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Examining Students' Motivation Towards Learning Science and Their Subject Experiences in Earth Science

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ABSTRACT

Purpose of the study: This study examined the motivation towards learning science and experience in the Earth Science subject among students when considered as a whole and grouped by sex and academic performance. Additionally, it examined the differences in motivation towards learning science and experience in the Earth Science subject when grouped by demographics.

Methodology: The study utilized a quantitative research design, particularly a descriptive comparative approach. The respondents were 115 randomly stratified sampled Grade 12 STEM students. A 35-item standardized questionnaire was used to assess students' level of motivation and a 25-item adopted instrument was used to evaluate their subject experiences. Frequency count, percentages, Mean, Standard Deviation, Mann-Whitney U test, and Kruskal-Wallis H test were utilized.

Main Findings: Hence, the students demonstrated a high level of motivation towards learning science. Likewise, the students reported a high level of experience in Earth Science, indicating that most perceived themselves as having engaged substantially. Meanwhile, the analysis revealed no significant differences in terms of sex for most motivational dimensions, except for the achievement goal. In terms of academic performance, the results showed there was no significant difference in performance goals. Additionally, there were no significant differences in the level of experience in the Earth Science subject based on the demographics.

Novelty/Originality of this study: The study is novel as it may serve as valuable input for science teachers in enhancing Earth Science instruction. It may inform the development of more effective teaching strategies that foster students motivation and engagement in science learning.

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1. INTRODUCTION

Examining the level of students' motivation in learning science is crucial in creating effective and meaningful classroom instruction [1], [2]. Motivation plays a key role in determining students' engagement, academic achievement, and sustained interest in science-related subjects [3], [4]. Similarly, identifying students' subject experiences provides valuable insights into how classroom strategies, content delivery, and assessment influence their perception and understanding of the subject [5]. Hence, these two aspects, namely level of motivation and subject experiences, are interdependent and form the foundation for developing responsive and student-centered teaching methodologies [6]. Hence, when the teachers understand how motivated students are

and their experience with the subject, they can design more effective interventions to foster deeper learning and higher academic performance [7].

In Southeast Asia, examining students' motivation and subject experiences in science is increasingly relevant, as many countries prioritize Science, Technology, Engineering, and Mathematics (STEM) education to advance national development goals [8]. For instance, Singapore has integrated innovative science education models that promote inquiry, critical thinking, and student engagement [9]. Meanwhile, Thailand and Indonesia are also strengthening their science curricula to increase student motivation and improve science literacy [10], [11]. Hence, understanding these trends allows educators and administrators to benchmark practices and address common challenges in promoting science education [8]. Thus, a comparative examination across South East Asia enables a better appreciation of the socio-economic demands and educational factors that shape student motivation and subject experiences.

In the Philippines, science education plays a central role in the K-12 curriculum, especially for students enrolled in the Science, Technology, Engineering, and Mathematics (STEM) strand [12], [13]. The Department of Education (DepEd) emphasizes the importance of learner-centered instruction and curriculum contextualization in science teaching [14]. This order promotes inclusivity and relevance, ensuring that the science subjects offered, including Earth Science, are meaningful and responsive to students' needs and realities [13]. Thus, assessing the motivation levels and subject experiences of Filipino STEM students is crucial in evaluating how such mandates are translated into actual classroom activities [15]. The findings may inform teachers, the curriculum development committee, and school administrators on how to enhance science pedagogy to support learners' academic and personal development better.

Meanwhile, the Grade 12 Filipino STEM students often face challenges that affect both their motivation to learn science and their experiences in science subjects, such as Earth Science. Many students struggle to stay motivated due to the demanding nature of the STEM curriculum, which encompasses complex topics that require higher-order thinking skills and numerous subjects to be taken every semester [15], [16]. Similarly, their learning experiences are affected by limited access to laboratory equipment, updated learning materials, and technology, especially in public schools [17]. In Earth Science, abstract concepts such as geological processes and climate patterns can be challenging to understand without hands-on activities or real-life applications [18], [19]. Additionally, traditional teaching methods and large class sizes make it more challenging for students to participate and remain actively engaged [20], [21]. These challenges underscore the importance of examining both motivation and subject experiences to foster more effective and supportive science learning.

Several studies have been conducted on students' motivation in learning science and their experiences in the Earth Science subject. Fortus and Touitou [3] and İnce [1] explored students' general motivation to learn science, while Nuraysha et al. [22] extended this understanding by examining motivation toward science learning in the context of junior high school. Liou et al. [4] assessed students' motivational beliefs about learning science across different grade levels and genders. Bazar et al. [23] contributed to the discourse by examining the relationship between students' well-being, motivation in learning science, and their academic achievement. Furthermore, Hwang et al. [24] focused on enhancing Earth Science learning achievement through a concept map-based community of inquiry framework in virtual learning contexts. Similarly, Boukayoua et al. [25] evaluated middle school students' interest in life and Earth sciences. Uy and Azuelo [26] also investigated students' academic self-concept in Earth Science through an online process-oriented guided inquiry approach. Despite these valuable contributions, a gap remains in the literature regarding the level of motivation and subject experiences in Earth Science among STEM students. This gap highlights the need for a targeted assessment within this specific context to inform instructional strategies more effectively.

This study theoretically assumed that students' levels of motivation towards learning science and their experiences in the Earth Science subject vary depending on their sex and academic performance. Hence, this assumption was anchored on the Expectancy-Value theory of Motivation by Wigfield and Eccles [27], which posits that students' achievement-related choices and behaviors are influenced by their expectations for success and the subjective value they place on a given task. Based on this study, the theory acknowledges the role of individual differences, including demographic variables such as sex and academic performance, in shaping these motivational processes. Thus, this framework supports the premise that students' level of motivation and their experiences in learning Earth Science may vary significantly depending on their sex and academic performance, which influence how they perceive and respond to science learning tasks.

The objective of the study was to examine the level of motivation towards learning science among students in a private school in Western Visayas. The results were considered as a whole and grouped by sex and academic performance. Additionally, this study assessed the level of experience in the Earth Science subject among students, considering them collectively and categorizing them by sex and academic performance. Moreover, this study examined the differences in motivation towards learning science and experience in the Earth Science subject when grouped by students' demographics. The study is novel as it may serve as valuable input for science teachers in enhancing Earth Science instruction. It may inform the development of more effective teaching strategies that foster students motivation and engagement in science learning.

2. RESEARCH METHOD

It utilized a descriptive comparative approach in quantitative research. The chosen design and methodology statistically measured a set of variables to answer the theory-guided research questions or problems, and hypotheses [28]. The descriptive approach examined the level of motivation towards learning science and the level of experience in the Earth Science subject among students, considering them as a whole and categorizing them based on their demographics. The comparative approach assessed the significant differences in motivation toward learning science and experience in the Earth Science subject among students grouped by their demographics. Meanwhile, the respondents in this study consisted of 115 Grade 12 STEM students from a private school in Western Visayas, selected through a stratified random sampling method. The sample size was determined using the Raosoft calculator, based on a 95% confidence level and a 5% margin of error.

Table 1 presents the demographic profile of the respondents. Of the 115 total participants, females represented a slightly larger proportion, accounting for 56.5% (n = 65), compared to males, who accounted for 43.5% (n = 50). Regarding academic performance, most respondents fell within the range of 91-95, comprising 67.8% (n = 78) of the total sample. A smaller group, representing 19.1% (n = 22), had an academic performance between 86 and 90. Only 7.8% (n = 9) of respondents achieved the highest range of 96-100, while the smallest proportion, 5.2% (n = 6), scored between 80 and 85. Overall, the data indicate that the majority of respondents performed academically at a high level (91 and above).

Table 1. Demographic Profile of the Respondents

Variable	n	%
Sex		
Male	50	43.5
Female	65	56.5
Academic Performance		
80 - 85	6	5.2
86 - 90	22	19.1
91 - 95	78	67.8
96 - 100	9	7.8
Whole	*115*	*100.0*

In data gathering, the study utilized a 35-item standardized questionnaire developed by Tuan et al. [2] to assess students' levels of motivation in learning science, focusing on the factors of self-efficacy, active learning strategies, science learning value, performance goals, achievement goals, and learning environment stimulation. Also, a 25-item instrument adopted from Liu et al. [29] was used to evaluate students' subject experiences in the areas of good teaching, generic skills, clear goals and standards, appropriate workload, and emphasis on independence. Generally, the 60 items were spread across the factors of students' motivation and areas of subject experiences. The instruments were pilot tested on 30 individuals who were not part of the actual respondents to evaluate their suitability within the Filipino context. The pilot test generated a Cronbach's alpha of 0.89, indicating that the instruments possess good reliability.

In data analysis, descriptive and comparative statistical analyses were applied. Frequency count and percentages were utilized to describe the distribution of respondents. Mean and Standard Deviation were employed to assess the students' level of motivation in learning science and their experiences in the Earth Science subject. The Kolmogorov-Smirnov tests revealed that all variables significantly deviated from normality; hence, the Mann-Whitney U test and Kruskal-Wallis H test were used to examine the significant differences in students' level of motivation towards learning science and their experiences in the Earth Science subject. Lastly, this study complied with the ethical guidelines set by the Philippine Health Research Ethics Board (PHREB). It upheld the core principles of respect for individuals, non-maleficence, beneficence, and justice to maintain ethical integrity. In particular, it took into account the vulnerability of the participants, safeguarded their anonymity, and ensured the confidentiality of the information collected.

3. RESULTS AND DISCUSSION

3.1. Level of Motivation Towards Learning Science

Table 2 and table 3 presents respondents' levels of motivation towards learning science and associated variables. Overall, the students demonstrated a high level of motivation towards learning science (M = 3.85, SD = 0.33), with females reporting slightly higher motivation (M = 3.89, SD = 0.33) than males (M = 3.79, SD = 0.33). Motivation also showed a positive relationship with academic achievement; respondents scoring highest academically (96-100) reported the highest motivation levels (M = 4.13, SD = 0.28), while those with the lowest academic scores (80-85) reported only moderate motivation (M = 3.31, SD = 0.32).

In terms of self-efficacy, respondents reported high overall levels (M = 3.71, SD = 0.53). Male students (M = 3.68, SD = 0.55) and female students (M = 3.73, SD = 0.52) reported similar high levels of self-efficacy. However, academic achievement was notably associated with variations in self-efficacy; students achieving scores of 96-100 reported the highest self-efficacy (M = 4.03, SD = 0.23), whereas students in the lowest academic bracket (80-85) reported moderate levels (M = 2.98, SD = 0.51). Active learning strategies were also highly utilized by respondents (M = 4.01, SD = 0.44). Female students (M = 4.08, SD = 0.45) reported slightly greater use of active learning strategies than male students (M = 3.93, SD = 0.42). Additionally, students in the highest academic achievement category reported very high use of active learning strategies (M = 4.44, SD = 0.46). In contrast, students with the lowest academic performance reported high, but comparatively lower, usage (M = 3.54, SD = 0.58).

Respondents attributed a high value to science learning overall (M = 4.18, SD = 0.52). Both sexes reported similarly high values, with females slightly higher (M = 4.20, SD = 0.51) compared to males (M = 4.16, SD = 0.53). Notably, those with the highest academic achievement perceived the greatest value in science learning (M = 4.49, SD = 0.39). In contrast, respondents with lower academic performance rated it relatively lower but still high (M = 3.57, SD = 0.74). Performance goals were rated moderately overall (M = 3.25, SD = 0.84), with negligible differences between male (M = 3.24, SD = 0.89) and female (M = 3.26, SD = 0.81) respondents. Students in the mid-range (86-90) academic category reported the highest emphasis on performance goals (M = 3.50, SD = 0.79), whereas the highest-scoring respondents rated this factor as lower (M = 2.86, SD = 0.85).

Regarding achievement goals, respondents overall indicated very high levels (M = 4.22, SD = 0.53). Females reported higher achievement goals (M = 4.31, SD = 0.51) compared to males (M = 4.10, SD = 0.54). Furthermore, the highest academic achievers (96-100) expressed particularly strong achievement goals (M = 4.58, SD = 0.50), whereas students in the lowest academic achievement category rated their achievement goals lower (M = 3.60, SD = 0.61). Lastly, respondents indicated a high perception of the learning environment's stimulation (M = 3.59, SD = 0.58). Females rated their learning environment as slightly more stimulating (M = 3.62, SD = 0.56) than males (M = 3.55, SD = 0.60). Academic achievement was again aligned with environmental perceptions; the highest-achieving respondents reported the greatest environmental stimulation (M = 4.00, SD = 0.50), while the lowest achievers rated it as moderately stimulating (M = 3.25, SD = 0.56).

This result indicates that the Grade 12 STEM students generally possess a high level of motivation towards learning science, with slight variations based on sex and academic performance. Students, regardless of sex or academic performance, tend to engage positively with science, although those with higher academic performance tend to exhibit greater motivation. This may be because students intentionally chose the STEM strand due to their interest in science-related fields [17], [30]. This finding is consistent with the studies by Sabanal [31] and Fernando and Bual [32], which suggest that when the chosen strand aligns with a student's interests, they are more likely to be motivated. It could also stem from the fact that high-performing students often have stronger self-efficacy and confidence in tackling scientific tasks, which boosts their motivation [23], [32], [33]. This finding aligns with Meece's [34] observation that science motivation is influenced by personal interest and perceived ability. This implies that matching students' academic strands with their interests plays a key role in fostering sustained motivation in science learning.

The result indicates that students demonstrated a moderate level of motivation in terms of performance goals, suggesting that their engagement in science is not primarily driven by competition or the desire for external validation. While some students may still value grades or recognition, these factors are not the dominant sources of their motivation. This could be because many STEM students are more intrinsically motivated, having chosen the strand based on a genuine interest in science [30], [31]. The moderate rating in this domain may be attributed to the fact that most students do not perceive the need for special attention from teachers, nor do they feel compelled to compete with their peers or view themselves as intellectually superior to others, as also highlighted in the study of Puson et al. [35] and Ismail et al. [36]. This suggests that instructional strategies focus more on fostering personal relevance and autonomy in science learning.

This result indicates that students exhibited very high levels of motivation in terms of achievement goals, with slight differences across sex and academic performance. This means that their participation in science learning is strongly driven by personal fulfillment, mastery of content, and the successful resolution of academic challenges [1], [37]. This could be because students find intrinsic satisfaction in understanding complex scientific concepts, solving difficult problems, and gaining acceptance from teachers and peers, which reinforces their motivation [2], [30], [31]. This could also be attributed to their academic orientation and internal drive for success, particularly among high-performing students who tend to set higher personal standards and goals [1], [38]. This finding is supported by the study of Miller et al. [39], which emphasized that students with strong achievement goals are more likely to engage in deep learning strategies and strive for mastery. Similarly, the study by Steinmayr et al. [38] found that achievement goals, particularly mastery-approach goals, are associated with high academic motivation and performance. This implies that nurturing students' internal sense of achievement and competence further enhances their engagement and persistence in science learning.

Table 2. Level of Motivation Toward Learning Science

Variable	Self-Efficacy			Active Learning Strategies			Science Learning Value			Performance Goal		
	M	SD	Int	M	SD	Int	M	SD	Int	M	SD	Int
Sex												
Male	3.68	0.55	High	3.93	0.42	High	4.16	0.53	High	3.24	0.89	Moderate
Female	3.73	0.52	High	4.08	0.45	High	4.20	0.51	High	3.26	0.81	Moderate
Academic Performance												
80-85	2.98	0.51	Moderate	3.54	0.58	High	3.57	0.74	High	2.83	0.54	Moderate
86-90	3.66	0.55	High	3.92	0.43	High	4.07	0.50	High	3.50	0.79	High
91-95	3.75	0.51	High	4.02	0.40	High	4.23	0.48	Very High	3.25	0.86	Moderate
96-100	4.03	0.23	High	4.44	0.46	Very High	4.49	0.39	Very High	2.86	0.85	Moderate
Whole	*3.71*	*0.53*	*High*	*4.01*	*0.44*	*High*	*4.18*	*0.52*	*High*	*3.25*	*0.84*	*Moderate*

Mean Range: 1.00-1.80=Very Low, 1.81-2.60=Low, 2.61-3.40=Moderate, 3.41-4.00=High, 4.21-5.00=Very High

Table 3. Level of Motivation Toward Learning Science

Variable	Achievement Goal			Learning Environment Stimulation			Students' Motivation Toward Learning Science		
	M	SD	Int	M	SD	Int	M	SD	Int
Sex									
Male	4.10	0.54	High	3.55	0.60	High	3.79	0.33	High
Female	4.31	0.51	Very High	3.62	0.56	High	3.89	0.33	High
Academic Performance									
80-85	3.60	0.61	High	3.25	0.56	Moderate	3.31	0.32	Moderate
86-90	4.11	0.49	High	3.46	0.47	High	3.79	0.31	High
91-95	4.25	0.51	Very High	3.60	0.59	High	3.87	0.30	High
96-100	4.58	0.50	Very High	4.00	0.50	High	4.13	0.28	High
Whole	*4.22*	*0.53*	*Very High*	*3.59*	*0.58*	*High*	*3.85*	*0.33*	*High*

Mean Range: 1.00-1.80=Very Low, 1.81-2.60=Low, 2.61-3.40=Moderate, 3.41-4.00=High, 4.21-5.00=Very High

3.2. Level of Experience in the Earth Science Subject

Table 4 and table 5 presents the students' level of experience in Earth Science. Overall, the students reported a high level of experience in Earth Science (M = 3.87, SD = 0.60), indicating that most perceived themselves as having engaged substantially with the subject. When disaggregated by sex, male students (M = 4.00, SD = 0.46) reported a slightly higher level of experience than female students (M = 3.77, SD = 0.68), although both fell within the high range. Across academic performance, students scoring 86-90 (M = 3.96, SD = 0.51) and 91-95 (M = 3.91, SD = 0.60) reported the highest levels, while those with scores of 96-100 had a slightly lower mean (M = 3.35, SD = 0.75), which fell within the moderate range.

In terms of good teaching, students generally perceived their instructors favorably, with an overall high mean (M = 3.74, SD = 0.62). Both male (M = 3.79, SD = 0.65) and female (M = 3.71, SD = 0.61) students rated this dimension similarly. Interestingly, students with an academic performance of 80-85 reported the highest mean (M = 4.07, SD = 0.55), suggesting that perceptions of effective teaching were strong even among those with relatively lower academic performance. This may reflect consistently applied teaching practices that are perceived positively across all achievement levels. For generic skills, such as problem-solving and critical thinking, developed through the Earth Science curriculum, students also reported generally high experiences (M = 3.41, SD = 0.43). Male students (M = 3.46, SD = 0.42) slightly outscored female students (M = 3.38, SD = 0.44). Looking at academic performance, students in the 80-85 (M = 3.47, SD = 0.27) and 91-95 (M = 3.44, SD = 0.44) ranges reported slightly stronger perceptions of gaining these skills, indicating that the development of such competencies was valued broadly across all performance groups.

In contrast, perceptions regarding clear goals and standards were slightly lower, with an overall mean of 3.01 (SD = 0.26), indicating a moderate level. Males (M = 3.05, SD = 0.28) rated this slightly higher than females (M = 2.98, SD = 0.25). The highest clarity was perceived by students in the 80-85 range (M = 3.47, SD = 0.27), followed closely by those in the 91-95 group (M = 3.44, SD = 0.44), suggesting some variability across performance levels. This implies that while students recognized quality teaching and skill development, they were less confident about the explicitness of course goals and evaluation criteria. Regarding the appropriate workload, students overall rated this dimension as moderate (M = 3.01, SD = 0.26), with minimal differences between males (M = 3.05, SD = 0.28) and females (M = 2.98, SD = 0.25). Across academic performance, scores

remained closely clustered, indicating that perceptions of workload balance were relatively uniform, neither overly burdensome nor excessively light, regardless of academic standing.

Finally, in terms of emphasis on independence, students expressed high perceptions (M = 3.98, SD = 0.59), indicating that their Earth Science experiences encouraged self-directed learning. Female students (M = 4.02, SD = 0.57) reported slightly higher levels of perceived independence than males (M = 3.94, SD = 0.62). Across academic performance, scores remained consistently high, suggesting that fostering independence was a well-integrated feature of the learning environment for students across achievement levels.

This result indicates that students generally reported a high level of experience in Earth Science, with slight variations observed across sex and academic performance. This means that most students perceive their Earth Science learning environment as engaging, with adequate teaching quality, skill development, clear expectations, and opportunities for independent learning [19], [24], [26]. This could be because Earth Science classes are designed to promote active learning through practical applications and clearly defined objectives [19], [40], [42]. It could also be attributed to effective teaching strategies that align with students' needs, particularly in encouraging independence and critical thinking [24], [26]. This finding is supported by Occhipinti [40] and Fernando et al. [41], who emphasized that positive perceptions of teaching and clear standards enhance student learning. This implies that sustaining a structured and responsive Earth Science classroom instruction further enhances students' academic experiences.

This result indicates that students perceived the workload in Earth Science as moderate, suggesting a balanced view of the demands placed on them in the subject. This means that while students did not find the workload overwhelming, they also did not perceive it as exceptionally light or easy, reflecting a neutral stance toward the volume and complexity of academic tasks [12], [40], [42]. This could be because Earth Science involves both theoretical and practical content, and students may find some topics abstract or broad, making comprehension more challenging when multiple concepts are introduced in a limited timeframe [19], [26]. This could also be attributed to the subject design, which may aim to cover a wide range of topics within a fixed schedule [5], [42]. It implies that carefully adjusting the content load and pacing in Earth Science may help students achieve a more profound understanding while maintaining a manageable academic experience.

Table 4. Level of Experience in the Earth Science Subject

Variable	Good Teaching			Generic Skills			Clear Goals and Standards		
	M	SD	Int	M	SD	Int	M	SD	Int
Sex									
Male	4.00	0.46	High	3.79	0.65	High	3.46	0.42	High
Female	3.77	0.68	High	3.71	0.61	High	3.38	0.44	Moderate
Academic Performance									
80-85	3.83	0.46	High	4.07	0.55	High	3.47	0.27	High
86-90	3.96	0.51	High	3.64	0.61	High	3.31	0.45	Moderate
91-95	3.91	0.60	High	3.73	0.62	High	3.44	0.44	High
96-100	3.35	0.75	Moderate	3.96	0.74	High	3.42	0.43	High
Whole	*3.87*	*0.60*	*High*	*3.74*	*0.62*	*High*	*3.41*	*0.43*	*High*

Mean Range: 1.00-1.80=Very Low, 1.81-2.60=Low, 2.61-3.40=Moderate, 3.41-4.00=High, 4.21-5.00=Very High

Table 5. Level of Experience in the Earth Science Subject

Variable	Appropriate Workload			Emphasis on Independence			Experiences in the Earth Science Subject		
	M	SD	Int	M	SD	Int	M	SD	Int
Sex									
Male	3.05	0.28	Moderate	3.94	0.62	High	3.62	0.31	High
Female	2.98	0.25	Moderate	4.02	0.57	High	3.51	0.38	High
Academic Performance									
80-85	3.08	0.20	Moderate	4.00	0.71	High	3.64	0.30	High
86-90	3.03	0.24	Moderate	4.02	0.61	High	3.55	0.33	High
91-95	3.01	0.27	Moderate	3.97	0.60	High	3.57	0.36	High
96-100	2.96	0.31	Moderate	3.94	0.46	High	3.44	0.39	High
Whole	*3.01*	*0.26*	*Moderate*	*3.98*	*0.59*	*High*	*3.56*	*0.35*	*High*

Mean *Range: 1.00-1.80=Very Low, 1.81-2.60=Low, 2.61-3.40=Moderate, 3.41-4.00=High, 4.21-5.00=Very High*

3.3. Difference in the Level of Motivation Towards Learning Science according to Sex

Table 6 presents the difference in the level of motivation towards learning science according to sex. The analysis showed no significant differences between male and female students in most motivational dimensions,

including self-efficacy [U=1554.50, p=0.690], active learning strategies [U=1355.50, p=0.126], science learning value [U=1592.50, p=0.853], performance goal [U=1587.00, p=0.829], learning environment stimulation [U=1515.00, p=0.533], and overall motivation toward learning science [U=1417.00, p=0.240]. However, a significant difference was found in the achievement goal dimension [U=1239.50, p=0.027], indicating that sex was associated with differing tendencies to pursue achievement-related objectives in learning science. This suggests that while most facets of science learning motivation are comparable between male and female students, they may vary in how strongly they orient themselves toward achieving or demonstrating competence.

This result indicates that a significant difference exists between male and female students in the achievement goal dimension of motivation towards learning science, with females showing a stronger orientation toward achievement-related objectives. This means that while both sexes are generally motivated to learn science, female students are more likely to feel fulfilled by gaining high scores, solving complex problems, and having their ideas accepted [21], [32], [43]. Another contributing factor may be related to differences in academic self-regulation and goal-setting. Studies have shown that female students are more likely to adopt mastery and performance goals, use effective study strategies, and persevere through academic challenges, which enhances their motivation to achieve [44]-[46]. This finding implies the possibility for teachers to design gender-responsive strategies that support and enhance achievement motivation in both male and female students, ensuring equitable opportunities for academic success in science learning.

Table 6. Difference in the Level of Motivation Towards Learning Science according to Sex

Variable	U	z	p
Self-Efficacy	1554.500	-0.400	0.690
Active Learning Strategies	1355.500	-1.530	0.126
Science Learning Value	1592.500	-0.185	0.853
Performance Goal	1587.000	-0.215	0.829
Achievement Goal	1239.500*	-2.215	0.027
Learning Environment Stimulation	1515.000	-0.623	0.533
Students' Motivation Toward Learning Science	1417.000	-1.174	0.240

*Note: *The difference in the means is significant when p≤0.05*

3.4. Difference in the Level of Motivation Towards Learning Science according to Academic Performance

Table 7 presents the difference in the level of motivation toward learning science according to academic performance. The results showed that there was no significant difference in performance goals among students across different academic performance levels [H(3)=7.229, p=0.065]. However, significant differences were observed in self-efficacy [H(3)=13.386, p=0.004], active learning strategies [H(3)=11.679, p=0.009], science learning value [H(3)=10.092, p=0.018], achievement goal [H(3)=10.373, p=0.016], learning environment stimulation [H(3)=8.175, p=0.043], and overall motivation toward learning science [H(3)=18.549, p=0.000].

Post hoc analyses revealed that students with academic performance of 80-85 generally reported lower levels of motivation across these domains compared to those with higher academic performance. Specifically, for self-efficacy, students with scores of 80-85 had significantly lower scores than those with scores of 86-90 ($p = 0.012$), 91-95 ($p = 0.003$), and 96-100 ($p < 0.001$). In active learning strategies, the 80-85 group was significantly lower than the 91-95 ($p = 0.033$) and 96-100 groups ($p = 0.001$), while the 86-90 group was also lower than the 96-100 group ($p = 0.009$). For science learning value, significant differences were found between the 80-85 group and both the 91-95 group ($p = 0.020$) and the 96-100 group ($p = 0.004$), as well as between the 86-90 group and the 96-100 group ($p = 0.030$). Regarding achievement goals, students with a performance score of 80-85 scored significantly lower than those with scores of 91-95 ($p = 0.015$) and 96-100 ($p = 0.002$); the 86-90 group was also lower than the 96-100 group ($p = 0.036$). In the learning environment stimulation, significant differences were found between the 80-85 and 96-100 ($p = 0.009$) groups, as well as between the 86-90 and 96-100 ($p = 0.022$) groups.

Finally, for overall motivation toward learning science, students with 80-85 had significantly lower scores compared to those with 86-90 ($p=0.009$), 91-95 ($p=0.001$), and 96-100 ($p<0.001$), with the 86-90 group also scoring lower than 96-100 ($p=0.010$), and 91-95 lower than 96-100 ($p=0.024$). These findings suggest that higher academic achievers consistently demonstrate stronger motivation across several dimensions related to learning science, underscoring the possible reciprocal relationship between academic success and motivational factors.

This result reveals that there was no notable difference in students' performance goal motivation across varying academic achievement levels, suggesting a relatively uniform outlook on externally driven reasons for engaging in science learning. This means that regardless of whether students were high or low achievers, their tendency to participate in science courses for the sake of grades, recognition, or attention remained consistent [30], [31]. This could be because performance goals are often shaped by classroom culture or peer expectations rather than individual academic standing [2]. It could also be attributed to the possibility that science learning in

the context of these students places more emphasis on mastery and understanding than on competition or external validation [35], [44]. This implies that fostering a learning environment centered on personal growth and collaboration may further reduce students' reliance on performance-based motivations.

Table 7. Difference in the Level of Motivation Towards Learning Science according to Academic Performance

Variable	H	df	p
Self-Efficacy	13.386*	3	0.004
Active Learning Strategies	11.679*	3	0.009
Science Learning Value	10.092*	3	0.018
Performance Goal	7.229	3	0.065
Achievement Goal	10.373*	3	0.016
Learning Environment Stimulation	8.175*	3	0.043
Students' Motivation Toward Learning Science	18.549*	3	0.000

*Note: *The difference in the means is significant when p≤0.05*

3.5. Difference in the Level of Experience in the Earth Science Subject according to Sex

Table 8 presents the difference in the level of experience in the Earth Science subject according to sex. The Mann-Whitney U test revealed no significant differences in the level of experience in the Earth Science subject based on sex. Specifically, male and female students did not differ significantly in their perceptions of good teaching [U=1312.500, p=0.077], generic skills [U=1485.000, p=0.426], clear goals and standards [U=1435.500, p=0.279], appropriate workload [U=1301.000, p=0.062], emphasis on independence [U=1524.000, p=0.549], or overall experiences in Earth Science [U=1303.000, p=0.069]. Although the p-values for the appropriate workload and overall experiences were close to the significance threshold, they remained above p = 0.05, indicating that these differences were not statistically significant. These findings suggest that both male and female students generally perceived their experiences in the Earth Science subject similarly across all measured dimensions.

This result indicates that there were no significant differences in the level of experience in Earth Science between male and female students across all measured domains. This means that both sexes perceived the quality of teaching, development of skills, clarity of expectations, workload, and opportunities for independent learning in a similar manner [4], [19], [24], [26]. This could be because the learning environment and instructional strategies used in Earth Science classes were designed to be inclusive and uniform, ensuring equal engagement and support for all students regardless of sex [40], [42]. This could also be attributed to shared classroom experiences, such as common assignments, assessments, and teaching styles that promote consistency in how students interact with and perceive the subject [24], [26]. This implies that maintaining a consistent and inclusive instructional approach in Earth Science may continue to support equitable learning experiences for both male and female students.

Table 8. Difference in the Level of Experience in the Earth Science Subject according to Sex

Variable	U	z	p
Good Teaching	1312.500	-1.771	0.077
Generic Skills	1485.000	-0.796	0.426
Clear Goals and Standards	1435.500	-1.083	0.279
Appropriate Workload	1301.000	-1.867	0.062
Emphasis on Independence	1524.000	-0.599	0.549
Experiences in Earth Science	1303.000	-1.818	0.069

Note: the difference in the means is significant when p≤0.05

3.6. Difference in the Level of Experience in the Earth Science Subject according to Academic Performance

Table 9 presents the difference in the level of experience in the Earth Science subject according to academic performance. The Kruskal-Wallis H test revealed no significant differences in the level of experience in the Earth Science subject based on academic performance. Specifically, students' perceptions did not significantly differ across academic performance groups in good teaching [H(3)=4.432, p=0.218], generic skills [H(3)=3.389, p=0.335], clear goals and standards [H(3)=1.838, p=0.607], appropriate workload [H(3)=0.941, p=0.815], emphasis on independence [H(3)=0.098, p=0.992], or their overall experiences in Earth Science [H(3)=1.152, p=0.765]. These results indicate that regardless of students' academic standing, they reported relatively similar experiences across all measured aspects of their Earth Science education, suggesting that the delivery and perceived quality of the subject were consistent among students with varying levels of academic achievement.

This result indicates that there were no significant differences in students' level of experience in Earth Science when grouped according to their academic performance. This means that students, regardless of whether

they were high or low achievers, shared similar perceptions regarding the quality of teaching, clarity of course goals, skill development, workload, and independence in learning [4], [24], [26]. This could be because Earth Science instruction is delivered in a standardized manner across sections, providing equal opportunities and expectations to all students [40], [42]. This could also be attributed to the subject's design and implementation, which may emphasize group activities, shared assessments, and teacher-led discussions that level the learning experience across academic groups [19], [24], [26]. This implies that equitable instructional practices in Earth Science may help sustain uniform engagement and perceptions across diverse academic achievers.

Table 9. Difference in the Level of Experience in the Earth Science Subject according to Academic Performance

Variable	H	df	p
Good Teaching	4.432	3	0.218
Generic Skills	3.389	3	0.335
Clear Goals and Standards	1.838	3	0.607
Appropriate Workload	0.941	3	0.815
Emphasis on Independence	0.098	3	0.992
Experiences in Earth Science	1.152	3	0.765

Note: the difference in the means is significant when p≤0.05

The Expectancy-Value Theory of Motivation, as proposed by Wigfield and Eccles [27], helps explain why students may exhibit different levels of motivation in learning science, depending on their sex and academic performance. The theory suggests that students are more motivated to learn when they believe they can succeed and perceive the subject as important or valuable. These beliefs are shaped by their past experiences and personal background. Students who excel academically are more likely to feel confident in their ability to succeed in science, which, in turn, can increase their motivation. Likewise, male and female students may view and approach science differently due to the influence of their environment or experiences. This theory suggests that students' motivation to learn science can vary depending on their individual characteristics and academic performance. Meanwhile, further studies are encouraged to validate the claims of this study.

4. CONCLUSION

The level of motivation towards learning science and subject experiences, are interdependent and form the foundation for developing responsive and student-centered teaching methodologies. The study underscores the importance of aligning students' academic strands with their interests to sustain motivation in science learning. It suggests that Earth Science instruction should emphasize personal relevance and autonomy over competitive performance, while fostering students' internal sense of achievement and competence to enhance engagement and persistence. A structured and responsive curriculum, with a well-balanced content load and pacing, can enrich academic experiences and promote a more profound understanding without overwhelming students. The findings also underscore the need for gender-responsive and inclusive strategies that foster achievement motivation and provide equitable learning opportunities for all students. Overall, equitable instructional practices in Earth Science contribute to consistent engagement and positive perceptions across diverse academic performances, guiding educators toward more effective, student-centered approaches.

The study acknowledges several limitations. First, the study was confined to Grade 12 STEM students from a single private school in Western Visayas, which restricts the applicability of the results to other student populations, such as those in public schools, different academic strands, or other regions. The reliance on quantitative self-report instruments, although standardized and adopted, may not fully capture the depth and nuance of students' motivation or classroom experiences, and may be influenced by recall bias or the respondents' perception at the time of data collection. Given these constraints, future research may consider employing a mixed-methods approach, involving multiple schools and a more diverse student sample, to validate and enrich the findings of this study.

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