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S-Glos Supplementary Material to Improve the Vocabulary Skills in Science of Grade 9 Learners

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APPROVAL CERTIFICATE

This Master's Thesis titled, "*S-Glos Supplementary Material to Improve the Vocabulary Skills in Science of Grade 9 Learners* " prepared and submitted by Lanilyn L. Hilado, in partial fulfillment of the requirements for the degree Master of Arts in Education major in General Science, has been examined and approved for Oral Examination.

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ABSTRACT

In science education, a major barrier to conceptual understanding is often the dense and unfamiliar terminology students must master. This study investigated the effectiveness of a Science Glossary (S-Glos) in improving the vocabulary skills of Grade 9 learners in a secondary school in Central Philippines during the School Year 2025–2026. Anchored on the Plan-Act-Observe-Reflect (PAOR) framework, this action research employed purposive sampling based on science vocabulary pretest performance. The study utilized a researcher-made pre/post-test and an S-Glos validated by experts using the Learning Resources Management and Development System (LRMDS) guidelines and the Lawshe validation tool. Findings revealed that S-Glos met LRMDS standards for quality content, clear format, accuracy, and organization, ensuring its classroom reliability. Implementation of S-Glos significantly improved learners' science vocabulary skills, shifting performance from low proficient to proficient levels, reflecting a substantial percentage gain. Both students and the teacher reported that S-Glos enhanced comprehension and supported scientific vocabulary development, though its effectiveness depended on consistent use and teacher guidance. Feedback recommended incorporating examples and visuals to further enhance usability. In conclusion, S-Glos proved to be an effective tool for improving science vocabulary, addressing initial learning gaps, and facilitating meaningful engagement with scientific concepts. The study emphasizes that challenges in science learning are often rooted in unfamiliar terminology rather than conceptual difficulty. This highlights the value of targeted vocabulary interventions and differentiated instruction to maximize student learning outcomes.

Keywords: *Science Education, Science Vocabulary, Vocabulary Skills, Science Glossary, Action Research, Central Philippines.*

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DEDICATION

This research is sincerely dedicated to those who have been my constant source of strength, inspiration, and steadfast support throughout this journey.

To my husband, Elyzar, whose unwavering support, encouragement, and quiet strength carried me through the most challenging moments.

To my children, Elle and Ethan, whose joy, laughter, and innocence reminded me of life's simple blessings and gave me the courage to persevere.

To my parents and siblings, for their constant prayers, guidance, and belief in my dreams, even when the journey seemed long.

And above all, to God, whose infinite grace and blessings have sustained me, guided my steps, and made this achievement possible.

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CHAPTER ONE
IINTRODUCTION

Science education is designed to develop scientific, technological, and engineering literacy among learners. This prepares them to become proactive, informed, and critical citizens capable of making evidence-based decisions regarding scientific applications that impact society, health, and the environment (Department of Education, 2024). Fostering these competencies allows learners to spot false information and think clearly about everyday claims (Mackenzie et al., 2023). This means learners do not just memorize facts, but instead learn how to work together and use science to solve real-world problems in their communities (Miranda et al., 2025).

Scientific literacy is an individual's capacity to understand scientific information and use it in everyday judgments and decisions (Stekelenburg, 2026). According to the Program for International Student Assessment (PISA), scientific literacy entails the ability to engage with science-related issues as a reflective citizen by explaining phenomena, designing inquiries, and interpreting data in real-life contexts. The Philippines' participation in PISA 2018 and 2022 highlighted persistent challenges, as Filipino students' scores in math, reading, and science remained among the lowest with minimal progress (Acido & Caballes, 2024). However, achieving scientifically literate learners is a societal problem.

Teachers face problems such as low English proficiency among students and diverse learning conditions (Del Rosario, 2024). When learners come to school with little or no grasp of the English language, it poses a major problem. Mahaguay (2021) observed that learners fail in different examinations not because they are incapable of answering the questions or because the exam is difficult, but because they often fail to understand the questions due to unfamiliar vocabulary. This simple limitation of vocabulary will bring a series of problems, like the misunderstanding of the question and the failure of the examination. Furthermore, reading comprehension is an essential interdisciplinary skill that serves as the foundation for all other subject areas. In science, as a subject rich in vocabulary words, the learner's ability to read and comprehend to generate a conceptual understanding cannot be set aside. Thus, integrating literacy strategies such as vocabulary instruction strategies in teaching the subject is of great help to the learners (Venida, 2021).

This problem is also observed by the teachers in one of the large schools in a component city in central Philippines. Learners are having a hard time answering even multiple-choice assessments because they cannot understand the meaning of some of the words that they are reading (Ward, 2023). In most cases, they would ask for the local translation of an English word. This is evidenced by a very low Mean Percentage Score (MPS) of 39.50 in science during the Division Assessment of Learning in the school year 2024-2025 and Grade 9 obtained an overall MPS of 38.00. The overall MPS of 39.50 has a corresponding descriptive equivalent of average mastery level and low proficiency level in science. This school caters to learners who are mostly coming from families with low economic income.

Due to the urgent need to enhance the science vocabulary of learners and address these localized academic deficits, the researcher developed S-Glos (Science Glossary) as a targeted, contextualized intervention. S-Glos is a researcher-made supplementary material designed to explicitly decode technical, abstract, and undefined terminologies embedded within the division-initiated Self-Learning Modules (SLM). The development of this tool was systematically anchored on the principles of instructional scaffolding, ensuring that each selected vocabulary word is paired with age-appropriate contextual descriptions that fit the cognitive level of Grade 9 learners. Rather than acting as a passive, detached dictionary, S-Glos functions as an active learning guide that bridges the gap between everyday language and dense academic text.

Multiple studies have shown that science vocabulary plays a vital role in students' academic performance in science. Mastery of science vocabulary knowledge has been shown to significantly predict science achievement and conceptual understanding (Lazaroff & Vlach, 2022). Furthermore, academic vocabulary is considered the most important factor in increasing learners' lexical competence, critical thinking, and making decisions, mainly in primary school, secondary school, and university (Khalilova, 2023). It plays an important part in improving learning in science and mathematics (Huei et al., 2021). To support student retention, educators must employ effective vocabulary teaching techniques and integrate targeted literacy strategies into their instruction (Yu, 2022; Venida, 2021). The utilization of S-Glos serves this purpose by enabling learners to effectively acquire and comprehend complex scientific terms and concepts.

Furthermore, this study aligns with the Teaching and Learning thematic area of the Basic Education Research Agenda (BERA), as outlined in Regional Memorandum No. 648, s. 2022 by focusing on the enhancement of Filipino learners' vocabulary skills. Thus, this study explores a critical pathway toward improving the overall quality of basic education.

- *Statement of the Problem*

This study aims to investigate how science glossary is used to improve the vocabulary skills of Grade 9 learners. Specifically, this study sought to answer the following questions:

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- What material can be developed to improve the vocabulary skills of learners?
- What is the quality of S-Glos as evaluated by experts?
- What is the level of vocabulary skills in science of learners before and after the implementation of S-Glos?
- Is there a difference in the level of vocabulary skills of learners in science before and after the implementation of S-Glos?
- What were the experiences of the learners and the teacher during the implementation of S-Glos?
- What improvements can be made to enhance S-Glos for future use?

➢ *Framework*

The theoretical framework for the study is drawn from the Cognitive theories of learning, mainly Constructivism by Piaget (1952) and Schema Theory by Bartlett (1932). The central idea of constructivism is that learning is an active process in which learners construct their understanding of new ideas based on what they already know or have experienced. According to Almulla (2023), learners actively engage in constructing knowledge through interaction, critical thinking, and the integration of prior experiences, which significantly influence learning outcomes. Learners must reflect on the information being taught and create interpretations based on prior knowledge, personal opinions, and cultural background.

When applying constructivist principles to enhancing vocabulary skills through science glossary integration, learners can actively engage with science concepts and terminology when they encounter them in context, such as in experiments, readings, or discussions. By interacting with scientific vocabulary in meaningful ways, they build connections between new words and their prior knowledge. Constructivism emphasizes the importance of prior knowledge in learning. Integrating science glossaries into vocabulary instruction allows learners to connect new scientific terms with their existing knowledge, helping them construct a more robust understanding of both vocabulary and scientific concepts.

On the other hand, Schema Theory by Sir Frederick Bartlett emphasizes that individuals use their existing knowledge to form frameworks known as schemas, which help in processing new information. Recent studies highlight that schema development supports structured knowledge acquisition and facilitates understanding by linking new information to prior cognitive structures (Meylani, 2024). Science glossaries introduce vocabulary terms within the context of scientific concepts and principles. When learners encounter these terms, they activate relevant schemas related to their prior knowledge of science. For example, encountering the term "photosynthesis" activates a schema related to plant biology and energy conversion processes.

As learners engage with science glossaries, they integrate new vocabulary terms into their existing schemas. They connect these terms with their understanding of scientific concepts, linking new words with related ideas and reinforcing their comprehension of both vocabulary and scientific content. From these theories, one can infer that a science vocabulary learning intervention may involve providing learners with science glossaries that facilitate the construction and organization of knowledge. They allow students to integrate their prior knowledge of science vocabulary with new terms. When learners refer to glossaries as a supportive tool to scrutinize the meaning of terms, they can construct a more cohesive and organized network of knowledge.

This study is primarily anchored on the Plan-Act-Observe-Reflect (PAOR) Framework by Kemmis & McTaggart (1988). This framework is a key component in action research, which follows a cyclical and reflective process aimed at improving practice through systematic inquiry (Nazari, 2022). It is described as a structured and iterative approach used for planning and implementing actions, observing outcomes, and reflecting on results for continuous improvement. Recent studies emphasize that action research operates through recurring cycles of planning, action, and reflection that allow researchers to refine interventions and address identified problems effectively (Feekery, 2023; Patjan & Sananuamengthaisong, 2025).

It involves spiral cycles consisting of four main phases namely; plan, act, observe, and reflect, which are the same phases that the researcher will go through in conducting this study. These phases are iterative in nature, allowing continuous modification and improvement of the intervention based on observed results and reflections (Patjan & Sananuamengthaisong, 2025).

The researcher-made Science Glossary is the tool that was used to address the identified problem, which is the poor science vocabulary skills of secondary school learners. Through the PAOR cycle, the intervention was carefully planned, implemented, observed, and evaluated to ensure its effectiveness in improving learners' vocabulary skills while promoting continuous instructional improvement.

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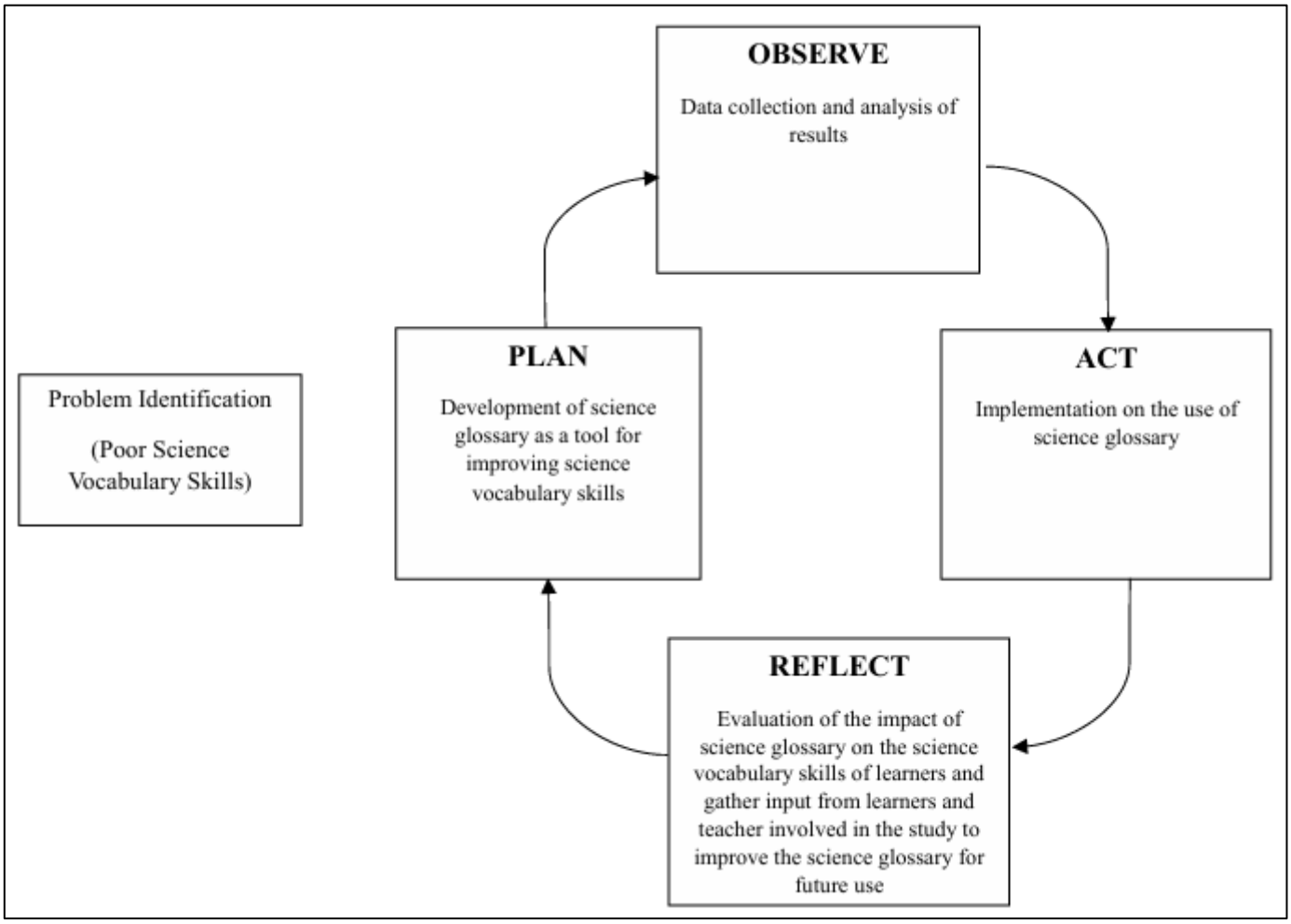

Fig 1 Schematic Diagram of the Study

➢ *Significance*

Enhancing learners' science vocabulary skills has numerous benefits, including improved understanding of scientific concepts, enhanced communication in scientific contexts, and increased academic achievement in science subjects.

Specifically, this study may be beneficial to the following:

- *Learners*

This study may help learners enhance their vocabulary skills in science. Having access to a glossary can help learners understand the technical terms and concepts used in science. This may facilitate a deeper comprehension of the subject matter. A strong science vocabulary allows learners to communicate more effectively with teachers, peers, and experts in the field. It enables them to articulate their thoughts and ideas clearly, fostering better interactions and collaboration in science-related activities. This may also lead to better performance on assessments, projects, and assignments that require understanding and application of scientific terms.

- *Teachers*

Teachers may utilize the science glossary to ensure that they are accurately incorporating scientific terms and concepts into their lesson plans. It can also serve as a reference tool for teachers during classroom instruction. When students have queries about specific scientific terms, teachers may easily access the glossary to provide clear explanations, fostering better understanding among learners. It may also be used when creating assessments and evaluating learners' comprehension of scientific terms.

- *School Principal*

This study may help the school principal ensure that the science curriculum aligns with the terminology and concepts commonly used in teaching science. It may also be utilized to plan professional development opportunities for science teachers. By identifying specific areas where teachers may need support or further training in scientific terminology, the principal can tailor professional development sessions to address these needs effectively.

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- *Education Program Supervisor in Science*

The Education Program Supervisor (EPS) in Science can work towards improving the overall quality of science education by incorporating science glossary as a tool for enhancing vocabulary skills in science instruction. Learners and teachers will have access to standardized scientific language and terminology, which can lead to a more coherent and effective science curriculum. By demonstrating the efficacy of S-Glos, the study offers the EPS empirical evidence to advocate for standardized scientific terminology and localized literacy tools that ensure vertical and horizontal alignment across the science curriculum. Moreover, this research empowers the EPS to foster a culture of innovation and resource-sharing across schools to effectively bridge systemic performance gaps in science literacy.

- *Present Researchers*

This study may serve as a valuable conceptual and methodological blueprint for present researchers in investigating vocabulary-building interventions in science education. It provides a clear roadmap for designing, validating and testing localized instructional materials like S-Glos. Present researchers can utilize these findings as a baseline for replication studies, a point of comparison for similar literacy tools, or a foundation for conducting further action research aimed at bridging the gap between scientific literacy and student comprehension.

- *Future Researchers*

The study may provide a foundation for future researchers to explore the effectiveness of science glossaries in enhancing science vocabulary. Researchers can build upon this study by conducting more in-depth investigations, possibly focusing on specific student populations, different educational settings, or other variables that may influence the outcomes.

➢ *Scope and Limitations*

This study investigated how Science Glossary can be used to improve the vocabulary skills of secondary school learners. It was conducted in one of the large public high schools in Central Philippines. The study involved the purposive selection of Grade 9 learners based on their scores on a science vocabulary pretest. The intervention was systematically deployed during the third quarter of school year 2025-2026, with the entire research process spanning a duration of six months. The researcher-made science vocabulary pretest and post-test, along with the science glossary, served as the primary research instruments in this investigation. Data collection was carried out in three stages: pre-intervention, intervention, and post-intervention. The study included a comparison of pretest and post-test scores to measure learners' vocabulary growth, as well as an analysis of qualitative responses to identify recurring patterns and themes regarding the impact of science glossary.

This study provided valuable insights for educators on the potential benefits of integrating science glossaries into classroom instruction. However, several limitations must be acknowledged. The findings may be constrained by the sample size and the specific demographic characteristics of the participants; therefore, the results may not be generalizable to a wider population. Additionally, the duration of the study and the level of exposure to the science glossary may influence the extent of vocabulary improvement.

Furthermore, the study relied partly on self-reported qualitative data, which may introduce bias or subjectivity. External factors such as teaching methods, individual learning styles, and prior exposure to scientific terminology may also affect learners' vocabulary development, but these variables are not extensively examined in this study. Lastly, while the use of science glossaries may contribute to improved academic performance, the primary focus of this research is to enhance the vocabulary skills of Grade 9 learners.

➢ *Definition of Terms*

Important terms in this study are defined to establish understanding and proper interaction between the researcher and the reader.

- *Experiences*

Conceptually,it refers to the immediate, subjective, and first-person narratives that participants construct when navigating a specific phenomenon or interacting with a newly introduced system (Hemming et al., 2021).

Operationally, it refers to the things that the learners faced, emotions that they felt, and knowledge and ideas that formulated during the implementation of S-Glos.

- *General Definition*

Conceptually, it refers to an invariant, skeletal semantic structure composed of domain-neutral features. It does not possess multiple meanings within the lexicon; rather, it is a single abstract value that allows for various interpretations depending on the conceptual domain in which it is used (Widoff, 2024).

Operationally, provides the broad or standard meaning of terms included in the glossary.

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- *Improvements*

Conceptually, improvement is defined as a deliberate, system-wide, and data-driven process designed to modify existing structures, processes, or behaviors to measurably enhance performance, efficiency, sustainability, or quality (Akinbowale, 2026; Vasileiou et al., 2024).

Operationally, it refers to the gradual development of the vocabulary skills of the learners after the implementation of S-Glos.

- *Life Science*

Conceptually, life science is divided into three distinct layers: the core criteria of a living system, the scale of biological organization, and the overarching paradigms that unify the discipline (Luft et al., 2022).

Operationally, it refers to the domain or the branch of science that the researcher used and focused in the implementation of S-Glos.

- *Real-life Examples*

Conceptually, real-life examples are educational illustrations derived from daily experiences that link abstract ideas to real-world scenarios. (Laius & Presmann, 2024).

Operationally, it refers to the examples provided in the glossary that explain, relate, and demonstrate how the terms are used in everyday life. These examples help learners understand the meaning of words more clearly by connecting them to real-life situations and daily experiences, making the concepts more practical and easier to comprehend.

- *Root Word*

Conceptually, it is defined as the fundamental unit in morphology that can function independently, such as the word invite (Hiebert & Pearson, 2021).

Operationally, root word is the primary, unaltered form of a word derived from Latin or Greek, which carries the core meaning and serves as the foundation for the formation of other words through the addition of prefixes or suffixes.

- *Science*

Conceptually, science is defined as a systematic, cooperative, and iterative process of inquiry that constructs verifiable, testable explanations and predictions about the universe (Ayeni, 2026; Burns, 2026).

Operationally, it refers to the subject of the Grade 9 learners in which a problem in vocabulary is identified. It is also the subject in which the researcher implemented the intervention, S-Glos.

- *S-Glos*

Operationally, it refers to the material created and used by the researcher to aid and improve the vocabulary skills of the learners.

- *Supplementary Material*

Conceptually, ayathis refers to auxiliary or adaptive instructional resource intentionally designed to accompany, enrich, and reinforce a primary textbook or mandated curriculum (Tolentino et al., 2023).

Operationally, this refers specifically to the S-Glos (Science Glossary), a researcher-made, contextualized vocabulary tool developed for Grade 9 learners.

- *Vocabulary Skills*

Conceptually, it refers to the suite of abilities that enable learners to identify, comprehend, apply, and acquire words. This includes receptive knowledge (recognizing words and grasping their meanings), productive knowledge (using words accurately in speech and writing), and strategic skills for picking up new vocabulary (such as inferring meaning from context, analyzing word parts, and applying word-learning strategies) (Ayana et al., 2024).

Operationally, it refers to the measured knowledge and understanding of the learners about scientific terms.

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CHAPTER TWO
METHODOLOGY

This chapter presents a logical presentation of the research methodology. It is composed of the research design, participants of the study, research instrument, validity and reliability of the data gathering instrument, data collection procedure, data analysis procedure and ethical considerations.

- *Design*

This study employed an Action Research design to examine how effectively the Science Glossary (S-Glos) improved the poor vocabulary skills of Grade 9 learners. The investigation was structured around this design to enable systematic implementation and evaluation of the intervention within the actual classroom setting.

Action research is a classroom-based inquiry conducted by teachers to address instructional challenges and enhance their professional practice. It follows an iterative, systematic cycle that includes diagnosis, planning, action, assessment, and learning (Natarajan & Pichai, 2024). This cyclical process allows educators to reflect on their practice and make data-driven adjustments throughout the study.

This design was chosen because the researcher needed a practical and reflective approach to implement S-Glos, monitor its impact in real time, and refine instruction through repeated cycles. Action research directly supports improving student outcomes while simultaneously developing the teacher's professional expertise in addressing specific learning difficulties.

- *Participants and Other Sources of Data*

This study involved three distinct groups of participants: the Learning Resource Management Development System (LRMDS) evaluators, the learners, and the teacher practitioner.

A panel of five expert evaluators were purposively selected to evaluate the quality of the S-Glos using quality assurance tool for printed learning resources based on the guidelines and processes of the LRMDS. This evaluative panel was composed of three designated LR evaluators, who assessed the material's technical, language, and instructional alignment with institutional standards, and two science experts, who quality-assured the conceptual accuracy and scientific precision of the terms and definitions.

The primary participants of this study were identified through a purposive sampling technique, in which they were selected based on their scores in the science vocabulary pretest (Heath, 2023). The participants were drawn from one Grade 9 section in one of the large schools in a component city in Central Philippines during the School Year 2025–2026.

To determine eligibility, all learners in the selected sections were given a 25-item science vocabulary pretest. Their performance was interpreted using the proficiency level descriptors aligned with the standards set by the Department of Education, particularly based on the policy guidelines in DepEd Order No. 31, s. 2020.

Those learners who are not proficient (0%-24%) and low proficient (25%-49%) for vocabulary proficiency level were the selected participants of the study, as this classification indicates that learners require additional support in developing their science vocabulary skills. This ensures that the intervention is targeted toward those who need it most. Furthermore, selection will be limited to learners who demonstrate consistent class attendance to ensure continuity in participation and reliability of the data collected.

In addition to the student participants, the researcher took an active role in the conduct of the study. A teacher practitioner who was willing to participate served as the facilitator in the implementation of this study.

- *Instrument*

The primary research instruments used in this study consisted of the S-Glos and a complementary, researcher-made pre/post-test. To ensure relevance, the glossary terminology was systematically extracted from the division-initiated Self-Learning Modules (SLMs), explicitly targeting complex terms left undefined within the modules. To establish validity, the S-Glos underwent rigorous review by an evaluative panel composed of three learning resource experts and two science education experts. The panel quality-assured the material utilizing a standardized evaluation sheet adapted from the DepEd Learning Resource Management and Development System (LRMDS) guidelines (Department of Education, 2020). This instrument systematically measured the glossary's quality across five core parameters: content, format, presentation and organization, and accuracy and up-to-datedness of information.

On the other hand, the pre/post-test consisted of a 25-item multiple-choice examination specifically designed to evaluate the vocabulary skills of Grade 9 learners. The development of the test items was strictly guided by a Table of Specifications (TOS) to ensure proportionate distribution and alignment with the Department of Education's learning competencies for Life Science specifically covering topics such as Respiratory and Circulatory Systems, Heredity, Biodiversity and Evolution and Ecosystems.

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The items on the pre/post-test were structurally designed as contextualized sentence-completion items. Learners are required to analyze the surrounding scientific descriptors such as the cooperative functions of organs and blood vessels to accurately deduce and select the correct technical terminology from four multiple-choice options. This design ensures that the instrument measures the learners' higher-order contextual application and conceptual understanding of Life Science vocabulary, rather than simple, low-level rote memorization.

- *Validity*

Validity is about what an instrument measures and how well it does so, whereas reliability is associated with the accuracy of the data obtained and the degree to which any measuring tool controls random error (Ahmed & Ishtiaq, 2021). The LRMDS Evaluation Tool for Print Resources which is a standardized tool for DepEd learning resources was used in evaluating the glossary. The evaluation tool contains the following factors; content, format, presentation and organization, accuracy and up-to-datedness of information. On the other hand, the pre/post-test was validated using Lawshe validation tool. The majority of the items in this study were deemed significant according to the acquired CVI value of 0.792. The Content Validity Index (CVI) is a commonly utilized measure in instrument creation since it shows the level of agreement among experts evaluating the items' appropriateness, relevance, and clarity (Muhammad et al., 2024). Strong content validity is indicated by CVI scores of 0.80 and higher, whereas values between 0.70 and 0.79 are generally regarded as adequate but may need adjustment, according to recognized recommendations (Jabbari et al., 2025).

- *Reliability*

As for the reliability of the pre/post test, a pilot-test was given to 17 learners of the same school who are not participants of the study. Based on the result of Kuder and Richardson Formula 20 for the internal consistency reliability of the tests, the value of 0.75 is considered an acceptable level of reliability. This suggests that the test items are sufficiently consistent in evaluating the same underlying construct, making it a viable tool for classroom-based evaluation. Reliability coefficients of 0.70 or greater are often considered acceptable in educational measurement, indicating that the test produces steady and consistent findings when given to comparable student groups. Even if the obtained value is sufficient, the instrument's reliability might be further increased by making minor adjustments to item quality and discrimination (Sireci & Benítez,2023).

➢ *Data Collection*

The science glossary is a learning intervention that aims to enhance the science vocabulary skills of Grade 9 learners. It was based on the division-initiated Self-Learning Modules (SLM). The conduct of this study is divided into three primary stages: the pre-intervention stage, the intervention stage, and the post-intervention stage.

- *Pre-Intervention Stage (Plan)*

The pre-intervention stage of this study comprises the "Plan" component of the PAOR framework. Following the identification of the classroom problem, which is the poor science vocabulary skills of learners, the researcher developed a plan of action to address this issue through the creation of a science glossary.

To develop the glossary, the researcher carefully examined the SLM and identified words that learners may find difficult, particularly those that are not defined in the modules. The words included both Tier-2 and Tier-3 vocabulary to support learners' understanding of science concepts. The selected terms were defined n a clear and simplified manner to ensure comprehension.

The science glossary was validated by five experts using a quality assurance tool for printed learning resources. In addition, a 25-item multiple-choice vocabulary pretest was prepared by the researcher to assess Grade 9 learners' vocabulary skills. This instrument was validated by fifteen experts in science education. The pretest included words taken from the science glossary.

Reliability testing was conducted among 17 Grade 9 learners from the same school who are not participants of the study. The study was also presented to the Science Department faculty to gather feedback and a Grade 9 teacher was identified to facilitate the implementation of the intervention. The teacher was given orientation and provided with implementation guidelines.

The pre-intervention stage also included the preparation of permits. A formal letter of permission was submitted to the school principal to authorize the conduct of the study. Consent forms were distributed after the participants are identified. After securing consent, an orientation was conducted to explain the study's goals, procedures, and expectations. Finally, the necessary materials for printing the glossary was prepared, followed by its production.

- *Intervention Stage (Act)*

The intervention stage comprises the "Act" component of the PAOR framework and started after the science glossary has been printed. Only learners who obtained a percentage score of 0%–24% (not proficient) and 25%–49% (low proficient) in the pretest were selected as participants. In addition, learners with attendance issues, specifically those who have accumulated 10 or more absences in the first and second quarter was excluded from the study.

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The science glossary was distributed to the Grade 9 section where the participants belong during the third quarter of the academic year 2025–2026. It included a set of terms relevant to Life Science. The subject teacher introduced the glossary and explained its purpose and content. It was emphasized that the included words are those that learners are likely to find difficult or are not defined in the SLM. The teacher also explained the distinction between Tier 2 and Tier 3 vocabulary.

Learners was instructed to review the glossary for at least three minutes before the start of each class to support retention. The glossary terms were also integrated into classroom discussions, and learners are occasionally asked to define them. This practice was implemented throughout the six modules in Grade 9 Science.

- *Post-Intervention Stage (Observe and Reflect)*

The post-intervention stage comprises the "Observe" and "Reflect" components of the PAOR framework. In this phase, learners' progress was assessed through a vocabulary post-test. The 25-item post-test contains the same content as the pretest but will be rearranged to reduce memorization effects. After scoring, results were analyzed to determine the learners' level of vocabulary mastery using a percentage-based proficiency scale. In addition, a focus group discussion (FGD was conducted to gather learners' perceptions and experiences regarding the science glossary and its effectiveness. Furthermore, an interview was conducted with the Science teacher involved in the study to obtain feedback, suggestions, and recommendations for improving the glossary for future use.

➢ *Data Analysis*

In order to analyze the data, statistical tools of analysis was used. First, to make sure that the research instruments that were used are valid, the researcher identified five experts. Two experts in the field of science education and three learning resource experts to evaluate the quality of the science glossary. They used the quality assurance tool for printed learning resources based on the updated guidelines and processes of the Learning Resources Management and Development System (LRMDS) of the Department of Education.

The level of science vocabulary skills of Grade 9 learners before and after introducing the science glossaries was measured through descriptive statistics such as mean and standard deviation for both pretest and post-test scores to describe the central tendency and variability of the data. The table below shows how the test scores will be interpreted (DepEd Order No. 31, s. 2020).

Table 1 Pre/Post Test Scores Interpretation

Pre/Post-test Scores	Proficiency Level	Proficiency Code	Interpretation
0-6	0-24%	NT	Not Proficient
7-12	25-49%	LP	Low Proficient
13-18	50-74%	NP	Nearly Proficient
19-22	75-89%	P	Proficient
23-25	90-100%	HP	Highly Proficient

Finally, a thematic analysis was conducted to identify significant themes and patterns from the Focus Group Discussion (FGD) with Grade 9 learners and from the interview with the subject teacher who facilitated the implementation of the study. The same was done with the recommendations that have been obtained on how to improve the science glossary.

➢ *Ethical Considerations*

This study strictly adheres to the ethical principles and guidelines set forth by the Philippine Health Research Ethics Board to ensure the protection of participants' rights, welfare, and dignity, as well as to uphold the integrity and credibility of the research.

- *Social Value*

The study addresses a critical societal and educational issue: the low proficiency and vocabulary deficits in science among Filipino learners, as highlighted by national PISA results. By developing and evaluating the S-Glos, the research provides a tangible, evidence-based instructional resource that directly benefits the local educational community.

- *Informed Consent*

Prior to data collection, voluntary and informed consent was obtained from all participants and their parents or legal guardians. An orientation was conducted to clearly explain the purpose, procedures, potential risks, and benefits of the study. Participants were also informed of their right to decline participation or withdraw from the study at any time without any penalty or disadvantage.

- *Vulnerability of the Respondents*

Given that the study involves Grade 9 minor learners, who may be particularly vulnerable due to their developmental stage, extra precautions were taken to ensure their protection. These precautions include obtaining parental consent for minors. The researcher instituted strict protective measures to ensure that no coercion, manipulation, or academic pressure occurred during any stage of the intervention.

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- *Risk and Benefits*

The study posed minimal to zero physical, psychological, or emotional risk to the participants, as the implementation was integrated into their regular science class hours using DepEd-aligned materials. Conversely, the direct benefit to the learners was substantial, as the intervention provided them with free, customized instructional designed to enhance their vocabulary skills in science.

- *Privacy and Confidentiality*

Privacy and confidentiality was observed throughout the research process. Personal information of participants was anonymized through the use of codes or pseudonyms. All collected data was securely stored, and access will be limited only to the researcher. Any information that may identify participants was not disclosed in any reports or publications.

- *Transparency*

To uphold the principle of transparency, the researcher ensured full disclosure of the study's purpose, scope, and procedures to all stakeholders including school administrator, teachers, parents/guardians, and Grade 9 learners prior to any data collection. No form of deception or covert observation was used in this study. Furthermore, the researcher commits to absolute honesty in data reporting.

- *Qualification of the Researcher*

As the researcher of this study, I am a licensed professional teacher and a registered nurse with almost 7 years of experience in teaching science. I am currently pursuing Master of Arts in Education major in General Science (MAEd GenSci), driven by a strong commitment to support my learners through meaningful and relevant research. Throughout the research process, I strictly adhered to ethical standards and ensured integrity in every stage of the study. I maintained objectivity and professionalism, taking care that personal biases did not influence the collection, analysis or interpretation of data.

- *Justice*

The researcher treated all participants with absolute fairness, respect, and equity. Purposive selection was strictly dictated by the objective parameters of the baseline vocabulary pretest scores, completely neutralizing bias or discrimination based on gender, ethnicity, religious beliefs, academic tracking, or the socioeconomic background of the learners' families.

- *Community Involvement*

Prior to the commencement of the study, a formal letter requesting permission to conduct the research was submitted to and approved by the school principal of the target public secondary school. Upon securing this institutional clearance, an orientation session was organized for the Grade 9 learners and the collaborating science teacher to transparently outline and discuss the study's scope and operational timeline.

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CHAPTER THREE
RESULTS AND DISCUSSIONS

This chapter presents comprehensive analysis and interpretation of data gathered. All of the responses are coded, categorized and interpreted accordingly.

- *The Developed Material to Improve the Vocabulary Skills of Learners*

The developed supplementary material, S-Glos, is a contextualized vocabulary intervention designed to enhance the vocabulary skills of Grade 9 learners by systematically deconstructing dense academic texts. As presented in Figure 2, the material is prominently titled S-Glos and subtitled with its core pedagogical objective: "Unlocking the Power of Vocabulary." As detailed in Figure 2, the material provides structural guidelines for facilitators to implement a targeted 3-minute daily review and categorizes terms into Tier 2 (general terms) and Tier 3 (domain-specific) vocabulary levels. Structurally, Figure 3 shows the core chapters utilize a unique four-column instructional scaffolding matrix consisting of the target vocabulary word, a general definition or morphological root breakdown, a technically precise science definition, and a real-life example acting as a relational cue. By integrating these linguistic and contextual layers, S-Glos transforms passive vocabulary memorization into an active learning process that bridges the gap between everyday vernacular and complex scientific concepts.

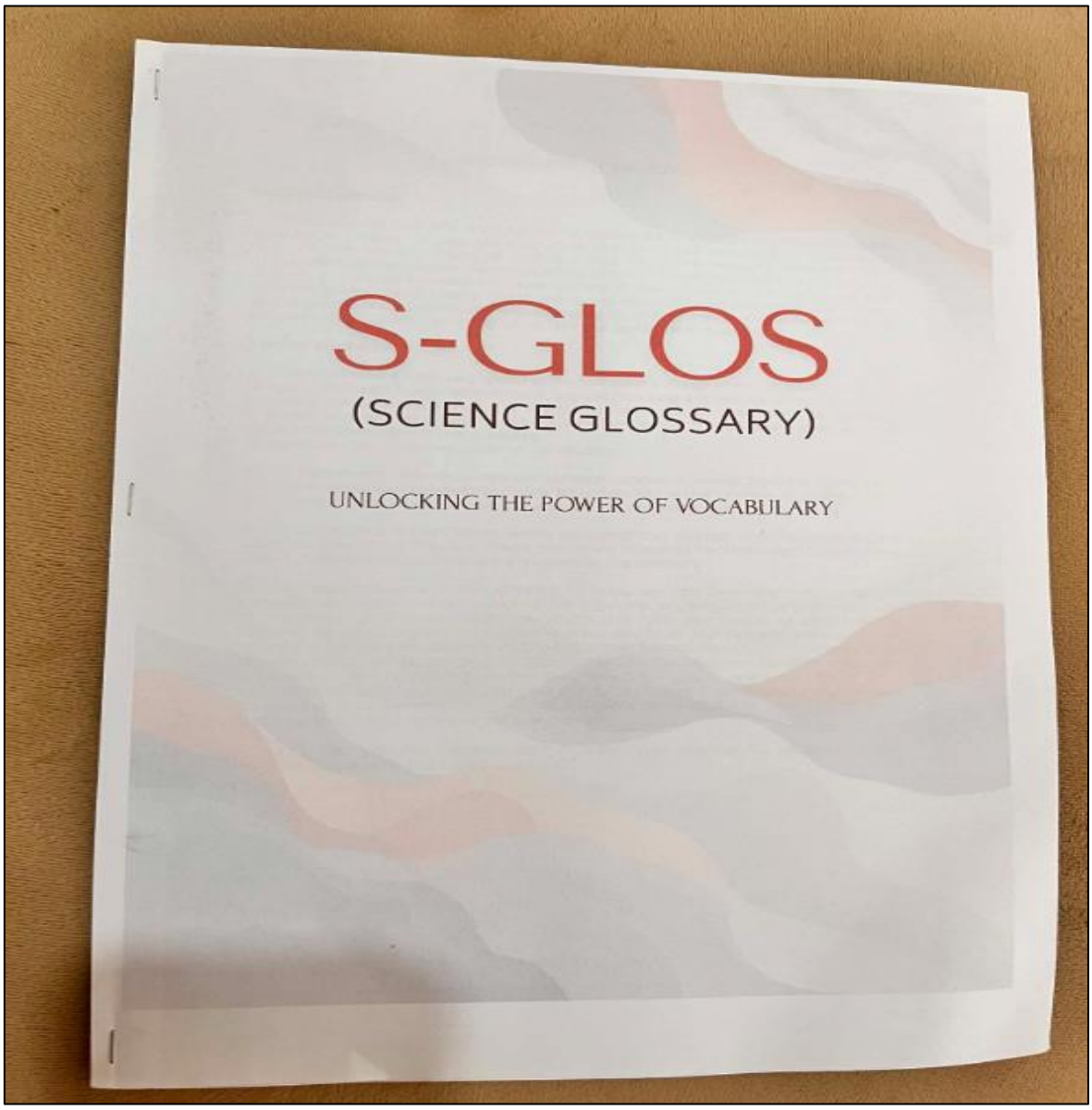

Fig 2 Glossary Coverpage

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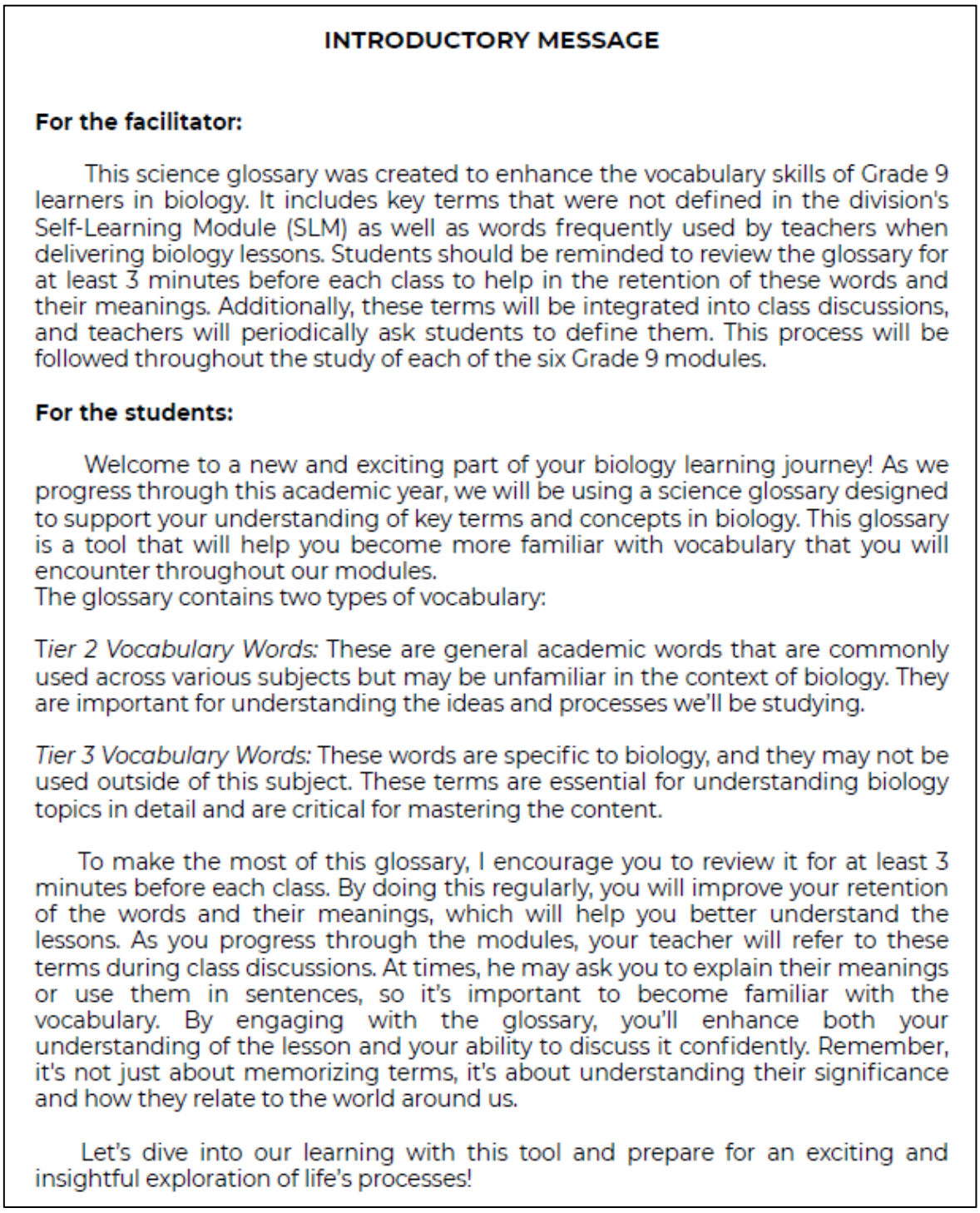

INTRODUCTORY MESSAGE

For the facilitator:

This science glossary was created to enhance the vocabulary skills of Grade 9 learners in biology. It includes key terms that were not defined in the division's Self-Learning Module (SLM) as well as words frequently used by teachers when delivering biology lessons. Students should be reminded to review the glossary for at least 3 minutes before each class to help in the retention of these words and their meanings. Additionally, these terms will be integrated into class discussions, and teachers will periodically ask students to define them. This process will be followed throughout the study of each of the six Grade 9 modules.

For the students:

Welcome to a new and exciting part of your biology learning journey! As we progress through this academic year, we will be using a science glossary designed to support your understanding of key terms and concepts in biology. This glossary is a tool that will help you become more familiar with vocabulary that you will encounter throughout our modules.
The glossary contains two types of vocabulary:

Tier 2 Vocabulary Words: These are general academic words that are commonly used across various subjects but may be unfamiliar in the context of biology. They are important for understanding the ideas and processes we'll be studying.

Tier 3 Vocabulary Words: These words are specific to biology, and they may not be used outside of this subject. These terms are essential for understanding biology topics in detail and are critical for mastering the content.

To make the most of this glossary, I encourage you to review it for at least 3 minutes before each class. By doing this regularly, you will improve your retention of the words and their meanings, which will help you better understand the lessons. As you progress through the modules, your teacher will refer to these terms during class discussions. At times, he may ask you to explain their meanings or use them in sentences, so it's important to become familiar with the vocabulary. By engaging with the glossary, you'll enhance both your understanding of the lesson and your ability to discuss it confidently. Remember, it's not just about memorizing terms, it's about understanding their significance and how they relate to the world around us.

Let's dive into our learning with this tool and prepare for an exciting and insightful exploration of life's processes!

Fig 3 Introductory Message

Figure 3 shows the introductory message that outlines the purpose and implementation of Grade 9 biology glossary designed to enhance learners vocabulary. For facilitators, it explains that the tool supplements the division's Self-Learning Modules and instructs teachers to actively integrate these frequently used terms into daily class discussions across all six modules. For learners, the message introduces a framework consisting of Tier 2 general academic words and Tier 3 specialized biology terms necessary for mastering the core content. Furthermore, both sections emphasize a shared routine where learners are expected to review the glossary for at least three minutes before each class, fostering deeper conceptual understanding and meaningful participation rather than just rote memorization.

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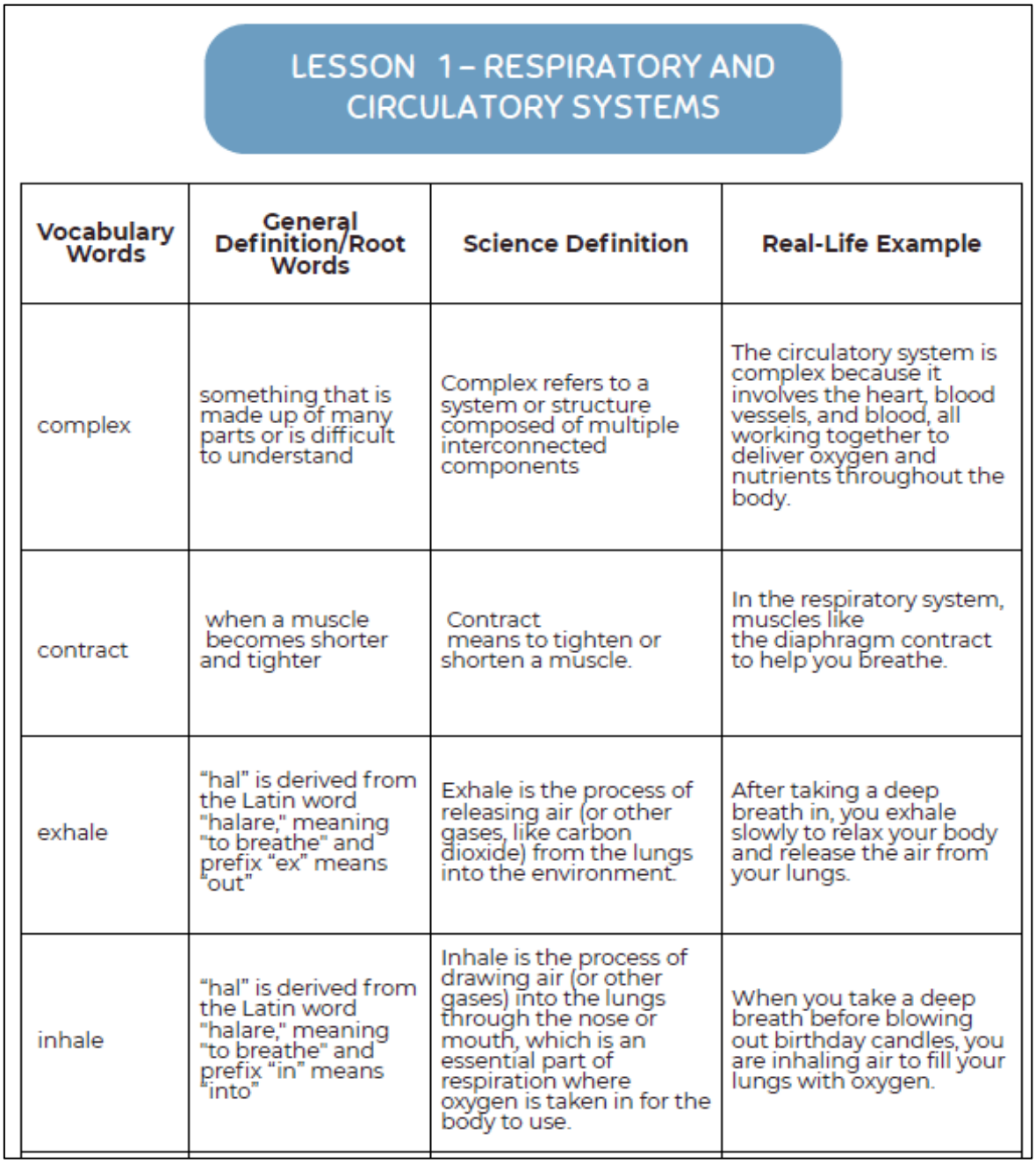

LESSON 1 – RESPIRATORY AND CIRCULATORY SYSTEMS

Vocabulary Words	General Definition/Root Words	Science Definition	Real-Life Example
complex	something that is made up of many parts or is difficult to understand	Complex refers to a system or structure composed of multiple interconnected components	The circulatory system is complex because it involves the heart, blood vessels, and blood, all working together to deliver oxygen and nutrients throughout the body.
contract	when a muscle becomes shorter and tighter	Contract means to tighten or shorten a muscle.	In the respiratory system, muscles like the diaphragm contract to help you breathe.
exhale	"hal" is derived from the Latin word "halare," meaning "to breathe" and prefix "ex" means "out"	Exhale is the process of releasing air (or other gases, like carbon dioxide) from the lungs into the environment.	After taking a deep breath in, you exhale slowly to relax your body and release the air from your lungs.
inhale	"hal" is derived from the Latin word "halare," meaning "to breathe" and prefix "in" means "into"	Inhale is the process of drawing air (or other gases) into the lungs through the nose or mouth, which is an essential part of respiration where oxygen is taken in for the body to use.	When you take a deep breath before blowing out birthday candles, you are inhaling air to fill your lungs with oxygen.

Fig 4 Glossary Content

Figure 4 shows the glossary content which includes the following components: Lesson Number and Title, Vocabulary Words, General Definition/Root Words, Science Definition and Real-Life Example. The lesson number and title at the top of the page informs learners about the specific biology topic being covered. The vocabulary words column shows target terms that learners need to master. General Definition/Root Words bridges the gap between a student's prior knowledge and new terminology. It provides either an everyday meaning or breaks the word down. The Science Definition column translates the vocabulary into precise, domain-specific scientific language tailored to biology.

Lastly, the Real-Life Example column anchors the abstract definitions into concrete reality, this column provides contextual scenarios.Together, these components create a robust vocabulary scaffolding system that moves learners away from shallow, rote memorization and toward deep conceptual understanding. Starting with a clear Lesson Title, learners mentally categorize the information. Moving from left to right, the table systematically builds word schema: the Root Words unlock morphological awareness (helping learners decode similar words in the future), the Science Definition builds technical accuracy, and the Real-Life Example ensures practical comprehension. This multi-layered approach ensures that learners can not only define the words but also confidently use and recognize them in context during class discussions.

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The development and implementation of the S-Glos carry profound educational implications that span classroom pedagogy, student cognition and institutional policy. For educators, the material demonstrates that vocabulary instruction must move away from passive rote memorization toward structured, micro-intervention models such as the 3-minute daily review that seamlessly integrate literacy into core science hours without sacrificing instructional time. Cognitively, the tool significantly reduces the reading anxiety and cognitive load of low-proficiency learners by providing a localized linguistic bridge, which fosters autonomous learning and eliminates the constant need for local vernacular translations. Finally, on an institutional level, this researcher-made intervention provides a data-driven, practical blueprint for addressing national scientific literacy deficits, aligning directly with the Department of Education's research agendas aimed at elevating student performance in international assessments.

Choosing the right words to teach and grouping them by difficulty is important for helping learners understand science and build their academic language skills. According to Beck et al. (2020), an effective way to do this is by looking at words in three different levels, or tiers. Teachers should teach high-utility academic words (Tier 2, like analysis) and technical, science-specific terms (Tier 3, like photosynthesis) side-by-side so learners can unpack tough science texts. This idea is backed by Hiebert and Goodwin (2021) and Hiebert and Kamil (2021), who argue that vocabulary choices must match the lesson goals and fit what learners already know to make learning meaningful and clear.

Moreover, Martínez and Mammola (2021) and Msipha and Mavuru (2022) point out that mastering science terms is absolutely necessary for learners to accurately read, understand, and talk about science concepts, while Lazaroff and Vlach (2022) prove that knowing science vocabulary directly predicts how well learners will achieve in the subject. When standard textbooks often fall short, targeted tools are badly needed. This is because limited access to specialized science terms creates a major barrier to understanding, a problem that directly explains why the learners in this study started with such low vocabulary scores (Zeng et al., 2025).

➢ *Quality of S-Glos as Evaluated by Experts*

Table 2 Quality of S-Glos as Evaluated by Experts

Factors	Perfect Score	Mean Score	Interpretation
Content	28	25	Passed
Format	72	69	Passed
Presentation	20	18	Passed
Accuracy and Up-to-datedness	24	24	Passed

- *Note.* To achieve an interpretation of Passed, the resource must meet or exceed the following minimum score thresholds: 21 out of 28 points for Content; 54 out of 72 points for Format; 15 out of 20 points for Presentation; and a perfect score of 24 out of 24 points for Accuracy and Up-to-datedness of Information.

Table 2 shows the quality of S-Glos as evaluated by experts. It gained positive results across all established metrics of the Learning Resources Management and Development System (LRMDS). Quantitative analysis of the five expert evaluations revealed that the material scored, translating to a qualitative descriptor of Passed. Specifically, the Content achieved 25 out of 28, Format received 69 out of 72, Presentation and Organization gained 18 out of 20, and Accuracy and Up-to-datedness of Information received a perfect score of 24 out of 24. All categories met the required standard.

The interpretation of the results is grounded in the descriptors for Factors 1 to 4 of the Evaluation Rating Sheet. The assessment of S-Glos shows that it satisfies all the standards expected of an effective learning resource. In terms of content, the score of 25 out of 28 suggests that the material is appropriate for Grade 8 learners. It aligns well with the intended learning objectives, supports cognitive development, encourages engagement, and remains free from bias. The slight difference from a perfect score may indicate minor gaps due to criteria that were not applicable during the evaluation. In terms of format, the score of 69 out of 72 indicates that S-Glos is highly effective in usability, readability, and visual presentation.

The material is generally well-organized and appealing, with only minimal areas for improvement, such as refining labels or enhancing the layout. Regarding presentation and organization, the score of 18 out of 20 indicates that the resource is clearly structured and easy to follow. Its language and overall design make it accessible and engaging for learners. The small deduction may point to minor opportunities to further improve sentence variety or increase engagement. Finally, the perfect score of 24 out of 24 in accuracy and up-to-datedness shows that S-Glos is free from errors and meets all standards for correctness, clarity, and relevance. It is a reliable and effective educational resource that promotes accurate understanding without causing confusion.

The findings of this study were supported by different literature and studies that emphasize the need for high-quality and expert-validated instructional materials as an intervention in the problem that both the teachers and learners faced inside the classroom. According to Baker et al. (2025), a vocabulary intervention is highly effective in boosting science vocabulary knowledge and content comprehension in learners which can be reflected in the passing score of the Content. Additionally, in contemporary classrooms, student progress and educational advancement are largely dependent on the format, presentation, and organization of

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instructional tools. Providing ready-to-use, standards-aligned content and well-structured tools lessen the workload of teachers and promote hybrid models that increase equity and engagement (OECD, 2023). The S-Glos' perfect score gained in Accuracy and Up-to-datedness of Information were in line with the fundamentals of 21st-century scientific education, which include technical accuracy and the science of reading (Petscher et al., 2020).

Furthermore, to sustain intervention efficacy, avoid long-term knowledge gaps, and promote successful vocabulary retention and comprehension gains, glossary information must be updated on a regular basis to ensure agreement with current scientific consensus. Evidence that accurate, up-to-date materials promote trustworthy scientific understanding supports this, reflecting precision-accuracy principles where trustworthy learning outcomes are driven by proximity to genuine values (Khatoon, 2026). Lastly, the use of content-specific tools like S-GLOS, which support human instruction and enable personalized learning paths in diverse classrooms, was found to be a major factor in improving science outcomes and learners' capacity for independent learning (Pan et al., 2023; Kamaghe, 2026).

➢ *Level of Vocabulary Skills in Science of Grade 9 Learners Before and After the Implementation of S-Glos*

Table 3 Level of Vocabulary Skills in Science of Grade 9 Learners Before and After the Implementation of S-Glos

	N	Mean	Interpretation	Standard Deviation (SD)
Pretest	25	7.26	Low Proficient	1.26
Post-test	25	20.33	Proficient	3.16

Table 3 shows the level of vocabulary skills of Grade 9 learners before and after the implementation of S-Glos. The pretest mean score of 7.27, which is interpreted as Low Proficient, suggests that respondents had a relatively poor understanding of vocabulary words used in teaching Biology in Grade 9 prior to the adoption of the science glossary. The standard deviation of 1.26, indicates that learners possessed minimal prior knowledge and that their initial understanding was consistently low across the group. Following the intervention, the post-test mean score increased to 20.33, which is interpreted as Proficient. This improvement shows that learners' comprehension of scientific terms and concepts was improved by the Science Glossary (S-Glos). The standard deviation for post-test was 3.16, showing substantial improvement among learners. The post-test standard deviation of 3.16 suggests that while there was a marked improvement in overall academic achievement, there was also a wider variation in the degree of progress among individual learners compared to the baseline.

These results imply that the shift from "Low Proficient" to "Proficient" suggests that the structured nature of the glossary directly assists in the cognitive processing and retention of complex scientific terminology. Furthermore, the increase in standard deviation post-intervention highlights that while the tool is broadly effective, learners respond to the resource at different rates, suggesting that it may benefit from being paired with differentiated instruction to accommodate varying levels of student readiness and learning paces.

The findings of this study were supported by recent researches and literature regarding the role of vocabulary in academic achievement. Zeng et al. (2025) emphasize that a lack of specialized terminology is a primary barrier to scientific comprehension, directly supporting the initial low proficiency levels observed in this study. It was further elaborated that understanding specialized scientific terminology is essential for genuine scientific comprehension because it allows learners to accurately access, interpret, and connect core concepts in discipline-specific texts and discussions (Martínez & Mammola, 2021; Msipha& Mavuru,2022). When learners or readers possess the appropriate technical vocabulary, they can decode dense scientific explanations, align everyday language with precise scientific meanings, and build coherent mental models of complex ideas.

In contrast, lacking specialized terminology significantly hinders comprehension, as learners either misapply everyday word meanings or remain unable to "unpack" scientific sentences, leading to confusion, fragmented understanding, and lower performance in science tasks (Msipha& Mavuru,2022). Therefore, it can be concluded that adapting vocabulary teaching to the individual needs and learning styles of learners may be a more effective strategy (Kansızoğlu & Bekiroğlu, 2025). Finally, embedded vocabulary in science classrooms shows that instruction deepens conceptual understanding.

➢ *Difference in the Level of Vocabulary Skills in Science of Grade 9 Learners Before and After the Implementation of S-Glos*

Table 4 Difference in the Level of Vocabulary Skills of Grade 9 Learners in Science before and after the Implementation of S-Glos

Pretest Mean Score	Post-test Mean Score	Mean Difference
7.26	20.33	13.07

Table 4 shows that the pretest mean score of the learners was 7.26, indicating a low level of performance prior to the intervention. After the implementation, the post-test mean score increased to 20.33, reflecting a significant improvement in performance. This resulted in a mean difference of 13.07, demonstrating that the intervention had a substantial positive effect on learners' outcomes.

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The improvement implies that the primary problem in science education for this group was not necessarily the complexity of the scientific concepts themselves, but the language barrier created by specialized vocabulary. The pretest results suggest that without an intervention like the S-GLOS learners were functionally locked out of lesson comprehension. The post-test results imply that providing a structured, easily accessible reference tool effectively reduced the cognitive load on learners, allowing them to bridge learning gaps and demonstrate academic competence. This suggests that the Science Glossary (S-Glos) serves as a critical equalizer, turning abstract terminology into usable knowledge.

Recent studies in the field reinforce the conclusions drawn from this study. Zeng et al. (2025) reinforce the initial findings, noting that a lack of academic vocabulary remains the most significant obstacle to learners accessing discipline-specific science materials. The success of the intervention aligns with Cervetti et al. (2023), who argue that structured vocabulary treatments involving clear definitions and frequent exposure are essential for language development. Recent experimental studies (Ayana et al.2024) further demonstrate that systematic vocabulary-learning-strategy interventions lead to measurable gains in vocabulary knowledge and reading comprehension.

Moreover, Saksittanupab (2025) adds that factors such as presenting vocabulary in real-life contexts, calibrating vocabulary difficulty, and learning in a relaxed atmosphere significantly enhance learners' motivation to learn vocabulary, suggesting that engagement-oriented conditions improve the effectiveness of vocabulary instruction. Finally, Erikson (2025) corroborates the quantifiable increases in accomplishment observed in this study, linking glossary-based instruction directly to improved word knowledge and conceptual recall. Together, these sources validates that the S-Glos is an effective, evidence-based instructional intervention.

➢ *Experiences of Grade 9 Learners During the Implementation of S-Glos*

The implementation of S-Glos showed both positive and negative experiences among Grade 9 learners and the teacher. A thematic analysis was conducted to identify significant themes and patterns from the Focus Group Discussion (FGD) with Grade 9 learners and from the interview with the subject teacher who facilitated the implementation of the study. The findings show that the S-Glos was beneficial in improving science vocabulary learning, although some challenges were also observed during its use.

- *Improved Understanding of Scientific Terms*

The data revealed that learners and teacher perceived the glossary as an effective tool for improving their understanding of scientific vocabulary. In this study, most of the participants agreed that S-GLOS helped them improved their understanding of scientific terms during the implementation of the said intervention. One student, Participant A, highlighted during an interview that S-GLOS provided aid in clarifying difficult words, emphasizing how the glossary served as a reliable reference whenever unfamiliar or complex scientific terms were encountered during lessons. This suggests that the tool supported comprehension by offering immediate explanations that reinforced learning.

"My experience with the science glossary was very good because it helped me understand terms."

Another student, Participant B, acknowledge the efficacy of S-Glos in making difficult terms easier to understand, pointing out that the glossary simplified complex scientific vocabulary into more understandable language. This indicates that the glossary contributed to reducing confusion and enhancing clarity in learning scientific concepts.

"Yes, S-Glos made understanding science terms easier."

These statements from learners was also supported by the teacher who stated that the glossary plays a crucial role in facilitating learners' comprehension by providing clear and accurate definitions. The teacher's perspective highlights the instructional value of the glossary as a supplementary tool that strengthens learners' grasp of scientific language.

"Using S-Glos in supporting learners' understanding of science terms is very effective; it gives a precise definition of scientific terms that easily helps the learners to comprehend."

Another student, Participant C, shared that S-Glos was particularly helpful in defining unfamiliar terms encountered during classroom discussions, enabling better understanding of lesson content. This implies that the glossary functioned as an immediate support system for vocabulary development during instruction.

"The glossary helped me understand the meaning of unfamiliar science words during the lesson."

Similarly, one student, Participant D, expressed that having access to the glossary allowed for smoother participation in class discussions, as it provided a way to quickly verify the meanings of scientific terms. This reflects how the glossary supported not only comprehension but also engagement in learning activities.

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"It was easier for me to follow the discussion because I could check the meaning of terms in the glossary."

In addition, a student, Participant E, stated that S-Glos reduced confusion when encountering new scientific terms, indicating that it helped simplify complex vocabulary and made learning more manageable. This further supports the idea that the glossary minimized learning difficulties associated with technical language.

"S-Glos made it less confusing when we encountered new scientific terms."

This indicates that the glossary functioned as a cognitive support tool, enabling learners to decode unfamiliar terminology and grasp scientific concepts more effectively. These findings suggest that integrating a science glossary in instruction can significantly enhance learners' conceptual understanding, particularly in subjects that are terminology-heavy like science. Through simplifying complex vocabulary, the glossary reduces cognitive load and allows learners to focus more on conceptual learning rather than mere memorization. However, the variation in responses also implies that glossaries should be supplemented with additional instructional strategies such as teacher explanation or contextual learning to maximize effectiveness.

- *Ease of Use and Accessibility*

Learner participants evaluated the S-Glos as easy to use, citing its intuitive interface that facilitates rapid term location and comprehension. During an interview, one student, Participant A, mentioned the convenience of S-Glos, emphasizing that the tool requires minimal effort to navigate and can be used effectively even without prior experience. This suggests that the design of the glossary supports immediate usability, allowing learners to engage with the material without difficulty.

"It was easy to use from the start."

Also, one respondent, Participant B, frequently noted that they got used to it after initial exposure, reflecting rapid acclimatization to the platform's structure. This indicates that while there may be a slight learning curve at the beginning, the system becomes familiar and manageable after repeated use, highlighting its user-friendly design.

"At first, it was difficult to use, but later I got used to it."

The alphabetical order arrangement was particularly commended for enabling efficient navigation to scientific terminology. Participant C stated that this feature allows users to locate terms systematically and without confusion, demonstrating how organized content presentation enhances usability.

"The alphabetical arrangement of terms is very useful for easy navigation of scientific terms."

Another participant, Participant D, shared that the clear arrangement of terms contributes to faster searching and retrieval of information. This implies that the structured layout of the glossary reduces the time spent locating definitions, making the learning process more efficient.

"I can quickly find the terms because everything is arranged clearly."

Similarly, one student, Participant E, expressed that the simplicity of the glossary minimizes confusion during use, indicating that the interface design supports straightforward interaction. This reflects the accessibility of the tool, particularly for learners who may struggle with complex systems.

"The glossary is simple to use, and I don't get confused when looking for words."

In addition, a respondent, Participant F, stated that the glossary helps save time when searching for definitions, suggesting that the tool enhances efficiency in completing academic tasks. This further supports the idea that S-Glos promotes productivity by *streamlining the process of understanding scientific terms.*

"It helps me save time because I can easily locate the meaning of terms."

These results indicate that S-Glos's ease of use design promotes immediate accessibility, allowing users to get used to the tool and sustain engagement with scientific content. The alphabetical order minimizes cognitive load, shifting focus from search mechanics to conceptual understanding. Consequently, S-GLOS holds potential to enhance science education outcomes, particularly for novice learners in resource-limited settings.

- *Positive Study Habits and Motivations*

The evaluation of S-Glos revealed that learners utilized the tool consistently, leading to more effective and positive results in improving the vocabulary skills. During an interview some learners revealed that they often used the material. Participant A stated

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that the glossary became a regular reference tool, especially when encountering unfamiliar or confusing scientific terms. This indicates that the tool supports independent learning by allowing students to clarify meanings on their own during study sessions.

"I frequently use the glossary, especially when I am confused of the words".

Participant B shared that the glossary was used almost daily, reflecting a high level of engagement and habitual use of the material. This suggests that the accessibility and usefulness of the glossary encouraged learners to incorporate it into their daily learning routines.

"Almost everyday, I try using it."

Furthermore, learners reported that the accessibility of the glossary significantly bolstered their enthusiasm for academic tasks. Participant C emphasized that the glossary served as a motivating factor in studying science lessons, as it made understanding terms easier and more manageable. This implies that improved comprehension can positively influence learners' motivation and willingness to learn.

"I am motivated to study the lesson in science because of the glossary. It helped me became motivated to study."

Another participant, Participant D, mentioned that the glossary was consistently used whenever unfamiliar terms appeared during lessons, showing that it functioned as an immediate support tool in the learning process. This highlights its role in enhancing real-time comprehension during classroom discussions.

"I use the glossary whenever I encounter unfamiliar terms during the lesson."

Similarly, Participant E expressed that the glossary was useful even beyond classroom instruction, as it allowed for continuous review of terms after lessons. This indicates that the tool supports both in-class learning and independent study, reinforcing vocabulary retention.

"The glossary helps me review the meaning of words even after class."

In addition, Participant F stated that the glossary encouraged more frequent studying by making scientific terms easier to understand. This suggests that when learners feel more confident in their comprehension, they are more likely to engage actively in their studies.

"It encourages me to study more because I can understand the terms better."

The high frequency of use underscores the necessity of intuitive, subject-specific digital resources in science education. By serving as an accessible reference, S-Glos reduces the cognitive barriers typically associated with technical terminology, which in turn fosters a sustainable habit of inquiry. The positive shift in student motivation suggests that when learners feel competent in navigating scientific language, they are more inclined to participate actively in class and engage deeply with the curriculum. Furthermore, providing such tools can transform classroom dynamics, moving learners from passive recipients of information to proactive, self-directed learners.

- *Positive Perception and Acceptance*

S-Glos efficacy in helping learners learn and understand scientific terms has been proven through focused group discussion. Most participants expressed a willingness to recommend the glossary to others, describing it as very helpful. One student, Participant A, said during an interview that the glossary was perceived as a practical and beneficial learning tool, particularly because it provided support in understanding scientific vocabulary. This reflects a positive evaluation of the glossary's usefulness in academic tasks.

"Yes, I would recommend it because it is useful."

Another student, Participant B, also commended the positive and effective effect of S-Glos, mentioning in his answer during an interview that he was willing to recommend it to others. He emphasized that his personal experience with the glossary significantly improved his understanding of complex scientific terms. This suggests that direct experience with the tool strengthened learners' confidence in its effectiveness.

"Yes, I would definitely recommend it to others. I have experienced how it helped me a lot in science, especially in understanding those difficult terms."

The teacher also confirmed in an interview that S-Glos was recommendable because of its simplified and precise definition of terms. The teacher's response highlights the instructional value of the glossary in presenting scientific vocabulary in a clear and

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concise manner, which supports student comprehension.

"The positive aspect of the glossary is that the definition of terms are simplified and precise."

Another participant, Participant C, shared that the glossary could be beneficial not only for personal use but also for peers, as it makes learning science more manageable. This indicates that learners recognize the broader applicability of the tool in supporting others' learning experiences.

"I would suggest this glossary to my classmates because it makes learning science easier."

Similarly, Participant D expressed that the glossary is particularly helpful for learners who experience difficulty in understanding scientific terms, suggesting that it serves as an inclusive learning aid. This reflects the tool's potential to support diverse learners with varying levels of comprehension.

"It is helpful for learners like me who struggle with scientific terms, so I would recommend it."

In addition, Participant E stated that the glossary is a useful resource that can benefit a wide range of learners, indicating a general positive perception of its effectiveness. This further reinforces the idea that the glossary is a valuable educational tool that can be integrated into classroom instruction.

"The glossary is a good tool, and I think other learners will benefit from using it."

This indicates a high level of acceptance and satisfaction with the tool. Even learners who noted some limitations still acknowledged its overall usefulness. The positive perception suggests that the glossary is a viable instructional intervention for improving science vocabulary. High acceptance among learners increases the likelihood of continued use and successful implementation in classrooms. This also implies that similar tools can be developed and integrated into other subject areas to support learning.

Research collectively demonstrates that structured linguistic and interactive supports are fundamental to mastering scientific discourse and fostering academic success. Venida (2021) established that learners taught via inquiry-based approaches integrated with explicit vocabulary instruction perform significantly better in conceptual understanding, a finding reinforced by Lazaroff and Vlach (2022), who identified domain-specific vocabulary mastery as a unique predictor of success in science. The role of specialized tools in bridging academic language gaps is further supported by Thamburaj et al. (2025), while Lee et al. (2023) and Strasser et al. (2024) highlight that targeted professional development and scaffolded environments enhance the transfer of conceptual understanding to new contexts. In terms of accessibility, Pagutayao & Paglinawan (2024) and Jolampong et al. (2025) note that reducing cognitive friction via intuitive tools increases learner confidence and independent research skills. This is bolstered by Mindo & Paglinawan (2025), who found that interactive tools correlate with active participation, and Bazar et al. (2024), who confirmed that well-supported, motivated learners demonstrate higher academic efficacy. Finally, acceptance of these interventions is tied to perceived utility; Baptiste (2021), Belisario & Paglinawan (2025), Bozhani et al. (2025), Van Dulmen et al. (2023), and Gaspard et al. (2023) collectively conclude that when learners perceive resources as relevant and accessible, it fosters a positive learning environment, sustains motivation, and directly improves academic performance.

➢ *Experiences of the Teacher Practitioner*

The researcher addressed various themes based on the interview with the teacher practitioner. Thematic analysis was used to analyze, code, and discuss the findings of the interview.

- *Glossary as a Tool for Comprehension*

The integration of S-Glos has proven to be a highly effective pedagogical strategy in the classroom. During the interview, the teacher emphasized the tool's utility, stating,

"Using S-Glos in supporting learners' understanding of science terms is very effective; it gives a precise definition of scientific terms that easily helps the learners to comprehend."

This finding suggests that the glossary acts as a vital bridge between complex terminology and student knowledge, allowing for a more streamlined grasp of difficult scientific concepts.

These results imply that by providing learners with precise definitions, educators can significantly reduce the cognitive load associated with scientific inquiry. When learners possess a reliable resource to clarify technical language, they are better equipped to engage in deeper analytical thinking rather than struggling with vocabulary. As the teacher noted, this clarity is foundational to comprehension, suggesting that well-designed instructional materials are essential for maintaining student motivation and ensuring that the classroom environment remains conducive to academic success.

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- *Supports Vocabulary Development*

The implementation of S-Glos has been identified as a significant factor in improving learners' comprehension of scientific content. During the interview, the teacher emphasized the direct benefit of this pedagogical tool, stating,

"The definition of science terms help learners to understand the meaning of those difficult science words."

This feedback indicates that the glossary serves as an effective, accessible reference that empowers learners to decode challenging terminology and engage more successfully with complex scientific concepts

These findings suggest that providing learners with precise, simplified definitions is a critical strategy for alleviating the cognitive challenges posed by scientific discourse. By integrating such tools, educators can shift the focus from rote memorization of unfamiliar terms to a more profound exploration of scientific meaning and application. This enhancement in comprehension not only bolsters student academic efficacy but also fosters an environment where learners feel more confident and motivated to participate in scientific inquiry and classroom discussions.

- *Simplification Enhances Understanding*

The evaluation of S-Glos demonstrated its distinct advantage in clarifying technical content compared to traditional textbooks. During an interview, the teacher highlighted this efficiency, noting,

"The positive aspect of the glossary is that the definition of the term is simplified and precise. In some books, the authors described the term in general or vague but in glossary, the scientific terms have specified definitions."

This feedback suggests that the glossary effectively bridges the gap between general textbook descriptions and the necessary rigor required for scientific mastery by providing learners with targeted, unambiguous explanations.

These findings indicate that specialized glossaries serve as essential pedagogical tools that enhance the precision of scientific communication in the classroom. By offering specified definitions, these tools minimize the ambiguity that often arises from the broad or generalized language found in standard textbooks. This clarity is crucial for student learning, as it enables them to grasp the exact technical nuance of a term, thereby reducing confusion and fostering a more accurate conceptual understanding of complex scientific topics.

- *Glossary as a Teaching Reference Tool*

The glossary functions as a pivotal reference teaching tool, providing essential support throughout the various phases of an inquiry-based lesson. In a recent interview, the teacher highlighted this practice, stating,

"In engage part or in explain part of the lesson, I sometimes put some unlocking of scientific terms."

This strategy demonstrates that the teacher proactively utilizes the glossary to define complex terminology during critical moments of the lesson, ensuring that learners possess the foundational vocabulary required to participate effectively in the learning process.

The intentional integration of vocabulary unlocking into the engage and explain phases suggests a deliberate pedagogical focus on scaffolding. By front-loading technical definitions, teachers reduce cognitive barriers that might otherwise prevent learners from forming meaningful connections to new scientific concepts. This approach not only promotes active participation during the lesson's exploratory phases but also empowers learners to utilize the glossary as a reliable, ongoing reference point. Such instructional habits transform the glossary from a static resource into a dynamic tool that actively drives conceptual growth.

The first and second themes; Glossary as a Tool for Comprehension and Supports Vocabulary Development were supported by the study of (Ayanaet al.2024) that demonstrates that systematic vocabulary-learning-strategy interventions lead to measurable gains in vocabulary knowledge and reading comprehension. Moreover, Baker et al. (2025) stated that a vocabulary interventions is highly effective in boosting science vocabulary knowledge and content comprehension. The theme Glossary as a Teaching Reference Tool was supported by Pan (2023); Kamaghe (2026) which stated that the use of content-specific tools like S-GLOS, which support human instruction and enable personalized learning paths in diverse classrooms, was found to be a major factor in improving science outcomes and learners' capacity for independent learning.

➢ *Improvement that can be Made to Enhance S-Glos for Future Use*

The following suggestions and recommendations below that will help improve S-Glos for future use were both gathered from the focused group discussion among learners and interview from the teacher.

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- *Need for Additional Support*

Despite the positive feedback, several learners expressed the need for additional support, such as examples, images, and teacher explanations. Statements like *"I still need teacher explanation"* and *"more examples are needed"* indicate that the glossary alone was not always sufficient for deep understanding. This suggests that while the glossary aids comprehension, it does not fully replace interactive instruction.

This finding highlights the importance of combining instructional tools with teacher facilitation. Glossaries should be enhanced with multimedia elements such as visuals and contextual examples to cater to diverse learning styles. Moreover, teachers play a crucial role in scaffolding learning by clarifying complex terms and providing contextual explanations. A blended approach that integrates glossaries with active teaching strategies is therefore recommended.

The need for active mediation is supported by research indicating that the general meaning of scientific terms is best grasped when educators integrate explicit vocabulary instruction and semantic scaffolding directly into live classroom discussions, rather than relying on independent student interpretation (Venida, 2021). Recent studies highlight that tools such as glossaries become genuinely impactful only when teachers intentionally integrate them into meaningful, context-rich activities. Research indicates that when these tools are used without sufficient context, they may result in only superficial cognitive engagement (Stoeckel, 2024; Ferede et al., 2025). Furthermore, Abad and Hattie (2025) emphasize the critical role of teachers, noting that empowering them to select and adapt instructional resources not only improves the quality of lesson planning but also supports ongoing professional growth. The need for a well-structured approach to implementation is supported by Ayado and Berame (2022), who found that supplementary materials are most effective when they target least-mastered competencies. Similarly, Cervetti et al. (2023) argue that vocabulary instruction is most successful when it is integrated into meaningful contexts and reinforced through repeated exposure. Similarly, Essien (2025) underscores that the effectiveness of tools like S-Glos relies heavily on strong implementation fidelity, highlighting that consistent, teacher-driven integration is a key factor in ensuring the success of such interventions.

- *Visual Enhancements for Better Engagement*

To better support learners, the teacher recommended using visual formatting as she stated during an interview *" I would suggest to put highlights or italicized or underline the terms to emphasize the scientific terms use I the real life example column."* The teacher also suggested for additional scientific terms to be added in the S-Glos for a broader and wider knowledge as learners' needs for vocabulary are also growing.

The findings imply that continuous improvement is vital for the S-Glos to remain an effective learning tool, especially as student feedback points to the need for more detailed explanations and visual aids. The teacher's request for more scientific terms indicates that learners are advancing in their proficiency and require a broader vocabulary to continue growing. Furthermore, the suggestion to use bolding, italics, or underlining to highlight how terms are used in real-life examples shows that vocabulary retention can be difficult when terms are buried in dense text. By using these visual anchors, the tool can better help learners bridge the gap between abstract definitions and practical application. Additionally, the effectiveness of the S-Glos depends not only on the information it provides but also on how that information is visually organized to guide the learner's attention.

The teacher's recommendation in improving S-Glos is well-supported by recent academic researches. Training learners to use vocabulary-learning strategies (including glossaries and word lists) significantly improves their vocabulary size and achievement, especially when learners work with a growing set of target words.This supports the idea that glossaries that include a growing number of terms (not just a small static list) help learners expand their word knowledge over time (Ayana, 2024). Moreover, expanding a glossary with more terms and richer explanations supports both vocabulary breadth and depth, which in turn expands learners' capacity to understand complex material and to keep learning (Tran, 2020). Another suggestion to enhance S-Glos is to improve the visual anchors of the material.This need for visual hierarchy is further supported by Widoff (2023), who posits that visual anchors such as italics provide a stable semantic core that helps learners isolate technical meaning within complex texts. Finally, Hwang et al. (2023) demonstrate that vocabulary interventions are most effective when they are content-rich and systematically integrated into active instruction.

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CHAPTER FOUR
FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusions, and recommendations of the study. This study was focused on improving the vocabulary skills of Grade 9 learners, School Year 2025-2026.

➢ *Findings*

This action research aimed to improve the poor vocabulary skills in science of Grade 9 learners through S-Glos in one of the large secondary schools in Central Philippines, school year 2025-2026. The following were the obtained findings during the conduct of the said intervention:

The developed S-Glos successfully improved science vocabulary skills of grade 9 learners by addressing the reading barriers that low-proficiency learners face. Data and supporting literature show that prior to using the glossary, learners exhibited low science vocabulary scores because limited access to specialized terminology directly blocks reading comprehension and conceptual understanding. By selecting and grouping high-utility academic words (Tier 2) and technical terms (Tier 3) side-by-side, the S-Glos functions as a localized linguistic bridge that systematically helps learners unpack dense and complex biology terms. Furthermore, the implementation of the glossary's structured 3-minute daily review protocol proves that vocabulary instruction can be seamlessly integrated into core science hours to build necessary academic language skills without sacrificing valuable lesson time. Indeed, the data demonstrates that this scaffolded approach significantly reduces cognitive load for the participants, allowing them to accurately read and connect core scientific concepts while fostering independent learning in the classroom.

Additionally, the S-Glos met LRMDS standards and was reliable for classroom use. Its content is appropriate for Grade 9 learners, well-aligned with learning objectives, and supports engagement and cognitive development, with only minor gaps noted. The format is clear, user-friendly, and visually appealing, requiring only slight refinements. Its presentation and organization are strong, making it easy to understand and engaging, with minimal room for improvement. Most notably, it achieved a perfect score in accuracy and up-to-datedness, confirming that the material is error-free, current, and suitable for educational use.

Furthermore, the level of vocabulary skills in science among Grade 9 learners improved after the implementation of S-Glos. From a pretest mean score of 7.26 and interpreted as Low Proficient, the results increased to a post-test mean score of 20.33, and interpreted as Proficient.

There was also an observable difference in the level of vocabulary skills of grade 9 learners before and after the conduct of S-Glos based on the visible increase on their post-test results. The mean scores increasing from 29.04% to 81.32% shows a gain of over 52 percentage points.

Based on the themes that emerged during the FGD with learners and the teacher-practitioner, S-Glos was found to be helpful vocabulary tool that enhances learning comprehension, fosters collaboration and focus during class discussions, and develops scientific vocabulary abilities, according to the experiences of both teachers and learners. However, its effectiveness is influenced by instructor support and frequent use.

S-Glos, despite its effectiveness on the current study, still, need further enhancement for a broader and wider use. Teacher and student feedback highlighted precise definitions aiding comprehension but noted needs for examples, images, and visuals.

➢ *Conclusions*

S-Glos is an effective instructional tool that successfully overrides the limitations of standard textbooks by dismantling the vocabulary barriers that hinder low-proficiency readers. The combination of high-utility academic words and technical terms serves as a necessary language bridge that simplifies complex biology terms for struggling learners.

The developed supplementary material also demonstrates strong effectiveness as a classroom-ready intervention for addressing Grade 9 science vocabulary challenges. It has also met established LRMDS standards with its strong ratings in format, presentation, and accuracy. This contributes to its effectiveness, making it not only easy to use but also engaging for learners.

The implementation of S-Glos led to substantial improvements in learners' vocabulary skills. It has improved learners' vocabulary skills from a low level of proficiency to a proficient level, confirming its ability to address initial learning gaps and support mastery of scientific terms.

The 52-percentage-point gain from the pretest to the post-test provides proof that the S-Glos intervention is highly effective. The increase in their test scores moving from a mean score of 29.04% before the implementation to a strong 81.32% afterward proves that this approach genuinely helped learners learn and retain new words.

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Moreover, S-Glos functions as a practical, high-value vocabulary tool that actively improves learning comprehension, boosts collaboration and focus among learners. However, its ultimate success relies heavily on regular daily use and active guidance from the teacher.

While S-Glos is highly effective in its current form, it requires continuous refinement before it can be used on a wider scale. To maximize its impact for a broader audience of learners, the text-based definitions must be upgraded with real-world examples and supportive visual aids. This positions S-Glos as more than just a reference material, it becomes an active tool that supports inquiry-based learning, particularly when thoughtfully integrated by teachers during key parts of instruction. Despite that, variations in learners' levels of improvement indicate that while the tool is broadly effective, learners respond differently to the intervention. This means teachers should use mixed teaching methods alongside S-Glos so that every student can benefit, no matter how fast or slow they learn.

- *Recommendations*

Learners are encouraged to regularly use S-Glos during science classes and in independent study to further develop their vocabulary skills, which can contribute to improved academic performance. Consistent use of the glossary can strengthen their retention and understanding of scientific terms. Science teachers are likewise encouraged to integrate S-Glos into their instruction or develop similar glossaries tailored to their specific field, as this approach has been shown to enhance learners' vocabulary and comprehension. Teachers from other subject areas may also adopt this strategy, given its demonstrated effectiveness.

Furthermore, school principals are encouraged to support the development and implementation of S-Glos materials and to promote their integration into science instruction as part of instructional innovation initiatives. For present researchers, it is highly recommended to immediately apply the feedback gathered from teachers and learners by enriching the current S-Glos with contextualized real-world examples, diagrams, and supportive visual aids to enhance its overall comprehensibility. At a broader level, the Education Program Supervisor in Science is encouraged to support the development and wider use of S-Glos across junior and senior high school science classes, including providing resources for improving its design and format. Strengthening institutional support for such innovations may help improve learners' comprehension skills and overall academic performance in science. Finally, future researchers are encouraged to conduct related studies involving larger and more diverse samples, as well as different subject areas. They may also build upon and further explore aspects of this study that were not fully examined, contributing to the continued improvement of research in this area.

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