ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14959381

Attitude, Scientific Literacy, and Career Readiness of the Science, Technology, Engineering and Mathematics (Stem) Learners

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Publication Date: 2025/03/03

Abstract: This study aimed to investigate the attitude, scientific literacy, and career readiness among Grade 12 STEM learners at Cronasia Foundation College, Inc. Using a mixed-methods research design, data were collected from 48 Grade 12 STEM learners through standardized tests, surveys, and qualitative interviews. The Test of Scientific Literacy Skills (TOSLS) and a survey questionnaire adapted from previous studies assessed scientific literacy and attitudes towards STEM. Findings indicate generally positive attitudes towards science, technology, engineering, and mathematics among the students. While scientific literacy levels were found to be "Approaching Proficiency", there is a need for improvement, particularly in critical thinking and problem-solving skills. However, learners exhibited high levels of career readiness, expressing enthusiasm for STEM careers and further education. A significant relationship was observed between scientific literacy and career readiness. Based on these findings, it is recommended to enhance scientific literacy through tailored study strategies, confidence-building activities, and increased practice in mathematics. Further research should replicate the study with a larger sample size and consider other variables, such as specific STEM career paths.

Keywords: *Attitude, Scientific Literacy, Career Readiness, Cronasia Foundation College, Inc., Grade 12 Stem Learners, Stem Education.*

How to Cite: Gealyn D. Albarracin (2025) Attitude, Scientific Literacy, and Career Readiness of the Science, Technology, Engineering and Mathematics (Stem) Learners. *International Journal of Innovative Science and Research Technology*, 10(2), 1159-1164. https://doi.org/10.5281/zenodo.14959381

I. INTRODUCTION

The Science, Technology, Engineering, and Mathematics (STEM) strand is one of the four strands available for senior high school in the Philippines. It aims to develop students' knowledge and skills in these critical disciplines, fostering a deeper understanding of scientific concepts and their practical application.

Scientific literacy is a fundamental component of the STEM Strand, covering the capacity to comprehend and effectively convey scientific ideas. Scientifically literate students have the knowledge and skills to engage in scientific investigation, analyze critically, solve complicated problems, and make informed judgments. The National Research Council defines scientific literacy as the capacity to "use evidence and data to evaluate the quality of science information and arguments put forth by scientists and in the media" (NRC, 1996).

As per Doctolero, J., 2023 report, President Marcos stated in his first State of the Nation Address in July 2022 that the Philippines should do better in International Rankings in Science, Technology, Engineering, and Mathematics (STEM). By fostering scientific literacy in STEM learners, we can empower them to become future innovators, researchers, and leaders in STEM fields. However, as the implementation of the STEM Strand is relatively new in Cronasia Foundation College, Inc., it is essential to investigate the scientific literacy levels of STEM learners. This study will address this need by investigating.

Through this study, the researcher aims to contribute valuable insights that will inform the ongoing development and improvement of the STEM Strand in Cronasia Foundation College, Inc. By understanding the attitude of the STEM learners at the institution mentioned above and its impact on Science Literacy Skills and career readiness, administrators can shape educational policies, curriculum design, and

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instructional practices to provide the students with a strong foundation in scientific literacy, enabling them to thrive in the STEM disciplines and beyond.

II. METHODOLOGY

The study employed a mixed-method research design to gather quantitative and qualitative data. The quantitative component focused on assessing the attitude, level of scientific literacy, and career readiness among Grade 12 STEM learners through standardized tests, surveys, or existing assessment tools. The qualitative component involved in-depth interviews, focus group discussions, or open-ended questionnaires to explore the experiences of Grade 12 STEM learners regarding STEM subjects.

The researcher utilized the purposive sampling technique to select participants based on their inclusion in the STEM Strand. The total number of respondents depended on the total population enrolled in the Grade 12 STEM Strand for the school year 2023-2024 at Cronasia Foundation College, Inc., General Santos City, Philippines.

To identify the scientific literacy level of the Grade 12 STEM learners, the researcher used the adopted standardized scientific literacy assessment tool called The Test of Scientific Literacy Skills (TOSLS), which was modified from Wang et al. (2010) that consists of 28 items multiple choice test.

The researcher adopted a survey questionnaire from Suprato's study (2016), which experts validated to gather data on career readiness and attitudes toward the role of scientific literacy in STEM education. It used a five-point Likert scale, described as 5 Strongly Agree, 4 Strongly Agree, 3 Moderately Agree, 2 Disagree, 1 Strongly Disagree.

The researcher also added open-ended questions to explore the learning experiences of Science, Technology, Engineering, and Mathematics (STEM) learners in STEM subjects.

Thematic analysis was used to analyze qualitative data, such as identifying the learning experiences of science, technology, engineering, and mathematics (STEM) learners with STEM subjects.

A weighted mean was used to determine the extent of the attitudes of the Grade 12 STEM learners.

To determine the scientific literacy level of the Grade 12 STEM learners, frequency count and mean percentage score (MPS) were used. The scale below shows the scientific literacy level of the learners adopted from the study of Cano et al. (2022):

A weighted mean was used to determine the extent of the career readiness of Grade 12 STEM learners.

Spearman rank was used to determine the significant relationship between science literacy and the learners' attitudes.

Spearman rank was used to examine the significant relationship between science literacy and the career readiness of the learners.

III. RESULT AND DISCUSSION

The findings are systematically presented to address each objective, providing a comprehensive understanding of the learners' attitudes, scientific literacy, career readiness, and personal experiences in STEM education. Through this analysis, the study aims to offer insights into how these factors interplay and influence the overall educational outcomes for STEM students at Cronasia Foundation College, Inc.

Table 1: Summary of the Attitude Level of the Grade 12 STEM Learners in Cronasia Foundation College, Inc.

Indicator	WM	Description
Science	3.69	Agree
Mathematics	3.32	Moderately Agree
Technology and Engineering	4.06	Agree
Science, Technology, Engineering and Math	4.18	Agree
Overall Mean	**3.81**	**Agree**

Legend: (4.51-5.00 Strongly Agree; 3.51-4.50 Agree; 2.51-3:50 Moderately Agree; 1.51-2.50 Disagree; 1.00-1.50 Strongly Disagree)

Table 1 summarizes the attitude level of the Grade 12 STEM learners in Cronasia Foundation College, Inc. Results revealed that the learners have a high attitude level, as evidenced by an overall mean of 3.81, described as agree. They have a high attitude towards Science, Technology, Engineering, and Mathematics. Nevertheless, they have a moderate level of scientific literacy in Mathematics.

The high attitude level towards STEM fields (science, technology, and engineering) suggests that students are probably well-versed in basic scientific ideas from various fields, including Physics, Chemistry, and Biology. They comprehend and use these ideas in many situations. They are skilled in conducting tests, evaluating information, and coming to conclusions while applying the scientific method. They exhibit the capacity to have intelligent conversations

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14959381

regarding science-related subjects since they were aware of current scientific problems and developments.

When it comes to Technology and Engineering, learners are proficient with a variety of tools, comprehend how they operate, and can use them to solve problems in the real world. They also possess a solid understanding of fundamental engineering concepts and can design and enhance systems or products. Students also display solid problem-solving abilities, particularly in developing, testing, and improving engineering solutions.

Shahali et al. (2019) uncovered intriguing insights from their study, indicating that two years after exiting the program, levels of interest in STEM careers remained consistent, while interest in STEM subjects did not. Through interviews, they identified potential factors contributing to this decline in STEM subject interest, highlighting concerns about the quality of teaching and learning experiences within the classroom as a significant contributor.

Table 2: Level of Scientific Literacy among the Grade 12 STEM Learners in Cronasia Foundation College, Inc.

Number of Items	Percentile	Frequency	Percentage	Description	Interpretation
28					
22.5-28.0	81-100	4	8.5	Advanced	Very High
16.9-22.4	61-80	11	23.4	Proficient	High
11.3-16.8	41-60	7	14.9	Approaching Proficiency	Average
5.7-11.2	21-40	22	46.8	Developing	Low
0.0-5.6	0-20	3	6.4	Beginning	Very Low
Mean	**47.11**			**Approaching Proficiency**	**Average**

Legend: (81-100 Advance; 61-80 Proficient; 41-60 Approaching Proficiency; 21-40 Developing; 0-20 Beginning)

Table 2 presents the level of scientific literacy among the Grade 12 STEM learners in Cronasia Foundation College, Inc. Results showed that 46.8% have a developing level of scientific literacy, and 23.4% have a proficient level of scientific literacy. There are 14.9% who have an approaching proficiency level of scientific literacy, 8.5% have an advanced level of scientific literacy, and 6.4% have a beginning level of scientific literacy. This has a mean of 47.11, described as approaching the proficiency level of scientific literacy. This further means that the learners have an average level of scientific literacy.

Building on this, Wahyu et al. (2020) found that utilizing STEM-based learning supported by Mobile Augmented Reality proved highly effective in augmenting students' scientific literacy levels. Additionally, Paristiowati et al. concluded that implementing acid-base learning within a contextual flipped classroom model significantly enhanced students' scientific literacy skills. These findings underscore the importance of innovative teaching methodologies in fostering science literacy among students.

Table 3: Extent of the Career Readiness of the Grade 12 STEM Learners in Cronasia Foundation College, Inc

Indicator	WM	Description
1. I feel confident in my problem-solving abilities.	3.64	Agree
2. My communication skills are well-developed.	3.81	Agree
3. I am proficient in using relevant technology and tools.	3.68	Agree
4. I am confident in my ability to adapt to new situations.	3.83	Agree
5. I feel well-prepared for further Education or training in a STEM-related field.	4.04	Agree
6. I know the educational and training opportunities in STEM.	4.38	Agree
7. I am passionate about pursuing a career in a STEM-related field.	4.38	Agree
8. My current STEM education aligns with my future career goals.	4.38	Agree
9. I am aware of the diverse career opportunities available in STEM.	4.23	Agree
10. I feel well-informed about the potential career paths within the STEM field.	4.32	Agree
Mean	**4.07**	**Agree**

Legend: (4.51-5.00 Strongly Agree; 3.51-4.50 Agree; 2.51-3:50 Moderately Agree; 1.51-2.50 Disagree; 1.00-1.50 Strongly Disagree)

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14959381

Table 3 presents the extent of the career readiness of the Grade 12 STEM learners in Cronasia Foundation College, Inc. Results revealed that the learners agree that they were aware of the educational and training opportunities available in STEM ($M = 4.38$); they are passionate about pursuing a career in a STEM-related field ($M = 4.38$); and they believed their current STEM education aligns with their future career goals ($M = 4.38$). Additionally, they feel well-informed about the potential career paths within the STEM field ($M = 4.32$) and were aware of the diverse career opportunities available in STEM. ($M = 4.23$). Also, they were proficient in using relevant technology and tools ($M = 3.68$) and feel confident in their problem-solving abilities ($M = 3.64$). This obtains a mean of 4.07 and is described as agreeing. This means that the learners have a high degree of career readiness.

Jelks and Crain (2020) mentioned that specific experiences such as faculty research involvement and fieldwork were linked to an increased probability of entering or persisting in STEM careers. Additionally, transfer students were identified as at higher risk of prematurely leaving STEM career fields.

Table 4: Relationship between the Scientific Literacy and the Attitude Level of the Learners

Variables Correlated	r	r^2	p-value	Extent of Relationship	Remark
Science Literacy and the Attitude Level of the Learners	.155	.024	.297	Very Low	Not Sig.

Significance at 0.05 Level

A Spearman rank correlation is computed to assess the relationship between the level of scientific literacy and the attitude level of the learners. There is a very low positive, not significant correlation between the level of scientific literacy and the attitude level of the learners, r (47) = .155, p =.297 > .05, explaining 2.4% of the variations in the level of scientific literacy. The other 97.6% of the variations are due to other variables. These results imply that the level of scientific literacy does not significantly influence the attitude level of the learners. These findings also suggest that as the level of scientific literacy increases, so does the level of attitude of the learners. The learners have a high attitude level, as evidenced by an overall mean of 3.81, which is described as agreeing. They have high attitudes towards science, technology, engineering, mathematics, technology and engineering, and science. Nevertheless, they have a moderate level of scientific literacy in mathematics.

Adarlo et al. (2022) revealed a positive moderate correlation between students' attitudes toward science and their science literacy levels. They emphasized the influence of educational interventions to enhance science literacy and attitudes.

Table 5. Relationship between the Scientific Literacy and the Career Readiness of the Learners

Variables Correlated	r	r^2	p-value	Extent of Relationship	Remark
Science Literacy and the Career Readiness of the Learners	.312	.097	.033	Low	Sig.

Significance at 0.05 Level

A Spearman rank correlation was computed to assess the relationship between the level of scientific literacy and the career readiness of the learners. There is a low positive significant correlation between the level of scientific literacy and the career readiness of the learners, r (47) = .312, p =.033 < .05, explaining 9.7% of the variations in the level of scientific literacy. The other 90.3% of the variations were due to other variables. These results imply that the level of scientific literacy significantly influences the level of career readiness of the learners. These findings also suggest that as the level of scientific literacy increases, so does the level of career readiness of the learners.

Smith et al. (2019) conducted a longitudinal study tracking a cohort of high school students for four years to explore the connection between their science literacy levels and their preparedness for STEM careers. Their findings indicated a positive correlation between higher levels of science literacy and heightened readiness for STEM careers.

- *Significant Experiences of the Grade 12 STEM Learners*

P1 noted managing a school Sci-Math event as a significant experience, emphasizing the importance of leadership and organizational skills in STEM education. Recent studies have shown that participation in extracurricular activities, including event management, can enhance students' leadership skills and foster a sense of responsibility (Fischer & Lande, 2019). P2's study of turbines in physics illustrates how STEM education can cater to individual interests and promote deeper understanding. According to a 2020 study by Renninger and Hidi, fostering individual interest in STEM subjects can lead to sustained engagement and deeper learning outcomes (Renninger & Hidi, 2020).

P3 and P4 emphasized the impact of engaging activities in subjects like Physics, Chemistry, and Biology. Hands-on experiments were particularly highlighted, consistent with research indicating that practical, experiential learning methods enhance student engagement and comprehension in

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14959381

STEM education (Freeman et al., 2021). P5 highlighted a Physics Innovation project as a memorable learning experience, underscoring the role of creativity and innovation in STEM education. Project-based learning, which emphasizes innovation and problem-solving, has been shown to significantly improve critical thinking skills and student motivation (Krajcik & Delen, 2022).

P6's positive experience with research projects reflects the importance of inquiry-based learning in STEM education. Inquiry-based approaches develop critical thinking and analytical skills, providing students with a deeper understanding of scientific processes (Hofstein & Kind, 2020). The diversity and complexity of Physics and Biology, as highlighted by P7 and P8, captivate students' interest and foster a deeper appreciation for these subjects. Research suggests that the inherent interest and perceived complexity of STEM subjects can enhance student engagement and learning outcomes (Alexander et al., 2021).

P9's experience with a filmmaking project in CPAR demonstrates the benefits of integrating arts and humanities with STEM education. This interdisciplinary approach can enhance creativity and critical thinking, supporting holistic learning and innovation (Henriksen et al., 2019).

- *Challenging Moments of the Grade 12 STEM Learners*

P1 faced significant challenges while organizing a school event, highlighting the importance of organizational skills. Research indicates that such experiences build resilience and problem-solving abilities, essential for success in STEM fields (Dweck, 2020). P1 and P2 mentioned difficulties with practical research projects, navigating these challenges through perseverance and mentor guidance. Recent studies highlight the critical role of mentorship and persistence in overcoming research challenges and fostering academic success (Byars-Winston & Rogers, 2019).

P3 and P5 highlighted the role of resources and support systems in overcoming STEM challenges. Effective use of resources and support from teachers and peers is crucial for mastering complex concepts and achieving academic goals (Bandura, 2020). P5's experience with unfamiliar terms during a presentation illustrates the importance of adaptability and perseverance in overcoming academic challenges. These qualities are essential for academic resilience and success (Martin & Marsh, 2020).

P6's reliance on advisor support to find relevant studies underscores the importance of collaboration and support systems in STEM education. Collaborative learning environments and supportive mentorship can significantly enhance student learning and achievement (Johnson et al., 2019). P7 and P8 emphasized time management challenges, overcoming them through self-discipline. Research indicates that effective time management and self-discipline are key predictors of academic success, particularly in demanding fields like STEM (Eliot & Turns, 2020).

P9 found lesson comprehension challenging, highlighting the difficulty of grasping complex STEM concepts. This underscores the need for effective teaching strategies that simplify complex ideas and enhance understanding (Chi et al., 2020).

- *Knowledge Gained by the Grade 12 STEM Learners*

P1 and P8 found joy in sharing STEM knowledge with family and friends, reinforcing their own understanding. This reflects the benefits of teaching others as a way to solidify one's own knowledge, supported by recent research on the "protégé effect" (Hoogerheide et al., 2019). P2's deeper understanding of turbines through physics exemplifies the impact of practical application on learning. Applying theoretical knowledge to real-world problems enhances comprehension and retention (Lombardi et al., 2021).

P3 noted that subjects like Empowerment Technology and Media Information Literacy provided practical skills for real-world problem-solving. Practical application of STEM knowledge has been shown to improve problem-solving skills and understanding (Kimmons et al., 2022). P4 found experiments on animals and plants educational and enriching, applying theoretical knowledge to real scenarios. Hands-on activities in STEM subjects are crucial for reinforcing theoretical knowledge and enhancing learning (Harrison et al., 2019).

P7 mentioned that observing everyday phenomena reinforced their STEM knowledge. This interplay between theoretical knowledge and practical observation is critical for effective learning in STEM (Peffer et al., 2020). P9 applied STEM knowledge during an earthquake by implementing safety protocols, demonstrating the practical importance of STEM education. Preparing students for real-life emergencies underscores the relevance and application of STEM education in everyday life (Finn & McGuire, 2021).

IV. CONCLUSION AND RECOMMENDATION

- *Conclusions*

The Grade 12 STEM learners at Cronasia Foundation College, Inc. generally have a positive attitude towards Science, a moderately positive attitude towards Mathematics, a highly positive attitude towards Technology and Engineering, and a very positive attitude towards STEM. The scientific literacy of Grade 12 STEM learners at Cronasia Foundation College, Inc. was at an "Approaching Proficiency" level considered average. Grade 12 STEM learners at Cronasia Foundation College, Inc. exhibit a high level of career readiness.

ISSN No:-2456-2165 https://doi.org/10.5281/zenodo.14959381

There is no significant relationship between scientific literacy and the attitude level of Grade 12 STEM learners at Cronasia Foundation College, Inc. There is a significant relationship between Science literacy and career readiness among Grade 12 STEM learners at Cronasia Foundation College, Inc.

➢ *Recommendations*

In the light of the findings from the data, the following are recommended:

- The learners should focus more on their studies to enhance their scientific literacy.
- The teachers may design activities for the learners to boost their confidence and be ready for their career path.
- The learners may practice more problems, particularly in mathematics, to gain confidence and do a good job with math.
- The study should be replicated, considering the sample size, and may include other variables, such as a career path in ST

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