

Original Article

Perceived Barriers in Pursuing STEM Education

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Article History:

Date received: June 10, 2026
Date revised: July 25, 2026
Date accepted: August 6, 2026

Recommended citation:

Laplana, J.M., Gorduiz, G., Relos, R., Punay, J.M., & Estrada, F. (2026). Perceived barriers in pursuing STEM education. *Journal of Interdisciplinary Perspectives*, 4(9), 53-66. <https://doi.org/10.69569/jip.2026.345>

Abstract. Science, Technology, Engineering, and Mathematics (STEM) education plays a crucial role in developing the scientific and technological workforce needed for national and global development. Despite educational reforms and increased promotion of STEM programs, many students continue to encounter barriers that may affect their participation and persistence in STEM-related fields. This study aimed to determine the perceived barriers to pursuing STEM education among Grade 12 students and to examine whether significant differences in these barriers exist when grouped by sex. Specifically, the study investigated psychological, social, institutional, gender stereotype, and socioeconomic barriers. A quantitative descriptive-comparative research design was employed involving 263 Grade 12 students selected through stratified random sampling with proportionate allocation, followed by simple random sampling within each stratum. Data were collected using an adapted survey questionnaire and analyzed using the weighted mean and the independent samples t-test. Results revealed that psychological barriers were perceived at a high level, whereas social, institutional, gender stereotype, and socioeconomic barriers were perceived at low levels. Inferential analysis further indicated no statistically significant differences in perceived barriers between male and female students across all dimensions. These findings indicate that psychological factors are the primary challenge for students pursuing STEM education, whereas external barriers are generally perceived as less influential. These findings suggest that schools should prioritize interventions that strengthen students' self-efficacy, resilience, and confidence through mentoring, guidance, and socio-emotional support programs, as these approaches may have a greater impact on promoting STEM participation than interventions focused solely on external barriers.

Keywords: Barriers to STEM participation; Gender differences; Psychological barriers; Senior high school students; STEM education.

STEM education—covering Science, Technology, Engineering, and Mathematics—has gained global importance for its essential role in promoting innovation, economic growth, and sustainable development. As countries increasingly depend on scientific and technological progress to tackle complex societal issues, the demand for individuals with STEM skills continues to rise. The fast-changing global job market, fueled by technological advancements and digitalization, has heightened the need for graduates with strong analytical, problem-solving, and technical abilities. Therefore, governments and educational bodies worldwide are investing heavily in enhancing STEM education and motivating students to pursue STEM careers and studies.

In the Philippines, STEM education is recognized as a crucial part of national development. The Department of Education, through the K-12 Basic Education Program, launched the STEM strand within the Academic Track to

prepare students for higher education and careers in science, engineering, technology, and health sectors. Additionally, the Department of Science and Technology has emphasized the need to increase the number of STEM professionals to support the country's scientific progress, industrial growth, and global competitiveness. Despite these efforts, challenges remain in encouraging student participation and success in STEM fields. The PISA 2022 results show Filipino students still score below the OECD average in mathematics and science, raising ongoing concerns about STEM readiness and educational quality. These results imply that educational reforms alone may not be enough to improve student engagement in STEM.

Numerous studies indicate that psychological factors significantly influence students' experiences and choices in STEM. Han et al. (2021) found that self-efficacy strongly impacts STEM learning and career goals. Students with higher confidence in their abilities are more likely to stay committed to STEM courses and careers. Similarly, Chan (2022) highlighted that self-efficacy is a key predictor of students' interest and aspirations in STEM fields. Psychological obstacles like self-doubt, anxiety, fear of failure, and low confidence can hinder students from fully engaging in STEM education. Similarly, Pascual (2026) demonstrated that interventions designed to enhance academic motivation significantly improved Grade 11 STEM students' engagement and learning outcomes. The findings underscore the importance of strengthening students' psychological readiness and motivation to promote persistence in STEM education.

Beyond individual psychological factors, social influences significantly affect students' educational choices and persistence in STEM pathways. Saw (2020) highlighted the importance of family support, mentorship, peer relationships, and social networks in shaping students' STEM aspirations and achievements. Students who receive encouragement and support from their families and communities are more likely to develop positive attitudes toward STEM disciplines. Likewise, Master and Meltzoff (2020) found that students' sense of belonging within STEM environments strongly influences their motivation and persistence. A lack of social support may contribute to feelings of isolation and reduce students' willingness to pursue STEM-related opportunities. In the Philippines, Rogayan et al. (2021) identified socio-cultural challenges, including family expectations, community influences, and social pressures, as significant obstacles encountered by STEM students. These findings underscore the importance of examining social barriers that may either facilitate or hinder students' participation in STEM education.

Institutional factors also contribute substantially to students' STEM experiences. Educational institutions play a crucial role in providing access to quality instruction, laboratory facilities, learning resources, and supportive learning environments. UNESCO (2023) reported that many schools worldwide continue to experience shortages of STEM resources, qualified teachers, and laboratory facilities, which may negatively affect students' STEM learning experiences. Similarly, Flores et al. (2026) reported that students experienced institutional challenges associated with limited instructional resources, inadequate academic support, and learning constraints, emphasizing the importance of strengthening educational resources and support services to improve students' learning experiences. Santiago and Soliven (2024) further reported that institutional support, teacher guidance, and the availability of educational resources significantly influence STEM students' research productivity and academic engagement. These findings suggest that institutional barriers may affect students' ability to develop STEM competencies and successfully pursue STEM-related studies.

Gender-related barriers continue to receive considerable attention within STEM education research. Despite increasing efforts to promote gender equity, disparities in STEM participation remain evident across many countries. Cheryan et al. (2025) observed that cultural beliefs and gender stereotypes continue to contribute to the underrepresentation of women in several STEM disciplines. The authors argued that societal perceptions regarding gender-appropriate careers influence students' academic interests, self-perceptions, and educational choices. Likewise, Miller et al. (2024) found that gender stereotypes about STEM abilities emerge early in childhood and become stronger throughout development. These stereotypes shape students' beliefs about their own capabilities and may discourage girls from pursuing STEM-related educational pathways. Master and Meltzoff (2020) further noted that cultural stereotypes and reduced sense of belonging contribute to gender gaps in STEM participation. These findings indicate that gender stereotypes may discourage some students from fully engaging in STEM learning environments and pursuing STEM careers.

Socioeconomic conditions likewise influence students' opportunities and experiences in STEM education. Students from economically disadvantaged backgrounds often face challenges related to limited access to

educational resources, technology, enrichment programs, and academic support. Turner et al. (2024) identified financial constraints as a significant factor affecting students' confidence and expectations regarding STEM success. OECD reports have similarly documented the relationship between socioeconomic status and educational achievement, emphasizing that students from lower-income households often experience fewer opportunities for STEM engagement. In the Philippine context, educational inequalities stemming from financial constraints, limited access to technology, and limited learning resources continue to affect students' educational experiences. Such disparities may limit students' ability to fully participate in STEM learning and influence their decisions about future STEM careers.

Although numerous studies have examined barriers affecting STEM participation, findings regarding gender differences remain inconclusive. Studies by Cheryan et al. (2025) and Master and Meltzoff (2020) suggest that female students often face greater challenges related to stereotypes, sense of belonging, and confidence in STEM environments. In contrast, Han et al. (2021) and Chan (2022) reported that factors such as self-efficacy, career awareness, and institutional support may influence STEM participation regardless of gender. These conflicting findings indicate that the relationship between gender and perceived STEM barriers may vary across educational and cultural contexts, warranting further investigation.

Moreover, while international and national studies have explored psychological, social, institutional, gender-related, and socioeconomic barriers in STEM education, limited research has simultaneously examined these dimensions among senior high school students in Southern Leyte, Philippines. Existing Philippine studies have largely focused on specific aspects of STEM participation, leaving a gap in understanding how multiple barriers collectively influence students' pursuit of STEM education and whether these barriers differ according to sex. Addressing this gap is important for developing evidence-based interventions that promote STEM participation and success among Filipino learners.

Therefore, this study aimed to determine the perceived barriers encountered by Grade 12 students in pursuing STEM education at The College of Maasin. Specifically, the study examined psychological, social, institutional, gender-stereotype, and socioeconomic barriers and investigated whether significant differences existed between male and female students in these perceived barriers. The findings of the study are expected to contribute to the growing body of literature on STEM education and provide insights to help educators, school administrators, and policymakers design programs that support students' participation and success in STEM fields.

Methodology

Research Design

This study employed a quantitative descriptive-comparative research design to examine the perceived barriers encountered by Grade 12 students in pursuing STEM education and to determine whether significant differences exist between male and female students. A descriptive design was used to identify and describe the extent to which students experience psychological, social, institutional, gender-related, and socioeconomic barriers. The comparative component of the design enabled the researchers to compare the perceptions of male and female students regarding these barriers. This design was deemed appropriate because it enabled the collection of measurable data that could be statistically analyzed to identify patterns and group differences in perceived barriers to STEM education.

Participants and Sampling Technique

The study was conducted at The College of Maasin, a private educational institution located in Tunga-Tunga, Maasin City, Southern Leyte. The target population consisted of Grade 12 students during the academic year in which the study was conducted. The study focused exclusively on Grade 12 students because they were at a critical stage of making decisions regarding college programs and future career pathways.

The study employed stratified random sampling to ensure adequate representation of male and female respondents. The population was first divided into two strata according to sex: male and female. The number of participants from each stratum was determined using proportionate allocation based on the population's gender distribution. After determining the required sample from each stratum, simple random sampling was used to select the individual respondents from the official population lists. A total of 263 Grade 12 students completed the survey questionnaire and were included in the final analysis. Of these respondents, 150 (57.03%) were female, and

113 (42.97%) were male. The inclusion criteria required participants to be officially enrolled Grade 12 students at The College of Maasin and to be willing to participate in the study. Students from other strands, Grade 11 students, and those who did not provide complete responses were excluded from the analysis.

Research Instrument

Data were collected using a researcher-made questionnaire entitled Perceived Barriers in Pursuing STEM Education. The instrument was developed based on existing literature on STEM participation, self-efficacy, social influences, gender stereotypes, institutional support, and socioeconomic challenges in STEM education. The questionnaire consisted of two parts. The first part collected demographic information, particularly the respondents' sex. The second part assessed students' perceived barriers across five dimensions: psychological, social, institutional, gender stereotypes, and socioeconomic.

The instrument utilized a four-point Likert scale, with response options ranging from 1 (Strongly Disagree) to 4 (Strongly Agree). Higher scores indicated greater perceived barriers to pursuing STEM education. To establish content validity, the questionnaire underwent expert validation by specialists in science education and educational research. Based on their recommendations, the original pool of 125 items was refined to 108 items. Of these, 87 items (69.6%) were retained with an Item Content Validity Index (I-CVI) of 1.00, indicating unanimous agreement among the validators regarding item relevance. Twenty-one items (18.8%) were revised and retained with an I-CVI of 0.67 following suggested modifications, while 17 items (13.6%) were merged due to conceptual overlap. The finalized instrument comprised 22 items for Psychological Barriers, 21 items for Social Barriers, 22 items for Institutional Barriers, 25 items for Gender Stereotypes, and 18 items for Socioeconomic Barriers.

Following expert validation, a pilot test was conducted with 15 Grade 12 STEM students from The College of Maasin who were not included in the actual study. The pilot testing assessed the clarity, comprehensibility, and reliability of the instrument. Minor revisions were made to improve item wording and readability based on participants' feedback. Internal consistency reliability was evaluated using Cronbach's alpha, yielding coefficients of 0.865 for Psychological Barriers, 0.948 for Social Barriers, 0.916 for Institutional Barriers, 0.921 for Gender Stereotypes, and 0.916 for Socioeconomic Barriers. These values exceeded the recommended threshold of 0.70, indicating that the instrument possessed high internal consistency and was suitable for use in the main study.

Data Gathering Procedure

Prior to data collection, approval to conduct the study was secured from the administration of The College of Maasin. After obtaining the necessary permissions, the researchers coordinated with school officials and teachers to administer the survey questionnaire. Respondents were informed about the purpose of the study, the voluntary nature of their participation, and the confidentiality of their responses. Data were collected via a survey administered to randomly selected Grade 12 STEM students. The questionnaires were distributed face-to-face and collected immediately after completion to ensure a high retrieval rate and minimize missing responses. Respondents were given sufficient time to complete the instrument and were allowed to seek clarification on the instructions when necessary. Completed questionnaires were checked for completeness before data encoding and analysis.

Data Analysis Procedure

The collected data were encoded and analyzed using Microsoft Excel and Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including frequency counts, percentages, and weighted means, were used to summarize the demographic profile of respondents and determine the extent of perceived barriers in pursuing STEM education. Weighted mean scores were computed for each barrier category to determine their corresponding levels of perception. To determine whether significant differences existed between male and female students in perceived barriers, an independent-samples t-test (two-tailed) was employed. This statistical procedure compared the mean scores of male and female respondents across the five barrier categories. All statistical analyses were conducted using a significance level of 0.05. Results were presented using tables and narrative interpretations to facilitate discussion of the findings.

Ethical Considerations

The researchers adhered to established ethical principles throughout the study. Approval to conduct the research was obtained from the administration of The College of Maasin prior to data collection.

Respondents were informed about the objectives of the study, the nature of their participation, and their right to decline to participate or withdraw at any time without penalty. Participation was entirely voluntary, and informed consent was obtained before respondents completed the questionnaire. To ensure confidentiality and anonymity, respondents were not required to disclose personally identifiable information. The name field in the questionnaire was optional, and all collected data were used solely for academic and research purposes. Only the researchers had access to the data, which were securely stored and handled in accordance with ethical research standards. Respondents were also informed that they could skip any question that made them uncomfortable. Furthermore, the researchers committed to the honest collection, analysis, and reporting of data and ensured proper acknowledgment of all sources used in the study.

Results and Discussion

Sex Distribution of the Study

Table 1. *Sex Distribution of the Study*

Sex	No. of Respondents	Percentage
Male	113	42.97%
Female	150	57.03%
Total	263	100%

The study involved 263 Grade 12 students, of whom 150 (57.03%) were female, and 113 (42.97%) were male. The findings indicate that female students constituted a slightly larger proportion of the respondents than male students. This distribution suggests a growing participation of female learners in STEM education, which contrasts with the traditional perception of STEM fields as predominantly male-oriented disciplines. The increasing representation of female students in STEM may reflect the positive effects of educational reforms and advocacy initiatives that promote gender inclusivity in science and technology education.

This finding is consistent with studies suggesting that gender participation patterns in STEM are gradually changing. Cheryan et al. (2025) reported that although gender disparities persist in certain STEM fields, female participation has increased substantially across many educational settings due to improved access to educational opportunities and shifting societal perceptions of gender roles. Similarly, Master and Meltzoff (2020) noted that supportive educational environments and greater representation of women in STEM-related careers contribute to improved female engagement in STEM learning. These developments may help reduce traditional barriers associated with gender stereotypes and encourage more female students to consider STEM pathways.

Perceived Barriers in Pursuing STEM Education

In terms of Psychological Barriers

Table 2 indicates that psychological barriers emerged as the most prominent challenge encountered by Grade 12 STEM students, with an overall weighted mean of 2.52, interpreted as a high level. This finding suggests that students' persistence in STEM is influenced more by their internal beliefs than by external conditions. Although respondents generally perceived social, institutional, gender-related, and socioeconomic barriers at low levels, many still experienced anxiety, self-doubt, lack of confidence, and pressure when confronted with academically demanding STEM tasks. This implies that improving educational resources alone may not be sufficient to increase STEM participation unless schools also strengthen students' confidence, resilience, and emotional preparedness.

The findings support Han et al. (2021), who identified self-efficacy as a significant predictor of STEM engagement and persistence. Similarly, Chan (2022) emphasized that students with greater confidence in their abilities are more likely to pursue STEM-related opportunities. Consistent with these studies, the present findings suggest that psychological factors may influence students' willingness to persist in STEM more strongly than the availability of external support. The relatively high ratings for anxiety when dealing with difficult STEM subjects, nervousness during calculation-based lessons, worry about grades, and discomfort when completing tasks without clear guidance indicate that students perceive the STEM strand as academically demanding. Such experiences may reduce participation, weaken confidence, and hinder sustained engagement if left unaddressed. These findings are consistent with Rogayan et al. (2021), who reported that psychological stress and academic pressure are common challenges among Filipino STEM students.

Table 2. *Perceived Psychological Barriers in Pursuing STEM Education*

	Psychological Barrier	Mean	Descriptors	Interpretation
1.	I often feel anxious when dealing with difficult STEM subjects.	2.80	Agree	High Level
2.	I doubt my ability to succeed in STEM-related tasks, and I avoid STEM subjects if I can.	2.50	Disagree	Low Level
3.	I feel that I am not as smart as other students in STEM.	2.87	Agree	High Level
4.	I do not have enough confidence to perform well in STEM activities, and I hesitate to participate in discussions.	2.62	Agree	High Level
5.	I feel that I do not fit in with STEM-oriented peers.	2.61	Agree	High Level
6.	I am not adequately prepared to take on STEM-related subjects.	2.51	Agree	High Level
7.	I lose motivation when I encounter challenging STEM lessons or problems.	2.43	Disagree	Low Level
8.	I feel that my teachers perceive me as less capable than my classmates.	2.34	Disagree	Low Level
9.	I am treated differently in STEM classes because of my gender.	1.87	Disagree	Low Level
10.	I am treated differently in STEM classes because of my race.	1.90	Disagree	Low Level
11.	I struggle to understand STEM lessons even after reviewing them.	2.43	Disagree	Low Level
12.	I feel nervous when STEM lessons involve calculations or formulas.	2.63	Agree	High Level
13.	I feel mentally exhausted after STEM classes more than after other subjects.	2.59	Agree	High Level
14.	I feel pressured when STEM tasks require problem-solving under time limits.	2.72	Agree	High Level
15.	I find it hard to stay motivated when STEM topics become more complex.	2.63	Agree	High Level
16.	I feel discouraged when I see others finish STEM tasks faster than I.	2.48	Disagree	Low Level
17.	I feel intimidated when using laboratory tools or equipment.	2.41	Disagree	Low Level
18.	I worry too much about my grades in STEM subjects.	2.72	Agree	High Level
19.	I feel uncomfortable working on STEM tasks without clear instructions.	2.81	Agree	High Level
20.	I find it difficult to learn STEM concepts without someone guiding me.	2.77	Agree	High Level
21.	I believe STEM requires talent more than effort.	2.47	Disagree	Low Level
22.	I feel that I will never be good at STEM, no matter how much I try.	2.34	Disagree	Low Level
	Weighted Mean	2.52	Agree	High Level

Note. The following scale was used for interpretation: 3.26–4.00 = Very High Level of; 2.51–3.25 = High Level; 1.76–2.50 = Low Level; and 1.00–1.75 = Very Low Level

Despite these concerns, several indicators were rated at a low level, including the belief that STEM success depends solely on innate talent ($\bar{x} = 2.47$), the perception that one will never become good at STEM ($\bar{x} = 2.34$), and loss of motivation when lessons become difficult ($\bar{x} = 2.43$). These results suggest that while students experience anxiety, they generally do not hold fixed negative beliefs about their abilities. Instead, they appear willing to persevere despite academic challenges.

Overall, the findings indicate that psychological barriers are the primary challenge to STEM participation, exceeding the influence of social, institutional, gender, and socioeconomic barriers. This suggests that the major obstacle is not limited access to opportunities but students' confidence in succeeding within those opportunities. Therefore, schools should complement existing academic support with interventions that strengthen self-efficacy, resilience, and coping skills through mentoring, academic counseling, and confidence-building learning experiences.

In terms of Social Barriers

Table 3 indicates that respondents perceived social barriers at a Low Level, with an overall weighted mean of 2.25. This finding suggests that family, peers, and teachers generally provide a supportive social environment that encourages students' participation in STEM rather than discouraging it. The low perception of social barriers implies that interpersonal relationships are not the primary obstacle to pursuing STEM education. Instead, students' participation appears to be influenced more by internal psychological factors than by a lack of social support. This also suggests that existing school and family support systems may already be fostering positive attitudes toward STEM among the respondents.

Despite the overall low level, one indicator—friends believing that STEM subjects are only for “smart” students ($\bar{x} = 2.56$)—was rated at a High Level, indicating that misconceptions about the difficulty of STEM continue to exist. Such perceptions may contribute to peer comparison and reduced academic confidence among some students, although they do not appear strong enough to discourage most respondents from pursuing STEM education. The findings support Saw (2020), who emphasized that family support, mentorship, and peer networks play important roles in promoting students' engagement and persistence in STEM. Similarly, Master and Meltzoff (2020) reported that students who experience a strong sense of belonging within their educational environment are more likely to participate actively in STEM learning. The present findings are likewise consistent with Rogayan

et al. (2021), who found that family and peer support serve as protective factors that help Filipino STEM students cope with academic challenges.

Table 3. *Perceived Social Barriers in Pursuing STEM Education*

Social Barriers		Mean	Descriptors	Interpretation
1.	My family or peers discourage me from pursuing STEM-related careers.	2.00	Disagree	Low Level
2.	There are a few STEM professionals that I know.	2.40	Disagree	Low Level
3.	My friends believe STEM subjects are too difficult or that they are only for “smart” people.	2.56	Agree	High Level
4.	My parents prefer that I choose a non-STEM course in college.	2.16	Disagree	Low Level
5.	People around me think STEM is more suitable for boys than girls.	2.12	Disagree	Low Level
6.	I feel pressured by my peers to take other strands or courses that are easier than STEM-related ones.	2.19	Disagree	Low Level
7.	I rarely hear positive stories about people succeeding in STEM careers.	2.35	Disagree	Low Level
8.	My teachers or classmates sometimes assume I am less capable in STEM.	2.17	Disagree	Low Level
9.	There are limited opportunities at school to interact with STEM mentors or professionals.	2.14	Disagree	Low Level
10.	I do not feel that my social circle values STEM subjects as much as other fields.	2.25	Disagree	Low Level
11.	My family rarely talks about STEM-related opportunities and is unfamiliar with STEM-career options.	2.32	Disagree	Low Level
12.	My friends do not take STEM subjects seriously.	2.13	Disagree	Low Level
13.	My peers make STEM students feel “different” from others.	2.40	Disagree	Low Level
14.	My friends influence me to focus on non-STEM interests.	2.22	Disagree	Low Level
15.	I feel isolated because not many people in my circle enjoy STEM.	2.19	Disagree	Low Level
16.	My family believes STEM courses are too stressful.	2.39	Disagree	Low Level
17.	People around me think STEM careers are not practical.	2.29	Disagree	Low Level
18.	I rarely receive praise or support from others when I do well in STEM.	2.38	Disagree	Low Level
19.	I feel discouraged when people underestimate my interest in STEM.	2.27	Disagree	Low Level
20.	My classmates do not include me in STEM group work	2.22	Disagree	Low Level
21.	I do not have anyone to talk to when I struggle in STEM subjects.	2.19	Disagree	Low Level
Weighted Mean		2.25	Disagree	Low Level

Note. The following scale was used for interpretation: 3.26–4.00 = Very High Level of; 2.51–3.25 = High Level; 1.76–2.50 = Low Level; and 1.00–1.75 = Very Low Level

Overall, the findings indicate that social barriers are not a major impediment to STEM participation among the respondents. While misconceptions about the difficulty of STEM persist among some peers, the generally supportive influence of families, classmates, and teachers appears to outweigh these concerns. These results suggest that schools should continue strengthening supportive relationships while also addressing misconceptions that may discourage students from fully engaging in STEM education.

In terms of Institutional Barriers

Table 4 indicates that respondents perceived institutional barriers at a Low Level, with an overall weighted mean of 2.35. This finding suggests that students generally view their school as providing adequate instructional support, learning resources, and opportunities for STEM education. The low perception of institutional barriers implies that the school environment is not a major obstacle to students' participation in STEM. Instead, students' persistence may depend more on their motivation, confidence, and ability to cope with the academic demands of the STEM strand than on limitations in institutional support.

Despite the overall low level, three indicators were rated at a High Level: hesitation to ask teachers for help ($\bar{x}$ = 2.60), insufficient time for explaining complex STEM topics ($\bar{x}$ = 2.56), and limited time for STEM experiments ($\bar{x}$ = 2.54). These findings suggest that the challenge may not be the availability of institutional support itself, but how students access and experience that support in the classroom. Strengthening teacher-student interaction, providing timely academic guidance, and increasing opportunities for hands-on learning may further enhance students' engagement and confidence in STEM. The findings are consistent with UNESCO (2023), which emphasized that qualified teachers, adequate learning resources, and supportive school environments are essential for promoting STEM participation. Likewise, Santiago and Soliven (2024) highlighted that institutional support, instructional resources, and teacher guidance positively influence students' academic engagement and persistence in STEM. The generally low perception of institutional barriers in the present study suggests that these supportive conditions are already evident in the respondents' learning environment.

Table 4. Perceived Institutional Barriers in Pursuing STEM Education

	Institutional Barrier	Mean	Descriptors	Interpretation
1.	There are not enough laboratory materials or facilities for STEM activities.	2.41	Disagree	Low Level
2.	I do not receive enough guidance, mentoring, and or encouragement from teachers about STEM careers.	2.28	Disagree	Low Level
3.	Teachers are not well-prepared to teach STEM courses effectively.	2.17	Disagree	Low Level
4.	There are not enough STEM extracurricular activities offered at my school.	2.31	Disagree	Low Level
5.	I feel hesitant to ask teachers for help with difficult STEM topics.	2.60	Agree	High Level
6.	My school does not have enough STEM clubs or programs to explore STEM careers.	2.29	Disagree	Low Level
7.	The STEM curriculum at my school is not updated or relevant to current technology and science.	2.28	Disagree	Low Level
8.	There is limited access to STEM learning resources like textbooks and online materials at my school.	2.30	Disagree	Low Level
9.	STEM lessons are sometimes skipped due to lack of materials.	2.19	Disagree	Low Level
10.	I hear comments that engineering is mainly for males.	2.28	Disagree	Low Level
11.	STEM activities are not conducted regularly in our classes.	2.30	Disagree	Low Level
12.	Some STEM topics are not explained well because teachers lack time.	2.56	Agree	High Level
13.	STEM assessments sometimes do not match what is taught in class.	2.41	Disagree	Low Level
14.	The school does not provide enough STEM enrichment activities.	2.31	Disagree	Low Level
15.	I have limited access to school computers for STEM tasks.	2.33	Disagree	Low Level
16.	STEM lessons lack demonstrations and hands-on experiments.	2.49	Disagree	Low Level
17.	My school does not provide enough training for research writing or investigation.	2.39	Disagree	Low Level
18.	STEM learning resources are outdated or not well-maintained.	2.34	Disagree	Low Level
19.	The school schedule does not allow enough time for STEM experiments.	2.54	Agree	High Level
20.	Teachers rarely connect STEM lessons to real-life applications.	2.42	Disagree	Low Level
21.	I do not receive enough feedback from teachers on my STEM performance.	2.30	Disagree	Low Level
22.	My school does not offer enough support programs for STEM learners.	2.21	Disagree	Low Level
	Weighted Mean	2.35	Disagree	Low Level

Note. The following scale was used for interpretation: 3.26–4.00 = Very High Level of; 2.51–3.25 = High Level; 1.76–2.50 = Low Level; and 1.00–1.75 = Very Low Level

Overall, the findings indicate that institutional barriers are not a major impediment to STEM participation among the respondents. While improvements in teacher support, classroom interaction, and practical learning opportunities remain important, students generally perceive their schools as providing an environment that supports their STEM learning and academic development.

In terms of Gender Stereotypes

Table 5 indicates that respondents perceived gender stereotype barriers at a Low Level, with an overall weighted mean of 2.17. This finding suggests that students generally view STEM as a field that is equally accessible to both males and females. The low perception of gender stereotypes implies that gender-based expectations are not a major factor influencing students' decisions to pursue STEM education. Instead, respondents appear to evaluate their abilities based on their interests and capabilities rather than on traditional beliefs about gender roles. This may reflect the growing influence of gender-inclusive educational practices and changing societal attitudes toward STEM careers in the Philippines.

The findings contrast with Cheryan et al. (2025), who reported that gender stereotypes continue to discourage participation in STEM in many countries by shaping perceptions of gender-appropriate careers. Likewise, Miller et al. (2024) reported that gender stereotypes regarding STEM abilities begin to develop early in childhood and become more pronounced over time, shaping students' perceptions of their abilities and educational aspirations. These findings suggest that stereotypical beliefs can influence students' engagement in STEM regardless of sex, underscoring the need for educational environments that foster equitable opportunities and challenge limiting perceptions. However, the present findings are consistent with Master and Meltzoff (2020), who argued that supportive and inclusive educational environments can reduce stereotype-related barriers and strengthen students' sense of belonging in STEM. The low level of perceived gender stereotypes in this study suggests that respondents generally experience an educational environment that promotes equal opportunities regardless of gender.

Table 5. Perceived Gender Stereotypes in Pursuing STEM Education

Gender Stereotypes		Mean	Descriptors	Interpretation
1.	Some STEM subjects are viewed as more suitable for males than females (or vice versa).	2.41	Disagree	Low Level
2.	I have experienced gender bias or unequal treatment in STEM activities.	2.18	Disagree	Low Level
3.	People of my gender are expected to be less interested in STEM subjects.	2.27	Disagree	Low Level
4.	Teachers often expect students of my gender to perform differently in STEM classes.	2.22	Disagree	Low Level
5.	I feel pressure to conform to gender roles when choosing STEM or non-STEM subjects.	2.16	Disagree	Low Level
6.	In my school, STEM activities are often geared more toward one gender.	2.08	Disagree	Low Level
7.	Students of my gender receive less encouragement to pursue STEM careers.	2.08	Disagree	Low Level
8.	Stereotypes about my gender affect how others perceive my abilities in STEM.	2.16	Disagree	Low Level
9.	I worry that my gender might limit my opportunities in STEM-related fields.	2.13	Disagree	Low Level
10.	Role models in STEM that share my gender are hard to find or nonexistent.	2.10	Disagree	Low Level
11.	People expect one gender to perform better in math and science.	2.14	Disagree	Low Level
12.	I hear comments that engineering is mainly for males.	2.28	Disagree	Low Level
13.	I hear comments that health-related STEM careers are mainly for females.	2.19	Disagree	Low Level
14.	Students of my gender are sometimes discouraged from joining STEM clubs.	2.16	Disagree	Low Level
15.	I feel judged when I show a strong interest in STEM because of my gender.	2.12	Disagree	Low Level
16.	Some classmates assume STEM leadership roles should belong to one gender.	2.12	Disagree	Low Level
17.	Teachers sometimes call on one gender more often during STEM discussions.	2.15	Disagree	Low Level
18.	I feel that my ideas in STEM group work are taken less seriously because of my gender.	2.23	Disagree	Low Level
19.	I feel pressure to prove myself more in STEM because of my gender.	2.15	Disagree	Low Level
20.	I notice that STEM competitions often have more participants from one gender.	2.23	Disagree	Low Level
21.	I rarely see people of my gender represented in STEM textbooks or examples.	2.06	Disagree	Low Level
22.	I feel uncomfortable joining STEM activities where my gender is a minority.	2.15	Disagree	Low Level
23.	I feel that gender stereotypes affect the confidence of students in STEM.	2.25	Disagree	Low Level
24.	I worry that choosing a STEM career will lead to gender-based discrimination.	2.15	Disagree	Low Level
25.	I believe that gender stereotypes influence students' STEM career choices.	2.13	Disagree	Low Level
Weighted Mean		2.17	Disagree	Low Level

Note. The following scale was used for interpretation: 3.26–4.00 = Very High Level of; 2.51–3.25 = High Level; 1.76–2.50 = Low Level; and 1.00–1.75 = Very Low Level

Overall, the findings indicate that gender stereotypes are not a major barrier to STEM participation among the respondents. While gender bias remains a concern in some educational settings, it appears to have limited influence within the present study. These findings highlight the importance of sustaining inclusive school practices and equal opportunities that encourage students to pursue STEM based on their interests and abilities rather than gender-based expectations.

In terms of Socioeconomic Barrier

Table 6 indicates that respondents perceived socioeconomic barriers at a Low Level, with an overall weighted mean of 2.40. This finding suggests that financial and material resources are generally not major obstacles to students' participation in STEM education. Most respondents appear to have adequate access to the resources needed to meet the academic requirements of the STEM strand. Consequently, students' decisions to pursue STEM seem to be influenced more by psychological factors than by their current socioeconomic conditions.

Despite the overall low level, three indicators were rated at a High Level: limitations in participating in STEM activities due to family finances ($\bar{x}$ = 2.53), inability to afford extra tutoring or workshops ($\bar{x}$ = 2.57), and financial concerns affecting the decision to pursue STEM in college ($\bar{x}$ = 2.51). These findings suggest that while students are generally able to cope with present academic demands, financial concerns become more evident when additional learning opportunities or future educational expenses are involved. This implies that socioeconomic barriers may become more influential as students transition to higher education, where STEM programs often require greater financial investment. The findings are consistent with the OECD (2023), which reported that socioeconomic status influences students' access to educational resources and learning opportunities. Although students from economically advantaged backgrounds generally have greater access to enrichment activities and technological resources, the low level of socioeconomic barriers in the present study suggests that respondents can meet most of their current academic needs despite differences in family income.

Table 6. *Perceived Socioeconomic Barriers in Pursuing STEM Education*

	Socioeconomic Barrier	Mean	Descriptors	Interpretation
1.	My family's financial situation limits my ability to fully participate in STEM activities (e.g., printing and meeting project output requirements).	2.53	Agree	High Level
2.	The cost of STEM materials (e.g., projects, experiments, and internet access) affects my performance in class.	2.46	Disagree	Low Level
3.	I cannot afford extra tutoring or workshops related to STEM topics.	2.57	Agree	High Level
4.	I sometimes skip STEM-related assignments because I lack the necessary technology or internet at home.	2.26	Disagree	Low Level
5.	I often have to work or help at home instead of doing extra science or technology work.	2.46	Disagree	Low Level
6.	Financial difficulties prevent me from accessing STEM-related learning resources outside of school.	2.36	Disagree	Low Level
7.	I worry that pursuing a STEM career will cost my family more than other career paths.	2.45	Disagree	Low Level
8.	I have fewer opportunities to attend STEM-related extracurriculars (e.g., clubs, camps) because of cost or travel.	2.40	Disagree	Low Level
9.	I do not have stable internet access for STEM assignments.	2.17	Disagree	Low Level
10.	I do not have a personal device for online STEM learning.	2.12	Disagree	Low Level
11.	I depend on mobile data, which limits my ability to do STEM research.	2.43	Disagree	Low Level
12.	I cannot always buy the materials needed for STEM performance tasks.	2.43	Disagree	Low Level
13.	I struggle to complete STEM requirements because of household responsibilities.	2.49	Disagree	Low Level
14.	I have limited access to learning resources, such as books or reviewers, at home.	2.35	Disagree	Low Level
15.	I find it difficult to participate in STEM competitions due to financial constraints.	2.38	Disagree	Low Level
16.	I cannot access STEM software or applications because they require payment.	2.37	Disagree	Low Level
17.	I feel disadvantaged because other students have better STEM tools and materials.	2.47	Disagree	Low Level
18.	Financial concerns affect my decision to pursue STEM in college.	2.51	Agree	High Level
Weighted Mean		2.40	Disagree	Low Level

Note. The following scale was used for interpretation: 3.26–4.00 = Very High Level of; 2.51–3.25 = High Level; 1.76–2.50 = Low Level; and 1.00–1.75 = Very Low Level

Overall, the findings indicate that socioeconomic barriers are not a major impediment to STEM participation among the respondents. However, concerns about the cost of STEM-related activities and future college education remain evident. These results highlight the importance of sustaining scholarship programs, financial assistance, and equitable access to learning resources to ensure that financial constraints do not limit students' long-term participation in STEM education.

Overall Interpretation of all Barriers

Table 7 presents the overall interpretation of the five categories of barriers affecting students' pursuit of STEM education. The findings show that psychological barriers obtained the highest weighted mean (2.52, High Level), while social (2.25), institutional (2.35), gender stereotype (2.17), and socioeconomic (2.40) barriers were all perceived at Low Levels. This overall pattern suggests that students' participation in STEM is influenced more by their internal beliefs, confidence, and emotional readiness than by external conditions such as social support, school environment, gender stereotypes, or financial circumstances. Although respondents generally perceived these external factors as supportive, many continued to experience anxiety, self-doubt, and pressure in meeting the academic demands of the STEM strand. These findings indicate that the primary challenge is not the availability of opportunities but students' confidence in succeeding within those opportunities.

Table 7. *Interpretation of All Barriers*

	Variables	Weighted Mean	Descriptors	Interpretation
1.	Psychological Barrier	2.52	Agree	High Level
2.	Social Barrier	2.25	Disagree	Low Level
3.	Institutional Barrier	2.35	Disagree	Low Level
4.	Gender Barrier	2.17	Disagree	Low Level
5.	Socioeconomic Barrier	2.4	Disagree	Low Level

The findings are consistent with Han et al. (2021) and Chan (2022), who emphasized that self-efficacy plays a critical role in students' STEM engagement, persistence, and career aspirations. Likewise, Rogayan et al. (2021) reported that psychological stress and academic pressure remain common challenges among Filipino STEM students. The present findings reinforce these studies by showing that psychological factors continue to exert a greater influence on STEM participation than external barriers.

Overall, the findings underscore the importance of strengthening students' psychological readiness alongside maintaining supportive educational environments. While schools should continue providing adequate institutional, social, and financial support, greater emphasis should be placed on interventions that enhance students' self-efficacy, resilience, and confidence to successfully engage in STEM learning.

Significant Difference in Perceived Barriers in STEM Education According to Sex *In terms of Psychological Barriers*

Table 8. *Difference in the Level of Psychological Barriers When Grouped According to Sex*

Variable	Mean (Male)	Mean (Female)	t-value	df value	p-value (2-tailed)	Interpretation
Psychological Barrier	2.523	2.518	-0.066	42	0.947	Not Significant

Table 8 presents the comparison of psychological barriers between male and female students pursuing STEM education. The independent-samples *t*-test revealed no statistically significant difference in psychological barriers when respondents were grouped according to sex ($p > .05$). This finding indicates that both male and female students experience comparable levels of anxiety, self-doubt, lack of confidence, and pressure in pursuing STEM education. The nearly identical mean scores further suggest that psychological challenges are shared by students regardless of sex and are more likely associated with the academic demands of the STEM curriculum than with gender-related differences.

The findings support Han et al. (2021), who identified self-efficacy as an important predictor of STEM engagement regardless of gender. Likewise, Chan (2022) emphasized that confidence, motivation, and academic expectations influence students' persistence in STEM similarly when equal educational opportunities are available. The present findings are also consistent with Elvira-Zorzo et al. (2025), who reported that psychological barriers such as anxiety and learning stress are commonly experienced by both male and female students, with differences that are often not statistically significant. Overall, the findings suggest that psychological barriers are a common challenge among STEM students regardless of sex. These results highlight the need for interventions that strengthen students' confidence, resilience, and psychological well-being across the entire STEM population rather than focusing on one gender alone.

In terms of Social Barrier

Table 9. *Difference in the Level of Social Barrier When Grouped According to Sex*

Variable	Mean (Male)	Mean (Female)	t-value	df value	p-value (2-tailed)	Interpretation
Social Barrier	2.29	2.217	-1.815	40	0.077	Not Significant

Table 9 presents the comparison of perceived social barriers between male and female students pursuing STEM education. The independent-samples *t*-test revealed no statistically significant difference in perceived social barriers when respondents were grouped according to sex ($p > .05$). This finding indicates that both male and female students experience similar levels of family support, peer influence, and social encouragement in pursuing STEM education. The result suggests that social factors affecting STEM participation are shared across both groups rather than being influenced by sex, reflecting a learning environment where support for STEM is generally provided equally to all students.

The findings support Saw (2020), who emphasized that family support, mentorship, and peer relationships promote STEM participation regardless of gender. Similarly, Master and Meltzoff (2020) found that a strong sense of belonging and supportive educational environments enhance STEM engagement among both male and female learners. The present findings suggest that social support systems within the respondents' context are sufficiently inclusive to minimize gender differences in perceived social barriers. Overall, the findings indicate that social barriers affect male and female students similarly. These results suggest that programs promoting family involvement, peer collaboration, and mentoring should continue to support all STEM students regardless of sex.

In terms of Institutional Barrier

Table 10 presents the comparison of perceived institutional barriers between male and female students pursuing STEM education. The independent-samples *t*-test revealed no statistically significant difference in institutional barriers when respondents were grouped according to sex ($p > .05$). This finding indicates that both male and

female students perceive similar levels of access to instructional resources, teacher support, laboratory facilities, and academic guidance. The results suggest that institutional conditions affecting STEM education are experienced similarly by all students and are more likely influenced by school-wide practices than by gender.

Table 10. *Difference in the Level of Institutional Barrier When Grouped According to Sex*

Variable	Mean (Male)	Mean (Female)	t-value	df value	p-value (2-tailed)	Interpretation
Institutional Barrier	2.373	2.328	-1.277	42	0.208	Not Significant

The findings are consistent with Santiago and Soliven (2024), who reported that institutional support and teacher guidance positively influence students' STEM engagement regardless of demographic characteristics. Likewise, Flores et al. (2026) emphasized that the availability of instructional resources, academic support, and institutional learning systems largely influences students' learning experiences. Their findings suggest that these institutional factors are determined by the educational environment rather than by students' sex, resulting in comparable learning experiences among male and female students. The present findings therefore suggest that respondents generally perceive an equitable learning environment that supports STEM learning for both male and female students. Overall, the findings indicate that institutional barriers are experienced similarly by male and female students. These results highlight the importance of continuously improving instructional quality, laboratory facilities, and academic support services to enhance STEM learning for all students, regardless of sex.

In terms of Gender Stereotypes

Table 11. *Difference in the Level of Gender Stereotypes When Grouped According to Sex*

Variable	Mean (Male)	Mean (Female)	t-value	df value	p-value (2-tailed)	Interpretation
Gender Stereotypes	2.185	2.16	-1.101	48	0.276	Not Significant

Table 11 presents the comparison of perceived gender stereotype barriers between male and female students pursuing STEM education. The independent-samples *t*-test revealed no statistically significant difference in perceived gender stereotype barriers when respondents were grouped according to sex ($p > .05$). This finding indicates that both male and female students perceive the influence of gender stereotypes on STEM participation in similar ways. The result suggests that stereotype-related barriers, while still recognized, are experienced comparably by both groups and are not substantially influenced by students' sex. This may reflect a learning environment that promotes equal participation in STEM regardless of gender.

The findings contrast with Cheryan et al. (2025), who reported that gender stereotypes continue to contribute to disparities in STEM participation in many educational contexts. Similarly, Miller et al. (2024) found that gender stereotypes about STEM abilities emerge early and influence students' beliefs about their academic capabilities and future educational choices. Although these stereotypes may affect STEM participation, the present study found that both male and female students perceived gender stereotypes similarly, suggesting that stereotypical beliefs may be experienced across sexes rather than being limited to one group. However, the present findings are consistent with Master and Meltzoff (2020), who argued that inclusive educational environments and greater representation of diverse STEM role models help reduce stereotype-related barriers and strengthen students' sense of belonging in STEM.

Overall, the findings indicate that gender stereotype barriers are perceived similarly by male and female students. These results suggest that efforts to promote gender-inclusive STEM education may be fostering more equitable perceptions of participation and success, while emphasizing the importance of sustaining inclusive practices that encourage all students to pursue STEM based on their interests and abilities rather than gender.

In terms of Socioeconomic Barriers

Table 12. *Difference in the Level of Socioeconomic Barriers When Grouped According to Sex*

Variable	Mean (Male)	Mean (Female)	t-value	df value	p-value (2-tailed)	Interpretation
Socioeconomic Barriers	2.404	2.397	-0.983	35	0.333	Not Significant

Table 12 presents the comparison of perceived socioeconomic barriers between male and female students pursuing STEM education. The independent-samples *t*-test revealed no statistically significant difference in socioeconomic barriers when respondents were grouped according to sex ($p > .05$). This finding indicates that both

male and female students perceive financial and resource-related challenges in pursuing STEM education similarly. The results suggest that socioeconomic barriers are influenced more by household economic conditions and resource availability than by students' sex.

The findings are consistent with Turner et al. (2024), who reported that socioeconomic conditions shape students' STEM experiences primarily through access to educational resources and learning opportunities rather than gender. Likewise, OECD (2023) emphasized that socioeconomic status influences educational outcomes across student populations regardless of sex. The present findings therefore suggest that respondents experience comparable socioeconomic conditions, resulting in similar perceptions of financial barriers to STEM education. Overall, the findings indicate that socioeconomic barriers are experienced similarly by male and female students. These results highlight the importance of providing equitable financial assistance, scholarships, and access to educational resources that support all STEM learners regardless of sex.

Conclusion

This study contributes to the growing body of STEM education research by providing empirical evidence on the barriers perceived by senior high school students pursuing STEM education within the Philippine context. The findings revealed that although social, institutional, gender stereotypes, and socioeconomic barriers were generally perceived at low levels, psychological barriers emerged as the most significant challenge among Grade 12 STEM students. This indicates that students' engagement and persistence in STEM are influenced more by internal factors, such as self-efficacy, confidence, anxiety management, and academic resilience, than by external environmental conditions. Moreover, the absence of significant differences across all barrier categories when respondents were grouped according to sex suggests that the challenges encountered by STEM learners are largely shared experiences rather than gender-specific concerns.

Beyond its empirical findings, this study contributes to STEM education literature by demonstrating that psychological barriers may play a more influential role than commonly examined external barriers in shaping students' STEM experiences. The findings reinforce theoretical perspectives emphasizing the importance of self-efficacy and socio-emotional factors in students' educational choices and persistence while providing evidence that these relationships are evident among Filipino senior high school learners. By examining multiple dimensions of perceived barriers simultaneously, the study offers a more comprehensive understanding of the factors influencing STEM participation and highlights the need to consider learners' psychological readiness alongside contextual and structural conditions.

The findings have important implications for educational practice. Schools and educators should move beyond focusing solely on external support mechanisms and place greater emphasis on strengthening students' psychological readiness for STEM learning. Interventions such as mentoring programs, academic coaching, guidance and counseling services, peer-support initiatives, and confidence-building activities may help students develop the resilience and self-belief necessary to succeed in demanding STEM environments. Likewise, creating classroom cultures that promote growth mindsets, constructive feedback, and supportive learning experiences may reduce anxiety while strengthening students' confidence and persistence in STEM.

From a policy perspective, the findings support integrating socio-emotional and psychological support into STEM education programs. While continued investments in facilities, instructional resources, and equitable access remain essential, policies that foster academic self-efficacy, student well-being, and inclusive learning environments may produce greater long-term benefits in sustaining STEM participation. The findings also suggest that current gender-inclusive educational initiatives may be contributing to more equitable perceptions of STEM participation among learners.

The study likewise provides directions for future research. Further investigations using mixed-methods or longitudinal designs may explain how psychological barriers develop and change throughout students' educational journeys. Studies involving different geographical regions, public and private schools, and additional demographic variables would enhance the generalizability of the findings. Future research may also evaluate interventions designed to strengthen students' self-efficacy, resilience, STEM identity, and academic confidence to determine effective strategies for improving STEM engagement and persistence.

Overall, this study demonstrates that promoting STEM participation extends beyond improving external learning conditions. Equally important is fostering students' confidence in their ability to succeed despite academic challenges. By highlighting psychological readiness as the most influential perceived barrier, this study underscores the importance of developing educational environments that not only provide opportunities but also empower learners to believe in their capabilities. Such an approach may strengthen STEM persistence, improve academic success, and ultimately contribute to the development of a more resilient and diverse future STEM workforce.

Contributions of Authors

Author 1: Conceptualization, methodology, data gathering, data analysis, interpretation of results, manuscript writing

Author 2: Conceptualization, methodology, data gathering, data analysis, interpretation of results, manuscript writing

Author 3: Conceptualization, methodology, data gathering, data analysis, interpretation of results, manuscript writing

Author 4: Conceptualization, methodology, data gathering, data analysis, interpretation of results, manuscript writing

Author 5: Supervision, conceptualization, methodology, data analysis, interpretation of results, project administration, manuscript review and final approval

Funding

This research received no external funding. All expenses related to the conduct of the study, including instrument development, data collection, data analysis, and manuscript preparation, were personally funded by the researchers.

Conflict of Interests

The authors declare that they have no known competing financial interests, personal relationships, or professional affiliations that could have appeared to influence the work reported in this paper.

Acknowledgment

The authors would like to express their sincere appreciation to all the Grade 12 STEM students who voluntarily participated in this study and to the administration of The College of Maasin for granting permission to conduct the research. The authors also acknowledge the experts who validated the research instrument and provided valuable recommendations that improved the quality of the questionnaire.

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