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Scientific Reasoning Skills and English Language Proficiency of Public High School Learners in a Technical-Vocational School

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ABSTRACT

Scientific reasoning skills and English language proficiency are essential competencies that support learners' academic success, as understanding concepts, interpreting information, and communicating ideas are fundamental. This study assessed the scientific reasoning skills and English language proficiency of public high school learners at Rafael Lentejas Memorial School of Fisheries, Schools Division of Calbayog City, for the School Year 2025-2026. The study employed a descriptive-comparative-correlational research design, using a validated survey questionnaire and a self-constructed multiple-choice test to collect data. Results revealed that public high school learners had generally demonstrated proficient levels of scientific reasoning and English language skills. More so, differences in scientific reasoning were observed among learners grouped by age, gender, and grade level, whereas no differences were found across nutritional status, family type, and monthly income. English language proficiency varied according to gender but remained similar across other profile variables. Moreover, English language proficiency and scientific reasoning skills were positively associated, indicating that stronger language ability supported better reasoning performance among learners. The study concluded that learners generally demonstrated proficient English language and scientific reasoning skills, which were positively associated, while age, gender, and grade level affected reasoning performance. Schools should implement the proposed intervention program to strengthen learners' language proficiency and scientific reasoning through integrated and inquiry-based instruction.

Keywords: inquiry-based instruction, academic literacy, cognitive development, evidence-based explanation, socioeconomic context

INTRODUCTION

Science education plays a fundamental role in shaping students' understanding of the natural world and equipping them with essential skills for 21st-century learning. It fosters scientific literacy, which enables learners to interpret evidence, evaluate scientific claims, and make informed decisions in daily life, an ability increasingly necessary in a technologically driven society (Bybee, 2016). Through inquiry-based learning, students develop critical thinking, reasoning, and problem-solving competencies that are transferable across multiple subject areas and real-world contexts (Furtak et al., 2019). Moreover, Science education provides structured opportunities for learners to engage in experimentation and hands-on investigations, reinforcing conceptual understanding and encouraging active exploration (Kang & Keinonen, 2018). The integration of Science in the curriculum also supports the development of collaborative and communication skills, which are essential for success in future academic and professional fields (Teo, 2020). Ultimately, Science education not only builds knowledge but also cultivates curiosity, resilience, and innovation among students, which are vital for participation in modern scientific and technological advancements (National Research Council, 2018).

Several studies have agreed that scientific reasoning is a core component of meaningful Science learning and a critical outcome of secondary Science education. International findings confirm that students who demonstrate stronger skills in hypothesis generation, evidence evaluation, and data interpretation show better performance in

Science subjects, according to studies by Olsson et al. (2023), Haas et al. (2021), Deng et al. (2022), Liao and Liu (2025), and Aguirre Muñoz et al. (2024). These studies emphasize that reasoning skills are shaped by instructional opportunities and by students' access to academic language. In the Philippine setting, Farillon (2022) reported that senior high school students' scientific reasoning and critical thinking are positively associated with Science achievement. These converging lines of evidence highlight the importance of examining the cognitive and linguistic factors that influence the development of scientific reasoning among Filipino learners.

Several studies in the Philippines suggest that scientific reasoning can be strengthened through metacognitive awareness and improved instructional practices. Bautista (2024) explained that metacognitive strategies allow STEM learners to monitor their thinking and improve problem-solving in conceptual and reasoning tasks. Pasigon (2024) found that reasoning contributes significantly to physics performance when combined with mathematical proficiency and metacognitive skills. Ortha and Yangco (2024) demonstrated that teachers' confidence in facilitating inquiry relates to students' reasoning and process skills, which reflects the substantial influence of pedagogy on cognitive outcomes. Superio and Carreon (2025) further showed that critical thinking can be boosted by strong engagement and positive attitudes toward Science. Together with the international studies of Haas et al. (2021) and Deng et al. (2022), these Philippine findings affirm that scientific reasoning is a multifaceted construct shaped by metacognition, instruction, engagement, and language use.

A growing body of research highlights the relationship between language proficiency and students' ability to reason scientifically. Philippine evidence from Gomez and Ranara (2022) indicates that English language proficiency significantly influences the quality of scientific reasoning produced by senior high school STEM learners. Mercado and Manzano (2024) reported that metacognitive reading strategies strengthen English comprehension, which in turn supports learning in content-based subjects. Abang and Paglinawan (2024) identified metacognitive ability as a predictor of junior high school students' English competence, which is essential for learning scientific terminology. Internationally, the work of Deng et al. (2022), Haas et al. (2021), Olsson et al. (2023), Liao and Liu (2025), and Aguirre Muñoz et al. (2024) establishes that academic language is a central tool for constructing explanations, evaluating evidence, and interpreting scientific scenarios. These studies collectively show that language proficiency is closely linked to higher-order reasoning in Science.

An increasing body of work highlights the essential role of academic language in shaping students' scientific understanding, noting that learners with stronger English proficiency, particularly in scientific vocabulary and comprehension, are better equipped to interpret complex information, construct logical inferences, and articulate scientific explanations. This proficiency supports deeper conceptual understanding by enabling students to process information more accurately and express their reasoning more clearly, demonstrating that scientific reasoning and language proficiency are interconnected abilities that enhance scientific literacy. Despite these insights, a noticeable gap persists in the local literature examining these two constructs together in public high school settings. Many existing studies focus separately on reasoning skills, language proficiency, or metacognitive processes without exploring how these abilities interact. Research on inquiry practices rarely considers English proficiency as a factor influencing reasoning outcomes, and local evidence on how academic language supports or limits reasoning remains limited, indicating the need for further investigation among Filipino learners. Thus, this study assessed the scientific reasoning skills and English language proficiency of public high school learners at Rafael Lentejas Memorial School of Fisheries, Schools Division of Calbayog City, for the School Year 2025-2026.

METHODOLOGY

The study employed a descriptive-comparative-correlational research design. Creswell (2012) explains that descriptive research aims to portray and summarize the current status of variables; comparative or causal-comparative research examines differences between naturally existing groups; and correlational research determines the strength and direction of relationships among variables. This design is appropriate for the present study, which assesses the scientific reasoning skills and English language proficiency of public high school learners in a technical-vocational setting. Moreover, this descriptive-comparative correlational design enables the researcher to describe learners' current performance levels, compare groups based on relevant characteristics such as grade level or class section, and examine how scientific reasoning and English proficiency relate, resulting in a comprehensive understanding of these academic skills within the school setting. The respondents of this study were the public high school learners from Rafael Lentejas Memorial School of Fisheries. Table 1 presents the distribution of respondents. Out of a total population of 1,221 students, 955 are from Junior High School, and 266 are from Senior High School.

Table 1 The distribution of respondents of the study

Grade Level	**Population (N)**	**Sample (n)**	**Percentage (%)**
Junior High School	955	229	78.16
Senior High School	266	64	21.84
Total	**1,221**	**293**	**100.00**

Using the Raosoft sample size calculator, the researcher determined a total sample size of 293 respondents, with 95% confidence and a 5% margin of error to ensure statistical reliability. The sample was then proportionally allocated to each grade level based on its population. Consequently, 229 respondents (78.16%) were drawn from Junior High School and 64 respondents (21.84%) from Senior High School.

This proportional allocation ensures that each subgroup is adequately represented in the study. In addition, the study employed stratified random sampling, a method that divides the population into distinct subgroups (strata) and randomly selects participants from each stratum. This approach reduces sampling bias and increases the sample's representativeness, ensuring that both Junior and Senior High School students are fairly represented in line with their actual population proportions.

Furthermore, the researcher generally used a self-constructed multiple-choice test consisting of three (3) parts. Part 1 gathered the profile of public high school learners in a technical-vocational school in terms of age, gender, nutritional status, family type, monthly family income, grade level, and type of previous school attended. Part 2 assessed the proficiency level in scientific reasoning skills of public high school learners in a technical-vocational school. Part 3 assessed the proficiency level in English language skills of public high school learners in a technical-vocational school.

Further, both Part 2 and 3 were answered by the high school learners through multiple-choice questions containing four (4) choices from letters A to D. Furthermore, the research instrument underwent thorough validation and reliability testing, with six (6) subject-matter experts confirming excellent content validity across both scientific reasoning and English language skills dimensions (S-CVI=0.98–0.99).

Pilot testing with 30 learners followed, and reliability was assessed using KR-21, where selected items demonstrated fair to excellent reliability, resulting in overall good internal consistency (KR-21=0.82). Ultimately, the instrument was deemed valid and reliable, making it acceptable for assessing the proficiency of public high school learners in scientific reasoning and English language skills. The researcher employed both descriptive and inferential statistics to examine learners' profiles and proficiency levels. Categorical variables like gender, nutritional status, family type, grade level, and school type were summarized using frequencies and percentages, while continuous variables such as age and family income were described with means and standard deviations.

Proficiency in scientific reasoning and English language skills was also analyzed using means and standard deviations. Importantly, normality tests using the Kolmogorov–Smirnov test showed p-values of 0.000 for both dimensions, indicating non-normal distributions. As a result, non-parametric tests were applied: Kruskal-Wallis with post-hoc analysis for group differences, and Spearman's rho for examining relationships between the two proficiency levels.

RESULTS

Proficiency Level in Scientific Reasoning Skills of Public High School Learners in a Technical-Vocational School

Table 2 presents the proficiency level in scientific reasoning skills of public high school learners in a technical-vocational school using descriptive statistics.

Table 2 Descriptive statistics on the proficiency level in scientific reasoning skills of public high school learners in a technical-vocational school (n=293)

Performance Level	**Percentile Score**	**Frequency (f)**	**Percentage (%)**
Beginning	0-24	1	0.30
Developing	25-49	13	4.40
Satisfactory	50-74	112	38.20
Very Good	75-89	58	19.80
Excellent	90-100	109	37.20
Number of Items	10		
Minimum (lowest score)	3		
Maximum (highest score)	10		
Mean Percentage Score (MPS)	75.70	Proficient	
Standard Deviation	17.77		

Legend: *90-100=Excellent; 85-89=Very Good; 80-84=Good; 75-79=Proficient; Below 75=Poor (DepEd Order No. 8, s. 2015)*

The descriptive statistics on the scientific reasoning skills of 293 public high school learners in a technical-vocational school show that most learners performed at a satisfactory to excellent level. Out of 10 items, 112 learners (38.20%) scored in the satisfactory range (50–74 percentile), 58 learners (19.80%) in the very good range (75–89 percentile), and 109 learners (37.20%) achieved excellent scores (90–100 percentile).

Only a few learners were at the beginning (0–24 percentile, 0.30%) and developing (25–49 percentile, 4.40%) levels. Scores ranged from a minimum of 3 to a maximum of 10 items correctly answered, with a mean percentile score of 75.70, which falls within the proficient category, and a standard deviation of 17.77, indicating moderate variation in performance. Overall, the findings suggest that the majority of learners demonstrate proficient scientific reasoning skills.

Proficiency Level in English Language Skills of Public High School Learners in a Technical-Vocational School

Table 3 presents the proficiency level in English language skills of public high school learners in a technical-vocational school using descriptive statistics.

Table 3 Descriptive statistics on the proficiency level in English language skills of public high school learners in a technical-vocational school (n=293)

Performance Level	Percentile Score	Frequency (f)	Percentage (%)
Beginning	0-24	1	0.30
Developing	25-49	13	4.40
Satisfactory	50-74	112	38.20
Very Good	75-89	58	19.80
Excellent	90-100	109	37.20
Number of Items	12		
Minimum (lowest score)	3		
Maximum (highest score)	12		
Mean Percentage Score (MPS)	79.92	Proficient	
Standard Deviation	16.66		

Legend: *90-100=Excellent; 85-89=Very Good; 80-84=Good; 75-79=Proficient; Below 75=Poor (DepEd Order No. 8, s. 2015)*

As shown in the table, the descriptive statistics on the English language skills of 293 public high school learners in a technical-vocational school indicate that most learners performed at a satisfactory to excellent level. Out of 12 items, 112 learners (38.20%) scored in the satisfactory range (50–74 percentile), 58 learners (19.80%) in the very good range (75–89 percentile), and 109 learners (37.20%) achieved excellent scores (90–100 percentile).

Only a few learners were at the beginning (0–24 percentile, 0.30%) and developing (25–49 percentile, 4.40%) levels. Scores ranged from a minimum of 3 to a maximum of 12 items correctly answered, with a mean percentage score of 79.92, which falls within the proficient category, and a standard deviation of 16.66, indicating moderate variability in performance. Overall, the table shows that the majority of learners demonstrate proficiency in English.

Test of Difference in the Proficiency Level in Scientific Reasoning Skills of Public High School Learners in a Technical-Vocational School when Grouped According to their Profile

Tables 4 and 4.1 present the test of difference in the proficiency level in scientific reasoning skills of public high school learners in a technical-vocational school when grouped according to their profile using the Kruskal-Wallis test and Dunn-Bonferroni post-hoc analysis.

Table 4 Kruskal-Wallis test of difference in the proficiency level in scientific reasoning skills of public high school learners in a technical-vocational school when grouped according to their profile

Profile Variables	$\chi^2(df)$	p	η^2
Age	11.612 (3)**	0.009	0.03
Gender	6.468 (2)*	0.039	0.015
Nutritional Status	0.771 (3)^{ns}	0.856	-

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Family Type	$1.610\ (3)^{ns}$	0.657	-
Monthly Income	$5.836\ (3)^{ns}$	0.120	-
Grade Level	$5.537\ (1)^{*}$	0.019	-
Note. All tests are adjusted for ties.			

The results indicate that age shows a statistically significant difference (χ^2=11.612, df=3, p=0.009, η^2=0.03), suggesting that learners' scientific reasoning skills vary across different age groups. Gender also shows a significant difference (χ^2=6.468, df=2, p=0.039, η^2=0.015), indicating a slight variation in proficiency between male, female, and LGBTQIA learners.

Grade level is another significant factor (χ^2=5.537, df=1, p=0.019), showing that learners in junior and senior high school differ in their scientific reasoning skills. In contrast, nutritional status (χ^2=0.771, p=0.856), family type (χ^2=1.610, p=0.657), and monthly income (χ^2=5.836, p=0.120) do not show significant differences, indicating that these variables do not influence scientific reasoning proficiency. Overall, age, gender, and grade level are the profile variables that significantly affect learners' scientific reasoning skills.

Table 4.1 Dunn-Bonferroni post-hoc test of significant difference in the proficiency level in scientific reasoning skills of public high school learners in a technical-vocational school when grouped according to their age and gender

Variables	**Significant Comparison**	**Adjusted *p***
Age	Middle adolescence vs. Late adolescence	0.030
Gender	Male vs. Female	-0.046
Note. Only statistically significant comparisons after Bonferroni adjustment are displayed.		

The Dunn-Bonferroni post-hoc test further examined significant differences in scientific reasoning skills among learners by age and gender. Results show that learners in middle adolescence (15–16 years old) scored significantly higher than those in late adolescence (17–18 years old), with an adjusted p-value of 0.030, indicating that age differences within these groups affect proficiency levels.

In terms of gender, male learners scored significantly lower than female learners, with an adjusted p-value of 0.046, suggesting that gender also contributes to variations in scientific reasoning skills. These findings highlight that both age and gender are significant factors influencing learners' proficiency, while other profile variables were not found to have a significant impact.

Test of Difference in the Proficiency Level in English Language Skills of Public High School Learners in a Technical-Vocational School when Grouped According to their Profile

Tables 5 and 5.1 present the test of difference in the proficiency level in English language skills of public high school learners in a technical-vocational school when grouped according to their profile using the Kruskal-Wallis test and Dunn-Bonferroni post-hoc analysis.

Table 5 Kruskal-Wallis test of difference in the proficiency level in English language skills of public high school learners in a technical-vocational school when grouped according to their profile

Profile Variables	$\chi^2(df)$	***p***	η^2
Age	$1.456\ (3)^{ns}$	0.692	-

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Gender	9.782 (2)**	0.008	0.027
Nutritional Status	3.387 (3)ns	0.336	-
Family Type	7.570 (3)ns	0.056	-
Monthly Income	6.200 (3)ns	0.102	-
Grade Level	1.422 (1)ns	0.233	-
Note. All tests are adjusted for ties.			

The Kruskal-Wallis test results indicate a statistically significant difference in gender (χ^2=9.782, df=2, p=0.008, η^2=0.027), suggesting that male, female, and LGBTQIA learners differ slightly in English language proficiency.

In contrast, age (χ^2=1.456, p=0.692), nutritional status (χ^2=3.387, p=0.336), family type (χ^2=7.570, p=0.056), monthly income (χ^2=6.200, p=0.102), and grade level (χ^2=1.422, p=0.233) show no significant differences, indicating that these profile variables do not significantly affect learners' English language skills. Overall, gender is the only profile variable that significantly influences English proficiency among the learners, while other factors such as age, nutrition, family background, income, and grade level have no significant impact.

Table 5.1 Dunn-Bonferroni post-hoc test of significant difference in the proficiency level in English language skills of public high school learners in a technical-vocational school when grouped according to their gender

Variables	**Significant Comparison**	**Adjusted *p***
Gender	Male vs. Female	-0.008
Note. Only statistically significant comparisons after Bonferroni adjustment are displayed.		

The Dunn-Bonferroni post-hoc test further examined the significant difference in English language proficiency based on gender. The results show that female learners scored significantly higher than male learners, with an adjusted p-value of 0.008. This indicates that gender is a significant factor affecting English language skills among public high school learners in the technical-vocational school, with females demonstrating higher proficiency compared to their male counterparts.

Test of Relationship between the Proficiency Level in the English Language and the Scientific Reasoning Skills of Public High School Learners in a Technical-Vocational School

Table 6 presents the test of the relationship between the proficiency level in the English language and the scientific reasoning skills of public high school learners in a technical-vocational school. The Spearman's rho correlation analysis indicates a moderate positive relationship between the proficiency level in English language skills and scientific reasoning skills of public high school learners in a technical-vocational school (r_s = 0.507, $p < 0.001$, n = 293).

This suggests that learners who demonstrate higher proficiency in English tend to also perform better in scientific reasoning, and the relationship is statistically significant at the 0.01 level, meaning the likelihood of this association occurring by chance is very low. Overall, the finding implies that English language proficiency may be positively associated with the development of scientific reasoning skills among these learners.

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Table 6 Spearman's rho correlation between the proficiency level in the English language and the scientific reasoning skills of public high school learners in a technical-vocational school

Variables	r_s	p	n
English language skills and Scientific reasoning skills	0.507	< 0.001	293
Note. Correlation is significant at the .01 level, two-tailed.			

DISCUSSION

Proficiency Level in Scientific Reasoning Skills of Public High School Learners in a Technical-Vocational School

The proficiency level in scientific reasoning skills of public high school learners in the technical-vocational school was overall, with a Mean Percentage Score (MPS) of 75.70 and relatively wide variability (SD=17.77). A substantial proportion of learners demonstrated proficient reasoning, with 37.20% achieving an excellent level and 19.80% reaching a very good level. Meanwhile, 38.20% of learners were classified as satisfactory, while only a small proportion fell within the developing (4.40%) and beginning (0.30%) levels. The highest score was 10 out of 10, whereas the lowest was 3, suggesting that although many learners demonstrated strong reasoning skills, others still struggled with specific reasoning tasks. Overall, most learners had the capacity to apply scientific reasoning processes, such as analyzing data, interpreting results, and drawing conclusions. However, the distribution also highlighted disparities in performance, suggesting that not all learners had fully mastered higher-order reasoning processes required in scientific inquiry. These results implied that while learners generally met the expected proficiency level set by the Department of Education, continuous instructional support was necessary to elevate students from satisfactory and developing levels toward advanced reasoning competencies. Strengthening inquiry-based learning, explicit reasoning instruction, and language-rich Science activities may help address the observed variability and further enhance students' capacity for critical thinking and problem-solving in Science.

These findings aligned with the existing literature, which emphasized the central role of scientific reasoning in Science learning and academic development. Science education has long been recognized as essential for developing inquiry, problem-solving, and evidence-based reasoning skills that enabled learners to understand scientific phenomena and make informed decisions (National Research Council, 2012). Scientific literacy extended beyond knowledge acquisition to include understanding scientific processes and applying them in real-world contexts (DeBoer, 2014). Integrated STEM approaches further strengthened these competencies by fostering higher-order thinking and encouraging learners to connect scientific concepts across disciplines (Honey et al., 2014). In addition, global education frameworks emphasized that strong Science reasoning skills were vital for preparing learners to address societal and environmental challenges (UNESCO, 2017). Contemporary Science standards likewise highlighted the importance of engaging students in reasoning processes similar to those used by scientists, rather than focusing solely on factual knowledge (NGSS Lead States, 2013).

Empirical studies also found that many secondary students demonstrated uneven reasoning ability, with difficulties particularly evident in experimental design and control-of-variables strategies (Van Vo & Csapó, 2021). Research on scientific reasoning assessments showed that learners may answer conceptual questions correctly yet still struggle to provide coherent explanations, indicating underlying misconceptions (Bhaw et al., 2023). Similarly, studies of reasoning development among middle school learners demonstrated wide variability in reasoning stages, with many students remaining at lower levels of reasoning proficiency (Abate et al., 2020). Cross-sectional analyses further showed that scientific reasoning was closely associated with other cognitive abilities, such as inductive reasoning, and significantly predicted achievement in STEM-related fields (Vo & Csapó, 2023). Intervention studies also demonstrated that instructional strategies such as problem-based learning significantly enhanced students' scientific reasoning abilities by engaging them in authentic problem-solving situations (Blancia, 2025). Longitudinal research on reasoning development further indicated that reasoning strategies evolved gradually and required explicit instructional support throughout secondary education (Csapó & Van Vo, 2023). Finally, studies examining the predictive validity of reasoning assessments showed that students' scientific reasoning performance at the secondary level was positively associated with success in technical and scientific education pathways (Sapia et al., 2022). Collectively, these studies corroborated the present findings by showing that while many learners achieved functional proficiency in scientific reasoning, sustained instructional interventions and contextualized learning experiences remained essential for developing the higher-order reasoning skills needed for advanced Science learning and technical-vocational careers.

Proficiency Level in English Language Skills of Public High School Learners in a Technical-Vocational School

The proficiency level in English language skills of public high school learners in the technical-vocational school revealed that the overall performance of the respondents fell within the proficient level, with a Mean Percentage Score (MPS) of 79.92 and a standard deviation of 16.66, which indicated moderate variability in learners' performance. A closer examination of the distribution showed that a substantial proportion of learners achieved higher levels of proficiency, with 37.20% classified as excellent and 19.80% as very good, suggesting that many learners demonstrated strong English language competencies in comprehension, vocabulary use, and communication. Meanwhile, 38.20% of learners fell within the satisfactory level, implying that although they possessed basic English competencies, they may have encountered challenges in higher-order language tasks such as critical interpretation, analytical reading, and structured academic writing. Only a small percentage of learners fell under the developing (4.40%) and beginning (0.30%) levels, indicating that the majority of students had attained at least a functional level of English proficiency necessary for academic engagement. The highest score was 12 out of 12, while the lowest was 3, indicating a wide range of language abilities among the learners. Overall, the findings demonstrated that most learners had developed adequate English language skills required for classroom communication and comprehension of academic texts. However, the significant proportion of learners in the satisfactory category underscored the need for targeted instructional strategies to strengthen academic language, particularly in inferential reading, technical vocabulary, and structured explanation. These findings suggested that teachers in technical-vocational schools needed to integrate language-rich instruction, contextualized literacy activities, and explicit vocabulary development to further enhance learners' communicative competence and support their understanding of academic and technical content.

These findings were supported by several studies that emphasized the critical role of language proficiency in academic learning, particularly in Science and technical education contexts. Research indicated that academic language skills strongly affect students' ability to construct scientific explanations and engage in reasoning processes, as learners need to interpret texts, link claims to evidence, and communicate ideas coherently (Uccelli et al., 2019). Similarly, cross-disciplinary language abilities were found to significantly predict the quality of students' Science summaries and academic writing beyond simple text production (Phillips-Galloway & Uccelli, 2020). Studies on English learners further revealed that limited language proficiency suppressed academic performance in content areas by reducing learners' confidence and restricting their understanding of assessment language (Sandilos et al., 2020). In addition, task-level analyses of reasoning assessments highlighted that language demands affected how students demonstrated their reasoning skills, suggesting that language proficiency played a mediating role in academic performance (Krell, 2022). Empirical investigations also showed that students' access to linguistic resources shaped the sophistication of their argumentation and sensemaking in Science-related tasks (Deng et al., 2022). Intervention research further demonstrated that explicit instruction in academic language structures such as causal connectives and disciplinary vocabulary significantly improved the clarity and depth of students' explanations (Hu et al., 2022). Likewise, studies on disciplinary language use revealed that learners who employed precise scientific terminology and cohesive language structures demonstrated deeper conceptual understanding (Olsson et al., 2023). In the Philippine context, research has shown that technical-vocational students often struggle with specialized academic vocabulary, which limits their ability to explain scientific ideas and comprehend discipline-specific texts (Iliw-Iliw, 2023).

Similar findings indicated that many learners relied on general vocabulary and struggled to interpret scientific concepts due to limited exposure to technical language (Agtarap et al., 2023). Studies have also revealed that Filipino learners frequently experience difficulty with higher-order reading skills, such as inference and evaluation, when interpreting complex academic texts (Caraig & Quimbo, 2022). Moreover, limited reading fluency and insufficient prior knowledge were identified as barriers to understanding scientific materials and integrating information across sources (Tapit, 2025). Research also showed that students often produced fragmented explanations because they struggled to organize ideas and link evidence to claims in written outputs (Pablo & Lasaten, 2023). Additional studies confirmed that technical-vocational learners struggled to construct coherent written explanations in English, particularly when integrating scientific terminology and logical reasoning (Esguerra, 2025). Furthermore, research indicated that Filipino high school students often demonstrated stronger literal comprehension but struggled with integrative and evaluative understanding of texts (Manuel, 2022). Finally, studies highlighted that learners' motivation, access to literacy resources, and home learning environment significantly affect language proficiency and academic achievement (Vu et al., 2022). Collectively, these studies corroborated the present findings by emphasizing that English language proficiency was a crucial factor influencing learners' academic success, particularly in technical-vocational contexts where comprehension of specialized texts, effective communication, and analytical thinking were essential for learning and professional preparation.

Test of Difference in the Proficiency Level in Scientific Reasoning Skills of Public High School Learners in a Technical-Vocational School when Grouped According to their Profile

The Kruskal–Wallis test results showed that age, gender, and grade level significantly affected proficiency in scientific reasoning among public high school learners in the technical-vocational school, whereas nutritional status, family type, and monthly income did not differ significantly. Specifically, age showed a significant difference ($\chi^2=11.612$, $p=0.009$, $\eta^2=0.03$), indicating that scientific reasoning skills varied across developmental stages, with the Dunn–Bonferroni post-hoc test confirming a significant difference between middle adolescence and late adolescence. Gender also showed a significant difference ($\chi^2=6.468$, $p=0.039$, $\eta^2=0.015$), with the post-hoc test indicating a significant comparison between male and female learners. Likewise, grade level showed a significant difference ($\chi^2=5.537$, $p=0.019$), suggesting that learners' reasoning abilities continued to develop as they progressed academically. In contrast, the absence of significant differences across nutritional status, family type, and monthly income suggested that these factors did not directly determine students' reasoning proficiency in this context. Overall, the results highlighted that developmental and academic factors played a more substantial role in shaping scientific reasoning skills than household or biological factors in this group of learners. These findings suggested that educators needed to consider developmental stages, gender-related learning patterns, and grade-level progression when designing instructional interventions to strengthen scientific reasoning. Tailored instructional strategies, such as differentiated inquiry-based learning and scaffolded reasoning activities, could help ensure that learners at different developmental stages acquire the higher-order thinking skills necessary for effective scientific inquiry.

These findings were supported by several studies emphasizing the developmental and instructional nature of scientific reasoning skills. Scientific reasoning was widely recognized as a complex cognitive ability that developed progressively through learning experiences and engagement in scientific inquiry (Van Vo & Csapó, 2021). Research indicated that many secondary learners struggled with the design and interpretation of controlled experiments, reflecting differences in reasoning abilities that often emerged across age groups and educational levels (Bhaw et al., 2023). Similarly, studies using scientific reasoning assessment tools documented considerable variability in the development of reasoning among adolescents, with some learners demonstrating higher-level reasoning skills while others remained at earlier developmental stages (Abate et al., 2020). Cross-sectional analyses further demonstrated that reasoning ability was strongly linked to other cognitive capacities, such as inductive reasoning, and gradually improved as learners progressed through higher grade levels (Vo & Csapó, 2023). Intervention-based research also showed that instructional strategies, such as problem-based learning, significantly enhanced students' scientific reasoning by engaging them in authentic problem-solving (Blancia, 2025).

Furthermore, longitudinal investigations of reasoning development revealed that certain reasoning strategies, particularly those involving control-of-variables reasoning, matured later and required targeted instructional support (Csapó et al., 2023). Predictive studies also indicated that students with stronger reasoning abilities in secondary school tended to perform better in tertiary technical and scientific programs, highlighting the long-term importance of reasoning development (Sapia et al., 2022). Research on reasoning instruction further demonstrated that sustained practice with real-world problem-solving tasks improved students' ability to analyze evidence and construct logical explanations (Khan & Krell, 2021). Studies on hypothesis formulation also revealed that many learners struggled to formulate testable predictions and isolate variables, reinforcing the need for explicit modeling and guided inquiry in Science instruction (Wulandari et al., 2025). Finally, research emphasized that scaffolding strategies such as guided experimentation, reflection, and iterative testing played a critical role in strengthening learners' reasoning processes and enabled them to develop deeper conceptual understanding (Hasanah, 2020). Collectively, these studies corroborated the present findings by highlighting that scientific reasoning skills were shaped by developmental progression and instructional experiences, underscoring the importance of targeted educational interventions to support learners' cognitive growth across different stages of secondary education.

Test of Difference in the Proficiency Level in English Language Skills of Public High School Learners in a Technical-Vocational School when Grouped According to their Profile

The results of the Kruskal–Wallis test indicated that gender was the only profile variable that showed a statistically significant difference in the proficiency level in English language skills among public high school learners in a technical-vocational school ($\chi^2=9.782$, $p=0.008$, $\eta^2=0.027$), while age, nutritional status, family type, monthly income, and grade level did not demonstrate significant differences. The Dunn–Bonferroni post-hoc analysis further confirmed that the significant difference occurred specifically between male and female learners, suggesting that gender-related variations affect students' English language proficiency in this context. The absence of significant differences across the other profile variables implied that English language skills among learners were shaped more by classroom experiences, instructional strategies, and individual engagement with language learning rather than demographic characteristics alone. In technical-vocational settings, where instruction often emphasized practical, skills-based learning, differences in language engagement, confidence in communication, and exposure to reading and writing tasks may have partly explained gender-related variations in English proficiency. The relatively small effect size also indicated that, although gender differences existed, they were modest and should be interpreted with caution. These findings implied that educators needed to strengthen inclusive language-learning strategies that supported both male and female learners, particularly by integrating structured reading, writing, and communication activities within technical-vocational contexts. Strategies such as contextualized vocabulary instruction, collaborative discussions, and writing-to-learn approaches could help reduce gender-related gaps and ensure that all learners developed the academic language skills necessary for scientific reasoning and technical communication.

These findings were supported by several studies emphasizing the role of demographic and educational factors in shaping English language proficiency. Research showed that demographic variables, particularly gender, affect language learning outcomes due to differences in motivation, language attitudes, and communication patterns (Capadeso & Banquiao, 2025). Studies also indicated that gender differences in language achievement emerged because female learners often demonstrated stronger engagement in reading and writing tasks, which were fundamental to language proficiency (Pei & Pamintuan, 2023). Meanwhile, research in Philippine secondary schools highlighted that students' English competence was affected by learning attitudes, classroom exposure, and opportunities to practice language skills rather than solely by demographic characteristics (Manuel, 2022). Socioeconomic and environmental factors were also examined, with evidence suggesting that home literacy environment and access to language-learning resources contributed to English performance, although these factors did not always produce statistically significant differences across groups (Besa, 2019). Similarly, international research demonstrated that students' language achievement was associated with motivation, self-efficacy, and access to educational resources, which interacted with demographic characteristics in complex ways (Tan et al., 2018).

Studies further emphasized that language proficiency developed through sustained exposure to academic discourse and opportunities for meaningful communication in classroom settings (Caraig & Quimbo, 2022). In technical-vocational education, learners' language skills were strengthened when teachers explicitly integrated vocabulary development and discipline-specific communication tasks within instruction (Iliw-Iliw, 2023). Research also indicated that scaffolded reading strategies and guided writing activities significantly enhanced learners' comprehension of complex academic texts (Tapit, 2025). Furthermore, structured writing instruction and argumentation activities improved students' ability to articulate ideas clearly and support claims with evidence (Pablo & Lasaten, 2018). Finally, classroom-based language support strategies that integrated reading, discussion, and reflective writing helped learners develop deeper comprehension and stronger academic communication skills (Esguerra, 2025). Collectively, these studies reinforced the present findings by showing that English language proficiency among secondary learners is shaped by a combination of demographic factors, learning environments, and instructional practices, and by highlighting the importance of inclusive, language-rich educational approaches in technical-vocational schools.

Test of Relationship between the Proficiency Level in the English Language and the Scientific Reasoning Skills of Public High School Learners in a Technical-Vocational School

The Spearman's rho correlation analysis revealed a moderate positive relationship between English language proficiency and scientific reasoning skills among public high school learners in a technical-vocational school (r_s=0.507, p<0.001). This statistically significant result indicated that learners with higher English proficiency also tended to exhibit stronger scientific reasoning abilities. The finding suggested that language competence played a meaningful role in enabling students to interpret scientific information, articulate explanations, and justify conclusions logically. In Science learning, reasoning processes often required learners to read and analyze texts, interpret data, construct hypotheses, and communicate findings clearly; thus, proficiency in the language of instruction served as an essential cognitive tool for expressing and organizing scientific thought. For technical-vocational learners, whose curriculum often integrated practical tasks with theoretical understanding, language proficiency facilitated the comprehension of scientific instructions, technical descriptions, and conceptual explanations. Consequently, learners with stronger English skills were better equipped to think analytically, interpret experimental results, and communicate evidence-based conclusions. The implication of this finding was that strengthening English language instruction, particularly academic reading, scientific vocabulary, and structured writing, could significantly support the development of students' scientific reasoning skills. Integrating language-focused strategies within Science instruction, such as explicit vocabulary teaching, guided reading of scientific texts, and argumentation-based writing tasks, could help learners develop linguistic competence and higher-order reasoning abilities simultaneously.

Several studies corroborated these findings, emphasizing the interconnectedness of language proficiency and scientific reasoning in Science education. Research showed that Science learning involved complex practices such as inquiry, explanation building, and evidence-based reasoning, all of which required students to comprehend and communicate ideas effectively through language (National Research Council, 2012). Scientific literacy was described not merely as acquiring factual knowledge but as the ability to interpret and apply scientific concepts in real-world contexts through meaningful communication (DeBoer, 2014). Integrated STEM education was found to enhance students' engagement and support higher-order thinking, which relied on the ability to analyze and communicate ideas across disciplines (Honey et al., 2014). Global education initiatives likewise highlighted that developing scientific literacy and communication skills was essential for preparing learners to address societal and environmental challenges (UNESCO, 2017). Moreover, standards-based Science frameworks emphasized integrating scientific practices, conceptual understanding, and communication skills to foster meaningful learning (NGSS Lead States, 2013). Empirical studies also reported that learners frequently struggled with reasoning tasks such as hypothesis construction and variable identification, underscoring the need for stronger conceptual and linguistic foundations (Wulandari et al., 2025; Schlatter et al., 2021). Instructional research also demonstrated that guided inquiry and reasoning-focused learning strategies improved students' ability to interpret evidence and formulate logical conclusions (Hačatrjana & Namsone, 2024; Pickal et al., 2023). Moreover, studies on reasoning development have indicated that hypothesis formulation and experimental design require both conceptual knowledge and effective communication skills (Dinata et al., 2025). Collectively, these studies supported the present findings by demonstrating that English language proficiency and scientific reasoning were closely linked, emphasizing the importance of integrating language development within Science instruction to enhance learners' analytical thinking and academic performance.

CONCLUSIONS

The demographic profile of public high school learners in the technical-vocational school showed that proficiency levels in both English language and scientific reasoning skills were rated as proficient. While a significant proportion of learners achieved excellent and very good levels, notable percentages remained at the satisfactory level, indicating variability in language and reasoning skills. The difference tests showed that age, gender, and grade level significantly affect scientific reasoning, whereas only gender significantly affected English proficiency. Finally, the correlation test revealed a moderate positive relationship between English language skills and scientific reasoning, suggesting that learners with higher English proficiency tended to exhibit stronger scientific reasoning. These results imply that developmental, gender-related, and academic factors play a critical role in shaping learners' cognitive and language skills in technical-vocational settings. Teachers should design instructional interventions that address learners' developmental stages, promote gender-inclusive practices, and integrate language-rich Science activities. Strengthening inquiry-based learning, scaffolded reasoning tasks, and contextualized literacy exercises may help elevate students from satisfactory levels to higher proficiency, supporting both academic success and technical competence. Additionally, the positive association between English proficiency and scientific reasoning suggests that explicit language instruction alongside Science education could enhance learners' analytical and communicative abilities, preparing them for effective engagement in STEM-related contexts and future technical-vocational pathways.

RECOMMENDATIONS

Based on the salient findings of the study, the researcher suggests the following recommendations: (1) teachers should design differentiated, inquiry-based science activities suited to learners' developmental stages; (2) teachers should use gender-inclusive strategies like collaborative discussions and structured language exercises; (3) school administrators should provide supplemental support and enrichment programs for learners at satisfactory and developing levels; (4) curriculum developers should integrate language-rich science activities and explicit vocabulary instruction to strengthen the link between English proficiency and reasoning; (5) parents and guardians should engage learners in literacy and reasoning-supportive activities at home; and (6) teachers and schools should apply scaffolded approaches such as guided experimentation, iterative feedback, and structured reflection to progressively build higher-order reasoning skills.

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