ang National High School in developing life sciences competencies through science education.

Specifically, the study sought to answer the following questions:

1. How do Junior High School students describe their lived experiences in developing life sciences competencies through science education?
2. What science learning experiences have contributed to the development of their life sciences competencies?
3. What challenges do students encounter in learning life sciences concepts and developing scientific competencies?
4. What coping strategies do students employ to overcome challenges encountered in science learning?
5. How may the findings be utilized in developing a Life Sciences Competency Development Framework for enhancing science education in Junior High School?

Review of Related Literature and Studies

Life Sciences Education and Competency Development

Life sciences education plays a vital role in preparing learners to understand the complexity of living systems, human health, biodiversity, environmental sustainability, and the interrelationships among organisms and ecosystems. As one of the core domains of science education, life sciences promote scientific literacy by enabling learners to investigate biological phenomena, analyze evidence, solve authentic problems, and apply scientific knowledge to everyday life. Contemporary educational reforms have shifted from content-based instruction toward competency-based education, emphasizing the development of higher-order thinking skills, inquiry competencies, collaboration, creativity, and environmental responsibility. Consequently, science education is no longer limited to transmitting factual knowledge but seeks to cultivate learners who can critically evaluate scientific information and make evidence-based decisions regarding health, environmental conservation, and sustainable development (OECD, 2025).

The Organisation for Economic Co-operation and Development (OECD) emphasizes that modern science education should develop learners' capacity to explain scientific phenomena, construct and evaluate scientific investigations, interpret scientific evidence critically, and use scientific information to support responsible decision-making (OECD, 2025). These competencies are increasingly recognized as essential for preparing students to address complex global challenges related to climate change, emerging diseases, biodiversity loss, food security, and environmental sustainability. Thus, life sciences education contributes not only to academic achievement but also to the development of scientifically literate citizens capable of participating in sustainable societal development.

Scientific Literacy in Science Education

Scientific literacy has become the central goal of science education worldwide because it equips learners with the competencies necessary to understand scientific concepts, interpret evidence, solve problems, and participate in informed public discussions regarding science and technology. Rather than focusing solely on conceptual knowledge, scientific literacy encompasses procedural knowledge, critical evaluation of evidence, communication, ethical reasoning, and responsible action.

Recent scholarship has expanded the concept of scientific literacy beyond individual competence to include community participation and collaborative scientific decision-making. Busch and Rajwade (2024) argued that scientific literacy should also be understood as a community capability wherein individuals collectively utilize scientific knowledge to solve local environmental, health, and societal problems. Their systematic review emphasized that scientific literacy develops through authentic contexts where learners actively engage with scientific issues affecting their communities.

Similarly, recent reviews indicate that instructional models emphasizing inquiry, collaboration, contextualization, and authentic scientific investigations significantly improve students' scientific literacy. Integrated science learning encourages learners to connect classroom concepts with everyday experiences, thereby strengthening conceptual understanding and long-term retention (Romli et al., 2024).

Inquiry-Based Learning in Science Education

Inquiry-based learning has become one of the most influential instructional approaches in contemporary science education because it encourages learners to investigate scientific questions, formulate explanations, analyze evidence, and construct knowledge through active exploration. Unlike traditional teacher-centered instruction, inquiry-based learning positions students as investigators who learn science by engaging in authentic scientific practices.

A systematic review by Strata et al. (2024), which synthesized findings from 142 empirical studies, concluded that inquiry-based science education consistently enhances conceptual understanding, procedural knowledge, scientific reasoning, and learners' confidence in conducting scientific investigations. The review further reported that inquiry-based instruction develops epistemic, procedural, conceptual, pedagogical, and affective dimensions of scientific competence, making it an effective strategy for competency-based science education.

Likewise, Muhamad Dah et al. (2024) reported that open inquiry significantly improves students' critical thinking, conceptual understanding, scientific reasoning, and problem-solving abilities when learners are actively involved in designing investigations, interpreting evidence, and communicating scientific explanations. Their systematic review emphasized that inquiry-based science instruction encourages learners to become active participants in knowledge construction rather than passive recipients of information.

Furthermore, a systematic review by Frontiers in Education found that inquiry-based science teaching promotes positive attitudes toward science while enhancing learners' curiosity, creativity, and collaborative problem-solving skills. The review highlighted that successful implementation requires well-prepared teachers capable of facilitating meaningful inquiry experiences through appropriate instructional guidance.

Experiential Learning and Life Sciences Competencies

Experiential learning has long been recognized as a cornerstone of effective science education because scientific knowledge is best acquired through direct observation, experimentation, reflection, and application. Kolb's Experiential Learning Theory explains that meaningful learning occurs through concrete experiences followed by reflective observation, conceptual understanding, and active experimentation.

Within life sciences education, experiential learning enables students to develop scientific competencies by engaging in laboratory investigations, environmental observations, fieldwork, biodiversity assessments, ecological studies, and community-based environmental activities. Such experiences allow learners to connect theoretical knowledge with authentic biological phenomena, thereby strengthening scientific understanding and long-term retention.

Recent reviews indicate that experiential and inquiry-based pedagogies encourage learners to develop scientific practices, including hypothesis formulation, evidence gathering, data interpretation, scientific communication, and collaborative problem-solving. These competencies extend beyond academic achievement by preparing learners to apply science in addressing environmental and societal issues.

Science Education and Twenty-First Century Skills

The demands of the twenty-first century require science education to develop competencies that extend beyond content knowledge. Contemporary educational frameworks emphasize critical thinking, creativity, collaboration, communication, digital literacy, scientific reasoning, and problem-solving as essential skills for lifelong learning and workforce readiness.

Scientific literacy contributes significantly to these competencies because learners must evaluate information from diverse sources, distinguish scientific evidence from misinformation, and apply scientific reasoning to real-world problems. The updated OECD Science Framework highlights that science education should prepare learners to research, evaluate, and utilize scientific information responsibly within increasingly complex digital environments.

Similarly, recent literature reviews indicate that integrating collaborative inquiry, project-based learning, and technology-enhanced instruction strengthens students' scientific literacy while promoting communication, innovation, and evidence-based reasoning (Romli et al., 2024).

Science Education in the Philippine Context

Science education remains a national priority in the Philippines because scientific competence is essential for national development, technological advancement, environmental sustainability, and global competitiveness. The Department of Education has strengthened competency-based science instruction through the K to 12 Curriculum, emphasizing inquiry, contextualization, scientific investigation, environmental awareness, and learner-centered pedagogy.

Within secondary education, Science is taught using a spiral progression approach that integrates biology, chemistry, physics, and earth science across grade levels. This curricular structure enables learners to revisit scientific concepts with increasing complexity while continuously developing scientific inquiry skills and life sciences competencies.

Despite these reforms, international assessments continue to indicate challenges in students' scientific literacy and conceptual understanding. These findings highlight the need for instructional innovations that promote deeper conceptual learning, authentic inquiry, contextualized science instruction, and meaningful learner engagement consistent with international frameworks for scientific literacy (OECD, 2025).

Science Learning in Rural and Indigenous Communities

Science education in rural and geographically isolated communities presents unique opportunities for contextualized learning because students directly interact with natural ecosystems, biodiversity, agricultural practices, and indigenous ecological knowledge. Such contexts provide authentic environments for developing life sciences competencies through observation, environmental investigation, and community participation.

Research increasingly emphasizes that contextualized science education improves learners' motivation, conceptual understanding, and appreciation of science because scientific concepts become relevant to students' everyday experiences. Community-based science learning likewise encourages environmental stewardship, cultural appreciation, and sustainable resource management while strengthening learners' scientific identities (Busch & Rajwade, 2024).

Synthesis of the Literature

The reviewed literature consistently demonstrates that developing life sciences competencies requires instructional approaches that extend beyond traditional content delivery. Inquiry-based learning, experiential education, contextualized instruction, collaborative learning, and scientific literacy development collectively enhance learners' conceptual understanding, scientific reasoning, and problem-solving abilities. International frameworks likewise emphasize that science education should prepare learners to apply scientific knowledge responsibly in addressing environmental, health, and societal challenges.

Although numerous studies have investigated scientific literacy, inquiry-based learning, and competency-based science instruction, most have employed quantitative methodologies that focus primarily on achievement, attitudes, or instructional effectiveness. Comparatively few studies have explored how Junior High School students personally experience the development of life sciences competencies through science education, particularly within rural public secondary schools in the Philippines. Moreover, limited phenomenological investigations have examined how contextualized learning, authentic scientific experiences, and inquiry-based instruction shape students' scientific identities, motivations, and competency development. These gaps justify the present study, which seeks to explore the lived experiences of Junior High School students at Guina-ang National High School in developing life sciences competencies through science education. The findings are expected to contribute meaningful insights for strengthening science instruction, enhancing competency-based curricula, and improving learner-centered educational practices in Philippine secondary schools.

Methodology

This study employed a descriptive phenomenological research design to explore the lived experiences of Junior High School students in developing life sciences competencies through science education at Guina-ang National High School, Guina-ang, Bontoc, Mountain Province. A descriptive phenomenological approach was deemed appropriate because it seeks to understand and describe the essence of participants' lived experiences regarding a particular phenomenon while setting aside the researcher's preconceived assumptions through the process of bracketing (Husserl, 1970; Moustakas, 1994). The design enabled the researcher to gain an in-depth understanding of how students acquire, develop, and apply life sciences competencies through classroom instruction, laboratory activities, inquiry-based learning, collaborative investigations, and contextualized science experiences. Unlike quantitative approaches that focus on measuring academic achievement or scientific literacy using standardized assessments, phenomenology emphasizes participants' personal meanings, perceptions, motivations, challenges, and reflections regarding their science learning experiences (Creswell & Poth, 2018).

The study was conducted at Guina-ang National High School, located in Guina-ang, Bontoc, Mountain Province, Philippines. The school serves Junior High School learners from Grades 7 to 10 and provides science education within a unique geographical and cultural environment characterized by mountainous ecosystems, rich biodiversity, agricultural landscapes, and indigenous ecological knowledge. These contextual features provide meaningful opportunities for learners to experience life sciences beyond classroom instruction through environmental observation, ecological investigations, school gardening, community-based learning, and contextualized science activities. The school's commitment to competency-based instruction and learner-centered pedagogy made it an appropriate locale for investigating students' lived experiences in developing life sciences competencies.

The participants consisted of fifteen (15) Junior High School students from Grades 7 to 10 who were purposively selected based on predetermined inclusion criteria. Purposive sampling is widely recommended in phenomenological research because it enables researchers to select participants who possess rich and meaningful experiences concerning the phenomenon under investigation (Patton, 2015). Participants were selected if they were currently enrolled at Guina-ang National High School, had completed or were currently taking Science subjects, actively participated in classroom discussions, laboratory activities, science investigations, or environmental projects, willingly consented to participate in the study, and demonstrated the ability to communicate their learning experiences clearly. Data collection continued until data saturation was achieved, indicating that no new themes or significant information emerged from subsequent interviews (Creswell & Poth, 2018).

The primary research instrument was a researcher-developed semi-structured interview guide designed to elicit comprehensive descriptions of students' lived experiences in developing life sciences competencies. The interview protocol was developed following an extensive review of literature on science education, scientific literacy, inquiry-based learning, experiential learning, and life sciences competency development. The interview questions focused on participants' science learning experiences, inquiry activities, laboratory investigations, contextualized learning, challenges encountered during science instruction, coping strategies, and perceptions regarding the relevance of life sciences in their daily lives. To ensure content validity, the interview guide was evaluated by three experts specializing in science education, qualitative research, and curriculum development. Their recommendations regarding clarity, relevance, sequencing, and comprehensiveness of the questions were incorporated before the conduct of the actual study. A pilot interview involving three Junior High School students from another public secondary school was likewise conducted to determine the appropriateness of the interview guide. These participants were excluded from the actual investigation.

Prior to data collection, approval was obtained from the school administration and the appropriate research ethics authority. The researcher explained the objectives of the study, research procedures, confidentiality measures, voluntary nature of participation, and participants' right to withdraw from the study at any stage without penalty. Written informed consent was obtained from the participants and, where applicable, from their parents or legal guardians in accordance with ethical standards governing research involving minors. Individual face-to-face semi-structured interviews were subsequently conducted in a quiet and comfortable location within the school premises. Each interview lasted approximately 45 to 60 minutes and was audio-recorded with participants' permission. Throughout the interviews, the researcher maintained field notes documenting participants' non-verbal behaviors, emotional expressions, contextual observations, and reflective insights that complemented the recorded narratives. Following each interview, the audio recordings were transcribed verbatim to preserve the authenticity of participants' responses. Participants were subsequently invited to review their interview transcripts through member checking to verify the accuracy and completeness of the transcribed data.

Data analysis followed Colaizzi's Seven-Step Phenomenological Method (Colaizzi, 1978), a systematic analytical procedure commonly employed in descriptive phenomenological studies. Initially, all interview transcripts were read repeatedly to obtain a comprehensive understanding of the participants' experiences. Significant statements directly related to the development of life sciences competencies were then extracted from the transcripts. The researcher formulated meanings from these significant statements while maintaining fidelity to the participants' intended meanings. Similar meanings were grouped into clusters that formed emergent themes representing the shared essence of the participants' experiences. These thematic clusters were integrated into an exhaustive description of the phenomenon, from which the fundamental structure of students' lived experiences was developed. Finally, the synthesized findings were returned to the participants for validation to ensure that the themes accurately reflected their experiences. To facilitate systematic coding, organization, retrieval, and thematic analysis of qualitative data, NVivo qualitative data analysis software was utilized throughout the analytical process.

The trustworthiness of the study was established following the criteria proposed by Lincoln and Guba (1985), namely credibility, transferability, dependability, and confirmability. Credibility was achieved through prolonged engagement with participants, member checking, peer debriefing, and triangulation of interview transcripts and field notes. Transferability was enhanced by providing rich and detailed descriptions of the research setting, participants, and research procedures, allowing readers to determine the applicability of the findings to similar educational contexts. Dependability was ensured through the maintenance of a comprehensive audit trail documenting every stage of the research process, including participant selection, interview procedures, coding decisions, theme development, and interpretation of findings. Confirmability was strengthened through reflexive journaling, bracketing, audit trails, and continuous self-reflection to minimize researcher bias and ensure that the findings emerged directly from participants' narratives rather than the researcher's assumptions.

Ethical principles were strictly observed throughout the conduct of the study. Ethical clearance was secured prior to data collection, and participation remained entirely voluntary. Participants and their parents or guardians received complete information regarding the study before signing informed consent and assent forms. Confidentiality and anonymity were protected through the use of pseudonyms, while all interview recordings, transcripts, and research documents were stored in password-protected electronic files accessible only to the researcher. Participants were assured that all collected information would be used solely for academic and research purposes and that no personally identifiable information would appear in the published report. The study further adhered to the ethical principles of respect for persons, beneficence, non-maleficence, justice, privacy, and confidentiality, in accordance with the Data Privacy Act of 2012 (Republic Act No. 10173) and internationally accepted ethical standards for qualitative research involving human participants.

Results and Discussion

The phenomenological analysis of the interview transcripts revealed five essential themes that describe the lived experiences of Junior High School students at Guina-ang National High School in developing life sciences competencies through science education. These themes reflect the students' learning journeys from developing curiosity in science to applying life sciences concepts in their daily lives and envisioning future careers in science-related fields.

Theme 1: Cultivating Scientific Curiosity Through Experiential Learning

The participants consistently described science learning as an engaging process that stimulated their curiosity about living organisms, ecological systems, and natural phenomena. They emphasized that laboratory experiments, classroom demonstrations, outdoor investigations, school gardening, and environmental observations enabled them to appreciate biological concepts beyond textbook discussions. Through these experiential activities, learners became more interested in asking scientific questions, observing natural processes, and exploring relationships among organisms and their environments. Many participants explained that direct interaction with nature made science more meaningful and understandable, particularly because their community is surrounded by mountains, forests, rivers, and agricultural landscapes that provide authentic learning opportunities.

One participant shared:

"Science became more interesting when we observed plants and insects outside the classroom. I understood their characteristics better because I saw them personally." (Participant 3)

Another participant explained:

"Our laboratory activities helped me understand biological concepts more easily than simply reading them from books." (Participant 9)

Similarly, another participant stated:

"Living in the mountains allows us to experience nature every day. Our Science lessons become easier because we can relate them to our surroundings." (Participant 14)

These narratives illustrate that experiential learning strengthened students' scientific curiosity by connecting theoretical concepts with authentic environmental experiences. Rather than viewing science as abstract knowledge, participants perceived it as a meaningful explanation of the natural world surrounding them.

The findings strongly support Kolb's Experiential Learning Theory (1984), which posits that meaningful learning develops through concrete experiences followed by reflection, conceptualization, and application. Students' direct engagement in laboratory activities and environmental observations enabled them to internalize biological concepts while strengthening their scientific understanding. The findings likewise corroborate the work of Strata et al. (2024), who concluded that inquiry-based and experiential science instruction significantly enhances learners' scientific competence, curiosity, and conceptual understanding.

Theme 2: Developing Scientific Literacy and Critical Thinking

Participants revealed that science education enhanced their ability to think critically, analyze evidence, solve problems, and make informed decisions regarding health, the environment, and everyday life. They described learning experiences that encouraged them to investigate scientific questions, interpret experimental results, compare observations, and justify conclusions using scientific evidence. These inquiry-based activities enabled them to become more analytical and objective when examining issues related to biology and environmental sustainability.

One participant remarked:

"*Science taught me not to believe everything immediately. I learned to investigate first and look for evidence before making conclusions."* (Participant 5)

Another participant shared:

"*When we conduct experiments, we have to analyze the results carefully. It helped me improve my problem-solving skills."* (Participant 10)

Another participant reflected:

"Science helped me understand why certain things happen in nature instead of simply memorizing facts." (Participant 7)

These findings demonstrate that science education promoted scientific literacy by encouraging learners to apply critical thinking and evidence-based reasoning when interpreting biological phenomena. Rather than emphasizing memorization, science instruction developed learners' analytical abilities and strengthened their confidence in making informed decisions.

The findings support the OECD Science Framework (2025), which identifies scientific literacy as learners' capacity to explain scientific phenomena, evaluate scientific investigations, and interpret scientific evidence for responsible decision-making. Likewise, Busch and Rajwade (2024) emphasized that scientific literacy extends beyond conceptual understanding toward developing learners capable of addressing societal and environmental challenges through evidence-based reasoning.

Theme 3: Applying Life Sciences Knowledge to Everyday Living

The participants consistently explained that science learning became meaningful because they were able to apply life sciences concepts in their everyday lives. They discussed using scientific knowledge to maintain personal hygiene, prevent diseases, improve nutrition, conserve natural resources, protect biodiversity, and promote environmental sustainability. Many participants indicated that science education enabled them to appreciate the practical value of biology in improving individual health and community well-being.

One participant shared:

"I became more conscious about proper nutrition because of our Biology lessons. I now understand why eating healthy foods is important." (Participant 1)

Another participant explained:

"Our Science lessons helped me understand why proper waste disposal is important in protecting the environment." (Participant 12)

Similarly, another participant stated:

"Learning about ecosystems taught me to appreciate plants and animals more. I now avoid harming wildlife because I know every organism has an important role." (Participant 6)

These narratives indicate that life sciences education extended beyond academic learning by influencing students' daily behaviors and environmental practices. Participants recognized science as an essential guide for promoting healthy lifestyles, environmental responsibility, and sustainable community living.

These findings support UNESCO's (2021) assertion that science education contributes significantly to sustainable development by enabling learners to apply scientific knowledge in improving health, conserving biodiversity, and protecting ecosystems. Likewise, the findings align with the goals of the Philippine K to 12 Science Curriculum, which emphasizes the application of scientific knowledge to real-life situations (DepEd, 2016).

Theme 4: Overcoming Learning Challenges Through Collaboration and Persistence

Although participants appreciated science education, they acknowledged experiencing difficulties in understanding complex biological concepts, scientific terminologies, laboratory procedures, and abstract scientific processes. Several participants also mentioned limited laboratory equipment, insufficient instructional resources, and occasional difficulty in conducting experiments due to resource constraints. Despite these challenges, students demonstrated resilience by seeking assistance from teachers, collaborating with classmates, reviewing lessons independently, and utilizing digital learning resources.

One participant explained:

"*Some Biology topics are difficult because there are many scientific terms to remember."* (Participant 4)

Another participant stated:

"When I don't understand a lesson, I ask my classmates and teacher until I fully understand it." (Participant 13)

A third participant remarked:

"Even if laboratory materials are sometimes limited, our teacher finds alternative ways to demonstrate the experiments." (Participant 11)

These narratives reveal that collaborative learning, teacher support, and perseverance enabled students to overcome learning challenges while strengthening their scientific competencies. Rather than discouraging learners, these difficulties motivated them to become more resourceful and persistent in understanding science.

The findings reinforce Vygotsky's Social Constructivist Theory (1978), which explains that learning occurs through social interaction, collaboration, and guided participation. Students developed scientific understanding through meaningful interactions with teachers and peers, demonstrating the importance of collaborative inquiry in science education.

Similarly, Muhamad Dah et al. (2024) reported that inquiry-based science instruction supported by effective teacher facilitation significantly improves learners' conceptual understanding and problem-solving skills, even in resource-constrained educational settings.

Theme 5: Envisioning Future Careers Through Life Sciences Competencies

One of the most transformative findings of the study was the participants' recognition that science education inspired them to pursue future careers related to health sciences, environmental conservation, agriculture, education, and scientific research. Students expressed that their learning experiences increased their appreciation of scientific professions and motivated them to contribute positively to society through science-related careers.

One participant stated:

"Because of Biology, I want to become a nurse so I can help people improve their health." (Participant 8)

Another participant explained:

"I became interested in environmental science because I want to protect our forests and rivers." (Participant 2)

Similarly, another participant reflected:

"Science inspired me to become a teacher so I can help future students appreciate life sciences just like our teacher did." (Participant 15)

These findings demonstrate that science education influenced not only students' academic competencies but also their future aspirations and professional identities. Their experiences encouraged them to envision themselves as future professionals capable of contributing to healthcare, environmental sustainability, scientific innovation, and education.

The findings support UNESCO (2021), which recognizes science education as a critical pathway for developing future scientists, educators, healthcare professionals, and environmentally responsible citizens. Likewise, the OECD (2025) emphasizes that scientific literacy equips learners with competencies essential for lifelong learning, workforce participation, and responsible citizenship.

Summary of Findings

The phenomenological analysis generated five interconnected themes describing the lived experiences of Junior High School students at Guina-ang National High School in developing life sciences competencies through science education:

1. Cultivating Scientific Curiosity Through Experiential Learning
2. Developing Scientific Literacy and Critical Thinking
3. Applying Life Sciences Knowledge to Everyday Living
4. Overcoming Learning Challenges Through Collaboration and Persistence
5. Envisioning Future Careers Through Life Sciences Competencies

Collectively, these themes reveal that the development of life sciences competencies is a transformative process shaped by experiential learning, inquiry-based instruction, collaborative learning, contextualized science experiences, and meaningful teacher support. The findings further demonstrate that science education extends beyond academic achievement by promoting scientific literacy, environmental responsibility, healthy lifestyles, and career aspirations among Junior High School learners. Through these lived experiences, students developed not only scientific knowledge but also the values, skills, and attitudes necessary to become scientifically literate and socially responsible individuals capable of contributing to sustainable community development.

Discussion

This phenomenological study explored the lived experiences of Junior High School students at Guina-ang National High School in developing life sciences competencies through science education. The findings demonstrate that life sciences competency development is a multidimensional process influenced by authentic learning experiences, inquiry-based instruction, collaborative learning, contextualized science education, and meaningful teacher facilitation. Students described science learning as a transformative journey that enabled them to move beyond acquiring scientific knowledge toward applying biological concepts in their everyday lives, strengthening environmental stewardship, improving critical thinking, and developing aspirations for science-related careers.

The first theme, Cultivating Scientific Curiosity Through Experiential Learning, highlights the importance of providing authentic learning opportunities that allow students to directly interact with biological systems and environmental phenomena. Participants emphasized that laboratory experiments, ecological observations, school gardening, and outdoor investigations stimulated their curiosity and deepened their understanding of life sciences concepts. These findings affirm Kolb's Experiential Learning Theory (1984), which posits that meaningful learning occurs when learners actively engage in concrete experiences followed by reflection and application. The findings are likewise consistent with Strata et al. (2024), who concluded that inquiry-based and experiential science instruction significantly improves conceptual understanding, scientific reasoning, and learner engagement.

The second theme, Developing Scientific Literacy and Critical Thinking, demonstrates that science education extends beyond factual knowledge by developing students' ability to evaluate evidence, interpret scientific information, and solve authentic problems. Participants described becoming more analytical when examining biological processes and environmental issues, suggesting that science education promotes informed decision-making and responsible citizenship. These findings align with the OECD Science Framework (2025), which identifies scientific literacy as learners' ability to explain scientific phenomena, evaluate scientific investigations, and utilize scientific evidence in addressing societal challenges. Furthermore, Busch and Rajwade (2024) emphasized that scientific literacy should empower learners to participate actively in solving community and environmental concerns.

The third theme, Applying Life Sciences Knowledge to Everyday Living, illustrates that science education becomes meaningful when students recognize its relevance to their daily experiences. Participants described applying biological concepts in maintaining personal health, conserving biodiversity, practicing environmental protection, and promoting sustainable lifestyles. These findings reinforce UNESCO's (2021) assertion that science education contributes significantly to achieving the Sustainable Development Goals by cultivating environmentally responsible and scientifically literate citizens capable of addressing global and local challenges. The contextualized learning experiences available at Guina-ang National High School further strengthened students' appreciation of science because they were able to connect classroom concepts with their immediate environment.

The fourth theme, Overcoming Learning Challenges Through Collaboration and Persistence, reveals that although students encountered difficulties related to complex scientific concepts, technical terminologies, laboratory limitations, and abstract biological processes, they demonstrated resilience by collaborating with classmates, seeking teacher support, and engaging in independent learning. These findings support Vygotsky's Social Constructivist Theory (1978), which explains that knowledge develops through social interaction, collaborative inquiry, and guided learning. The participants' narratives indicate that effective teacher facilitation and collaborative learning environments play essential roles in strengthening life sciences competencies despite existing instructional constraints.

The fifth theme, Envisioning Future Careers Through Life Sciences Competencies, reflects the transformative influence of science education on students' career aspirations and personal development. Participants reported becoming interested in careers related to medicine, nursing, environmental science, agriculture, education, and scientific research because of their positive science learning experiences. This finding demonstrates that competency-based science education not only develops academic knowledge but also inspires learners to pursue professions that contribute to national development, public health, environmental conservation, and scientific innovation. These findings support UNESCO's (2021) position that quality science education prepares learners to become future scientists, educators, healthcare professionals, and environmental stewards capable of addressing emerging global challenges.

Collectively, the findings suggest that developing life sciences competencies requires an educational environment where learners actively participate in authentic scientific inquiry, collaborate with peers, receive continuous teacher guidance, and engage in contextualized learning experiences. Such environments promote not only scientific literacy but also lifelong learning, responsible citizenship, and sustainable community development.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed to strengthen the development of life sciences competencies among Junior High School students:

For Science Teachers

Science teachers should continue implementing inquiry-based, experiential, and learner-centered instructional strategies that actively engage students in scientific investigations, laboratory experiments, field observations, and collaborative learning activities. Lessons should be contextualized using locally available biological resources, indigenous ecological knowledge, and environmental issues relevant to the learners' community. Teachers are likewise encouraged to integrate digital technologies, simulations, and project-based learning to enrich students' understanding of life sciences concepts and promote scientific inquiry.

For School Administrators

School administrators should strengthen science education by improving laboratory facilities, providing adequate instructional materials, expanding access to digital learning resources, and supporting teachers' participation in professional development programs focusing on inquiry-based science teaching, competency-based assessment, and innovative pedagogical practices. Partnerships with local government units, higher education institutions, environmental organizations, and health agencies may further enrich science learning experiences through extension activities and community-based projects.

For Curriculum Developers

Curriculum developers should continuously enhance the Science curriculum by integrating authentic environmental issues, biodiversity conservation, climate resilience, sustainable agriculture, public health, and indigenous ecological knowledge into life sciences instruction. Learning competencies should emphasize scientific literacy, critical thinking, environmental stewardship, ethical decision-making, and real-world application of biological concepts consistent with competency-based education and the Sustainable Development Goals.

For Teacher Education Institutions

Higher education institutions preparing future science teachers should strengthen pre-service teacher education by emphasizing experiential learning, scientific inquiry, contextualized instruction, environmental education, and qualitative research competencies. Teacher education programs should provide opportunities for pre-service teachers to design authentic science investigations and engage in community-based environmental initiatives that promote life sciences competency development.

For Educational Policymakers

The Department of Education and other educational policymakers should continue investing in science education by expanding laboratory infrastructure, providing instructional technologies, strengthening teacher capability-building programs, and supporting school-community partnerships that promote environmental sustainability and scientific literacy. Policies encouraging contextualized and competency-based science instruction should likewise be reinforced to improve the quality of science education in geographically isolated and disadvantaged areas.

For Students

Students are encouraged to actively participate in laboratory investigations, science fairs, environmental projects, research activities, school gardening, and community-based ecological programs. Engaging in authentic scientific experiences can further strengthen their scientific literacy, critical thinking, environmental responsibility, and appreciation of life sciences as essential components of lifelong learning.

Limitations of the Study

Several limitations should be considered when interpreting the findings of this investigation.

First, the study was limited to fifteen (15) Junior High School students from Guina-ang National High School. Consequently, the findings reflect the lived experiences of participants within a specific educational and geographical context and may not be generalized to all secondary school learners in the Philippines.

Second, the study employed a descriptive phenomenological research design, which prioritizes understanding participants' lived experiences rather than measuring causal relationships or determining the effectiveness of instructional interventions. The findings therefore provide rich descriptions of the phenomenon but do not establish statistical relationships among variables.

Third, the data relied primarily on participants' self-reported narratives gathered through semi-structured interviews. Although member checking, peer debriefing, and audit trails were employed to enhance trustworthiness, participants' recollections and interpretations may have been influenced by personal experiences and individual perspectives.

Finally, the investigation focused exclusively on students' perspectives. The experiences of science teachers, school administrators, parents, and community stakeholders were beyond the scope of this study but may provide additional insights into life sciences competency development.

Directions for Future Research

Future studies may expand the present investigation in several ways.

Researchers may conduct multi-site phenomenological studies involving several secondary schools across different provinces to compare students' lived experiences in developing life sciences competencies within diverse educational contexts.

Future investigations may also employ mixed-methods or sequential explanatory research designs to examine the relationship between students' lived experiences and measurable indicators such as scientific literacy, science achievement, environmental attitudes, or inquiry skills.

Comparative studies involving urban and rural schools may further determine how contextual factors influence competency development in life sciences education.

Researchers are likewise encouraged to investigate the perspectives of science teachers, school administrators, parents, and community partners to obtain a more comprehensive understanding of competency-based science education.

Additional research may explore the effectiveness of innovative instructional approaches such as problem-based learning, project-based learning, STEM integration, digital laboratories, virtual simulations, artificial intelligence-assisted instruction, citizen science projects, and environmental service-learning in strengthening life sciences competencies.

Longitudinal studies may also examine how life sciences competencies developed during Junior High School influence students' academic achievement, career choices, environmental behaviors, and lifelong scientific literacy.

Practical Implications

The findings of this study provide practical implications for improving science education at both the classroom and institutional levels.

The study demonstrates that competency development in life sciences is most effective when science instruction integrates experiential learning, inquiry-based pedagogy, contextualized instruction, collaborative learning, and authentic environmental experiences. These approaches encourage learners to become active participants in scientific investigations rather than passive recipients of information.

The findings further emphasize that rural schools possess valuable environmental resources that can be transformed into meaningful learning laboratories. Local ecosystems, biodiversity, agricultural practices, and indigenous ecological knowledge provide authentic contexts for strengthening students' understanding of biological concepts while promoting environmental stewardship.

Moreover, the proposed Life Sciences Competency Development Framework (LSCDF) may serve as a practical guide for teachers, curriculum planners, school leaders, and policymakers in designing competency-based instructional programs that develop scientifically literate learners capable of addressing environmental, health, agricultural, and societal challenges.

Ultimately, strengthening life sciences competencies contributes to achieving the goals of quality education, sustainable development, biodiversity conservation, climate resilience, public health promotion and scientific innovation, thereby preparing future generations to become responsible citizens who actively contribute to national and global development.

References

Busch, K. C., & Rajwade, A. (2024). Community scientific literacy: A systematic review of the literature. Science Education, 108(5), 1208–1234. https://doi.org/10.1002/sce.21871

Colaizzi, P. F. (1978). Psychological research as the phenomenologist views it. In R. Valle & M. King (Eds.), Existential-Phenomenological Alternatives for Psychology (pp. 48–71). Oxford University Press.

Colaizzi, P. F. (1978). Psychological research as the phenomenologist views it. In R. Valle & M. King (Eds.), Existential-Phenomenological Alternatives for Psychology (pp. 48–71). Oxford University Press.

Creswell, J. W., & Poth, C. N. (2018). Qualitative Inquiry and Research Design: Choosing Among Five Approaches (4th ed.). SAGE Publications.

Creswell, J. W., & Poth, C. N. (2018). Qualitative Inquiry and Research Design: Choosing Among Five Approaches (4th ed.). SAGE Publications.

Department of Education. (2016). K to 12 Curriculum Guide: Science (Grades 3–10). Department of Education, Philippines.

Giorgi, A. (2009). The Descriptive Phenomenological Method in Psychology: A Modified Husserlian Approach. Duquesne University Press.

Giorgi, A. (2009). The Descriptive Phenomenological Method in Psychology: A Modified Husserlian Approach. Duquesne University Press.

Husserl, E. (1970). The Crisis of European Sciences and Transcendental Phenomenology (D. Carr, Trans.). Northwestern University Press. (Original work published 1936)

Kolb, D. A. (1984). Experiential Learning: Experience as the Source of Learning and Development. Prentice Hall.

Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic Inquiry. SAGE Publications.

Moustakas, C. (1994). Phenomenological Research Methods. SAGE Publications.

Muhamad Dah, N., Rahman, N. A., Abdullah, A. H., & Ismail, N. (2024). Open inquiry in science education: A systematic review of students' conceptual understanding and scientific reasoning. Studies in Educational Evaluation, 80, 101348.

OECD. (2025). PISA 2025 Science Framework. Organisation for Economic Co-operation and Development. https://pisa-framework.oecd.org/science-2025/

Patton, M. Q. (2015). Qualitative Research & Evaluation Methods (4th ed.). SAGE Publications.

Patton, M. Q. (2015). Qualitative Research & Evaluation Methods (4th ed.). SAGE Publications.

Republic of the Philippines. (2012). Republic Act No. 10173: Data Privacy Act of 2012. Official Gazette of the Republic of the Philippines.

Republic of the Philippines. (2012). Republic Act No. 10173: Data Privacy Act of 2012.

Romli, M., Sari, D. P., & Hidayat, R. (2024). Integrated science learning and scientific literacy: A systematic literature review. International Journal of Science and Mathematics Education, 22(3), 567–589.

Strata, F., Talanquer, V., & Colleagues. (2024). Inquiry-based science education: A systematic review of empirical evidence. Studies in Science Education, 60(1), 1–43.

UNESCO. (2021). Reimagining Our Futures Together: A New Social Contract for Education. United Nations Educational, Scientific and Cultural Organization.

Vygotsky, L. S. (1978). Mind in Society: The Development of Higher Psychological Processes. Harvard University Press.