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Relationship Between Extrinsic Motivation and Academic Performance in Biology Among Grade 12 STEM Students

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Abstract. Extrinsic motivation can influence students' engagement and achievement, yet the extent to which different forms of extrinsic motivation are associated with academic performance in Biology remains insufficiently understood, particularly among senior high school students. This study examined the level of extrinsic motivation among Grade 12 Science, Technology, Engineering, and Mathematics students and determined its relationship with academic performance in Biology. A causal-comparative research design was employed with 80 students, comprising 27 males and 53 females, from a private school in Zamboanga City, Philippines, selected through total enumeration. Data were collected using a modified academic motivation scale for learning Biology with responses rated on a six-point Likert scale. Descriptive statistics, correlation analysis, linear regression, independent-samples t-tests, and analysis of variance were used to analyze the data. Results showed a significant positive relationship between overall extrinsic motivation and academic performance in Biology ($r = 0.395$, $p = 0.012$). Among the dimensions of extrinsic motivation, identified motivation ($r = 0.281$, $p = 0.012$) and integrated motivation ($r = 0.326$, $p = 0.003$) were significant predictors of academic performance, whereas external and introjected motivation were not significant predictors. No significant differences in extrinsic motivation were found according to gender or socioeconomic status. However, female students had significantly higher academic performance than male students ($p = 0.018$), while socioeconomic status had no significant effect on academic performance. The findings suggest that academic performance in Biology was more strongly associated with internalized forms of extrinsic motivation than with externally regulated or introjected forms. The results support attention to learning conditions that foster more internalized motivation while maintaining equitable opportunities for students across gender and socioeconomic groups.

Keywords: External Motivation; Identified Motivation; Integrated Motivation; Introjected Motivation

Introduction

Student motivation is widely recognized as an important factor in academic behavior, engagement, and achievement (Deci & Ryan, 2000; Saeed and Zyngier, 2012, Nayir, 2017; Howard, et al., 2021). Motivated learners are more likely to participate actively, exert effort, and remain engaged in learning activities (Rahayu, 2015; Adamma, et al., 2018). In science education, motivation is relevant because learning often requires sustained attention, persistence, and engagement with scientific concepts and learning tasks (Tuan, et al., 2005 as cited in Kışoğlu, 2018). Recent research continues to examine motivation in relation to students' learning experiences and academic outcomes, although findings are not entirely consistent across contexts (Howard, et al., 2021; Lo, et al., 2022; Capunitan, et al., 2023). These differences suggest that examining motivation as a single construct may not fully explain variations in students' academic performance.

Self-Determination Theory provides the principal theoretical foundation for understanding the different forms of motivation. Deci and Ryan (2000) distinguish intrinsic motivation, extrinsic motivation, and amotivation according to the reasons underlying behavior. Within the theory, extrinsic motivation varies according to the degree to which behavior has been internalized. The four forms include external, introjected, identified, and integrated motivation. External motivation involves behavior regulated by external rewards or punishments, whereas introjected motivation involves internal pressures such as guilt, ego, or the desire to avoid feelings of failure. Identified motivation occurs when an individual recognizes the value or importance of an activity, while integrated motivation represents a more fully internalized form in which the behavior is consistent with personal values and sense of self (Deci & Ryan, 2000). Thus, extrinsic motivation does not represent a single type of externally controlled behavior but encompasses different levels of internalization.

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Subsequent studies have applied these motivational distinctions in educational contexts and have examined their relationships with students' learning behaviors and outcomes (Anderson, 2016; Legault, 2017; Howard, et al., 2021). The distinction among these forms is particularly important because the degree of internalization may be associated with different patterns of engagement and academic outcomes.

Previous empirical findings concerning motivation and academic performance, however, are not uniform. Some studies have reported positive relationships between motivation and academic achievement (Sharma, & Sharma, 2018; Bin Abdulrahman et al., 2023).However, in science learning, Capunitan et al. (2023) found no significant relationship between motivational factors and academic performance among the science students included in their study, although motivational factors were significantly associated with students' satisfaction with learning components. These findings indicate that motivation may be related differently to engagement, satisfaction, and academic performance depending on the context and variables examined. Consequently, the presence of motivation alone may not adequately explain academic achievement. Instead, the particular form and degree of internalization of motivation may be important considerations. Within Self-Determination Theory, external and introjected motivation involve comparatively greater external or internal pressure, whereas identified and integrated motivation reflect greater internalization and autonomy (Deci & Ryan, 2000). Examining these forms separately may therefore provide a more specific understanding of the relationship between extrinsic motivation and academic performance in Biology.

The need to examine factors associated with science learning is further highlighted by continuing challenges in Philippine science education. Filipino learners have demonstrated performance below desired proficiency levels in science. These concerns are also reflected in international assessments. In the 2018 and 2022 Programme for International Student Assessment, the Philippines recorded science scores of 357 and 356, respectively, remaining below the Organization for Economic Cooperation and Development average (Congressional Policy and Budget Research Department [CPBRD], 2024). Similarly, the 2019 Trends in International Mathematics and Science Study reported limited mastery of foundational scientific concepts among Filipino learners (Mullis et al., 2019). These assessment results do not establish that motivation is responsible for low science performance; rather, they demonstrate the continuing need to examine learner-related factors associated with science learning outcomes. Motivation is relevant to this concern because students' willingness to participate, exert effort, and remain engaged in learning activities forms part of their academic behavior and learning experience (Ongowo, 2018).

Philippine studies provide additional evidence that motivation is relevant to students' educational experiences, although the relationships vary according to the outcome and learner population examined. Fernandez and Marcelo (2024), in a study involving 225 Grade 12 students at Maliwalo National High School in Tarlac City, reported high levels of motivation and classroom engagement across cognitive, affective, and psychomotor indicators. However, the relationships between participation in school clubs, extracurricular activities, co-curricular activities, and classroom engagement varied across the different indicators. The study found no significant gender differences in the impact of motivation on classroom engagement, while significant differences in affective engagement were observed according to paternal educational attainment and family income. These findings suggest that motivation and student engagement may be associated with different learner and contextual characteristics within the Philippine senior high school setting. In another Philippine study, Capuyan et al. (2024) examined extrinsic and intrinsic motivation in relation to academic performance among pupils in public elementary schools in Quezon District, Baguio City. The study reported a strong relationship between extrinsic motivation and pupils' academic performance, whereas the relationship between intrinsic motivation and academic performance was reported as weak. The study, however, focused on elementary pupils and examined extrinsic motivation broadly rather than distinguishing among external, introjected, identified, and integrated motivation. Taken together, these local findings indicate that motivation has been examined in relation to classroom engagement and academic performance in Philippine educational settings, but the findings and contexts differ according to learner population and outcome.

International and Philippine evidence therefore complement one another while also revealing areas that require further investigation. International research provides broader evidence concerning the relationship between different forms of motivation and educational outcomes, whereas Philippine studies demonstrate that these relationships may also be observed within local educational settings. However, differences in educational contexts, learner characteristics, socioeconomic conditions, and learning opportunities make it inappropriate to assume that findings from one population automatically apply to another. Previous research has reported gender-related differences in science performance, with Kristyasari et al. (2018) associating female students with stronger content mastery, conceptual understanding, and use of scientific evidence, consistent with De La Fuente's (2022) evidence that female students outperformed male students in science literacy in the Philippines. Socioeconomic conditions may likewise be associated with students' access to learning materials and educational opportunities (Destin et al., 2019; Aldama as cited in Nunez & Villanueva, 2020). These findings provide a basis for considering gender and socioeconomic status

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when examining motivation and academic performance while recognizing that such relationships may vary across educational contexts.

At the local school level, variations in students' motivation, classroom participation, and academic performance in Biology have been observed among Grade 12 Science, Technology, Engineering, and Mathematics students. Some students demonstrate active participation in discussions and learning activities, whereas others appear to rely more on external rewards, compliance, or avoidance of failure, characteristics associated with external and introjected forms of motivation (Deci & Ryan, 2000; Staddon & Cerutti, 2003; Ongowo, 2018; Anderson, 2016). Differences in performance across quizzes, laboratory activities, and summative assessments further provide a context for examining whether particular forms of extrinsic motivation are associated with Biology academic performance. More autonomous forms of motivation, particularly identified and integrated motivation, also warrant examination because they represent greater internalization of the value of an activity (Deci & Ryan, 2000). These local observations provide a practical basis for investigating the relationship between specific forms of extrinsic motivation and Biology academic performance among Grade 12 Science, Technology, Engineering, and Mathematics students.

Despite the established literature on student motivation, a specific research gap remains. Existing studies have examined motivation in relation to classroom engagement, satisfaction, and academic performance, but the findings are not entirely consistent and the populations and educational contexts vary (Anderson, 2016; Capunitan et al., 2023; Fernandez & Marcelo, 2024; Capuyan et al., 2024). More specifically, the Philippine studies identified above have examined either classroom engagement among Grade 12 students or extrinsic motivation and academic performance among elementary pupils. Limited local evidence specifically examines the four forms of extrinsic motivation—external, introjected, identified, and integrated motivation—in relation to Biology academic performance among Grade 12 Science, Technology, Engineering, and Mathematics students. Examining these forms separately may clarify whether particular types of extrinsic motivation are more closely associated with academic performance than others. Considering gender and socioeconomic status further provides a basis for determining whether differences in motivation and academic performance are evident across selected student characteristics.

The study is also aligned with Sustainable Development Goal 4, which emphasizes inclusive, equitable, and quality education (United Nations Children's Fund, 2023). Within this broader educational priority, understanding learner-related factors associated with academic performance may provide evidence relevant to efforts to support student engagement and learning. The present investigation therefore focuses on the empirical relationship between specific forms of extrinsic motivation and academic performance rather than assuming that motivation directly causes achievement.

This study examined the extrinsic motivation of Grade 12 Science, Technology, Engineering, and Mathematics students and its relationship with their academic performance in Biology. Specifically, it determined the relationships of external, introjected, identified, and integrated motivation with academic performance; identified which forms of extrinsic motivation significantly predicted academic performance; and examined whether motivation and academic performance differed according to gender and socioeconomic status. By distinguishing among the four forms of extrinsic motivation and examining their relationships with Biology academic performance within a Philippine senior high school context, the study seeks to contribute empirical evidence to the literature on student motivation and science education.

Research Questions

This study aimed to determine the relationship between students' motivation and academic performance in biology. Specifically, this study aimed to answer the following questions that may help achieve the study's objectives.

1. What are the demographic profiles of the G12 STEM students in terms of gender and socio-economic status?
2. Is there a relationship between students' motivation and academic performance in terms of external motivation, introjected motivation, identified motivation, and integrated motivation?
3. Which among the four models best predicts the students' academic performance?
   3.1 External Motivation
   3.2 Introjected Motivation
   3.3 Identified Motivation
   3.4 Integrated Motivation
4. Do students' extrinsic motivation and academic performance in Biology significantly differ when moderated by gender and socioeconomic status?
5. What action plan can be proposed to enhance the motivation and academic performance of students in Biology?

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Scope and Delimitation of the Study

This study focuses on the extrinsic motivation of Grade 12 STEM students and its relationship to their academic performance in biology. However, it is subject to certain limitations. First, only the four types of extrinsic motivation: External, introjected, identified, and integrated are examined. Second, the study was conducted in a single private school in Zamboanga City, which may limit the generalizability of the findings to other schools with different teaching methods or learning environments. Third, the respondents are limited to Grade 12 STEM students enrolled in biology, restricting the scope of the study to this specific group. Finally, academic performance was measured solely based on the students' first-semester general average grade in biology, which may not fully capture all aspects of their learning outcomes

Literature Review

Student Motivation and Academic Performance

Motivation is widely recognized as an important factor influencing students' behavior, engagement, and academic performance. Deci and Ryan (2000), through Self-Determination Theory, distinguish motivation according to the reasons underlying behavior and identify intrinsic motivation, extrinsic motivation, and amotivation as major motivational orientations. Legault (2017) likewise discusses motivation within the framework of Self-Determination Theory, emphasizing differences in the quality and regulation of motivation. Empirical study generally indicate that students with higher levels of motivation tend to participate more actively, interact more with others, exert greater effort, and demonstrate better academic outcomes than students with lower levels of motivation (Tršková, 2016). In classroom settings, feedback, attention, participation in discussions and activities, and interaction between teachers and peers may also contribute to students' motivation and engagement (Jefferson & Paul, 2019).

The relationship between motivation and learning is particularly relevant to science education. Motivated students are more likely to engage with academic tasks and develop learning behaviors that support understanding. Tuan, Chin, and Shieh (2005, as cited in Kışoğlu, 2018) associated students' motivation with the development of critical thinking, conceptual understanding, and learning strategies in science. Similarly, Agboghoroma and Oyovwi (2015) indicated that motivation is related to students' learning in science. Adamma et al. (2018) further emphasized that motivation is associated with students' engagement in academic learning and their orientation toward learning tasks. Taken together, these findings establish motivation as an important factor in academic learning, particularly in science, while also indicating that motivation should be examined according to the specific reasons that lead students to engage in academic activities.

Forms of Extrinsic Motivation

Self-Determination Theory provides an important framework for understanding the different forms of extrinsic motivation. Deci and Ryan (2000) identified external, introjected, identified, and integrated motivation as distinct forms of extrinsic regulation that vary in their degree of internalization and autonomy. External motivation is characterized by behavior regulated through external rewards and punishments. Introjected motivation involves internal pressure, such as the desire to avoid guilt, protect the ego, or meet expectations. Identified motivation occurs when students recognize the value or importance of an activity, while integrated motivation represents a more fully internalized form in which the behavior is consistent with personal values and sense of self (Deci & Ryan, 2000; Anderson, 2016).

The distinction among these forms is important because students may display similar academic behaviors for different reasons. Students motivated externally may participate because of rewards, additional points, praise, or avoidance of punishment (Deci & Ryan, 2000; Ongowo, 2018; Staddon & Cerutti, 2003). Such external incentives can encourage students to perform required behaviors, and Anderson (2016) noted that students may exert effort because of rewards, ego, fear, or obligation. However, this type of regulation may not necessarily reflect genuine personal interest in the learning activity. Adamma et al. (2018) further reported that students who are primarily motivated by rewards may become less interested when rewards are removed and may focus more on grades and rewards than on learning itself. These findings suggest that external regulation can encourage observable academic behavior while potentially providing a less autonomous basis for learning.

Introjected motivation represents a somewhat more internalized but still controlled form of extrinsic motivation. Students may engage in academic activities because of internal pressures involving guilt, ego, fear, or a sense of obligation (Deci & Ryan, 2000; Anderson, 2016). Williams et al. (1996, as cited in Deci & Ryan, 2000) indicated that external and introjected regulation may form a controlled motivation composite. Chatter et al. (2014) similarly associated controlled motivation with feelings of obligation and pressure in performing

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academic tasks. These findings distinguish introjected motivation from external motivation while maintaining that both forms involve relatively controlled reasons for academic behavior.

Identified and integrated motivation represent greater degrees of internalization. Students with identified motivation recognize the value or importance of their actions and understand that the activity may be beneficial for future goals (Deci & Ryan, 2000; Anderson, 2016). Integrated motivation represents an even more autonomous form because the behavior is consistent with personal values and sense of self (Deci & Ryan, 2000; Anderson, 2016). Thus, although both identified and integrated motivation remain forms of extrinsic motivation, they differ from external and introjected motivation because the behavior is increasingly accepted and personally valued by the learner.

The literature therefore indicates that extrinsic motivation should not be treated as a single, uniform construct. External and introjected motivation are more controlled, whereas identified and integrated motivation reflect greater internalization and autonomy (Deci & Ryan, 2000). This theoretical distinction provides an important basis for examining the four forms separately when investigating their relationship with academic performance.

Extrinsic Motivation and Academic Performance

Previous literature provides evidence that motivation may be associated with academic performance, but the findings are not entirely consistent. Tršková (2016) reported that highly motivated individuals tend to participate actively, interact with others, and work more efficiently. This finding support a positive association between motivation and academic performance. Similarly, Aquino (2019) reported that external motivational factors such as rewards and punishments were associated with changes in students' behavior and academic performance. Such findings suggest that external incentives may encourage students to perform academic tasks and may be associated with improved performance.

However, the relationship between extrinsic motivation and academic performance cannot be assumed to be uniformly positive. Staddon and Cerutti (2003) explained that behavior can be influenced by rewards and consequences, while Ryan and Deci (2000) indicated that students who become accustomed to external rewards may be less likely to perform an activity for its own sake when the reward is absent. Adamma et al. (2018) similarly observed that students who are motivated primarily by rewards may become less interested when rewards are removed and may focus more on grades than learning. These findings suggest that external motivation may influence academic behavior without necessarily producing the same quality of engagement associated with more internalized forms of motivation.

The literature also presents evidence that the relationship between extrinsic motivation and academic performance may be negative or inconsistent. Clark et al. (2014) emphasized that the relationship between extrinsic motivation and academic performance is less consistent than might be expected. Prospero and Vohra-Gupta (2009, as cited in Clark et al., 2014) reported that extrinsic motivation predicted lower grade point averages. This finding contrasts with studies reporting positive associations between motivation and academic performance (Tršková, 2016; Aquino, 2019). The inconsistency suggests that the effect or association of motivation with academic performance may depend on the particular form of motivation being considered.

This distinction is particularly relevant to Biology and science learning. Motivation has been associated with critical thinking, conceptual understanding, and learning strategies in science (Tuan, Chin, & Shieh, 2005, as cited in Kışoğlu, 2018), while Agboghoroma and Oyovwi (2015) indicated that motivation influences students' science learning. Sjukur (2012) also reported a relationship between motivation and Biology learning achievement. Nurhikmah et al. (2018) discussed the use of learning strategies and multimedia in supporting students' understanding of biological concepts, while Emuas and Sabri (1999) emphasized laboratory exposure in developing skills. Although these studies provide evidence concerning motivation and learning in Biology and science, they do not establish that all forms of extrinsic motivation have the same relationship with Biology academic performance.

The reviewed evidence therefore presents an unresolved issue. On one hand, motivation is generally associated with active participation and better academic outcomes (Tršková, 2016). On the other hand, findings concerning extrinsic motivation specifically are inconsistent, with some studies reporting positive associations and others identifying less favorable outcomes (Aquino, 2019; Prospero & Vohra-Gupta, 2007, as cited in Clark et al., 2014). Self-Determination Theory provides a possible basis for understanding these differences because external, introjected, identified, and integrated motivation represent different degrees of internalization and autonomy (Deci & Ryan, 2000). This unresolved empirical issue justifies examining the four forms of extrinsic motivation separately in relation to academic performance in Biology.

Gender and Academic Performance

Gender is another factor considered in the literature on motivation and academic performance. Existing findings suggest that male and female students may differ in motivational orientations and academic

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outcomes, although the direction and magnitude of these differences are not consistent. Adigun et al. (2015) emphasized that male and female students may differ in characteristics associated with academic performance. Anderman and Anderman (1999, as cited in Ayub, 2010) reported that male students were more likely to demonstrate extrinsic forms of motivation, particularly external motivation, whereas Mecca and Holt (1993, as cited in Ayub, 2010) associated female students more strongly with intrinsic motivation. Ayub (2010) likewise examined intrinsic and extrinsic motivation in relation to academic performance and highlighted differences in students' motivational orientations.

Other studies provide evidence of differences in science-related academic performance. González-Gómez et al. (2013) reported that female students demonstrated greater collaboration, participation, and self-directed learning than male students. Kristyasari et al. (2018) likewise associated female students with stronger content mastery, understanding of science concepts, and scientific evidence. De La Fuente (2022), reporting on Philippine science literacy results, indicated that female students outperformed male students in science. These findings collectively provide evidence that female students may demonstrate advantages in selected science-learning outcomes.

However, the evidence is not uniform. Jia et al. (2020) reported that male students outperformed female students in science academic achievement, directly contrasting with findings that favor female students (De La Fuente, 2022; Kristyasari et al., 2018). The conflicting findings indicate that gender differences in science achievement may vary according to educational context, population, and assessment. Therefore, rather than assuming that one gender consistently performs better, the literature supports the need to examine gender differences within the specific population and subject context of the present study.

Socioeconomic Status and Academic Performance

Socioeconomic status is also associated with students' educational opportunities and academic outcomes. Betancur et al. (2018) examined socioeconomic gaps in science achievement and reported a relationship between socioeconomic conditions and science performance. Destin et al. (2019) likewise found that students with higher socioeconomic status had advantages in academic achievement. Aldama (as cited in Nunez & Villanueva, 2020) emphasized that students with greater socioeconomic resources have better access to materials needed for learning. These findings suggest that socioeconomic conditions may shape students' access to educational resources and opportunities and, consequently, may be associated with academic performance.

The relationship between socioeconomic status and science achievement may be particularly important because learning may require access to instructional materials and other educational resources. Villaseñor (2024) emphasized that socioeconomic disparities can widen the digital divide by creating unequal access to digital devices, internet connectivity, and other educational technologies, which may consequently affect students' academic performance. Destin et al. (2019) further indicated that students from higher socioeconomic backgrounds have advantages in academic performance, while Betancur, et al. (2018) noted that household income and parental education were associated with disparities in science achievement. The study further indicated that family income may shape children's academic development through differences in educational investments, including access to quality education, books, learning materials, extracurricular activities, and other learning experiences. In addition, parental education was associated with greater access to stimulating materials and activities that support children's learning. These findings suggest that socioeconomic conditions may contribute to differences in academic achievement by shaping the learning resources, educational experiences, and support available to students.

Nevertheless, the literature does not establish socioeconomic status as the sole explanation for differences in academic performance. Rather, socioeconomic conditions represent one contextual factor associated with students' educational experiences. The consistent relationship identified in the literature provides a basis for examining socioeconomic status alongside motivation and academic performance in Biology.

Methodology

Research Design

A causal-comparative research design was employed to examine the relationship between the four types of extrinsic motivation and students' academic performance in Biology. The study also investigated differences in motivation and performance based on gender and socioeconomic status and identified which type of extrinsic motivation best predicts academic performance. The design was considered appropriate because the study examined naturally occurring characteristics and group differences without manipulating the participants' motivational conditions. The design therefore allowed the study to examine relationships, and predictive associations among the variables as they naturally occurred among the participants.

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Research Locale

The study was conducted in a private school in Zamboanga City, Philippines, where the participating Grade 12 Science, Technology, Engineering, and Mathematics (STEM) students were enrolled in Biology. The school was selected as the research locale because it provided an accessible population of eligible Grade 12 STEM students relevant to the objectives of the study. The setting served as the institutional context in which the biology-related research activities and data collection were conducted.

Research Participants

The study included 80 Grade 12 Science, Technology, Engineering, and Mathematics (STEM) students enrolled in Biology at the selected private school, comprising 27 males and 53 females. Total enumeration was used to include all eligible Grade 12 STEM students within the identified population. This sampling approach was appropriate because the study focused on the complete accessible population of eligible students in the selected setting. Thus, the sample size was determined by the total number of eligible students rather than by selecting a smaller sample from the population. The use of total enumeration allowed all eligible students to have the opportunity to participate and provided a complete representation of the accessible population within the selected school.

Research Instrument

The study utilized a modified Academic Motivation Scale as the primary survey instrument to assess students' extrinsic motivation in Biology. The instrument measured four types of extrinsic motivation: external, introjected, identified, and integrated motivation. The amotivation subscale was excluded because it was not among the variables examined in the study. Each sub-dimension consisted of four items rated on a 6-point Likert scale ranging from 1 (Strongly Disagree) to 6 (Strongly Agree). The six-point scale was used to avoid a neutral response (Aydin et al., 2014). The instrument was adapted from the Academic Motivation Scale developed by Vallerand et al. (1992). The items were slightly adapted to the Biology context to ensure that the statements were relevant to the participants' learning experiences. For example, the statement "In order to have a better salary later on" was contextualized as "In order to have better grades later on." The adaptation retained the intended motivational dimensions while making the statements appropriate to Biology learning. The survey also included a first part that collected demographic information, specifically gender and socioeconomic status, together with the participants' first-semester Biology grades. The Biology grades were verified through the school registrar using the students' Gsuite email addresses. After verification, the grades were matched with the corresponding survey responses, and the participants were assigned codes to protect their identities.

Data Gathering Procedure

Data were collected through a systematic and chronological procedure following ethics approval, institutional authorization, informed consent, survey administration, data verification, and secure data management. Prior to data collection, the researcher submitted the required research documents to the appropriate Research Evaluation Committee and obtained ethics clearance (Approval Code No. 2023-0016), confirming that the study procedures addressed participant rights, confidentiality, and voluntary participation. Parental informed consent and participant assent were subsequently secured using consent forms prepared in English and Filipino, which explained the study purpose, procedures, potential benefits and risks, confidentiality measures, and the voluntary nature of participation, including the participants' right to withdraw at any time without penalty; appropriate assistance, witness certification, and thumbprint options were provided when necessary, and copies of the signed forms were retained by both the researcher and parents or guardians. The researcher also coordinated with the school principal, Academic Coordinator, and class advisers to finalize the schedule and arrangements for data collection. Data were then gathered from Grade 12 Science, Technology, Engineering, and Mathematics (STEM) students in one private school in Zamboanga City through face-to-face administration in the school conference room. Before completing the instrument, participants received an orientation on the study purpose, survey instructions, and their rights as research participants, after which they accessed the validated and modified Academic Motivation Scale for Biology through Google Forms using their available devices; completion required approximately 5–10 minutes, with additional time provided when necessary, and non-monetary tokens such as snacks, pens, and sticky notes were provided as appreciation for participation. The questionnaire consisted of two parts: the first collected demographic information, including gender and socioeconomic status, and participants' first-semester Biology grades, which were verified through the school registrar using their Gsuite email addresses and matched with survey responses before being anonymized through participant codes; the second contained 16 items measuring external, introjected, identified, and integrated forms of extrinsic motivation, with four items for each dimension, rated on a six-point Likert scale ranging from 1 (Strongly Disagree) to 6 (Strongly Agree), in

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response to the question, "Why do you study Biology?" with statements slightly adapted to the Biology context while retaining their intended motivational dimensions. Following data collection, survey responses and verified Biology grades were compiled, coded, and prepared for statistical analysis, with participant identifiers replaced by research codes to preserve confidentiality; electronic files were stored in password-protected files, physical documents were kept in secure storage, and access to the data was restricted to the researcher. After completion of the required analysis and research activities, all research files were securely destroyed in accordance with the established data-management and ethical procedures.

Results and Discussions

Research Question 1: What are the demographic profiles of the G12 STEM students in terms of gender and socio-economic status?

Table 1. Demographic Profile of STEM-12 in terms of Gender

Gender	Frequency	Percentage
Male	27	33.75 %
Female	53	66.25 %
N	**80**	**100 %**

Table 1 presents the demographic profile of the Grade 12 STEM students in terms of gender. Among the 80 respondents, 27 (33.75%) were male, while 53 (66.25%) were female, indicating a higher representation of female students in the sample. The predominance of female students in the present sample provides a different pattern from some earlier reports on STEM participation. The Longitudinal Study of Young People in England, as reported by the Institute for Employment Research University of Warwick (IERU, 2011), found a higher proportion of male students in STEM, while Kaleva et al. (2019) similarly reported male predominance in STEM participation in Finland. These findings indicate that gender patterns in STEM participation may differ across educational contexts.

The present finding, however, is consistent with evidence concerning female participation in Philippine programs associated with STEM. Abrigo and Ortiz (2019) reported substantial female representation in several health-related fields, including dentistry, midwifery, nursing, nutrition, medicine, dietetics, and pharmacy. This may help contextualize the higher proportion of female students observed in the present STEM group, particularly because the STEM strand encompasses fields beyond mathematics and engineering. At the same time, the finding should be interpreted specifically as a description of the participants in the present study rather than as evidence that female students generally outnumber male students across all STEM programs.

Issues concerning gender participation in STEM remain relevant because workplace conditions and gender-related experiences may influence students' educational and career choices. Previous literature has identified male-centered workplace cultures, limited representation in leadership, gender discrimination, and sexual harassment as concerns affecting women's participation in STEM-related fields (PBCWE, 2019; Maryville University, 2023). The present distribution therefore provides useful contextual information for interpreting the subsequent findings on motivation and academic performance by gender.

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Table 2. Demographic Profile of STEM-12 in terms of Socio-economic Status

Monthly Family Income	Frequency	Percentage
Poor-Income Class (Less than PhP 12,082 per month)	24	30%
Low-Income Class (Between PhP 12,082 to PhP 24,164 per month)	22	27.5%
Middle-Income Class (Between PhP 24,164 to PhP 241,640 per month)	34	42.5%
a. Middle-Income Class (Between PhP 24,164 to PhP 48,328 per month)	17	
b. Middle-Middle-Income Class (Between PhP 48,328 to PhP 84,574 per month)	13	
c. Upper-Middle Income Class (Between PhP 84,574 to PhP 144,984 per month)	2	
d. High-Middle Income Class (Between PhP 144,984 to PhP 241,640 per month)	2	
Rich-Income Class (Between PhP 241, 640 and above)	0	0 %
N	**80**	**100%**

Among the 80 respondents, 24 students (30%) belonged to the Poor-Income Class, 22 students (27.5%) to the Low-Income Class, and 34 students (42.5%) to the Middle-Income Class. No participants were categorized under the Rich Income Class. Table 2 presents the distribution of Grade 12 STEM students based on socio-economic status (SES). The SES categories included Poor-Income Class (less than PhP 12,082/month), Low-Income Class (PhP 12,082–24,164/month), Middle-Income Class (PhP 24,164–48,328/month), Upper-Middle Income Class (PhP 48,328–144,984/month), High-Middle Income Class (PhP 144,984–241,640/month), and Rich Income Class (PhP 241,640 and above).

The demographic profile of STEM-12 students revealed a notable gender disparity, with females comprising 66.25% and males 33.75% of the population, indicating female predominance in the strand. This finding contrasts with studies in England and Finland, where male students historically outnumbered females in STEM programs, often motivated by strong academic inclinations toward mathematics and engineering (IERU, 2011; Kaleva et al., 2019). Female underrepresentation in STEM has been linked to male-centered workplace cultures, limited leadership opportunities, discrimination, and harassment (PBCWE, 2019; Maryville University, 2023). However, the STEM strand also includes medical and health-related fields, where female participation has traditionally been higher. In the Philippines, female students dominate enrollment in programs such as dentistry (69.2%), midwifery (90.1%), nursing (74.1%), nutrition (88.3%), medicine (56.9%), dietetics (88.3%), and pharmacy (83.5%) (Abrigo & Ortiz, 2019). Initiatives like STEM + PH aim to improve gender equity in STEM careers, contributing to the observed increase in female enrollment (UNESCO, as cited in PBCWE, 2019). Thus, the female predominance observed among the STEM-12 students is consistent with the cited Philippine evidence showing higher female participation in several STEM-related fields, while differing from the patterns reported in England and Finland.

Regarding socio-economic status, the majority of STEM students belonged to the middle-income class (42.5%), followed by poor-income (30%) and low-income (27.5%) groups, with no students in the rich-income category. Middle-income families typically have stable salaried employment or engage in entrepreneurial activities (Albert et al., 2018; PSA, 2021; Zoleta, 2022). The distribution indicates that the participants came from varied socio-economic backgrounds, although the middle-income class represented the largest group. In contrast, students from lower-income households face greater challenges accessing learning materials and technology, particularly in private institutions. These barriers are partially alleviated through scholarships and government voucher programs, ensuring equitable access to education (Aldama, cited in Nunez & Villanueva, 2020). The presence of students from poor-income and low-income groups in the present study therefore highlights the relevance of access to educational resources when considering the socio-economic profile of the participants. The demographic findings provide the context for examining whether gender and socio-economic status are associated with differences in students' extrinsic motivation and academic performance in Biology.

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Research Question 2: Is there a relationship between students' motivation and academic performance in terms of external motivation, introjected motivation, identified motivation, and integrated motivation?

Table 3: Relationship of Extrinsic Motivation and Academic Performance in Biology

Students' Motivation	Academic Performance in Biology	
	Pearson's r	p-value
Extrinsic Motivation	0.395	0.012
External Motivation	0.076	0.504
Introjected Motivation	0.032	0.776
Identified Motivation	0.281	0.012
Integrated Motivation	0.326	0.003

Table 3 shows the relationship between extrinsic motivation and academic performance in Biology. Overall, extrinsic motivation had a weak positive correlation with academic performance ($r = 0.395$, $p = 0.012$). External motivation ($r = 0.076$, $p = 0.504$) and introjected motivation ($r = 0.032$, $p = 0.776$) were not significantly related to academic performance. In contrast, identified motivation ($r = 0.281$, $p = 0.012$) and integrated motivation ($r = 0.326$, $p = 0.003$) showed weak but significant positive correlations. These findings indicate that the more autonomous forms of extrinsic motivation were associated with better academic performance in Biology (Deci & Ryan, 2000).

The significant but weak positive relationship between overall extrinsic motivation and academic performance is consistent with previous findings indicating that extrinsic motivation is positively related to students' academic outcomes (Deci & Ryan, 2000; Duckworth & Seligman, 2005; Mustopa et al., 2020). External factors such as rewards, recognition, and other motivators can enhance student engagement and participation, thereby improving performance (Chen & Widjaja, 2017; Nurhikmah et al., 2018). However, the weak magnitude of the relationship indicates that extrinsic motivation is associated with academic performance but does not account for a large proportion of the variation in students' performance.

The results for the individual forms of extrinsic motivation provide further distinction among the four types. External motivation and introjected motivation were not significantly related to academic performance, indicating that external rewards, punishments, or ego-driven pressures were not significantly associated with students' Biology performance in the present study (Deci & Ryan, 2000). In contrast, identified and integrated motivation showed weak but significant positive correlations with academic performance. This finding suggests that students who recognize the personal value of learning or integrate learning with their sense of self may tend to demonstrate higher academic performance in Biology, consistent with the self-determination perspective on autonomous motivation (Deci & Ryan, 2000; Vallerand et al., 1992).

Among the four types, integrated motivation showed the stronger relationship with academic performance ($r = 0.326$, $p = 0.003$), compared with identified motivation ($r = 0.281$, $p = 0.012$). Integrated motivation, being the most autonomous form of extrinsic motivation, closely resembles intrinsic motivation and supports self-determination and self-regulation, which contributes to higher academic performance. The findings therefore show a pattern in which the more autonomous forms of extrinsic motivation were significantly associated with academic performance, whereas external and introjected motivation were not.

These findings align with Self-Determination Theory (Deci & Ryan, 2000), which emphasizes that intrinsic motivation and the satisfaction of autonomy, competence, and relatedness needs are stronger predictors of academic success than external incentives alone (Pitzer & Skinner, 2017, as cited by Anderson et al., 2018). Thus, the findings do not indicate that external incentives alone are sufficient to improve academic performance. Rather, the significant relationships observed for identified and integrated motivation suggest the importance of forms of motivation that are more closely associated with personal value, self-determination, and self-regulation. Therefore, while extrinsic motivators play a role, fostering intrinsic motivation and self-regulated learning is recommended to enhance students' performance in Biology.

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Research Question 3: Which among the four models best predicts the students' academic performance?

Table 4. Extrinsic Motivation Model Predictor Measures

Model	R^2	p-value
Extrinsic Motivation Model	0.156	0.012
External Motivation Model	0.00576	0.504
Introjected Motivation Model	0.00104	0.776
Identified Motivation Model	0.0790	0.012
Integrated Motivation Model	0.106	0.003

Table 4 presents the predictor measures of extrinsic motivation on students' academic performance in Biology. Overall, the extrinsic motivation model accounted for 15.6% of the variance in academic performance and was statistically significant ($R^2 = 0.156$, $p = 0.012$), indicating that extrinsic motivation is a good predictor of academic performance. Individually, external motivation ($R^2 = 0.00576$, $p = 0.504$) and introjected motivation ($R^2 = 0.00104$, $p = 0.776$) were not significant predictors, suggesting minimal influence on academic performance. In contrast, identified motivation explained 7.9% of the variance ($R^2 = 0.079$, $p = 0.012$), while integrated motivation explained 10.6% of the variance ($R^2 = 0.106$, $p = 0.003$). Among the four types of extrinsic motivation, integrated motivation accounted for the largest proportion of variance and was therefore the strongest predictor of Biology achievement.

The findings show a distinction among the four types of extrinsic motivation. The significant overall model indicates that extrinsic motivation, taken as a whole, was associated with students' academic performance. However, the individual models show that this pattern was not consistent across all forms of extrinsic motivation. External and introjected motivation were not significant predictors, whereas identified and integrated motivation were significant predictors. This pattern is consistent with the relationship results, in which identified and integrated motivation also showed significant positive relationships with academic performance.

These results align with Deci and Ryan's (2000) Self-Determination Theory, which emphasizes that integrated motivation is highly autonomous and promotes active engagement, self-regulation, and improved academic outcomes. Integrated motivation reflects self-internalization, where students connect their actions to personal values and beliefs, gradually moving toward intrinsic motivation (Anderson, 2016). Identified motivation also positively contributes to performance, as students recognize the personal value of their academic efforts. Conversely, external and introjected motivations, which rely on rewards, punishments, or ego-driven pressures, were poor predictors in the present study.

The findings underscore the importance of fostering identified, integrated, and intrinsic motivation to optimize student performance. Teachers, parents, and peers can support these forms of motivation by providing meaningful guidance, rewards, and feedback that satisfy students' psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000). As noted by Vallerand (2004), low levels of autonomous motivation may shift students toward external, introjected, or amotivation, highlighting the need for strategies that cultivate higher-order motivation and promote sustained academic achievement. In the context of the present findings, greater attention to identified and integrated motivation may provide a more appropriate direction for supporting academic performance than relying primarily on external and introjected forms of motivation.

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Research Question 4: Do students' extrinsic motivation and academic performance in Biology significantly differ when moderated by gender and socio-economic status?

Table 5. Gender as Moderating Variable

Students Motivation	Gender	Mean	p-value
External Motivation Model	Female Male	4.54 4.66	0.850
Introjected Motivation Model	Female Male	4.33 4.44	0.898
Identified Motivation Model	Female Male	4.93 4.90	0.190
Integrated Motivation Model	Female Male	4.98 5.02	0.353
Academic Performance in Biology	Female Male	91.3 88.1	0.018

Table 5 presents gender differences in extrinsic motivation and academic performance in Biology. The results indicated no significant differences between males and females in any extrinsic motivation subtype: external (p = 0.850), introjected (p = 0.898), identified (p = 0.190), and integrated (p = 0.353). These results indicate similar levels of extrinsic motivation across genders. In contrast, academic performance differed significantly by gender, with female students obtaining a higher mean score (91.3) than male students (88.1, p = 0.018). Thus, while the levels of extrinsic motivation did not significantly differ between males and females, a significant difference was observed in their academic performance in Biology.

The absence of significant gender differences across all four types of extrinsic motivation indicates that both male and female students demonstrated comparable levels of extrinsic motivation. Previous studies suggest that male students tend to focus on external rewards such as grades and peer recognition (Anderson, et al., 2018; Deci & Ryan, 2000), whereas female students, while also externally motivated, are more likely to move toward self-exploration, self-determination, and internal satisfaction (Deci & Ryan, 2000; Addama et al., 2018). The present findings, however, did not show statistically significant differences between males and females in external, introjected, identified, or integrated motivation. Teachers also contributed by using external means of motivation, including rewards, praise, and point systems, to support student engagement. These classroom practices may provide external motivational experiences to students regardless of gender.

The significant difference in academic performance, with female students obtaining higher mean scores than male students, aligns with the cited literature. Female students are more likely to be self-determined, intrinsically motivated, and self-regulated, which enables them to achieve higher grades (Mecca & Holt, 1993, as cited in Ayub, 2010; Pitzer & Skinner, 2017, as cited by Anderson et al., 2018). In contrast, male students rely more on external motivators and may become amotivated if these are removed (Anderman & Anderman, 1999, as cited in Ayub, 2010). Deci and Ryan (2000) also noted that female students tend to have higher academic ethics and internalized motivation, driven by interest and personal satisfaction. This is consistent with Liu, He, Zhao, and Hong (2021), who found that self-regulated students outperform peers by effectively controlling their learning processes (Adam et al, 2017).

Taken together, the findings show that gender was not significantly associated with differences in extrinsic motivation, but a significant difference was observed in academic performance. The difference in academic performance may therefore be considered alongside the cited literature emphasizing self-determination, internalized motivation, and self-regulation. The findings highlight the importance of fostering both extrinsic and intrinsic motivation, with an emphasis on self-regulation. Teachers, peers, and parents can support motivation by combining external incentives with strategies that encourage autonomy, competence, and relatedness, ultimately improving academic outcomes for all students.

Table 6. Difference of Socio-Economic Status and Extrinsic Motivation

Students' Motivation	p-value
External Motivation Model	0.752
Introjected Motivation Model	0.908
Identified Motivation Model	0.299
Integrated Motivation Model	0.336

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Table 6 presents the differences in extrinsic motivation in biology according to students' socioeconomic status. The results indicated no significant differences across all extrinsic motivation subtypes: external (p = 0.752), introjected (p = 0.908), identified (p = 0.299), and integrated (p = 0.336). This suggests that students' extrinsic motivation in learning biology is similar regardless of their socioeconomic background.

Table 7. Difference of Socio-Economic Status and Academic Performance in Biology

Socio-economic Status			Mean Difference	P-value
Academic Performance in Biology	Poor Income Status	Low Income Status	2.852	0.152
		Middle Income Status	0.243	
	Low Income Status	Middle Income Status	-2.610	

Table 7 presents the differences in academic performance in Biology according to students' socioeconomic status. The results showed no significant difference in academic performance among the different socioeconomic groups (p = 0.152). This indicates that, within the participants of the present study, academic performance in Biology did not significantly differ according to socioeconomic status.

The finding differs from prior studies that reported socioeconomic disparities in science achievement. Betancu et al. (2018) reported a relationship between socioeconomic status and academic performance, while Destin et al. (2019) found that students from higher-income families generally achieved better academic results. Conversely, Li, Peng, Yang, and Chen (2020) observed that students with lower socioeconomic status sometimes outperform higher-income peers in explorative learning. The non-significant difference observed in the present study therefore differs from these findings, indicating that the pattern reported in the cited studies was not observed among the participants in this study.

In the context of the present study, the lack of a significant difference may be related to the school's provision of equal access to educational technology and learning resources. The school ensures that all learners have access to necessary materials, computers, smart TVs in classrooms, an online learning management system, and high-speed internet (Saint Joseph School Foundation, Incorporated, 2022).Such access provides students from different socioeconomic backgrounds with comparable learning resources and opportunities to engage in Biology learning. Previous literature highlights that unequal access to technology can contribute to lower academic performance (Villaseñor, 2024). In SJSFI, the availability of interventions and learning resources may therefore help mitigate these challenges and may be considered in interpreting the non-significant difference observed in academic performance.

These findings illustrate the relevance of equitable access to learning resources when considering socioeconomic differences in student outcomes. SDG 4 emphasizes inclusive and equitable quality education and the promotion of lifelong learning opportunities for all (United Nations Children's Fund, 2023). By ensuring that students from different economic backgrounds receive comparable access to instructional materials, digital tools, and academic support, the school supports the principle of equitable access to education. The findings therefore provide a basis for recognizing the role of accessible learning resources in the context of the present study, while the non-significant result indicates that socioeconomic status was not significantly associated with differences in academic performance among the participants.

Research Question 5. Proposed Plan to Improve Students Motivation and Performance in Biology

Based on the findings, an action plan was proposed to enhance students' motivation and academic performance in Biology. The proposed interventions focus on strengthening identified and integrated motivation to improve academic achievement, sustaining equitable learning opportunities regardless of students' socio-economic backgrounds, providing teacher training and professional development on strategies that foster student motivation, and implementing continuous monitoring and evaluation of students' academic performance to assess the effectiveness of these interventions and guide ongoing improvements.

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Objectives	Strategies/Activities	Person Involved	Time Frame	Expected Outcome
1. Enhancing Identified and Integrated Motivation to Improve Academic Performance				
1.1 Increase students' autonomous motivation in Biology	• Integrate real-life, career-related applications of Biology topics. • Use project-based learning aligned with health, environment, and STEM careers. • Provide students with choices in tasks to promote autonomy (SDT).	Biology Teachers, Academic Coordinators	Quarterly	Students will understand the value of Biology and show improved identified and integrated motivation.
1.2 Support students academically and motivationally	• Implement peer-assisted study groups led by high-performing students. • Conduct remedial or enrichment sessions focusing on difficult Biology concepts. • Provide mentorship for students (teacher/peer mentors).	Biology Teachers, Peer Tutors	Bi-monthly	Students demonstrate improved performance and engagement.
1.3 Strengthen self-regulated learning	• Teach goal-setting and self-monitoring strategies. • Implement weekly reflection journals on learning progress. • Conduct workshops on metacognitive strategies.	Biology Teachers, Guidance	Monthly	Higher level of self-regulation and improved academic performance.
2. Sustaining Equitable Learning Opportunities Across Socio-Economic Levels				
2.1 Maintain equal access to learning resources	• Continue providing ICT tools (smart TVs, LMS, internet) in all Biology classes. • Ensure availability of laboratory materials for all students. • Offer school-based loaner devices for learners without gadgets.	School Administration, ICT Department	Continuous	Students from all SES groups continue to have equal learning opportunities
2.2 Strengthen support programs for low-income students	• Sustain voucher and scholarship support. • Provide printed modules or resource packs for those with limited home access. • Establish "Learning Resource Corners" in each classroom.	Admin, Guidance Office	Annual Review	No SES gaps in learning motivation and academic performance.
3.Teacher Training and Professional Development				
3.1 Strengthen teachers' skills in fostering SDT-based motivation	• Conduct school-based INSET on Self-Determination Theory (Deci & Ryan). • Training in differentiated instruction and autonomy-supportive teaching. • Develop modules integrating motivation strategies into daily lesson	Principal, Academic Heads, Teachers	Semestral	Teachers are able to enhance student motivation and academic success in Biology.
4. Monitoring and Evaluation				
4.1 Track improvements in motivation and performance	• Conduct mid-year and year-end motivation surveys. • Review Biology grades per quarter. • Evaluate effectiveness of interventions through classroom observations. • Involve parents in the evaluation and monitoring process through PTA meetings.	Principal, Academic Heads, Teachers, Guidance Office, and Parents	Quarterly	Continuous improvement and data-driven refinements to teaching strategies

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Ethical Considerations

Ethical issues (including plagiarism, informed consent, assent consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the author. Ethical approval was obtained from the institutional ethics review committee prior to the conduct of the study with a research evaluation committee code of 2023-0016. Informed consent was obtained from the participants before data collection, and participation was voluntary. Participants were informed of the purpose of the study and their right to participate or withdraw. Confidentiality was ensured by protecting participants' identities and limiting access to the collected data to the researchers.

Conclusion

Thus, this study examined the relationship between students' extrinsic motivation and their academic performance in Biology, with gender and socioeconomic status as moderating variables. The results revealed a weak but significant positive relationship between extrinsic motivation and academic performance, with identified and integrated motivation, the more self-determined forms of extrinsic motivation, showing the strongest associations. Extrinsic motivation did not differ significantly across gender or socioeconomic groups, while academic performance was significantly higher among female students, and no significant difference in academic performance was found across socioeconomic groups. The findings contribute to the existing literature by providing evidence that the more autonomous forms of extrinsic motivation, particularly identified and integrated motivation, were significantly associated with academic performance in Biology, whereas external and introjected motivation were not significantly associated with academic performance. The findings also provide evidence that gender was significantly associated with differences in academic performance, while socioeconomic status was not significantly associated with differences in either extrinsic motivation or academic performance among the participants of the present study. Based on these findings, the study highlights the importance of fostering identified and integrated motivation in Biology learning. In the context of the present study, teachers, parents, and peers may support these forms of motivation through meaningful guidance, feedback, and learning experiences that encourage autonomy, competence, and relatedness. The findings also support the continued provision of equitable access to instructional materials and technology, particularly given the non-significant differences in academic performance across socioeconomic groups. These implications are limited to the variables examined and the participants of the present investigation and may provide a basis for interventions and further studies on students' motivation and academic performance in Biology.

Recommendations

Based on the findings of the study, several recommendations are proposed to strengthen the application and understanding of student motivation and academic performance in Biology. For teachers and parents, it is recommended that extrinsic motivational strategies be integrated with approaches that promote autonomy, competence, and relatedness to support students' academic engagement and performance, with appropriate external encouragement complemented by learning experiences that foster self-determination, confidence, meaningful relationships, and the internalization of learning goals. For school administrators, institutional support should be provided to enable teachers to implement classroom practices, guidance strategies, feedback mechanisms, and learning activities that promote identified and integrated forms of motivation, particularly by helping students recognize the personal value of Biology and relate learning to their goals, interests, and self-concept. For future researchers, further studies should examine the relationship between academic motivation and academic performance by incorporating both intrinsic and extrinsic forms of motivation to provide a more comprehensive account of the motivational factors associated with student achievement. Future investigations should also consider larger and more diverse samples drawn from multiple public and private schools or educational institutions and from different geographic and educational contexts to enhance the generalizability of findings and provide a broader basis for understanding how motivation relates to academic performance in Biology.

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