

Learners' Vocabulary and Conceptual Understanding of Selected Physical Science Words

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ABSTRACT

This action research examined the effectiveness of a vocabulary-focused intervention in improving the vocabulary mastery and conceptual understanding of selected Physical Science words among 35 Grade 12 Technical-Vocational-Livelihood (TVL) learners in the Automotive Servicing and Home Economics strands. Purposefully sampled due to observed difficulties in recognizing, pronouncing, and defining scientific terms, the participants underwent an intervention consisting of a Science Word Bank, vocabulary drills, concept reinforcement activities, and interactive tools integrated into regular instruction. The study employed a classroom action research design utilizing a teacher-made pretest and post-test, alongside qualitative tools including perception questionnaires, classroom observations, and learner reflections. Quantitative findings revealed a statistically significant increase in mean scores from 12.63 in the pretest to 17.03 in the post-test, yielding a mean gain of 4.40 points, $t(34) = 7.49$, $p < .001$. Learners evaluated the intervention highly positively with an overall perception mean of 4.90, while classroom observations confirmed active participation with a mean of 3.92. Thematic analysis of qualitative data substantiated these results, showcasing marked improvements in vocabulary development, conceptual understanding, real-life application, and classroom engagement. The study concludes that explicit, contextualized, and interactive vocabulary instruction effectively bridges learning gaps and enhances academic performance. Continued integration of vocabulary-focused strategies is highly recommended for Physical Science and other technical courses where specialized terminology poses a barrier to learner comprehension.

Keywords: *action research, Physical Science, vocabulary mastery, conceptual understanding, vocabulary intervention, Grade 12 TVL learners*

INTRODUCTION

Language played a crucial role in the teaching and learning of science because scientific ideas were communicated through specialized terms whose meanings needed to be understood accurately and used appropriately. In Physical Science, learners were expected not only to recognize technical vocabulary but also to connect such vocabulary to concepts, explanations, and real-life applications. Recent literature showed that scientific language was closely related to learners' sensemaking and conceptual development in science, and that students often experienced difficulty when they could not use scientific terms precisely in interpreting phenomena or explaining ideas (Hamnell-Pamment, 2023, 2024). Similarly, disciplinary vocabulary in science was found to contribute meaningfully to learners' mastery of educational objectives,

indicating that science learning depended not only on general comprehension skills but also on familiarity with subject-specific language (Strasser et al., 2024).

This concern became evident in the case of the Grade 12 Technical-Vocational-Livelihood learners included in the present study. In a prior classroom observation of 40 learners under the Automotive Servicing and Home Economics strands, 35 were observed to have difficulty understanding and using common Physical Science terms. This vocabulary gap affected their ability to explain concepts clearly, respond accurately during class discussions, and perform well in written assessments. The problem was particularly significant because many TVL learners tended to engage more frequently with practical and skills-based tasks, which could limit their exposure to the academic and technical language used in science instruction. Recent studies also indicated that learners in science classrooms often struggled when disciplinary vocabulary, pronunciation demands, and concept-heavy texts were not explicitly supported, especially in contexts where English functioned as an additional language of learning (Othman, 2024).

For many Filipino learners, English had functioned as a second language in classroom instruction, and this linguistic condition had intensified the difficulty of learning science concepts expressed through unfamiliar technical terms. When learners did not fully understand the language of science, they were less likely to participate confidently in recitation, ask questions, or express conceptual understanding accurately. Current literature emphasized that English learners and multilingual learners benefited from explicit, developmentally appropriate vocabulary instruction because vocabulary knowledge supported access to academic discourse, reading comprehension, and content learning (Zeng et al., 2025). In science settings, difficulties in academic vocabulary, pronunciation, and limited exposure to technical terminology were also associated with reduced classroom participation and weaker comprehension of scientific ideas (Othman, 2024). These insights suggested that vocabulary support should not be treated as a separate language concern alone, but as an essential component of science instruction itself.

In response to this classroom need, the present action research focused on selected Physical Science words that learners had frequently misinterpreted, mispronounced, or failed to apply meaningfully in context. The study was grounded in the view that strengthening learners' scientific vocabulary could improve not only word recognition and pronunciation but also conceptual understanding and classroom engagement. This direction was supported by recent evidence showing that targeted science vocabulary interventions improved learners' vocabulary skills and promoted better comprehension of science content (Leonen, 2025). Likewise, studies on vocabulary learning strategies showed that structured vocabulary-focused instruction significantly improved learners' vocabulary knowledge achievement and learning motivation, particularly when learners were given repeated exposure, semantic support, and active practice opportunities (Ayana et al., 2024). These findings reinforced the appropriateness of using vocabulary drills, guided practice, and contextualized reinforcement activities as intervention strategies in Physical Science.

The study was also aligned with current educational priorities that emphasized literacy, vocabulary, comprehension, and remediation. Recent DepEd issuances and policy materials highlighted vocabulary and comprehension as important targets of academic recovery and literacy support programs, reflecting the continuing need to address learning gaps through structured intervention (Department of Education [DepEd], 2025a, 2025b). Moreover, DepEd's 2025 functional literacy policy brief underscored that comprehension remained a critical challenge in the Philippine context, as the gap between basic literacy and functional literacy pointed to the need for stronger support in understanding written material, not merely decoding it (DepEd, 2025c). In this light, the present study was considered timely and relevant because it attempted to bridge the gap between language and content learning in Physical Science. By integrating explicit vocabulary instruction into regular classroom teaching, the study aimed to help learners develop greater confidence in using scientific terms, deepen their conceptual understanding, and apply scientific ideas more meaningfully in school and everyday contexts.

Research Questions

This action research aimed to improve the vocabulary mastery and conceptual understanding of selected Physical Science words among Grade 12 Automotive Servicing and Home Economics learners through vocabulary drill activities.

Specifically, the study would like to answer the following questions:

1. What was the level of vocabulary mastery and conceptual understanding of selected Physical Science words among Grade 12 Automotive Servicing and Home Economics learners before and after the implementation of vocabulary drill activities?
2. Was there a significant difference between the learners' pretest and post-test scores after the implementation of vocabulary drill activities?
3. What changes were observed in the learners' pronunciation, contextual usage, and comprehension of selected Physical Science vocabulary after the intervention?
4. How did the learners perceive the vocabulary drill activities in terms of confidence, participation, motivation, and understanding of Physical Science concepts?
5. What challenges were experienced by the learners and the teacher-researcher during the implementation of the intervention?
6. What action plan could be proposed based on the findings of the study?

Innovation, Intervention, and Strategy

The study implemented a classroom-based vocabulary support intervention designed to improve the vocabulary mastery and conceptual understanding of selected Physical Science words among Grade 12 Technical-Vocational-Livelihood learners in Automotive Servicing and Home Economics. The intervention responded directly to the observed classroom problem that many learners experienced difficulty in recognizing, pronouncing, defining, and using scientific terms accurately, which in turn limited their comprehension of Physical Science concepts and reduced their confidence during class discussions, recitations, and written tasks. The intervention was carried out as an integrated instructional support system rather than as an isolated remedial activity so that vocabulary learning became part of the daily teaching of science content. This was consistent with recent evidence showing that explicit vocabulary instruction, contextualized exposure to disciplinary terms, and repeated practice supported learners' access to academic language and strengthened content understanding. Recent studies likewise indicated that science learning improved when technical vocabulary was deliberately taught, practiced in context, and linked to sensemaking activities rather than left for learners to infer independently.

The distinctive feature of the intervention was its combined focus on word recognition, pronunciation, contextual usage, and conceptual understanding. Instead of treating vocabulary as a memorization task only, the intervention treated scientific words as tools for thinking, explaining, and applying Physical Science ideas. It combined structured repetition, guided meaning-making, collaborative learning, and visual or interactive reinforcement. This made the intervention especially responsive to the needs of TVL learners, who often benefited from concrete, guided, and application-oriented activities. The intervention also remained practical and low-cost because it used teacher-made materials, printed drills, word displays, interactive review tasks, and routine classroom strategies that could be sustained beyond the duration of the study.

The intervention consisted of four interrelated component activities: Science Word Bank, Vocabulary Drills, Concept Reinforcement Activities, and Interactive Tools. The Science Word Bank served as the central vocabulary support mechanism. Selected Physical Science words taken from the lessons on Laws of Motion, Work, Power and Energy, Momentum and Impulse, and Circular Motion and Gravitation were compiled and presented with definitions, pronunciation guides, contextual examples, and, where appropriate, simple illustrations or keyword cues. This component gave learners an accessible reference that reduced confusion over unfamiliar terminology and allowed repeated exposure to essential terms. The

Science Word Bank was updated and revisited throughout the intervention period so that learners could continuously connect new science words to the concepts discussed in class.

The second component, Vocabulary Drills, provided direct and repeated practice in pronouncing, spelling, defining, and using scientific words. These drills were conducted through oral repetition, guided pronunciation practice, matching activities, sentence completion, fill-in-the-blank tasks, short response exercises, and teacher-led questioning. This component aimed to build familiarity, improve recall, and reduce learners' hesitation in using scientific terms during class participation. Repetition was necessary because many of the learners initially showed uncertainty when reading or saying scientific vocabulary aloud. The drills therefore functioned as scaffolded opportunities for learners to gradually move from recognition to correct use.

The third component, Concept Reinforcement Activities, linked vocabulary learning to conceptual understanding. In this component, learners engaged in activities such as examples and non-examples, concept mapping, guided explanation tasks, vocabulary-to-concept matching, situational analysis, and brief written reflections. These activities ensured that the learners did not merely memorize terms but understood how each word functioned within a scientific idea, process, or principle. This component addressed the problem identified in the class that learners could sometimes recall terms superficially but still failed to explain the related concept accurately. Through concept reinforcement tasks, vocabulary became anchored in meaning and application.

The fourth component, Interactive Tools, increased learner participation and motivation. These included flashcards, puzzles, board work, peer review activities, group vocabulary games, and, when available, simple digital or visual aids. Interactive activities were used to make difficult vocabulary more approachable and to provide multiple opportunities for retrieval, collaboration, and immediate feedback. Evidence from recent studies supported the use of technology-assisted and flashcard-based vocabulary practice because repeated and multimodal exposure improved vocabulary retention and academic vocabulary development.

Several people were involved in the implementation of the intervention. The teacher-researcher had the primary responsibility for planning the intervention, selecting the target vocabulary, preparing the Science Word Bank and instructional materials, conducting the drills and reinforcement activities, observing learner responses, documenting classroom evidence, and administering the pretest and post-test. The learners served as the direct participants and actively engaged in all vocabulary-related tasks, oral practice, written activities, peer interaction, and reflection exercises. The school head and subject-area colleagues also played indirect but important roles by supporting the conduct of the study, allowing classroom implementation, and serving as professional resources for instructional improvement and action research practice. Where needed, collaboration with colleagues helped validate the practicality of the materials and strengthened the instructional coherence of the intervention.

The intervention was implemented because of both professional and personal motivations grounded in the teacher-researcher's classroom experience. Prior to the conduct of the study, repeated observation revealed that many learners had difficulty understanding and using Physical Science words correctly. This problem was not limited to pronunciation alone; it also affected comprehension, participation, confidence, and performance in assessments. The teacher-researcher found that learners often failed to explain scientific concepts not because they were entirely incapable of thinking through the lesson, but because they lacked the language needed to express understanding accurately. This recurring classroom experience motivated the implementation of a vocabulary-focused intervention that could directly address the language demands of science learning. The intervention was therefore implemented not as an abstract innovation, but as a practical response to a persistent and observable teaching-learning difficulty.

The scope of the intervention covered the improvement of specific learner outcomes related to selected Physical Science vocabulary. Specifically, it aimed to improve learners' ability to recognize, pronounce, define, recall, and use selected Physical Science terms correctly in oral and written contexts. It

also aimed to improve conceptual understanding of lessons where those terms functioned as key disciplinary vocabulary, as reflected in learners' test performance, classroom participation, responses during recitation, written outputs, and reflective statements. In addition, the intervention aimed to improve confidence, motivation, and willingness to engage in science discussions using appropriate terminology.

However, the intervention also had clear limitations. It did not attempt to address all dimensions of English language proficiency, such as general grammar mastery, broad reading comprehension across all disciplines, essay-wide writing competence, or long-term language development outside the selected Physical Science lessons. It also did not attempt to resolve all causes of low achievement in science, such as absenteeism, weak mathematical background, home-related learning constraints, or broader cognitive and motivational issues beyond vocabulary support. Although these factors were closely related to classroom performance, they were not the direct targets of the intervention. The study also focused only on selected Physical Science words included in the second-quarter coverage and did not extend to all science vocabulary used across the Senior High School curriculum.

The intervention solved the identified problem by directly reducing the language barrier that prevented learners from understanding and discussing scientific concepts. Because many of the learners struggled with technical terms, they often misinterpreted test items, hesitated in oral participation, and failed to connect vocabulary to meaning. The intervention addressed this by making science words visible, repeatable, explainable, and usable in context. The Science Word Bank made unfamiliar words more accessible. Vocabulary Drills strengthened recall, pronunciation, and confidence. Concept Reinforcement Activities connected terms to actual scientific meaning and application. Interactive Tools sustained engagement and encouraged active participation. Together, these components worked as a layered scaffold that gradually moved learners from uncertainty toward familiarity, then from familiarity toward understanding, and finally from understanding toward confident application.

The conduct of the component activities followed the regular Physical Science class schedule during the intervention period for second-quarter lessons. The Science Word Bank was introduced at the start of each target lesson and was revisited throughout class discussion. Vocabulary Drills were conducted before, during, or after the lesson proper depending on the complexity of the target terms and the needs of the learners. Concept Reinforcement Activities were conducted after the introduction of the lesson content to deepen understanding and check whether the learners could apply the vocabulary meaningfully. Interactive Tools were integrated during review sessions, peer work, group tasks, and reinforcement periods. The pretest was administered before the intervention, while the post-test, perception questionnaire, classroom observations, and learner reflections were completed after or during the implementation period as appropriate.

The main setting of the intervention was the Physical Science classroom where the Grade 12 TVL learners regularly attended instruction. Classroom-based implementation was important because it situated vocabulary support within authentic science teaching rather than in an artificial pull-out arrangement. Some activities were conducted during whole-class instruction, while others were carried out through pair work, small-group tasks, seatwork, recitation, and teacher-guided review within the same classroom environment. The classroom setting also allowed the teacher-researcher to observe changes in participation, confidence, word use, and conceptual explanation under actual instructional conditions.

The plausibility of the intervention was supported by scientific and scholarly literature as well as by established theories of learning. Recent studies suggested that technical or academic vocabulary learning improved when instruction combined repeated exposure, contextualized practice, interactive support, and multimodal reinforcement. Research on digital flashcards and vocabulary-focused instruction showed that repeated retrieval and multiple forms of presentation improved academic vocabulary knowledge. Studies on technical vocabulary instruction also indicated that contextualized and technology-assisted approaches could strengthen retention and meaningful use of specialized terms.

The intervention was also informed by several complementary theories. Schema Theory helped explain why learners benefited when unfamiliar Physical Science terms were connected to prior knowledge, familiar examples, and existing concepts. Dual Coding Theory explained why the use of words together with visual aids, flashcards, diagrams, and interactive materials likely improved recall and comprehension. Social Constructivist Theory explained the value of guided questioning, peer interaction, recitation, and scaffolded practice, because learners developed understanding through supported participation and dialogue. Cognitive Load Theory also provided support for the intervention because explicit vocabulary teaching reduced unnecessary language-related processing demands, allowing learners to focus more effectively on the meaning of science concepts. These theories coherently informed the design of the intervention by showing that vocabulary learning in science was most effective when learners were supported cognitively, visually, socially, and contextually.

METHODS

This study employed Classroom Action Research using the Plan, Act, Observe, Reflect cycle. The design was appropriate because it addressed a concrete classroom problem while allowing the teacher-researcher to improve instruction in response to emerging classroom evidence.

Participants and/or Sources of Data and Information

The participants of the study consisted of the teacher-researcher and 35 Grade 12 learners enrolled in the Technical-Vocational-Livelihood (TVL) track, specifically from the Automotive Servicing and Home Economics strands. In action research, the teacher-researcher was considered an active participant because the study directly emerged from classroom practice and from the teacher's effort to improve instruction in response to an identified learning problem. The teacher-researcher implemented the intervention, monitored learner responses, documented observations, analyzed the findings, and reflected on the effectiveness of the classroom strategies used.

The 35 learner-participants were selected through purposive sampling, which was appropriate because action research focused on a specific classroom problem affecting a particular group of learners rather than on generating findings that were statistically representative of a larger population. The participants were intentionally chosen from the larger class population because they consistently demonstrated difficulty in recognizing, pronouncing, defining, and applying selected Physical Science terms during classroom instruction, oral recitation, written activities, and assessment tasks. Their inclusion in the study was necessary because they were the learners who most clearly needed the innovation, intervention, and strategy implemented in the research. In other words, the intervention was designed specifically for learners who showed vocabulary-related barriers that affected their conceptual understanding of Physical Science.

The inclusion criteria for learner-participants were clearly established. First, they had to be officially enrolled in Grade 12 TVL Physical Science under the Automotive Servicing or Home Economics strand during the period of implementation. Second, they had to demonstrate observable difficulty with selected Physical Science vocabulary, as evidenced by classroom observation, responses during recitation, errors in written work, and low initial performance in vocabulary-related tasks. Third, they had to be present during the implementation period and participate in the intervention activities and related data-gathering procedures. These criteria were important because the study did not aim to include all learners indiscriminately; rather, it focused on those who experienced the actual instructional problem that the intervention sought to address. The learner-participants needed the IIS because their limited understanding and use of scientific vocabulary hindered their comprehension of Physical Science concepts, restricted their confidence in participating in class, and contributed to weak performance in science-related tasks.

In terms of participant characteristics, the study involved 35 Grade 12 TVL learners from two strands: Automotive Servicing and Home Economics. These learners were in the senior high school level and belonged to a curriculum track that emphasized technical and practical competencies alongside academic subjects. The participants included both male and female learners. Considering the nature of the strands, it was expected that Automotive Servicing had a higher proportion of male learners, while Home Economics included more female learners; however, both groups formed part of the same target population because they shared the same difficulty related to science vocabulary learning. If exact sex distribution is available from your class record, it should be inserted in the final paper for greater accuracy.

The learner-participants were generally within the typical Grade 12 age range of approximately 17 to 19 years old. They came from a community context where many learners were likely exposed more strongly to applied, skills-based, and everyday language tasks than to academic scientific discourse. As TVL learners in a public-school setting, many may also have come from low-income to lower-middle-income households, where access to academic enrichment materials, digital learning resources, and extensive science reading opportunities may have varied. These socio-demographic considerations were relevant because vocabulary development in science could be influenced by learners' language exposure, educational resources, and learning environment. The school and community context therefore formed an important background for understanding why vocabulary-related difficulties emerged and why a structured vocabulary support intervention was needed.

The study setting also suggested a practical and classroom-based learner profile. The participants were not selected because they represented all senior high school learners, but because they represented a specific group experiencing a concrete learning challenge in the actual teaching context of the researcher. Their needs were directly tied to the language demands of Physical Science, particularly in lessons involving Laws of Motion, Work, Power and Energy, Momentum and Impulse, and Circular Motion and Gravitation. These topics required learners to understand and use specialized vocabulary accurately in order to explain scientific principles, respond to questions, and connect concepts with real-life situations.

Aside from the learners and the teacher-researcher, the study also used other sources of data to enrich and validate the findings. These included the learners' pretest and post-test scores, perception questionnaire responses, classroom observation results, oral recitation responses, written reflection outputs, and teacher-researcher notes or field observations. These supplementary data sources were important because they provided both quantitative and qualitative evidence of change in learner performance, participation, confidence, and conceptual understanding. The pretest and post-test measured changes in vocabulary mastery and conceptual understanding. The perception questionnaire captured learners' views regarding the usefulness and effect of the intervention. Classroom observations documented visible behaviors such as participation, cooperation, confidence, and correct use of scientific terms. Written reflections and teacher-researcher notes provided deeper insights into learners' experiences, challenges, and perceived improvements during the implementation of the intervention.

The teacher-researcher was also an important source of data and professional insight in the study. As the classroom teacher handling Physical Science, the researcher had direct and sustained interaction with the learners throughout the intervention period. The teacher-researcher was therefore in a strong position to identify the recurring vocabulary problem, implement appropriate classroom responses, observe learner changes over time, and reflect critically on the effectiveness of the intervention. In the final version of the paper, it would strengthen this section further to insert the researcher's specific profile, such as number of years in service, years of teaching science or Physical Science, relevant training or experience in the subject area, and whether the researcher was a resident of the local community or was familiar with the learners' social context. These details would help establish the researcher's positionality and practical knowledge of the classroom problem.

Overall, the participants and other sources of data were appropriate for the study because they matched the problem-focused and improvement-oriented nature of action research. The learner-participants

were those who directly experienced the vocabulary difficulty addressed by the intervention, while the teacher-researcher and the multiple classroom-based data sources provided a rich and credible basis for understanding how the intervention influenced vocabulary mastery and conceptual understanding in Physical Science.

Data Gathering Methods

The study used both quantitative and qualitative data-gathering methods in order to obtain a more comprehensive understanding of how the vocabulary intervention influenced the learners' vocabulary mastery and conceptual understanding of selected Physical Science words. The use of multiple sources of data strengthened the study because it allowed the teacher-researcher to examine not only changes in test performance but also changes in learner participation, confidence, classroom behavior, and personal learning experiences.

Before the implementation of the intervention, the teacher-researcher secured the necessary permission to conduct the study and informed the learners and their parents or guardians about the nature and purpose of the research. After the ethical requirements were observed, the teacher-researcher identified the learner-participants based on the established inclusion criteria. Baseline data were then gathered through the administration of a teacher-made pretest designed to assess the learners' initial level of vocabulary mastery and conceptual understanding of selected Physical Science words. The pretest contained items that measured vocabulary recognition, vocabulary application, and conceptual understanding related to the target lessons in Physical Science. The results of the pretest served as the basis for confirming the learners' difficulty and for planning the implementation of the intervention.

After the collection of baseline data, the teacher-researcher implemented the vocabulary intervention during the regular conduct of Physical Science classes. The intervention included the use of the Science Word Bank, vocabulary drills, concept reinforcement activities, and interactive tools integrated into the lessons on Laws of Motion, Work, Power and Energy, Momentum and Impulse, and Circular Motion and Gravitation. During the implementation period, data were gathered continuously through classroom-based procedures. The teacher-researcher used classroom observation to monitor learner participation, vocabulary use, confidence in recitation, cooperation during group tasks, and engagement in the intervention activities. An observation checklist was used to guide the recording of these learner behaviors in a systematic manner.

To gather the learners' views and experiences regarding the intervention, the teacher-researcher also administered a perception questionnaire after the intervention period. The questionnaire asked the learners to rate their agreement with statements related to enjoyment of the activities, confidence in using scientific terms, participation in class discussions, motivation to learn Physical Science, and perceived improvement in understanding scientific concepts. This instrument was important because it captured the learners' subjective assessment of the usefulness and effect of the intervention, which could not be fully explained by test scores alone.

In addition, written reflections were collected from the learners to provide deeper qualitative evidence about how they experienced the intervention. Through these reflections, the learners were able to describe the challenges they encountered, the improvements they noticed in themselves, and the ways by which the intervention helped them understand and use Physical Science vocabulary more effectively. These reflection responses gave the teacher-researcher richer insight into the learners' thought processes, confidence, and meaning-making beyond what could be observed during class sessions.

The teacher-researcher also gathered data from oral recitations, written classroom outputs, and field notes recorded during the implementation of the intervention. Oral responses were useful in determining whether the learners were becoming more confident and accurate in pronouncing and using scientific terms during class discussions. Written outputs such as practice exercises, sentence construction tasks, and concept-based responses helped show whether learners could apply vocabulary in context. Teacher-

researcher field notes were likewise valuable in documenting recurring classroom patterns, notable learner responses, implementation difficulties, and emerging improvements observed throughout the study.

At the end of the intervention period, the teacher-researcher administered a post-test that paralleled the coverage and skills measured in the pretest. The post-test was used to determine whether there was improvement in the learners' vocabulary mastery and conceptual understanding after exposure to the intervention. The comparison between the pretest and post-test results provided quantitative evidence regarding the effect of the vocabulary drill activities and related support strategies on learner performance.

Data Analysis Plan

The study used both quantitative and qualitative approaches in analyzing the gathered data in order to provide a comprehensive understanding of the effects of the vocabulary intervention on the learners' vocabulary mastery and conceptual understanding of selected Physical Science words.

For the quantitative data, descriptive statistics were used to summarize and describe the learners' performance and perceptions. The mean was used to determine the average pretest and post-test scores of the learners, which served as indicators of their level of vocabulary mastery and conceptual understanding before and after the implementation of the intervention. The percentage was used to present the distribution of learners who improved, remained the same, or obtained lower scores in the post-test. The weighted mean was used to analyze the learners' responses to the perception questionnaire and the results of the classroom observation checklist in order to determine the extent of learner agreement, participation, confidence, engagement, and observable classroom behaviors during the implementation of the intervention.

To determine whether the observed difference between the pretest and post-test scores was statistically significant, a paired-samples t-test was employed. This statistical test was appropriate because the same group of learners took both tests before and after the intervention. The paired-samples t-test allowed the researcher to examine whether the increase in scores could be attributed to the intervention rather than to chance alone. The level of significance was set at 0.05. If the computed p-value was less than 0.05, the difference between the pretest and post-test scores was considered statistically significant, indicating that the intervention had a significant effect on the learners' vocabulary mastery and conceptual understanding.

For the qualitative data, the learners' written reflections, oral responses, classroom observation notes, and teacher-researcher field notes were analyzed through thematic analysis. This method was used to identify, organize, and interpret recurring patterns and themes that emerged from the participants' responses and classroom experiences. The qualitative data were first read and reviewed carefully several times in order to gain familiarity with the responses. Significant statements, recurring ideas, and meaningful learner expressions were then identified and coded. After coding, related responses were grouped together into broader categories and themes. These themes focused on areas such as vocabulary development, conceptual understanding, confidence in using scientific terms, classroom engagement, participation, perceived usefulness of the intervention, and challenges encountered during implementation.

The integration of quantitative and qualitative analysis strengthened the study because it allowed the researcher to examine both the measurable outcomes of the intervention and the learners' actual experiences during its implementation. While the quantitative results provided evidence of changes in test performance and learner ratings, the qualitative findings explained how the learners experienced the intervention, what improvements they observed in themselves, and what challenges remained. Through this combined analysis, the study was able to present a more complete and meaningful interpretation of the effectiveness of the vocabulary drill intervention in Physical Science.

Action Research Work Plan and Timelines

Table 1. Schedule of Research Activities

Activity	Timeline	Duration
Planning Phase	Week 1	2 days
Identify the problem and target learners (Grade 12 Automotive & HE) and prepare research instruments		
Baseline Data Gathering	Week 2	3 days
Administer pre-test on selected Physical Science vocabulary		
Implementation of Interventions	Week 3–6	20 days
Introduce Science Word Bank Program and Vocabulary Drills		
Observation & Monitoring	Week 3–6	20 days
Conduct continuous observation of learners' participation, pronunciation, and comprehension		
Post-Assessment	Week 7	3 days
Data Analysis	Week 8	5 days
Reflection and Writing	Week 9–10	10 days
Presentation and Dissemination	Week 11	2 days
Total Span		45 days

Ethical Issues

Participation in the study was voluntary, and informed consent was obtained from the learners and their parents or guardians before the implementation of the intervention. The participants were informed about the purpose of the study, the procedures involved, and the nature of their participation. They were also assured that their participation was entirely optional and that they could decline or withdraw without any negative consequence. To protect their rights and welfare, the teacher-researcher ensured that participation or non-participation did not affect the learners' grades, classroom standing, or relationship with the teacher.

Confidentiality and privacy were strictly observed throughout the study. The identities of the learners were not disclosed in any part of the research report, and all responses, scores, reflections, and observation records were treated with care and used solely for research purposes. The data were presented in summary form to avoid identifying individual participants. Throughout the conduct of the study, the teacher-researcher remained mindful that the intervention should support learning and not place the learners at risk of embarrassment, pressure, or unfair treatment.

RESULTS AND DISCUSSION

Vocabulary Mastery Before and After the Intervention

Table 2 presents the summary of the learners' pretest and post-test scores. Before the intervention, the learners obtained a mean score of 12.63 (SD = 3.07), indicating a relatively low baseline level of vocabulary mastery and conceptual understanding. After the implementation of the Science Word Bank, vocabulary drills, concept reinforcement activities, and interactive tools, the mean increased to 17.03 (SD = 4.26). The mean gain of 4.40 points shows that the intervention produced a clear improvement in learner performance.

Table 2. *Summary of Pretest and Post-Test Scores*

Test	N	Mean	SD	Interpretation
Pretest	35	12.63	3.07	Lower baseline mastery
Post-test	35	17.03	4.26	Improved mastery

Table 2 showed that the learners obtained a mean pretest score of 12.63 with a standard deviation of 3.07, which indicated a low baseline level of vocabulary mastery and conceptual understanding before the intervention. After the implementation of the Science Word Bank, vocabulary drills, concept reinforcement activities, and interactive tools, the mean post-test score increased to 17.03 with a standard deviation of 4.26, resulting in a mean gain of 4.40 points. This result indicated that the intervention was associated with a clear improvement in the learners' performance. The increase suggested that the learners became better able to recognize, understand, and use selected Physical Science words, and that this vocabulary growth likely supported better conceptual processing of the lessons as well.

This finding was consistent with recent studies showing that structured vocabulary instruction improved learners' vocabulary achievement and strengthened learning motivation. Ayana et al. (2024) found that explicit vocabulary learning strategies significantly improved students' vocabulary knowledge achievement, especially when learners received repeated and guided practice. The present result was also consistent with the systematic review of Zeng et al. (2025), which concluded that vocabulary instruction was most effective when it was explicit, scaffolded, interactive, and connected to meaning. In the same way, the increase in the post-test mean suggested that the intervention worked not simply because learners memorized words, but because they were repeatedly exposed to scientific terms in meaningful classroom contexts. The result also aligned with recent work emphasizing that vocabulary knowledge helped learners access larger concepts represented by those words. However, the study differed from many language-focused vocabulary studies because it was situated specifically in a Physical Science classroom and focused on technical scientific vocabulary, making the intervention more directly tied to disciplinary understanding rather than to general language development alone.

Significance of the Difference in Scores

To determine whether the observed gain was statistically significant, a paired-samples t-test was conducted. As shown in Table 2, the computed t-value was 7.49 with a p-value of 0.00000001. Since the p-value is far lower than the 0.05 level of significance, the null hypothesis of no significant difference between pretest and post-test scores is rejected. This means that the intervention had a statistically significant positive effect on learners' vocabulary mastery and conceptual understanding. The effect size was also large (Cohen's $d = 1.27$), indicating that the improvement was not only statistically detectable but educationally meaningful.

Table 3. *Paired-Samples t-Test for Pretest and Post-Test Scores*

Comparison	Mean Gain	t	df	p-value	Decision
Post-test Pretest	4.40	7.49	34	0.00000001	Significant

Table 3 showed that the computed t-value was 7.49 with $df = 34$ and a p-value of 0.00000001. Since the p-value was far below the 0.05 level of significance, the null hypothesis was rejected. This indicated that the difference between the pretest and post-test scores was statistically significant. The result meant that the improvement observed in Table 1 was not due to chance alone. The intervention therefore had a significant positive effect on the learners' vocabulary mastery and conceptual understanding of selected Physical Science words. The reported effect size of Cohen's $d = 1.27$ further suggested that the effect of the intervention was large and educationally meaningful.

This result supported the growing body of literature showing that targeted vocabulary instruction could produce measurable gains in academic performance. Ayana et al. (2024) likewise reported statistically significant post-test improvement after vocabulary learning strategy training, showing that structured vocabulary support could meaningfully improve performance. The present finding also agreed with studies on science and technical vocabulary instruction that reported better retention and stronger content-related understanding when vocabulary was taught through repeated, contextualized, and multimodal approaches. At the same time, the result appeared stronger than some studies that reported only moderate gains, possibly because the intervention combined several mutually reinforcing components rather than relying on a single technique alone. This suggests that the strength of the present result may have come from the layered structure of the intervention: learners were not only introduced to words, but were also given opportunities to pronounce, define, apply, and revisit them in interactive and concept-based tasks.

Learners' Perceptions of the Intervention

Learners' perceptions of the intervention were highly favorable. The overall weighted mean for the perception questionnaire was 4.90, which indicates a very positive response to the vocabulary-focused activities. As shown in Table 3, all indicators received high to very high ratings, with several items obtaining a perfect mean of 5.00. The highest-rated indicators were enjoyment of Physical Science classes, active participation in drills and discussions, confidence in using Physical Science words, and increased motivation to learn the subject.

Table 4. *Learners' Perception of the Vocabulary Intervention*

Indicator	Weighted Mean	Interpretation
The vocabulary activities made my Physical Science classes more enjoyable.	5.00	Very High
I participated actively in the vocabulary drills and discussions.	5.00	Very High
I feel more confident using Physical Science words in class discussions.	5.00	Very High
I am no longer afraid to use scientific terms when explaining concepts.	4.80	Very High
The activities improved my understanding of Physical Science concepts.	4.54	Very High
The Science Word Bank helped me remember difficult terms.	4.97	Very High
Vocabulary drills helped me recall scientific words faster.	4.97	Very High
Concept reinforcement activities (games, exercises) improved my retention of terms.	4.97	Very High
Interactive tools (digital or visual aids) made science terms easier to understand.	4.80	Very High
The interventions increased my interest and motivation to learn Physical Science.	5.00	Very High
Overall Weighted Mean	4.90	Very High

Table 4 revealed that the learners had a very positive perception of the intervention, with an overall weighted mean of 4.90. Several indicators received a perfect mean of 5.00, particularly those related to enjoyment of the class, active participation, confidence in using Physical Science words, and increased motivation to learn the subject. The rest of the indicators were also rated very highly, with values ranging from 4.54 to 4.97. These results indicated that the intervention was not viewed merely as an additional academic requirement, but as a meaningful support system that made science learning easier, more engaging, and more manageable for the learners.

This pattern agreed with recent literature showing that vocabulary-focused and active learning interventions often improved motivation, confidence, and classroom engagement alongside academic achievement. Ayana et al. (2024) found that strategy-based vocabulary instruction improved not only vocabulary knowledge but also learner motivation. Similarly, recent work on active learning in senior high school science reported that student-centered strategies increased learner participation and engagement, especially when learners were given more active roles in classroom tasks. The present finding also resonated with recent reviews emphasizing that learners benefited when vocabulary instruction was scaffolded socially and cognitively, because this reduced anxiety and helped them participate more confidently in classroom discourse. A point of difference, however, was that many vocabulary studies focused on language learning classes, whereas the study demonstrated similarly positive affective outcomes in a science classroom where learners often experienced technical terms as barriers to understanding. This made the result especially valuable because it showed that vocabulary instruction in science could influence not only achievement but also learners' emotional readiness to engage with scientific language.

Observed Classroom Behaviors During the Intervention

Classroom observation data also support the effectiveness of the intervention. The overall weighted mean for the observation checklist was 3.92, interpreted as often to always observed. The strongest indicators were encouragement of classmates to use science terms and learner enthusiasm and motivation, both with a weighted mean of 4.00. The remaining indicators ranged from 3.74 to 3.97, showing that the desired classroom behaviors were consistently demonstrated during the intervention period.

Table 5. *Classroom Observation Checklist Results*

Indicator	Weighted Mean	Interpretation
Student participates in vocabulary drills.	3.74	Always Observed
Student contributes to building/using the Science Word Bank.	3.94	Always Observed
Student volunteers answers during class recitation.	3.97	Always Observed
Student uses Physical Science terms correctly in context.	3.94	Always Observed
Student explains concepts using proper scientific vocabulary.	3.94	Always Observed
Student shows interest in concept reinforcement activities.	3.80	Always Observed
Student uses interactive tools without hesitation.	3.94	Always Observed
Student cooperates with peers in group vocabulary activities.	3.89	Always Observed
Student encourages classmates to use science terms.	4.00	Always Observed

Student shows enthusiasm and motivation in learning Physical Science vocabulary.	4.00	Always Observed
Overall Weighted Mean	3.92	Always Observed

Table 5 showed an overall weighted mean of 3.92, interpreted as Always Observed. The highest indicators were encouraging classmates to use science terms and showing enthusiasm and motivation in learning Physical Science vocabulary, both with a weighted mean of 4.00. Other indicators, such as participation in drills, contribution to the Science Word Bank, volunteering answers, correct contextual use of vocabulary, and cooperation with peers, also received high ratings ranging from 3.74 to 3.97. These results suggested that the intervention positively influenced the learners' classroom behavior. The gains were not limited to written performance; they were also reflected in observable participation, confidence, collaboration, and willingness to use scientific vocabulary in actual classroom interaction.

These observation results were consistent with recent studies indicating that active, scaffolded, and collaborative instruction improved learner engagement and supported better classroom interaction. Research on active learning in senior high school science found that learner-centered strategies strengthened retention, engagement, and participation, which is comparable to the classroom behaviors observed in your study. The present result also aligned with the systematic review by Zeng et al. (2025), which emphasized that group discussion, peer-supported activities, and multimodal vocabulary instruction were especially effective because they created more opportunities for learners to construct meaning collaboratively. Compared with studies that focused only on test-based outcomes, your observation data added an important dimension by showing that the intervention influenced the actual learning environment. In other words, the effect of the IIS was visible not only in scores but also in how learners behaved, interacted, and used scientific language during instruction.

Thematic Analysis of Student Reflections

The thematic analysis of the learners' reflections revealed that the intervention influenced not only vocabulary learning but also conceptual understanding, confidence, classroom engagement, and the perceived relevance of Physical Science in daily life. Across the responses, the learners described the intervention as a meaningful academic support that helped them understand difficult scientific terms and use them more effectively in class. The reflections therefore supported the quantitative findings by showing how the intervention was experienced by the learners themselves.

Under the theme of vocabulary development, the learners emphasized that familiarity with scientific terms made the lessons easier to understand. One learner shared,

"Learning the science terms first gave me a strong foundation. I could follow the lessons more easily because I understood the words being used."

This excerpt indicated that vocabulary support reduced confusion and provided a stronger foundation for lesson comprehension. It suggested that the intervention helped learners become more secure in recognizing and understanding technical terms before dealing with more complex scientific explanations.

For conceptual understanding, the learners recognized that vocabulary learning went beyond memorizing isolated definitions. A participant stated,

"I learned that memorizing definitions is not enough. Applying the words in real-life examples made the concepts stick in my mind."

This showed that the intervention supported deeper understanding by helping learners connect terminology with meaning, application, and concept formation. The excerpt suggested that vocabulary became a pathway toward genuine comprehension rather than a simple recall task.

The theme of application to real life was also strongly evident. One learner explained,

"I liked that we were asked to use the terms in everyday examples. It made me realize that science is part of daily life, not just in textbooks."

This response showed that the intervention helped learners view Physical Science as relevant and practical. By linking scientific terms to familiar experiences, the study made vocabulary more meaningful and helped learners appreciate the real-world value of science concepts.

In terms of confidence and engagement, the reflections showed that improved vocabulary knowledge increased learners' willingness to participate. Another learner expressed,

"I felt more engaged in class discussions because I knew the right words. It gave me confidence to participate actively."

This excerpt suggested that mastery of scientific vocabulary reduced hesitation and strengthened classroom participation. It also implied that learners felt more capable of expressing understanding once they had the language needed for explanation.

The theme of learning process awareness reflected the learners' growing understanding of how they learned best. One participant reflected,

"The activities taught me that learning is a process. At first, I struggled, but with practice, I became more confident."

This showed that the intervention encouraged persistence and self-awareness in learning. The learner's statement suggested that repeated exposure, guided practice, and structured tasks helped make learning more manageable and progressive.

For broader impact, the learners reported benefits beyond the immediate classroom activities. A learner noted,

"The study improved my ability to write science-related essays. I could express my thoughts more clearly because I had the right words."

This indicated that the gains from the intervention extended beyond oral participation and test performance, influencing written expression and broader academic communication in science. The excerpt suggested that vocabulary mastery supported not only understanding but also more precise academic writing.

Finally, under overall reflection, the learners described the intervention as a helpful and meaningful learning experience. One learner summarized,

"Overall, the study was very helpful in making science more meaningful. It gave me tools to understand and apply physical science concepts better."

This excerpt captured the general positive tone of the reflections and reinforced the interpretation that the intervention contributed meaningfully to both vocabulary development and conceptual understanding. Taken together, the thematic findings confirmed that the intervention improved not only academic performance but also the learners' confidence, engagement, and appreciation of Physical Science.

Challenges and Improvements in Pronunciation, Usage, and Comprehension

The integrated findings indicate clear improvements in pronunciation, vocabulary usage, and comprehension. Learners became more willing to say and use Physical Science terms during oral recitation and discussion, and the observation results showed frequent correct application of scientific vocabulary in context. The perception ratings and thematic reflections also suggest that learners were less afraid of technical terms and more able to connect those terms to concepts, formulas, and real-life examples. These gains show that the intervention did not merely help learners memorize isolated definitions; it supported more accurate language use and stronger conceptual understanding.

Problems and Difficulties Experienced by Learners and the Teacher-Researcher

Some implementation difficulties were still noted. A few learners initially hesitated to pronounce unfamiliar terms, needed repeated guidance in sentence construction, or relied on memorization before they could explain ideas independently. Time management was also a practical concern because vocabulary drills, concept reinforcement activities, and interactive tools required careful pacing within regular classroom instruction. For the teacher-researcher, preparing materials, monitoring participation, and giving

immediate corrective feedback demanded sustained attention. Nevertheless, these difficulties were manageable and did not outweigh the overall positive effect of the intervention.

Problems and Difficulties Encountered During Implementation

Although the findings were generally positive, some difficulties were encountered during implementation. A few learners still registered unchanged or lower post-test scores, indicating that not all participants progressed at the same pace. This may be attributed to differences in prior knowledge, attendance, study habits, or confidence in using English scientific terms. Time management was also a practical challenge because vocabulary instruction needed to be integrated with the regular pacing of Physical Science lessons. Despite these constraints, the intervention remained manageable and beneficial, particularly because the tools used were low cost, repeatable, and adaptable to routine classroom instruction.

Summary

The findings of the study showed that the vocabulary-focused intervention contributed positively to the learners' vocabulary mastery and conceptual understanding of selected Physical Science words. Based on the pretest and post-test results, the learners' mean score increased from 12.63 in the pretest to 17.03 in the post-test, resulting in a mean gain of 4.40 points. This improvement indicated that after the implementation of the Science Word Bank, vocabulary drills, concept reinforcement activities, and interactive tools, the learners demonstrated better performance in recognizing, understanding, and applying selected Physical Science terms. The increase in scores suggested that strengthening vocabulary knowledge also supported better understanding of the related scientific concepts.

The statistical analysis further confirmed that the improvement in learner performance was significant. The paired-samples t-test revealed a computed t-value of 7.49 and a p-value of 0.00000001, which was far below the 0.05 level of significance. This meant that the difference between the pretest and post-test scores was statistically significant and that the improvement was unlikely to have occurred by chance alone. Thus, the intervention was found to have a significant positive effect on the learners' vocabulary mastery and conceptual understanding of selected Physical Science words. The large effect size reported in the study also suggested that the intervention was not only statistically effective but also educationally meaningful in the context of classroom instruction.

The learners' perception of the intervention was also highly favorable. The overall weighted mean of 4.90, interpreted as Very High, indicated that the learners viewed the vocabulary intervention as helpful, enjoyable, and motivating. In particular, they rated very highly the indicators related to enjoyment of Physical Science classes, active participation in vocabulary drills and discussions, confidence in using Physical Science words, and increased motivation to learn the subject. These findings suggested that the intervention did not only improve test performance but also enhanced the learners' attitudes toward science learning and reduced their fear of using scientific terms in classroom interaction.

The classroom observation results also supported the effectiveness of the intervention. With an overall weighted mean of 3.92, interpreted as Always Observed, the data showed that the desired classroom behaviors were consistently manifested during the intervention period. The learners were observed to participate actively in vocabulary drills, contribute to the Science Word Bank, volunteer during class recitation, use Physical Science terms correctly in context, cooperate with peers, and show enthusiasm in learning science vocabulary. These findings indicated that the intervention positively influenced not only academic performance but also learner participation, engagement, and classroom behavior.

The thematic analysis of the learners' reflections provided deeper support for the quantitative findings. The learners' responses revealed recurring themes related to vocabulary development, conceptual understanding, application to real life, confidence and engagement, learning process awareness, broader impact, and overall positive reflection. The learners described how understanding scientific terms first helped them follow the lessons more easily, explain concepts more clearly, and appreciate the relevance of science in everyday life. They also reported feeling more confident in class discussions, less anxious during examinations, and more aware that learning required gradual practice and repeated exposure. These

reflections showed that the intervention influenced not only what the learners knew, but also how they experienced the process of learning Physical Science.

CONCLUSION

The study concluded that the implementation of the vocabulary-focused intervention significantly improved the learners' vocabulary mastery and conceptual understanding of selected Physical Science words. The quantitative findings demonstrated a statistically significant improvement in learner performance, while the qualitative findings confirmed that the intervention enhanced learners' confidence, engagement, and ability to connect scientific terms with meaningful concepts and real-life situations. These results established that vocabulary instruction was not merely a supplementary classroom activity but an essential support mechanism in science teaching, particularly for learners who experienced difficulty with the language demands of the subject.

Furthermore, the study concluded that integrating the Science Word Bank, vocabulary drills, concept reinforcement activities, and interactive tools into regular instruction provided an effective and feasible response to the identified classroom problem. The intervention helped transform science vocabulary from a source of confusion into a foundation for understanding, participation, and academic growth. Therefore, explicit and contextualized vocabulary instruction should be recognized as a meaningful pedagogical approach in Physical Science, especially among Grade 12 TVL learners whose comprehension and participation may be limited by difficulties in scientific language.

Recommendations

In light of the findings of the study, it is recommended that Physical Science teachers continue to integrate vocabulary-focused strategies such as the Science Word Bank, vocabulary drills, concept reinforcement activities, and interactive tools into their regular classroom instruction. These strategies may help learners develop stronger familiarity with scientific terms, improve conceptual understanding, and participate more confidently in class discussions and learning tasks. Since the study showed that vocabulary support reduced learners' difficulty in understanding and using selected Physical Science words, explicit vocabulary instruction should be treated as an important component of science teaching rather than as an optional or supplementary activity.

It is also recommended that similar interventions be applied to other science topics and, where appropriate, to other subject areas that involve technical or discipline-specific vocabulary. Teachers may design contextualized vocabulary support activities that suit the needs, language background, and learning profile of their learners. Learners who show minimal or inconsistent progress may likewise be provided with additional follow-up support through small-group remediation, guided review sessions, repeated practice, and differentiated learning tasks. In this way, vocabulary instruction may be sustained not only for the whole class but also for those who require more focused academic assistance.

At the school level, school heads, master teachers, and instructional leaders may support the wider use of vocabulary-based interventions by incorporating them into Learning Action Cell sessions, school-based training, and collaborative lesson planning. Sharing the materials, strategies, and results of this study with other teachers may help promote evidence-based classroom practices that address language-related barriers to learning. Since the intervention used practical and low-cost materials that can be integrated into routine instruction, it may be adapted easily in similar educational settings where learners experience difficulty with academic vocabulary in science.

Finally, future researchers may conduct related studies that examine the long-term retention of science vocabulary, the effectiveness of similar interventions across different grade levels or learner groups, and the possible relationship between vocabulary mastery and other learning outcomes such as reading comprehension, problem-solving, and written scientific explanation. Further studies may also explore the

use of localized language support, digital vocabulary tools, or mother tongue-based scaffolding in science instruction. Such research may contribute to a deeper understanding of how vocabulary interventions can be strengthened and sustained in improving science learning outcomes.

Financial Report

The original cost estimates were reformatted into a simple financial report aligned with the actual materials and classroom resources needed for the intervention. The entries below reflect the direct expenses associated with the preparation and implementation of the vocabulary-based activities.

Table 6. *Financial Report for the Vocabulary Intervention*

Particulars	Unit	Quantity	Unit Cost (PHP)	Amount (PHP)
Bond paper for printed drills, worksheets, and reflection sheets	ream	1	300.00	300.00
Printer ink / printing materials	set	1	650.00	650.00
Cartolina / illustration board / manila paper for word wall and visual aids	set	1	250.00	250.00
Marker pens, pens, and correction materials	set	1	200.00	200.00
Laminating / plastic envelopes / folders for reusable word cards	set	1	350.00	350.00
Flashcards and game materials	set	1	300.00	300.00
Photocopying of tests, questionnaires, and observation forms	lot	1	500.00	500.00
Internet/data load for interactive tools and online quiz preparation	lot	1	400.00	400.00
Snacks during remediation / focused review sessions	lot	1	600.00	600.00
Contingency and miscellaneous classroom supplies	lot	1	450.00	450.00
Total				4,000.00

Action Plan

In response to the findings of the study, the following action plan was formulated to sustain the gains of the intervention, strengthen learners' vocabulary mastery and conceptual understanding, and guide the continued implementation of vocabulary-focused strategies in Physical Science.

Table 7. *Proposed Action Plan for the Utilization of Findings*

Objective	Activity	Persons Involved	Time Frame	Success Indicator	Expected Output
Sustain vocabulary support in Physical Science	Integrate Science Word Bank and vocabulary drills in weekly lesson delivery	Science teacher, learners	Whole quarter	Vocabulary activities included in lesson implementation	Regular classroom use of vocabulary tools
Strengthen conceptual understanding through application	Use concept reinforcement activities and contextual examples in every target lesson	Science teacher, learners	Whole quarter	Learners correctly explain terms in class and written tasks	Improved concept explanation and application
Promote learner confidence and participation	Conduct recitation, peer discussion, and game-based review using science terms	Science teacher, learners	Twice a week	Increased recitation and peer interaction using scientific vocabulary	Higher class participation and confidence
Share effective practices with colleagues	Present findings and sample materials during LAC session	Teacher-researcher, Science and TVL teachers, school head	After completion of study	LAC presentation conducted and materials shared	School-level adoption of vocabulary strategies
Institutionalize support for struggling learners	Provide remediation sessions for learners with low or unchanged post-test gains	Science teacher, selected learners, adviser	After assessment periods	Target learners attend review sessions and show improved follow-up performance	Focused remediation plan for at-risk learners

References

- Alonzo, R. (2018). Developing a science word bank strategy to improve oral fluency among Filipino learners. *Philippine Journal of Education, 95*(2), 34–42.
- Anderson, R. C. (1977). Schema-directed processes in language comprehension. In A. Lesgold, J. Pellegrino, S. Fokkema, & R. Glaser (Eds.), *Cognitive psychology and instruction* (pp. 67–82). Springer.
- Ayana, H., Tadesse, T., & Kinde, S. (2024). Effect of vocabulary learning strategies on students' vocabulary knowledge achievement and motivation: The case of Grade 11 high school students. *Frontiers in Education, 9*, Article 1399350.
- Bernardo, A. (2004). McKinley's questionable bequest: Over 100 years of English in Philippine education. *World Englishes, 23*(1), 17–31.
- Cummins, J. (2000). *Language, power, and pedagogy: Bilingual children in the crossfire*. Multilingual Matters.
- Department of Education. (2016). *K to 12 curriculum guide: Senior high school – physical science*. Department of Education.
- Department of Education. (2025a). *DepEd expands 2025 summer programs to address learning gaps across all grade levels*. Department of Education.
- Department of Education. (2025b). *DepEd memorandum no. 033, s. 2025: Implementation of the 2025 summer programs*. Department of Education.

- Department of Education. (2025c). *Policy brief 25-002: Functional literacy*. Department of Education.
- Department of Education. (2025d). *Supplemental guidelines on the implementation of the Literacy Remediation Program*. Department of Education.
- Fang, Z. (2005). Scientific literacy: A systemic functional linguistics perspective. *Science Education*, 89(2), 335–347.
- Florian, L., & Black-Hawkins, K. (2011). Exploring inclusive pedagogy. *British Educational Research Journal*, 37(5), 813–828.
- Hamnell-Pamment, Y. (2023). Scientific language use and sensemaking in concept maps: Interaction between concept systems, scientific concepts and everyday concepts. *Knowledge Management & E-Learning*, 15(3).
- Hamnell-Pamment, Y. (2024). The role of scientific language use and achievement level in student sensemaking. *International Journal of Science and Mathematics Education*, 22, 737–763. <https://doi.org/10.1007/s10763-023-10405-7>
- Hanauer, D. I., & Englander, K. (2011). Quantifying the burden of writing research articles in a second language: Data from Mexican scientists. *Written Communication*, 28(4), 403–416.
- Hernández-García, Y. I., Murrieta-Saldívar, J., Valderrama, R., & Amaro-Reyes, A. (2023). The impact of English as a global language on scientists' time use and productivity. *PLOS Biology*, 21(7).
- Hewitt, P. G. (2017). *Conceptual physics* (12th ed.). Pearson Education.
- Leonen, C. A. (2025). Effectiveness of COSCIVOW (Contextualized Science Vocabulary Worksheet) in the level of vocabulary skills of Grade 10 learner. *International Journal of Multidisciplinary: Applied Business and Education Research*, 6(1).
- Nation, I. S. P. (2013). *Learning vocabulary in another language* (2nd ed.). Cambridge University Press.
- Newton, J. (2013). Incidental vocabulary learning in classroom communication tasks. *Language Teaching Research*, 17(2), 164–187.
- Othman, J. (2024). Academic vocabulary learning in EMI classrooms: Challenges and strategies. *Arab World English Journal*, 15(2), 3–18. <https://dx.doi.org/10.24093/awej/vol15no2.1>
- Paivio, A. (1990). *Mental representations: A dual coding approach*. Oxford University Press.
- Pressley, M. (2006). *Reading instruction that works: The case for balanced teaching* (3rd ed.). Guilford Press.
- Rumelhart, D. E. (1980). Schemata: The building blocks of cognition. In R. J. Spiro, B. C. Bruce, & W. F. Brewer (Eds.), *Theoretical issues in reading comprehension* (pp. 33–58). Lawrence Erlbaum Associates.
- Serway, R. A., & Jewett, J. W. (2018). *Physics for scientists and engineers* (10th ed.). Cengage Learning.
- Skinner, B. F. (1957). *Verbal behavior*. Appleton-Century-Crofts.
- Snow, C. (2010). Academic language and the challenge of reading for learning about science. *Science*, 328(5977), 450–452.
- Snow, C. E., & Uccelli, P. (2009). The challenge of academic language. In D. R. Olson & N. Torrance (Eds.), *The Cambridge handbook of literacy* (pp. 112–133). Cambridge University Press.
- Strasser, K., Meneses, A., Iturra, C., & Marin, A. (2024). Disciplinary vocabulary and mastery of educational objectives in first-grade. *Learning and Instruction*, 94, Article 102000. <https://doi.org/10.1016/j.learninstruc.2024.102000>
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257–285.
- Thorndike, E. L. (1932). *The fundamentals of learning*. Teachers College Press.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Ward, J. (2009). A basic engineering English word list for less proficient foundation engineering undergraduates. *English for Specific Purposes*, 28(3), 170–182.
- Zeng, Y., Kuo, L.-J., Chen, L., Lin, J.-A., & Shen, H. (2025). Vocabulary instruction for English learners: A systematic review connecting theories, research, and practices. *Education Sciences*, 15(3), Article 262. <https://doi.org/10.3390/educsci15030262>