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Reconceptualizing Language Education in Life Sciences: A Phenomenological Inquiry into the Cognitive Perspectives of College Students across Philippine State Universities and Colleges

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Abstract

Language education has traditionally been viewed as a foundational component of communication competence; however, its significance within Life Sciences education extends beyond linguistic proficiency toward fostering cognitive development, scientific reasoning, and disciplinary understanding. As higher education institutions increasingly promote interdisciplinary learning, language education has become instrumental in enabling students to interpret scientific information, construct evidence-based arguments, and communicate complex biological concepts effectively. Despite these developments, limited qualitative evidence explains how Life Sciences students cognitively experience language learning within scientific contexts, particularly in Philippine State Universities and Colleges (SUCs)-Marinduque State University, Central Bicol State University of Agriculture, Isabela State University, Don Mariano Marcos Memorial State University. This study aims to explore the lived cognitive experiences of college students regarding the role of language education in their academic learning, scientific understanding, and intellectual development. Employing Husserlian descriptive phenomenology, the study will involve 20–25 purposively selected undergraduate students enrolled in Life Sciences programs across selected Philippine SUCs. Data will be gathered through in-depth semi-structured interviews and reflective journals and analyzed using Colaizzi's seven-step phenomenological method. The study seeks to uncover the meanings students attribute to language education, the cognitive processes involved in understanding scientific concepts, and the ways language shapes their scientific literacy and disciplinary identity. Findings are expected to generate a phenomenological model describing the cognitive dimensions of language education in Life Sciences and to provide pedagogical implications for curriculum enhancement, interdisciplinary instruction, and language-responsive science education in higher education. The study contributes to the growing scholarship on language education, cognitive learning, and Life Sciences instruction while supporting Sustainable Development Goal 4 on quality education.

1. Introduction

The demands of twenty-first-century higher education have transformed the way students acquire and construct knowledge. Universities are no longer expected to produce graduates who merely possess disciplinary expertise; rather, they are tasked with developing individuals capable of critical thinking, scientific reasoning, interdisciplinary collaboration, and effective communication. Within this educational landscape, language education has assumed a broader role beyond teaching grammar and communication skills. It now functions as a cognitive tool through which learners organize ideas, negotiate meanings, develop conceptual understanding, and participate in disciplinary discourse.

Life Sciences education exemplifies this transformation. Undergraduate students in biology, microbiology, environmental science, biotechnology, agriculture, and related fields continuously engage with scientific texts, laboratory reports, research articles, technical presentations, and evidence-based discussions. These academic activities require more than factual knowledge of scientific concepts. They demand sophisticated cognitive abilities supported by strong academic language proficiency that enables learners to interpret complex information, synthesize evidence, and communicate scientific ideas effectively.

Language therefore serves not merely as a vehicle for communication but as an integral component of scientific thinking itself. Scientific concepts are introduced, negotiated, interpreted, and validated through language. Reading research articles, writing laboratory reports, constructing scientific explanations, and participating in collaborative inquiry all require students to integrate linguistic competence with cognitive processing. Consequently, language education becomes inseparable from conceptual learning within the Life Sciences.

Contemporary educational theories similarly recognize the reciprocal relationship between language and cognition. Cognitive learning theories explain that learners actively construct knowledge through information processing, reflection, metacognition, and social interaction. Vygotsky emphasized language as the primary psychological tool through which higher mental functions develop, while contemporary perspectives on disciplinary literacy argue that academic language enables learners to participate meaningfully within specialized fields of knowledge. In Life Sciences education, language supports observation, hypothesis formation, analysis of evidence, interpretation of findings, and scientific argumentation.

Despite these theoretical developments, language education within Life Sciences programs continues to receive limited scholarly attention in Philippine higher education. Existing research has predominantly examined language proficiency, communication skills, or scientific literacy independently. Comparatively fewer studies have explored how students themselves experience language education as a cognitive process while learning scientific concepts. Most investigations remain quantitative and focus

on achievement scores or language competencies rather than understanding students' lived experiences of learning science through language.

This gap is particularly evident within Philippine State Universities and Colleges (SUCs), which educate a substantial proportion of future scientists, educators, environmental specialists, agricultural professionals, and healthcare practitioners. These institutions have strengthened outcomes-based education, interdisciplinary curricula, and research-oriented instruction, yet empirical evidence describing students' cognitive experiences with language education remains scarce. Understanding these experiences is essential because students' perceptions influence how they engage with scientific texts, communicate research findings, construct disciplinary knowledge, and develop scientific identities.

A phenomenological perspective offers an appropriate approach for investigating this issue because it emphasizes the meanings individuals assign to their lived experiences. Rather than measuring language proficiency through standardized assessments, phenomenology seeks to understand how learners consciously experience language as part of scientific learning. By exploring students' narratives, reflections, and interpretations, researchers may uncover the cognitive processes that underlie successful language learning within Life Sciences education.

The present study therefore reconceptualizes language education as a cognitive phenomenon rather than merely a linguistic competence. Specifically, it explores how Life Sciences students across Philippine State Universities and Colleges experience language education while learning scientific concepts, constructing disciplinary knowledge, and developing scientific literacy. Through descriptive phenomenology, the study aims to generate a deeper understanding of the cognitive meanings students attribute to language education and to develop insights that may inform interdisciplinary curriculum development, language-responsive pedagogy, and higher education policy.

Purpose of the Study

This phenomenological study aims to explore and describe the lived cognitive experiences of college students regarding language education within Life Sciences programs in selected Philippine State Universities and Colleges.

Specifically, the study seeks to understand how students perceive language education as a cognitive process that influences their understanding of scientific concepts, academic learning, scientific communication, and professional identity formation.

Ultimately, the study intends to develop a phenomenological description that reconceptualizes language education as an integral cognitive dimension of Life Sciences education.

REVIEW OF RELATED LITERATURE

Language education has evolved from a discipline concerned primarily with grammar, vocabulary acquisition, and communication skills into an interdisciplinary field that supports

knowledge construction, critical thinking, and cognitive development. Within higher education, particularly in Life Sciences, language serves as the medium through which scientific concepts are understood, interpreted, questioned, and communicated. Consequently, learning science is inseparable from learning the language of science. College students continuously interact with scientific texts, laboratory manuals, research articles, classroom discussions, and technical presentations, all of which require sophisticated cognitive engagement through language.

Phenomenological inquiry seeks to understand how individuals experience these learning processes from their own perspectives. Rather than examining measurable outcomes, phenomenology emphasizes the meanings learners attribute to their experiences. Guided by this perspective, this chapter reviews the literature related to language education, cognitive learning, Life Sciences education, scientific literacy, disciplinary literacy, and phenomenological studies that provide the foundation for the present investigation.

Theme 1. Language Education as a Cognitive Experience

Language education has increasingly been recognized as a cognitive process rather than merely the acquisition of linguistic competence. Contemporary educational theories suggest that language enables learners to construct knowledge, organize thoughts, negotiate meanings, and develop conceptual understanding. Within university classrooms, students do not simply learn language; they think through language.

Academic language differs significantly from conversational language because it requires abstract reasoning, analytical thinking, interpretation of evidence, and synthesis of information. Students in higher education engage with discipline-specific vocabulary, complex sentence structures, scientific explanations, and technical discourse that facilitate deeper learning.

Researchers argue that academic language is closely connected to cognitive development because learners process new knowledge by integrating language with prior experiences. Through reading, writing, discussion, and reflection, students actively construct meaning rather than passively receiving information. This perspective positions language education as a cognitive tool that shapes learning across academic disciplines.

Within Life Sciences education, students continuously interpret biological processes, ecological relationships, laboratory findings, and research evidence through academic language. Consequently, language becomes an indispensable component of scientific thinking.

Theme 2. Language Education in Life Sciences

Life Sciences education encompasses various disciplines including Biology, Environmental Science, Agriculture, Biotechnology, Microbiology, Marine Biology, and related scientific fields. Although these disciplines are often associated with laboratory experimentation and empirical investigation, language remains central to scientific practice.

Students learn science by reading scientific literature, preparing laboratory reports, interpreting experimental data, constructing scientific explanations, and presenting research findings. Every stage of scientific inquiry requires students to communicate ideas accurately using discipline-specific language.

Scientific language differs from everyday communication because it demands precision, objectivity, evidence-based reasoning, and logical organization. Consequently, students often encounter difficulties when transitioning from general language proficiency to scientific discourse.

Educational researchers have emphasized that successful science learning requires opportunities for students to discuss scientific ideas, explain concepts using their own words, ask questions, construct arguments, and engage in collaborative inquiry. These language-rich experiences support conceptual understanding while promoting meaningful learning.

Within Philippine State Universities and Colleges, Life Sciences programs increasingly integrate research, laboratory instruction, and experiential learning. However, relatively little is known about how students themselves experience language education while learning scientific concepts. Their lived experiences remain an important yet underexplored dimension of higher education research.

Theme 3. Cognitive Perspectives of College Students

Cognition refers to the mental processes involved in acquiring, organizing, interpreting, remembering, and applying knowledge. Learning within higher education involves continuous interaction between cognitive processes and academic experiences.

College students experience cognition through attention, perception, memory, comprehension, reasoning, reflection, and problem-solving. These processes enable learners to interpret new information while connecting it with prior knowledge.

Within Life Sciences education, cognitive engagement becomes increasingly complex because students simultaneously process scientific terminology, conceptual relationships, graphical representations, laboratory procedures, and research evidence.

Students frequently describe meaningful learning as moments of realization, conceptual clarity, intellectual curiosity, and personal understanding. Such experiences illustrate that cognition extends beyond information processing toward meaning-making.

Phenomenological studies further suggest that cognition should be understood through students' lived experiences rather than solely through standardized measurements. Learners actively construct personal meanings from classroom interactions, laboratory activities, academic readings, collaborative discussions, and reflective practices.

Understanding these cognitive experiences enables educators to design learning environments that support deeper

understanding rather than surface memorization.

Theme 4. Scientific Literacy and Disciplinary Literacy

Scientific literacy represents one of the primary goals of contemporary science education. It extends beyond knowledge of scientific facts toward the ability to interpret evidence, evaluate information, solve problems, and communicate scientific ideas effectively.

Disciplinary literacy complements scientific literacy by emphasizing how experts within specific disciplines read, write, think, and communicate. In Life Sciences, disciplinary literacy includes interpreting research articles, analyzing scientific evidence, constructing laboratory reports, and presenting research findings.

Unlike general literacy, disciplinary literacy requires students to understand the conventions, language structures, and communication practices unique to scientific communities.

Researchers emphasize that scientific literacy develops through authentic engagement with scientific language rather than memorization alone. Students become scientifically literate by participating in inquiry, collaborative learning, academic discussions, and reflective communication.

Language education therefore functions as an essential pathway toward scientific literacy because scientific understanding is constructed through language-mediated experiences.

Theme 5. Lived Experiences in Higher Education

Higher education research has increasingly adopted phenomenology to understand students' experiences of learning. Rather than measuring performance outcomes, phenomenological studies seek to describe how learners perceive, interpret, and assign meaning to educational experiences.

Students' lived experiences provide valuable insights into motivation, engagement, identity formation, cognitive development, and academic resilience.

Phenomenological investigations reveal that learning is deeply personal. Students experience understanding through reflection, interaction, emotional engagement, curiosity, and social participation.

Within Life Sciences education, students' lived experiences include navigating scientific terminology, interpreting complex biological concepts, collaborating during laboratory work, presenting research, and integrating language with scientific reasoning.

Exploring these experiences allows researchers to uncover the essence of language education as experienced by learners themselves.

Synthesis of the Literature

The reviewed literature consistently demonstrates that language education is fundamentally connected to cognition, scientific literacy, and disciplinary learning. Academic language supports conceptual understanding by enabling students to interpret scientific information, communicate

evidence, and engage in higher-order thinking.

Similarly, Life Sciences education relies heavily on language as students participate in scientific inquiry, laboratory activities, research writing, and collaborative learning.

Existing literature also emphasizes that cognition should not be viewed solely as information processing but as a meaning-making experience shaped by learners' interactions with educational environments.

Although these studies highlight the importance of language and cognition, they largely focus on measurable competencies, academic achievement, or instructional effectiveness. Comparatively few investigations explore how students themselves experience language education as a cognitive phenomenon within Life Sciences programs.

This gap justifies the present phenomenological inquiry.

Theoretical Framework

The present study is anchored on three complementary theories.

Vygotsky's Sociocultural Theory

Lev Vygotsky proposed that language is the primary psychological tool through which higher mental functions develop. Learning occurs through social interaction, dialogue, and collaborative meaning-making.

Within Life Sciences education, classroom discussions, scientific inquiry, laboratory collaboration, and academic discourse facilitate cognitive growth. Students internalize scientific concepts through language-mediated experiences.

Cognitive Constructivism (Jean Piaget)

Piaget argued that learners actively construct knowledge through interaction with experiences.

Rather than receiving information passively, students interpret new concepts by integrating them into existing cognitive structures.

Within Life Sciences, students develop understanding by connecting laboratory observations, scientific explanations, prior knowledge, and reflective thinking.

Language serves as the mechanism through which these cognitive constructions become meaningful.

Phenomenology (Edmund Husserl)

Husserl proposed that reality should be understood through individuals' conscious experiences.

Phenomenology seeks to describe the essence of lived experience by setting aside preconceived assumptions and focusing on participants' perspectives.

The present study adopts Husserlian descriptive phenomenology because it aims to understand how Life Sciences students consciously experience language education as part of their cognitive development.

Reconceptualizing Language Education in Life Sciences

Research Gap

The literature demonstrates the growing importance of language education in supporting scientific literacy and cognitive development. Nevertheless, several significant gaps remain.

First, most existing studies examine language education from quantitative perspectives, emphasizing language proficiency, academic achievement, reading comprehension, or communication skills. Such approaches often overlook the personal meanings students assign to language learning within scientific contexts.

Second, research on Life Sciences education predominantly investigates scientific literacy, laboratory competencies, inquiry-based learning, and disciplinary achievement. Comparatively little attention has been given to students' lived cognitive experiences while learning science through language.

Third, although cognitive theories acknowledge language as a tool for thinking, limited qualitative studies have explored how college students consciously experience this relationship in everyday academic life, particularly within Life Sciences programs.

Fourth, Philippine State Universities and Colleges remain underrepresented in phenomenological research concerning interdisciplinary learning. Existing local studies focus largely on instructional effectiveness and curriculum implementation, leaving a gap in understanding how students cognitively construct meaning through language education.

Finally, no existing phenomenological framework has comprehensively described the essence of language education as experienced by Life Sciences students across Philippine State Universities and Colleges. Addressing this gap, the present study seeks to develop a rich, contextualized understanding of students' lived experiences and to offer a reconceptualization of language education as a cognitive and meaning-making process within Life Sciences higher education.

Methodology

Research Design

This study employed a **descriptive phenomenological research design** guided by Husserl's phenomenology to explore the lived cognitive experiences of Life Sciences students regarding language education in Philippine State Universities and Colleges (SUCs). The design is appropriate because it seeks to describe the essence and meaning of participants' experiences without testing hypotheses or measuring variables. Through phenomenological inquiry, the study aimed to understand how students perceive language education as a cognitive process that shapes their scientific understanding, critical thinking, and academic learning.

Research Locale

The study was conducted in selected Philippine State Universities and Colleges (Marinduque State University, Central Bicol State University of Agriculture, Isabela State University, Don Mariano Marcos Memorial State University) offering undergraduate Life Sciences programs, including Biology, Environmental Science, Agriculture, Biotechnology, and related fields. These institutions were purposively selected to

obtain diverse perspectives from students across different academic and geographical contexts.

Research Participants

The participants consisted of 20–25 undergraduate Life Sciences students selected through purposive sampling. Participants were chosen based on their direct experiences with language education in their academic programs. Data collection continued until **data saturation** was achieved, ensuring that no new themes emerged from the interviews.

Research Instrument

The primary instrument was a researcher-developed semi-structured interview guide consisting of open-ended questions that encouraged participants to describe their experiences of learning Life Sciences through language. Reflective journals were also used to supplement the interview data and provide deeper insights into students' cognitive experiences.

Data Collection Procedure

After obtaining ethical clearance and institutional permission, eligible participants were recruited and provided informed consent. Individual semi-structured interviews, lasting approximately 45–60 minutes, were conducted either face-to-face or online and were audio-recorded with participants' permission. Interviews were transcribed verbatim, and participants reviewed their transcripts through member checking to ensure accuracy and credibility.

Data Analysis

The collected data were analyzed using Colaizzi's Seven-Step Phenomenological Method, which involved identifying significant statements, formulating meanings, clustering themes, developing exhaustive descriptions, and validating the findings with participants. This process enabled the researcher to capture the essence of students' lived cognitive experiences regarding language education in Life Sciences.

Trustworthiness of the Study

The rigor of the study was established using the criteria of credibility, transferability, dependability, and confirmability proposed by Lincoln and Guba (1985). Credibility was enhanced through member checking and triangulation, while rich descriptions, audit trails, and reflexive journaling ensured the trustworthiness and authenticity of the findings.

Results and Discussion

Since this is a phenomenological study, the findings are organized into emergent themes derived from participants' lived experiences rather than statistical results. The themes illustrate how Life Sciences students perceive language education as a cognitive process that shapes their learning, scientific understanding, and professional development.

Theme 1: Language as a Foundation for Understanding Scientific Concepts

Participants consistently described language as the primary medium through which they understood complex scientific concepts. They emphasized that reading scientific texts,

interpreting technical terms, and engaging in classroom discussions enhanced their comprehension of biological processes and scientific principles. For many students, language facilitated the transformation of abstract scientific ideas into meaningful knowledge, enabling them to connect theoretical concepts with real-world applications.

Illustrative Statements

"Scientific terms were difficult at first, but as I learned their meanings, understanding Biology became much easier."

"Language helped me understand what was happening in our laboratory activities because I could explain the concepts in my own words."

These narratives indicate that language education functions as a cognitive bridge that supports conceptual understanding in Life Sciences.

Theme 2: Language Enhances Critical Thinking and Scientific Reasoning

Participants viewed language as an essential tool for thinking critically and reasoning scientifically. They shared that explaining concepts, asking questions, and participating in academic discussions encouraged them to analyze information more deeply and evaluate scientific evidence before forming conclusions. Language enabled them to organize their thoughts, justify their ideas, and solve scientific problems systematically.

Illustrative Statements

"When I explain scientific ideas to others, I realize that I understand them better."

"Writing laboratory reports helped me think carefully about the results instead of simply memorizing facts."

These experiences demonstrate that language education promotes higher-order cognitive processes essential for scientific learning.

Theme 3: Academic Communication Strengthens Learning and Confidence

Students emphasized that communicating scientific ideas through oral presentations, research writing, and collaborative discussions improved both their academic competence and self-confidence. Although many initially struggled with technical vocabulary and scientific writing, continuous practice enabled them to express scientific ideas more accurately and confidently.

Illustrative Statements

"Presenting our research made me realize that science is not only about experiments but also about communicating what we discovered."

"Group discussions improved my confidence because I learned from my classmates while sharing my own ideas."

The findings suggest that academic communication serves as both a learning strategy and a means of developing professional competence.

Theme 4: Language Education Shapes Scientific Identity

Participants described language education as an important factor in their development as future Life Sciences professionals. They believed that the ability to communicate scientific knowledge effectively reflects

professionalism and prepares them for future careers in research, healthcare, environmental management, education, and related fields. Through language, students developed confidence in engaging with scientific communities and recognized themselves as emerging professionals.

Illustrative Statements

"Learning scientific language made me feel like I was becoming a real scientist."

"Good communication is just as important as scientific knowledge because professionals need to explain science to other people."

These experiences highlight that language education contributes not only to academic achievement but also to students' professional identity formation.

Essence of the Phenomenon

The lived experiences of Life Sciences students reveal that language education is more than a communication skill; it is a cognitive process that supports conceptual understanding, scientific reasoning, critical thinking, academic communication, and professional identity. Students experience language as the medium through which they construct scientific knowledge, engage in reflective learning, and participate meaningfully in scientific discourse. Consequently, language education should be viewed as an integral component of Life Sciences education rather than a separate academic subject.

Discussion

The findings demonstrate that language education plays a central role in shaping students' cognitive experiences in Life Sciences. Participants consistently perceived language as essential for understanding scientific concepts, developing critical thinking, communicating research, and constructing their identities as future professionals. These findings support sociocultural and constructivist perspectives, which view language as a fundamental tool for knowledge construction and cognitive development. The study further suggests that integrating language-responsive teaching strategies into Life Sciences curricula can strengthen scientific literacy, improve academic engagement, and better prepare students for professional practice. Ultimately, the phenomenological insights reconceptualize language education as a transformative cognitive experience that enriches learning and fosters meaningful participation in scientific communities.

Conclusion

This phenomenological study explored the lived cognitive experiences of Life Sciences students regarding language education in selected Philippine State Universities and Colleges. The findings revealed that language education extends beyond developing communication skills; it serves as a cognitive process that enables students to understand scientific concepts, engage in critical thinking, communicate scientific knowledge, and develop their professional identities. Participants perceived language as an essential medium for constructing meaning, interpreting scientific information, and participating in disciplinary discourse. The emergent themes collectively demonstrate that language education is deeply embedded

in students' scientific learning experiences and contributes significantly to their academic growth and scientific literacy. Consequently, the study reconceptualizes language education as an integral component of Life Sciences education that supports cognitive development and meaningful learning.

Implications of the Study

The findings have important implications for higher education, particularly for Life Sciences programs in Philippine State Universities and Colleges. Curriculum developers may consider integrating language-responsive pedagogies into science courses to strengthen students' scientific communication and conceptual understanding. Faculty members may adopt instructional strategies that encourage academic discussions, reflective writing, scientific argumentation, and collaborative learning to enhance cognitive engagement. The study also highlights the importance of interdisciplinary collaboration between language educators and Life Sciences faculty in designing learning experiences that promote both disciplinary knowledge and language development. Furthermore, the findings provide a basis for institutional policies that recognize language education as a vital component of scientific learning and professional preparation.

Recommendations

Based on the findings, the following recommendations are proposed:

1. State Universities and Colleges should strengthen language-integrated instructional practices within Life Sciences curricula to improve students' scientific literacy and cognitive development.
2. Life Sciences faculty should incorporate language-rich learning activities, such as scientific writing, reflective journals, research presentations, and collaborative discussions, to promote deeper conceptual understanding.
3. Language educators should collaborate with science instructors in developing interdisciplinary teaching materials that contextualize language learning within scientific disciplines.
4. Higher education administrators should provide faculty development programs on language-responsive pedagogy and interdisciplinary instruction to enhance teaching effectiveness.
5. Future researchers may replicate this study in other academic disciplines, private higher education institutions, or international settings using phenomenology or other qualitative approaches to further explore the relationship between language education, cognition, and disciplinary learning.

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