

Understanding Student Motivation in Learning Biology Among Undergraduate Students

Capua, Vanesa P.*

School of Graduate Studies, Saint Mary's University, Philippines

*Corresponding Author

DOI: <https://doi.org/10.47772/IJRISS.2026.100400065>

Received: 06 March 2026; 11 April 2026; Published: 27 April 2026

ABSTRACT

Motivation is a key driver of students' engagement and success in learning biology. This study investigated the level of motivation of undergraduate students in learning biology and examined whether significant differences exist when grouped according to sex and course. It also sought to identify the relationship between students' age and their level of motivation, as well as to determine which profile variable significantly predicts motivation. Quantitative research approach was employed, using descriptive-comparative, correlational, and predictive research designs. Data were collected from 112 voluntary undergraduate students through a validated biology motivation questionnaire. Descriptive statistics were used to analyze students' level of motivation. Differences by sex and course were examined using an independent samples t-test and one-way ANOVA, respectively. Pearson's r was utilized to assess the relationship between motivation and age, whereas multiple linear regression was used to identify significant predictors of students' motivation in learning biology. Results revealed that the undergraduate students were highly motivated to learn biology, regardless of sex and course, as there were no significant differences in motivation levels when grouped by these variables. However, age was found to significantly influence students' motivation, with a direct but weak correlation observed between age and motivation levels. Among the profile variables, age emerged as the most significant predictor of motivation in learning biology. These findings suggest that educators and academic institutions may consider age-related differences when designing instructional strategies and support systems to sustain and improve student motivation in biology learning contexts.

Keywords: Biology, Motivation, Undergraduate, Subscale

INTRODUCTION

Motivation is a multifaceted psychological process that activates, guides, and maintains behavior (Rani & Lenka, 2012; Bandhu et al., 2024). It includes both physiological and psychological elements that affect an individual's behavior, objectives, and perseverance (Bandhu et al., 2024). Motivation, by definition, is what propels us forward. It is the rationale for all our actions. According to Broussard and Garrison (2004), motivation is characterized as "the attribute that compels us to act or refrain from action." It is an intrinsic motivation or compulsion to engage in a certain action or behavior (Deci & Ryan, 2008).

Hadre et al. (2007) contended that motivation is one of the most significant factors influencing students' success or failure in education. In the educational domain, enhancing students' desire to participate in academic endeavors is integral to instructors' pedagogical strategies if they aspire to achieve consistent and high quality outcomes. In higher education, comprehending the mechanics of motivation may elucidate how students interact with intricate disciplines like biology. Successful learning of students is consistently associated with their motivation (Bunda et al., 2024).

Educational psychologists, although being active educators, have always acknowledged the significance of motivation in learning and engagement. They assert that motivation is a fundamental life and work-related impetus necessary for goal attainment (Lai, 2011). The domain of biology adheres to this principle, with several

research confirming the correlation between motivation and various facets of teaching and learning biology (Mahler et al., 2017).

Studies highlight the significance of motivation in higher education, especially in demanding disciplines such as biology, where sustained effort and engagement are essential for understanding and proficiency (Linnenbrink-Garcia et al., 2013). Biology, a fundamental scientific discipline, necessitates a profound comprehension of intricate ideas, which might be difficult to grasp without substantial motivation (Olimpo & Esparza, 2020). Students exhibiting strong intrinsic motivation are more inclined to investigate biological subjects outside the curriculum, resulting in enhanced comprehension and memory (Oudeyer et al., 2016). A deficiency in motivation may lead to disengagement, poor performance, and less interest in further studies in biology-related disciplines (Rone et al., 2023).

Insufficient disciplinary interest is a possible risk to motivation (Renninger and Hidi, 2015; Glynn et al., 2015) and, ultimately, to students' perseverance (Graham et al., 2013). One of the most often mentioned reasons for departing from a science major during college is a loss of interest in the discipline (Hunter, 2019). In this regard, the study of biology offers distinct problems and possibilities for student participation. The topic necessitates knowledge of complex ideas, critical thinking, and practical application, making it essential for students to maintain motivation throughout their educational path. Hence, motivation improves the capacity to comprehend biological information and elevates the probability of long-term retention and application (Tracy, 2022).

Motivation significantly influences biology learning outcomes and student achievement. Studies demonstrate that intrinsic motivation, self-efficacy, and the perceived value of biology are critical determinants of student achievement (Gibbens, 2019; Lang & Šorgo, 2024). Differences in motivation and attitudes towards biology based on gender and class level have been noted (Kışoğlu, 2018). Self-efficacy exerts both direct and indirect influences on biology learning outcomes, with motivation acting as a mediator variable (Firmansyah et al., 2018). To enhance motivation in biology education, educators should prioritize the cultivation of intrinsic motivation, personal significance, and vocational aspiration (Lang & Šorgo, 2024). Furthermore, alleviating student anxiety around assessments and enhancing self-efficacy in evaluations may lead to better learning outcomes (Lang & Šorgo, 2024; Gibbens, 2019). These findings highlight the significance of including motivational aspects in biology instruction.

To further explore this intricacy, it is essential to analyze the influence of profile characteristics, including gender, age, and academic background. These elements have been recognized as possible determinants of students' motivation and learning behaviors. Studies have shown that these characteristics influence students' self-perception, their reactions to obstacles, and their overall academic performance (Eccles et al., 1993). Thus, in the field of biology education, comprehending these aspects may clarify the varied experiences of students and guide ways to improve participation.

Although considerable study has been undertaken about motivation in general scientific education, a notable gap persists in the literature especially in addressing higher education biology students. Furthermore, insights into biology as a separate science are constrained. Contemporary research frequently extrapolates results across broad scientific disciplines, neglecting the distinct obstacles and content-specific elements that may affect motivation in biology (Hulleman & Harackiewicz, 2020). Furthermore, there is an absence of thorough study investigating the synergistic impacts of demographic characteristics, including sex, age, and course, on motivation for biology learning. Addressing these gaps may yield a more comprehensive knowledge of students' needs and facilitate the development of modified educational strategies (Ishida & Sekiyama, 2024).

This study seeks to address these gaps by investigating the level of motivation among undergraduate students. The study seeks to examine the difference, relationship, and influence of various profile variables, including sex, age, and course, on student motivation in learning biology among undergraduate students. It also aims to elucidate the elements affecting academic achievement by examining student motivation and participation in biology education. The results will then be beneficial for educators and policymakers seeking to cultivate a more supportive and effective biology learning environment, thereby enhancing student retention and achievement in biology education.

Statement of the Problem

Generally, this study aimed to assess the level of motivation in learning biology among undergraduate students enrolled in the academic year (A.Y.) 2024-2025. Specifically, the researcher aimed to answer the following questions:

1. What is the level of motivation of undergraduate students in learning biology?
2. Is there a significant difference on the level of motivation of undergraduate students in learning biology when grouped by the following profile variables?
 - a. sex
 - b. course
3. Is there a significant correlation between the level of motivation of the undergraduate students and their age?
4. Which among the profile variables significantly influence the level of motivation of undergraduate students in learning biology?

THEORETICAL FRAMEWORK

This study is grounded on social cognitive theory, developed by Bandura (2001) and self-determination theory of Deci et al. (2008). Both theories offer comprehensive frameworks for understanding motivation. Social cognitive theory emphasizes the importance of learning from the social environment, highlighting essential motivating mechanisms such as goals, self-assessments, result expectancies, and self-efficacy (Schunk & Usher, 2012). Self-determination theory, on the other hand, examines how social circumstances fulfil or impede fundamental psychological demands for autonomy, competence, and relatedness, hence affecting motivation and behavior (Goldman et al., 2017). These theories provide significant insights into human motivation, establishing a basis for comprehending and predicting behavior across contexts.

Social cognitive theory interprets human functioning as an order of interactions involving personal attributes, contextual settings, and behaviors (Bandura, 2006). Social cognitive theory posits that students achieve optimal learning when it is self-regulated, characterized by their ability to comprehend, monitor, and govern their motivation and behavior, resulting in favorable educational results. In this perspective, motivation is described as an internal condition that stimulates, guides, and maintains goal-directed behavior. (Schunk et al., 2008).

Motivation to learn, as defined by social cognitive theory, is a multifaceted entity. The elements consist of kinds and qualities of motivation, as examined by Glynn and Koballa (2006), Koballa and Glynn (2007), and Schunk et al. (2008). Examples of these elements include intrinsic motivation, self-efficacy, and extrinsic motivation. The interdependent elements of motivation enhance the interest, direction, and persistence of students' science learning behavior. Collectively, these elements form a componential model of motivation based on social cognitive theory. Conversely, self-determination theory asserts that all persons possess three fundamental psychological needs: autonomy, competence, and relatedness, the fulfilment of which fosters autonomous motivation and general well-being (Deci et al., 2017).

Autonomy denotes the perception of initiative and self-direction in one's acts, wherein individuals regard themselves as the initiators of their behavior rather than being governed by other influences. Individuals who perceive autonomy are more inclined to experience intrinsic motivation, which enhances engagement, perseverance, and pleasure in their activities (Ryan & Deci, 2000). Autonomy in biology education is crucial as the discipline necessitates both comprehension of intricate concepts and their application in practical, real-world contexts.

Furthermore, competence means the aspiration to perceive oneself as efficient in interactions with the environment and to achieve mastery over tasks. Individuals who view themselves as competent are more inclined to participate in activities, invest effort, and maintain motivation, particularly when they feel their efforts might yield favorable results (Ryan & Deci, 2000).

In biology education, competency is especially important due to the subject's complexity and the cognitive demands necessary to comprehend its concepts. Biology frequently entails data interpretation, comprehension of molecular and ecological processes, and the application of knowledge to address real-world issues. Students who view themselves as capable are more inclined to participate actively in learning activities, hence enhancing their academic performance and knowledge retention (Ferla et al., 2010).

Meanwhile, relatedness conveys the fundamental psychological necessity to experience connection and appreciation from others. It is the sense of belonging that individuals feel within a social setting, promoting interpersonal ties and emotional stability. This need is fundamental for sustaining intrinsic motivation, since it enables individuals to feel supported and integrated within a group (Ryan & Deci, 2000). When relatedness is satisfied, students are more inclined to maintain engagement in their learning and preserve their drive. These interactions foster a feeling of community among students, enhancing shared learning experiences and collective comprehension of intricate topics.

Together, these theories provide a comprehensive understanding of the internal and external factors influencing students' motivation to learn biology.

Conceptual Framework

According to Glynn and Koballa (2006) and Schunk et al. (2008), there were six motivational components that influence self-regulatory learning. Among the motivational components that have been linked to learning science, there were six dimensions that have been extensively studied but generally independently of each other, although they may be related. This includes intrinsic motivation, extrinsic motivation, personal relevance, responsibility, self-efficacy, and anxiety.

Intrinsic Motivation refers to motivation that is driven by an interest or enjoyment in the task itself, and exists within the individual rather than relying on any external pressure. Research has found that it is usually associated with high educational achievement and enjoyment by students (Singh, 2011). Intrinsically driven students exhibit several advantages, including enhanced learning, improved behavior, increased happiness, a heightened feeling of well-being, higher classroom engagement, respectful treatment of others, and meaningful contributions to societal improvement.

Conversely, extrinsic motivation is defined as a concept that relates to an activity performed to achieve a distinct end. Extrinsic motivation contrasts with intrinsic motivation, which pertains to engaging in an activity only for the pleasure derived from the activity itself, rather than for its practical benefits (Ryan & Deci, 2000).

Another component was self-efficacy, defined as the perception of one's capabilities. Albert Bandura (2001) characterizes self-efficacy as "the conviction in one's capacity to orchestrate and execute the actions requisite for attaining particular achievements." Confidence in one's capabilities affects motivation, especially at the initial phases of learning or goal-setting. Students with elevated self-efficacy in a specific domain will establish more ambitious objectives and will not fear failure. Numerous investigations have identified statistically significant disparities between males and girls.

Moreover, Glynn et al. (2009) defined personal relevance as the "relevance of science learning to personal goals," which involves future life and professional aspirations. This is considered an essential component in the design of a science curriculum (Yager, 1989), and according to Teppo and Rannikmäe (2003), "students are motivated to study when the science material is comprehensible, engaging, and relevant to their daily life."

Ultimately, responsibility pertains to self-determination in the study of biology, specifically with students' conviction that they govern their own learning process. Finally, worry or fear in the instrument pertains to

assessment anxiety, which is a terrible tension associated with grading in science. Anxiety frequently emerges during assessments or evaluations of knowledge, since pupils fear failure (Glynn et al., 2007).

METHOD

Research Design

This study used a quantitative approach in research. Specifically, it utilized descriptive-comparative design for the reason that the study identified the level of motivation of undergraduate students in learning biology. Likewise, it compared the level of motivation of undergraduate students in learning biology when grouped by sex and course. Further, it also used correlational in a way that it intended to determine the relationship between the level of motivation of undergraduate students in learning biology and their age. Then, it also utilized predictive design to identify which among the profile variables significantly influence the level of motivation of undergraduate students in learning biology.

Research Environment

The study was conducted at Ifugao State University (IFSU) – Potia Campus, one of the six campuses of IFSU, located at Potia, Alfonso Lista, Ifugao, Cordillera Administrative Region, Philippines. IFSU is a distinguished institution of higher learning in the Province of Ifugao and one of the recognized active performing state universities in Cordillera Administrative Region. As a premier university, IFSU’s vision is to be a globally recognized University upholding excellence amidst rich cultural heritage while its mission is to produce employable graduates who are morally upright, socially and culturally responsible professionals through quality, relevant, and innovative instruction, research, extension, and resource generation.

The researcher selected IFSU – Potia Campus as the research setting because of its varied course offerings and diverse student backgrounds, which can yield pertinent information for the study. Furthermore, the IFSU – Potia Campus provides an environment that is both academically engaged and culturally diverse, which makes it an appropriate location to investigate motivational trends in biology education within a regional context.

Research Respondents

The respondents of the study involved 112 undergraduate students of IFSU-Potia Campus enrolled in Academic Year (A.Y.) 2024-2025, with 28 students randomly selected from each of the following courses: Bachelor of Secondary Education major in Science (BSEd Science), Bachelor of Science in Agriculture (BS Agriculture), Diploma in Midwifery, and Bachelor of Science in Criminology (BS Criminology). This selection provided a heterogeneous group of respondents, reflecting varied perspectives and experiences relevant to the study. The inclusion of students from these diverse programs ensured a comprehensive understanding of motivation in learning biology across varying academic contexts and disciplines.

Furthermore, the respondents were categorized into age range of 17 to 18, 19 to 20, and 21 and above, with 35, 39, and 38 respondents in each category, respectively. This approach minimizes bias and allows for a balanced comparison. Also, there was an equal number of male and female respondents with 56 males and females. This was based on the principle of equal representation to ensure that each sex contributed an equitable number of respondents to the study.

Table 1 presents the demographic profile of the respondents in the study, categorized by course, age, and sex, along with the frequency and percentage distribution for each category.

Table 1. Demographic Profile of the Respondents

Profile	Categories	Frequency	Percent
Course	BSEd Science	28	25.0
	BS Agriculture	28	25.0
	Diploma in Midwifery	28	25.0

Profile	Categories	Frequency	Percent
	BS Criminology	28	25.0
Age	17-18	35	31.2
	19-20	39	34.8
	21 and above	38	33.9
Sex	Male	56	50.0
	Female	56	50.0

Research Instrument

This study employed a 30-item Likert-type instrument called the Biology Motivation Questionnaire (BMQ). The BMQ was developed by Glynn and Koballa (2006) as a Science Motivation Questionnaire (SMQ). Then, later adapted by Lang & Šorgo (2024) as a BMQ. The difference between the SMQ and the BMQ was the word “science” in SMQ was replaced with “biology” for BMQ.

The BMQ contains six subscales which are Intrinsic Motivation (IM) with items 1, 2, 3, 4, and 5, Extrinsic Motivation (EM) with items 6, 7, 8, 9, and 10, Personal Relevance (PR) 11, 12, 13, 14, and 15, Responsibility (RE) with items 16, 17, 18, 19, and 20, Self-efficacy (SE) with items 21, 22, 23, 24, and 25, Anxiety (AN) with items 26, 27, 28, 29, and 30. All items in subscale AN were reversed to compute for the overall mean. The BMQ has good reliability, with a Cronbach's alpha coefficient of 0.91.

Data Gathering Procedure

The researcher enquired about the respondents' availability. Upon scheduling the respondents' availability, a consent letter was provided to the students to obtain their approval prior to administering the questionnaires. The researcher requested the class assistance of the class captain and administered the test directly at the respondents' most convenient time. Subsequently, the questionnaires were retrieved, consolidated and subjected for data coding ready for statistical analysis.

Treatment of the Data

The researcher analyzed the data based on the order of the research problems. For the first problem, the data on the level of motivation of undergraduate students were analyzed using frequency, percent distribution, mean, and standard deviation. The mean for each item as well as the composite mean for each dimension was calculated and then interpreted using the guide for interpretation for the level of motivation of undergraduate students as reflected in Table 2.

Table 2. Qualitative Description for the Level of Motivation of Undergraduate Students in Learning Biology

Mean Range	Qualitative Description
3.50 - 4.00	Very High Motivation
2.50 - 3.49	High Motivation
1.50 - 2.49	Low Motivation
1.00 - 1.49	Very Low Motivation

For the second problem which was to determine the significant difference on the level of undergraduate students when grouped by sex, t-test for independent samples was considered. One way ANOVA was used for comparison of level of motivation when grouped by course. For the third problem, Pearson-r was computed to determine the significant correlation between the level of motivation of higher education students in learning biology and their age. Lastly, Multiple Linear Regression was used to determine which among the profile variables significantly

influence the level of motivation of higher education students in learning biology. The collected data were processed using the IBM-SPSS Statistics software.

RESULTS AND DISCUSSIONS

This chapter comprised of 4 sections. Section 1 determines the level of motivation of undergraduate students in learning biology. Section 2 shows the significant difference between the level of motivation of undergraduate students in learning biology when grouped by sex and course. Section 3 discusses the relationship between the level of motivation of undergraduate students in learning biology and their age. Lastly, Section 4 includes the profile variables that significantly influence the level of motivation of higher education students in learning biology.

Section 1. Level of Motivation of Undergraduate Students in Learning Biology

Table 3 shows the frequency count and percent distribution of the level of motivation of undergraduate students in learning biology. The table provides a breakdown of responses into four categories, along with the overall mean and standard deviation.

Table 3. Frequency Count and Percent Distribution of the Level of Motivation of Undergraduate Students in Learning Biology

Level of Motivation	Frequency	Percent
Very Low Motivation	0	0
Low Motivation	22	19.6
High Motivation	88	78.6
Very High Motivation	2	1.8
Total	112	100

Mean: 2.76 (High Motivation) Standard Deviation: 0.355

Based on Table 3, majority of the respondents were highly motivated in learning biology (78.6%). On the other hand, some of them had low level of motivation in learning biology (19.6%). Notably, only 1.8% of the students were very highly motivated, which indicates that very few students experience a consistently high level of motivation. Interestingly, the students have some degree of motivation in learning biology. On the average, the respondents were highly motivated with an over-all mean of 2.76 with standard deviation of 0.355.

The results highlight that most students exhibit high motivation level in learning biology. This suggests that students generally find biology interesting, rewarding, and valuable for their academic and personal growth. However, the small percentage of students who reported feeling always motivated indicates that while motivation exists, it is not always the case across all students. On the other hand, the finding that some of the students feel rarely motivated may point to potential issues such as lack of personal interest, ineffective teaching methods, or course difficulty. Teachers and educators should observe these patterns and implement strategies to improve motivation, including the implementation of engaging teaching techniques, the development of supportive learning environments, and the integration of real-world applications of biology concepts (Rone et al., 2023).

These findings are consistent with previous research emphasizing the role of motivation in science education. Collie and Martin (2019) contend that personal interest and reward derived from learning is significant in fostering students' sustained engagement and achievement. Similarly, research conducted by Glynn et al. (2011) utilizing the Science Motivation Questionnaire indicated that students exhibiting high levels of motivation achieved superior learning outcomes.

However, the current findings contrast with studies where students reported low motivation levels in science subjects. For instance, Cheung, (2017) found that many students perceive science as difficult and abstract, leading to reduced motivation. Additionally, the research conducted by Osborne, Simon, and Collins (2003)

revealed that almost 40 percent of students expressed a lack of interest in science subjects, attributing this to teaching methods and insufficient contextual relevance.

The results of this study indicate that although the majority of students demonstrate moderate level of motivation in learning biology, it is essential for educators to attend to the needs of those who show rare motivation. This is consistent with the suggestions put forth by Hunaepi et al. (2024), who highlighted the significance of nurturing curiosity and promoting active learning to sustain student engagement in science education.

The succeeding tables in this section are the level of motivation of students in learning biology in each subscale of the BMQ. The mean of each item and the composite mean for each subscale were used as basis in evaluating the level of motivation of undergraduate students in learning biology using the qualitative description on Table 1.

Table 4 presents the means and standard deviations of the level of intrinsic motivation of higher education students in learning biology, as measured by the Intrinsic Motivation (IM) subscale of the Biology Motivation Questionnaire (BMQ). The table includes five statements that reflect different aspects of students' intrinsic motivation, along with their corresponding qualitative descriptions.

Table 4. Level of Motivation of Undergraduate Students in Learning Biology for the IM Subscale of the BMQ

Statement	Mean	SD	Qualitative Description
1. I enjoy learning biology.	2.76	0.738	High Motivation
2. The biology I learn is more important to me than the grades I receive.	2.77	0.794	High Motivation
3. I find learning biology interesting.	2.99	0.844	High Motivation
4. I like biology that challenges me.	2.88	0.836	High Motivation
5. Understanding biology gives me a sense of accomplishment	3.07	0.667	High Motivation
Composite Mean	2.89	0.776	High Motivation

Looking on Table 4, the statement “*Understanding biology gives me a sense of accomplishment*” yielded the highest mean score of 3.07 (SD = 0.667), indicating that students frequently find personal satisfaction and achievement when learning biology. Conversely, the statement “*I enjoy learning biology*” had the lowest mean score of 2.76 (SD = 0.738). Overall, the composite mean for IM subscale is 2.89 (SD = 0.776), which suggests that, on average, undergraduate students exhibit high intrinsic motivation in learning biology.

The results suggest that students value biology as a subject that provides personal growth and achievement. This highlights the significance of cultivating an educational atmosphere that prioritizes comprehension and mastery of material, as this can boost students' intrinsic motivation. Nonetheless, the lower average scores for statements like “*I enjoy learning biology*” and “*The biology I learn is more important to me than the grades I receive*” suggest that, although students frequently engage in biology, their enjoyment and prioritization of the subject over grades may still be improved.

Similarly, a study by Taskinen et al. (2013) on science motivation revealed that students often value personal achievement and understanding, reflecting strong intrinsic motivation in science-related fields. On the other hand, another study has shown contrasting results. For instance, Schatz (2023) found that despite the importance of intrinsic motivation, numerous students often rely on extrinsic motivators, such as grades and career prospects, which can occasionally obscure their intrinsic interest.

Table 5 presents the mean and standard deviations of the level of extrinsic motivation of undergraduate students in learning biology, along with the qualitative description as measured through the Extrinsic Motivation (EM) subscale of the BMQ. The table includes five statements that assess students' extrinsic motivation, focusing on their desire for grades, performance, career goals, and external outcomes.

Table 5. Level of Motivation of Undergraduate Students in Learning Biology for the EM Subscale of the BMQ

Statement	Mean	SD	Qualitative Description
6. I like to do better than the other students in biology assessments.	2.52	0.735	High Motivation
7. Achieving a good biology grade (Achieved/Merit/Excellence) is important to me.	3.02	0.827	High Motivation
8. I think about how biology will affect my certificate endorsement.	2.69	0.794	High Motivation
9. I think about how learning biology can help my career.	3.13	0.777	High Motivation
10. I think about how learning biology can help me get a good job.	2.95	0.792	High Motivation
Composite Mean	2.86	0.785	High Motivation

Table 5 shows that students frequently experience extrinsic motivators when engaging in biology. The statement “*I think about how learning biology can help my career*” has the highest mean score of 3.13 (SD = 0.777), showing that career advancement is a strong motivating factor for students. On the other hand, the statement “*I like to do better than the other students in biology assessments*” has the lowest mean score of 2.52 (SD = 0.735), indicating that competition among peers is a relatively less prominent extrinsic motivator. The composite mean of 2.86 (SD = 0.785) suggests that, overall, students are frequently driven by extrinsic factors in their biology learning.

The findings suggest that extrinsic motivation plays a significant role in students’ engagement in learning biology. The high mean score for career-related statements suggests that students are motivated by their long-term aspirations, particularly in seeking career opportunities. This emphasizes the significance of linking biology education to practical applications and career opportunities to maintain students' engagement and enthusiasm. Nonetheless, the comparatively lower score for competition suggests that students focused more on individual achievement rather than surpassing their classmates. This insight allows for the development of a cooperative learning environment, prioritizing group collaboration over competition, which can enhance both extrinsic and intrinsic motivation. Furthermore, recognizing that students prioritize external outcomes provides a basis for institutions in crafting assessments and learning activities that highlight practical applications and quantifiable success.

The findings are consistent with those of Ryan and Deci (2020), who highlighted that extrinsic motivation, including career aspirations, can improve performance when students recognize the significance of their learning. Additionally, Taskinen et al. (2013) observed that students pursuing science-related disciplines, particularly biology, frequently prioritize extrinsic goals like job prospects as their main sources of motivation, particularly within higher education contexts.

On the other hand, John et al., (2023) argue that an excessive focus on extrinsic rewards, like grades or recognition, could potentially undermine intrinsic motivation. This discrepancy indicates that although external motivators are essential, it is important to balance them with internal factors, like nurturing curiosity and enjoyment, for sustained engagement.

Table 6 presents the means and standard deviations of the level of personal relevance of higher education students in learning biology, along with the qualitative description as measured through the Personal Relevance (PR) subscale of the BMQ.

Table 6. Level of Motivation of Undergraduate Students in Learning Biology for the PR Subscale of the BMQ

Statement	Mean	SD	Qualitative Description
11. The biology I learn relates to my personal goals.	2.73	0.782	High Motivation
12. The biology I learn is relevant to my life.	2.95	0.757	High Motivation
13. The biology I learn has practical value for me.	2.96	0.816	High Motivation

Statement	Mean	SD	Qualitative Description
14. I think about how the biology I learn will be helpful to me.	3.05	0.669	High Motivation
15. I think about how I will use the biology I learn.	2.80	0.815	High Motivation
Composite Mean	2.90	0.768	High Motivation

Table 6 reveals that majority of the students find learning biology as personally relevant. Among the statements, “*I think about how the biology I learn will be helpful to me*” received the highest mean score of 3.05 (SD = 0.669), suggesting that students strongly consider the helpfulness of biology in their lives. Conversely, the lowest mean score (2.73) was observed for the statement “*The biology I learn relates to my personal goals*”, which implies that students perceive a weaker connection between biology and their specific personal ambitions. The composite mean of 2.90 (SD = 0.768) indicates that students consistently recognize the relevance of biology, though some variability exists in student responses. Overall, these results highlight that while students often see biology as practical and useful, there is a slight gap in how they associate biology with their personal goals and aspirations.

According to the results, students are mainly motivated to learn biology because they believe it will be useful and relevant to their daily lives. Teachers can take advantage of the fact that students often find biology useful and applicable by relating biological ideas to real-world situations, careers, and practical applications. Teachers and curriculum designers ought to still strengthen the links between biology and students' goals, as indicated by the somewhat lower score for personal goals.

According to a study by Stuckey et al. (2013), students' motivation in science courses is significantly impacted by perceived relevance and future value, highlighting the significance of contextual learning. Karakolidis et al. (2019) discovered, however, that students frequently perceive science subjects, such as biology, as abstract and disconnected from personal experiences, which results in a decrease in motivation. This disparity emphasizes the necessity of incorporating biology subjects with customized assignments and practical difficulties in order to increase motivation even further.

Table 7 illustrates the means and standard deviations of the level of motivation of undergraduate students in learning biology, along with the qualitative description as measured through the Responsibility (RE) subscale of the BMQ.

Table 7. Level of Motivation of Undergraduate Students in Learning Biology for the RE Subscale of the BMQ

Statement	Mean	SD	Qualitative Description
16. If I am having trouble learning biology, I try to figure out why.	2.78	0.813	High Motivation
17. I put enough effort into learning biology.	2.75	0.691	High Motivation
18. I use strategies that ensure I learn biology well.	2.78	0.694	High Motivation
19. It is my fault if I do not understand the biology ideas.	2.42	0.866	Low Motivation
20. I prepare well for the biology assessments (both intrinsic and extrinsic).	2.62	0.688	High Motivation
Composite Mean	2.67	0.750	High Motivation

Based on Table 7, students frequently exhibit behaviors such as putting in effort, using learning strategies, and preparing for assessments. The highest mean score of 2.78 were recorded for two statements: “*If I am having trouble learning biology, I try to figure out why*” and “*I use strategies that ensure I learn biology well.*” This suggests that students often take an active approach to address learning difficulties and adopt strategies to improve their understanding of biology.

However, the statement “*It is my fault if I do not understand the biology ideas*” had the lowest mean score of 2.42 (SD = 0.866). This suggests that students are less likely to take personal accountability when they struggle

to understand biology concepts. The composite mean of 2.67 with a standard deviation of 0.750 indicates that although students work hard to solve problems and apply strategies to enhance their learning, they tend to overlook their own role in encountering these difficulties. This means that students may attribute their struggles to external factors rather than personal accountability, highlighting potential influences such as teaching methods, learning environments, or the complexity of the subject matter (Tracy et al., 2022).

This implies that while students show initiative in addressing learning challenges, they have the tendency to attribute difficulties to external factors rather than their own accountability which may hinder deeper self-reflection and growth. This lack of personal ownership could limit their ability to identify and address the root causes of their struggles effectively. Hence, Colomer et al. (2020) suggests the need for educators to foster a more reflective learning environment where students are encouraged to evaluate both internal and external factors influencing their learning. Strategies such as reflective journals, self-assessment exercises, and feedback-oriented learning can help students recognize their role in achieving success and develop a better balance between taking responsibility for their learning and recognizing valid external challenges.

These results correspond with Wang et al. (2016) which emphasizes that self-reflective strategies and personal accountability are essential in inspiring learners to enhance their academic performance. Moreover, Patall et al. (2018) noted that students frequently neglect to assume responsibility for their learning when the material appears too difficult or irrelevant to their interests.

Table 8 presents the level of motivation of students in learning biology for the Self Efficacy (SE) subscale of the BMQ. Self-efficacy refers to a student's confidence in their ability to achieve specific academic goals and succeed in learning biology. The table evaluates this confidence through five statements, each with corresponding mean scores, standard deviations, and qualitative descriptions.

Table 8. Level of Motivation of Undergraduate Students in Learning Biology for the SE Subscale of the BMQ

Statement	Mean	SD	Qualitative Description
21. I expect to do as well as or better than other students in a biology course.	2.47	0.710	Low Motivation
22. I am confident I will do well on the written and practical biology assessments.	2.61	0.689	High Motivation
23. I believe I can master the knowledge and skills in the biology course.	2.70	0.695	High Motivation
24. I am confident I will do well in the biology assessments.	2.64	0.721	High Motivation
25. I believe I can earn 'excellence' grades in the biology course.	2.74	0.756	High Motivation
Composite Mean	2.63	0.714	High Motivation

Table 8 illustrates that most students frequently feel confident in their ability to perform well in various aspects of biology. The highest mean score of 2.74 (SD = 0.756) was recorded for the statement "*I believe I can earn 'excellence' grades in the biology course,*" reflecting a positive perception of their potential to achieve high grades. On the other hand, the lowest mean score of 2.47 (SD = 0.710) was observed for the statement "*I expect to do as well as or better than other students in a biology course.*" This indicates that students may lack confidence when comparing their performance to that of their peers. Overall, the composite mean of 2.63 with a standard deviation of 0.714 means that students often feel confident in their ability to succeed in biology, although with occasional doubts about their comparative performance.

The results indicate that although students frequently demonstrate self-efficacy in their capacity to understand biology, their confidence is not absolute. The comparatively lower average for "*I expect to do as well as or better than other students*" suggests that certain students may encounter difficulties with social comparison, perhaps detrimentally affecting their motivation and overall performance. This deficiency in comparative confidence may arise from emotions of inadequacy or an excessively competitive academic atmosphere. Educators can utilize this by advocating for mastery-oriented learning, prioritizing individual advancement over competition.

Facilitating opportunities for achievement, including formative evaluations and positive reinforcement, can enhance students' confidence in their capabilities.

The results align with Bandura's (1997) social cognitive theory, which emphasizes that self-efficacy significantly influences academic motivation and achievement. Similar findings have been reported by Schunk (2023), who found that students with high self-efficacy are more likely to set challenging goals, persist through difficulties, and achieve better outcomes. The higher scores for confidence in mastering knowledge and earning good grades align with this theory, as students who believe in their abilities are more likely to engage actively and persistently in their learning.

In contrast, Usher and Pajares (2008) have demonstrated that low comparative self-efficacy, as evidenced by the lower score for outperforming peers, can be the result of negative experiences, a lack of encouragement, or perceived competition. For instance, students who are consistently subjected to competitive grading systems may experience diminished self-assurance when they compare their accomplishments to those of others. Interventions that emphasize the cultivation of a collaborative and supportive learning environment in order to mitigate the adverse effects of social comparison may be explored.

Table 9 presents data on the level of motivation of students in learning biology for the Anxiety (AN) subscale of the BMQ. It includes students' responses to specific statements regarding anxiety related to biology assessments with the corresponding mean scores, standard deviation, and qualitative description.

Table 9. Level of Motivation of Undergraduate Students in Learning Biology for the AN Subscale of the BMQ

Statement	Mean	SD	Qualitative Description
26. I am nervous about how I will do in biology assessments. *	2.35	0.768	Low Motivation
27. I become anxious when it is time to sit a biology assessment. *	2.49	0.710	Low Motivation
28. I worry about failing biology assessments. *	2.33	0.864	Low Motivation
29. I am concerned that the other students are better at biology.	2.78	0.802	High Motivation
30. I hate taking biology assessments. *	2.96	0.884	High Motivation
Composite Mean	2.58	0.806	High Motivation

Note: Scores in negative statements were reversed.

Based on Table 9, there are varied levels of anxiety experienced by students when engaging with biology assessments. The statement "*I worry about failing biology assessments*" has the lowest mean score of 2.33 (SD = 0.864), indicating that fear of failure is the most prominent source of anxiety among students. Moreover, the statement "*I hate taking biology assessments*" has the highest mean score of 2.96 (SD = 0.884), indicating that outright dislike for biology assessments is relatively less common. Overall, the composite mean of 2.58 (SD = 0.806) for the Anxiety subscale indicates low level of anxiety in learning biology.

The findings imply that students experience significant anxiety related to biology assessments, particularly fear of failure. This type of anxiety may hinder their ability to perform well and fully engage with the subject. To address this, teachers can implement strategies such as offering more formative assessments, providing regular feedback, and creating a supportive learning atmosphere to build students' confidence (Moss & Brookhart, 2019).

Furthermore, results correspond with research emphasizing the influence of anxiety during exams on students' learning. Nunes et al. (2022) indicated that the fear of failing assessments significantly contributed to anxiety associated to biology. Cotner et al. (2020) also identified exam anxiety as a major impediment to student motivation and performance in science.

In contrast, Majali (2020) suggested that while anxiety can be detrimental, it can sometimes act as a motivator for students to prepare more rigorously. However, this dual effect of anxiety depends on individual coping mechanisms and learning environments. Educators should consider providing supportive strategies, such as stress management techniques, practice assessments, and constructive feedback, to help reduce anxiety levels.

Additionally, they could also explore other strategies to reduce assessment-related anxiety while maintaining student motivation.

Section 2. Significant Difference Between the Level of Motivation of Undergraduate Students in Learning Biology when Grouped by Sex and Course

The following null hypotheses were tested for the succeeding tables.

Ho = There is no significant difference between the level of motivation of undergraduate students when grouped according to sex.

Ho = There is no significant difference between the level of motivation of undergraduate students when grouped according to course.

Table 10 presents the results of a statistical test analyzing the significant difference in the level of motivation in learning biology between male and female undergraduate students. The table includes the number of males and females, mean scores, standard deviations, and the t-test statistic with its associated p-value to determine significance.

Table 10. Significant Difference Between the Level of Motivation of Undergraduate Students in Learning Biology when Grouped by Sex

Sex	n	Mean	SD	Test Statistic
Male	56	2.73	.379	t(110) = -.636, p=.526
Female	56	2.78	.333	

*significant at 0.05

Based on Table 10, the mean score of the female respondents ($m = 2.78$, $SD = .333$) is higher than the male respondents ($m = 2.73$, $SD = .379$). However, t-test for independent samples disconfirmed the difference in the mean score, $t(110) = -.636$, $p = .526$. This indicates that the null hypothesis was accepted because there is no significant difference in the mean score of the level of motivation of the students when grouped by sex. Hence, the level of motivation of the undergraduate students in learning biology is the same regardless of their sex.

This implies that the slight difference in mean scores is not significant enough to conclude that gender plays a role in determining students' motivation. This implies that motivational factors in biology learning may be influenced more by other variables such as teaching methods, interest in the subject, or academic environment rather than by gender. Educators can, therefore, focus on creating inclusive and engaging learning strategies that benefit all students equally, regardless of sex.

The findings are consistent with studies that suggest gender does not always lead to significant differences in academic motivation. Areepattamannil et al., (2023) indicated that gender disparities in motivation were negligible and statistically insignificant. Male and female students exhibited comparable levels of intrinsic and extrinsic desire for scientific education, including biology. Kiran & Sungur (2012) also reported significant differences in science self-efficacy between male and female students. This discrepancy suggests that while gender differences in motivation may not always be significant, other factors may still influence specific outcomes.

Table 11 presents the comparison of level of motivation in learning biology among undergraduate students when grouped by course. The table includes the mean, standard deviations, and the test statistic with its corresponding p-value to determine if significant differences exist between the groups.

Table 11. Significant Difference Between the Level of Motivation of Undergraduate Students in Learning Biology when Grouped by Course

Course	n	Mean	SD	Test Statistic
BSEd Science	28	2.83	.303	F(3) = 1.965, p = .124
BS Agriculture	28	2.62	.324	
Diploma in Midwifery	28	2.76	.353	
BS Criminology	28	2.81	.414	

*significant at 0.05

Based on table 11, undergraduate students taking BSEd Science have the highest mean of 2.83 (SD = 0.303), indicating they are more motivated to learn biology compared to other courses. Moreover, BS Criminology students had the second highest mean of 2.81 (SD = .414). On the other hand, undergraduate students in BS Agriculture have the lowest mean of 2.62 (SD = 0.324). However, one way ANOVA disconfirmed the difference in the mean score, $F(3) = 1.965$, $p = 0.124$. Since the p-value is greater than the significance level of 0.05, null hypothesis was rejected and the differences in motivation levels among the courses are not significant. This suggests that the variations in mean scores across courses are not large enough to conclude that different course significantly affects motivation in learning biology. Thus, the level of motivation of undergraduate students in learning biology are the same regardless of their course.

The findings imply that students across different courses exhibit relatively similar levels of motivation to learn biology, with no statistically significant differences observed. However, the slightly higher motivation among BSEd Science students could be attributed to their closer alignment with science-related fields, which may naturally foster greater interest and perceived relevance of biology (Manalansan et al., 2020). On the other hand, students in BS Agriculture, despite biology's relevance to their field, reported the lowest mean motivation, which could imply a need to consider tailoring instructional strategies emphasizing its importance to help enhance motivation. The results align with studies that show motivation in science subjects can vary depending on perceived relevance to a student's chosen field of study. Howard et al. (2021) emphasized that students' interest in science is closely tied to how they see its connection to their future careers. This may explain why BSEd Science students, who are preparing to teach science, exhibit the highest motivation. Conversely, Gormally & Heil (2022) found that even in non-science courses, students' motivation could increase if the relevance of biology to their future goals was clearly demonstrated.

Section 3. Correlation Between the Level of Motivation of Undergraduate Students in Learning Biology and their Age

Table 12 presents data on the relationship between the level of motivation of higher education students in learning biology and their age. The table includes the Pearson correlation coefficient, the significance level (2-tailed), and the sample size.

Table 12. Significant Correlation Between the Level of Motivation of Undergraduate Students in Learning Biology and their Age

		Level of Motivation	Age
Level of Motivation	Pearson correlation (r)	1	.266
	p-value		.005
	n	112	112
Age	Pearson correlation (r)	.266	1
	p-value	.005	
	n	112	112

* $p < 0.05$

As shown in the table, age and level of motivation of higher education students in learning biology has direct or positive yet weak correlation ($r=.266$). The result suggests that as the student gets older, the level of motivation in learning biology also gets higher. Additionally, the result of the Pearson- r test reveals that the correlation is significant ($p=.005$), indicating that the age is correlated with the level of motivation of higher education students in learning biology. While the correlation exists, it is not strong enough to imply a substantial relationship.

The findings indicate that age is a factor influencing students' motivation to learn biology. Older students may have greater clarity regarding the relevance of biology to their personal, academic, or career goals, which could explain their higher motivation compared to younger students. This trend suggests that educators might consider tailoring motivational strategies based on age groups, such that, younger students may benefit from engaging, hands-on learning activities or mentoring to foster interest, while older students might respond better to career-related applications of biology.

The positive, although weak relationship between age and motivation aligns with findings of Phair (2014), who suggested that age moderates the relationship between motivational factors and academic resilience, with self-efficacy, planning, and persistence having a stronger effect on resilience for older students. Similarly, Richardson et al. (2012) found that older university students tend to display stronger self-regulation and goal orientation, which contribute to higher levels of motivation. However, Berg and Corpus (2013) found that age does not significantly influence academic motivation. This shows that while age may have a slight positive influence on motivation, its impact could be mediated by other external factors.

Section 4. Profile Variables that Significantly Influence the Level of Motivation of Undergraduate Students in Learning Biology

Table 13 presents the results of a multiple linear regression analysis assessing the relationship between three profile variables (course, sex, and age) and the level of motivation of students in learning biology.

Table 13. Analysis of Profile Variables Influencing the Level of Motivation of Undergraduate Students in Learning Biology

Variables	B	Std. Error	Beta	t	Sig.
(Constant)	2.544	.098		25.943	.000
Course	-.006	.085	-.007	-.065	.948
Sex	-.079	.074	-.112	-1.072	.286
Age	.126	.041	.288	3.055	.003

Dependent Variable: Mean; Adjusted R-square=.058, $F(3)=3.274$, $p=.024$

As shown in the table, the Adjusted R-square is 0.058 indicating that 5.8% of the variances can be explained by the model. The resulting equation is $= 2.544-.006(\text{course})-.079(\text{sex})+.126(\text{age})$. This means that in every unit increase in course and in sex, the level of motivation decreases by .006 and .079 respectively. Moreover, it also shows that the older the age by one unit, the attitude increases by .126. ANOVA result shows that $p=.024$, meaning there is significant linear relationship between the dependent and independent variables. Furthermore, p-values of t-test are not significant (p is higher than 0.05) for course and sex, but significant for age (p -values of t-test is less than 0.05). This means that among the predictors, age significantly and positively influences the level of motivation in learning biology. This means that older students tend to be more motivated than younger students. On the other hand, course and sex do not have a significant impact on motivation. The overall model explains a small portion of the variance in motivation, so additional factors should be explored.

The findings highlight that age is a significant predictor influencing the level of motivation of undergraduate students in learn biology, which implies that older students may have clearer goals compared to younger peers. This could be due to their increased maturity, experience, and better understanding of the relevance of the subject to their careers or academic progression. Conversely, the insignificant results for sex and course suggest that motivation levels do not vary based on gender or the specific course being pursued.

The positive influence of age on motivation aligns with previous studies that emphasize how older students exhibit higher levels of intrinsic motivation and goal clarity. Eckland and Berenbaum (2023) found that emotional clarity and goal clarity increase with age, with older adults showing the highest levels of emotional clarity. Similarly, Richardson et al. (2012) found that age positively correlates with academic motivation in higher education, reflecting a stronger commitment to learning goals among older students. However, previous research suggests that factors like interest and self-efficacy play a significant role in academic motivation and performance, rather than age alone. Meanwhile, Berg and Corpus (2013) observed no relationship between age and motivation in alternative educational settings.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

With the findings of the study, the following conclusions were drawn. The undergraduate students were highly motivated in learning biology. However, there is no significant difference on the level of motivation of undergraduate students in learning biology when grouped by sex and course. On the other hand, age significantly influences the level of motivation of undergraduate students in learning biology, hence, the direct yet weak correlation between the level of motivation of undergraduate students in learning biology and their age. Among the profile variables, age was found as a significant predictor influencing the level of motivation of undergraduate students in learning biology.

Recommendations

Based on the conclusions of the study, educators should sustain the implementation of engaging, student-centered instructional strategies. Moreover, teachers may also consider age-specific approaches and developmentally appropriate strategies to better address the varying motivational needs of students across age groups. Additionally, academic institutions may develop or enhance support programs, such as mentoring and academic advising that consider students' age and motivational levels to improve engagement and learning outcomes in biology. Future researchers may also explore additional factors such as socioeconomic background, learning environments, and teaching strategies to better understand the complex interplay of variables influencing the level of motivation in learning biology. They may also consider incorporating qualitative approaches to gain deeper insights into students' motivational experiences.

Ethics declaration: The researcher observed and adhered to ethical practices applicable to scientific research. Prior to data collection, informed consent was obtained by affirming their signature and strict confidentiality was maintained. To protect participants' identities, all responses were anonymized or coded. No harm or coercion was imposed on individuals who chose not to participate in the survey.

Conflicts of Interest: The researcher declares that there is no conflict of interest in the conduct of this study, as she has no affiliations with any organizations or entities that may influence the outcomes of the study.

Data Availability Statement: The data are available from the author upon reasonable request.

Author contribution: The sole author was involved in the conceptualization, design, data collection, interpretation, and writing the content of this study.

Funding: No funding source is reported for this study.

REFERENCES

1. Areepattamannil, S., Khurma, O. A., Ali, N., Al Hakmani, R., & Kadbey, H. (2023). Examining the relationship between science motivational beliefs and science achievement in Emirati early adolescents through the lens of self-determination theory. *Large-Scale Assessments in Education*, 11(1), 25. <https://doi.org/10.1186/s40536-023-00175-7>

2. Bandhu, M. D., Mohan, M. M., Nittala, N. A. P., Jadhav, P., Bhadauria, A., & Saxena, K. K. (2024). Theories of motivation: A comprehensive analysis of human behavior drivers. *Acta Psychologica*, 244, 104177. <https://doi.org/10.1016/j.actpsy.2024.104177>
3. Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215. <https://doi.org/10.1037/0033-295X.84.2.191>
4. Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52, 1–26. <https://doi.org/10.1146/annurev.psych.52.1.1>
5. Berg, D. J., & Corpus, J. H. (2013). Enthusiastic students: A study of motivation in two alternatives to mandatory instruction. <https://www.semanticscholar.org>
6. Broussard, S. C., & Garrison, M. E. B. (2004). The relationship between classroom motivation and academic achievement in elementary school-aged children. *Family and Consumer Sciences Research Journal*, 33(2), 106–120.
7. Bunda, T. P., Neviyarni, S., & Nirwana, H. (2024). The role of motivation in influencing student success in learning. *Manajia: Journal of Education and Management*. <https://doi.org/10.58355/manajia.v2i1.29>
8. Chen, X., Zimmerman, B. J., & Schunk, D. H. (2022). Motivation and learning in adult education. *Learning and Individual Differences*, 75, 101–115.
9. Cheung, D. (2017). The key factors affecting students' individual interest in school science lessons. *International Journal of Science Education*, 40(1), 1–23. <https://doi.org/10.1080/09500693.2017.1362711>
10. Collie, R., & Martin, A. (2019). Motivation and engagement in learning. Oxford University Press. <https://doi.org/10.1093/acrefore/9780190264093.013.891>
11. Colomer, J., Serra, T., Canabate, D., & Bubnys, R. (2020). Reflective learning in higher education: Active methodologies for transformative practices. *Sustainability*, 12(9), 3827. <https://doi.org/10.3390/su12093827>
12. Cotner, S., Jenö, L. M., Walker, J. D., Jørgensen, C., & Vandvik, V. (2020). Gender gaps in the performance of Norwegian biology students: The roles of test anxiety and science confidence. *International Journal of STEM Education*, 7, 1–10.
13. Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology*, 49, 182–185. <https://doi.org/10.1037/A0012801>
14. Deci, E. L., Olafsen, A. H., & Ryan, R. M. (2017). Self-determination theory in work organizations: The state of a science. <https://doi.org/10.1146/ANNUREV-ORGPYCH-032516-113108>
15. Dou, R., Cian, H., & Espinosa, V. (2021). Undergraduate STEM majors on and off the premed/health track: A STEM identity perspective. *CBE—Life Sciences Education*, 20, 1–12. <https://doi.org/10.1187/cbe.20-12-0281>
16. Eckland, N. S., & Berenbaum, H. (2023). Clarity of emotions and goals: Exploring associations with subjective well-being across adulthood. *Affective Science*, 4, 401–412. <https://doi.org/10.1007/s42761-022-00179-6>
17. Eccles, J. S., Midgley, C., Wigfield, A., Buchanan, C. M., Reuman, D., Flanagan, C., & Mac Iver, D. (1993). Development during adolescence: The impact of stage-environment fit on young adolescents' experiences in schools and in families. *American Psychologist*, 48(2), 90–101. <https://doi.org/10.1037/0003-066X.48.2.90>
18. Ferla, J., Valcke, M., & Schuyten, G. (2010). Judgments of self-perceived academic competence and their differential impact on students' achievement motivation, learning approach, and academic performance. *European Journal of Psychology of Education*, 25, 519–536. <https://doi.org/10.1007/s10212-010-0030-9>
19. Firmansyah, F., Komala, R., & Rusdi, R. (2018). Self-efficacy and motivation: Improving biology learning outcomes of senior high school students. *Jurnal Pendidikan Biologi Indonesia*. <https://doi.org/10.22219/jpbi.v4i3.6878>
20. Gibbens, B. B. (2019). Measuring student motivation in an introductory biology class. *The American Biology Teacher*, 81, 20–26. <https://doi.org/10.1525/abt.2019.81.1.20>
21. Glynn, S. M., & Koballa, T. R., Jr. (2006). Motivation to learn college science. In J. J. Mintzes & W. H. Leonard (Eds.), *Handbook of college science teaching*, 25–32. National Science Teachers Association Press.

22. Glynn, S. M., Bryan, R. R., Brickman, P., & Armstrong, N. (2015). Intrinsic motivation, self-efficacy, and interest in science. In K. A. Renninger, M. Nieswandt, & S. Hidi (Eds.), *Interest in mathematics and science learning*, 189–202. American Educational Research Association.
23. Goldman, Z. W., Goodboy, A. K., & Weber, K. (2017). College students' psychological needs and intrinsic motivation to learn: An examination of self-determination theory. *Communication Quarterly*, 65, 167–191. <https://doi.org/10.1080/01463373.2016.1215338>
24. Gormally, C., & Heil, A. (2022). A vision for university biology education for non-science majors. *CBE—Life Sciences Education*, 21(4), es5. <https://doi.org/10.1187/cbe.21-12-0338>
25. Grahaam, M. J., Frederick, J., Byars-Winston, A., Hunter, A.-B., & Handelsman, J. (2013). Increasing persistence of college students in STEM. *Science*, 341(6153), 1455–1456. <https://doi.org/10.1126/science.1240487>
26. Guay, F., Chanal, J., Ratelle, C. F., Marsh, H. W., Larose, S., & Boivin, M. (2010). Intrinsic, identified, and controlled types of motivation for school subjects in young elementary school children. *British Journal of Educational Psychology*, 80(4), 711–735.
27. Hadre, P., Crowson, H., Debacker, T., & White, D. (2007). Predicting the academic motivation of rural high school students. *Journal of Experimental Education*, 75, 247–269.
28. Howard, J. L., Bureau, J. S., Guay, F., Chong, J. X. Y., & Ryan, R. M. (2021). Student motivation and associated outcomes: A meta-analysis from self-determination theory. *Perspectives on Psychological Science*, 16(6), 1300–1323. <https://doi.org/10.1177/1745691620966789>
29. Hulleman, C. S., & Harackiewicz, J. M. (2020). Promoting interest and performance in high school science classes. *Science Education*, 104(2), 215–227.
30. Hunaepi, H., Suma, I. K., & Subagia, I. W. (2024). Curiosity in science learning: A systematic literature review. *International Journal of Essential Competencies in Education*, 3(1), 77–105. <https://doi.org/10.36312/ijece.v3i1.1918>
31. Hunter, A. B. (2019). Why undergraduates leave STEM majors: Changes over the last two decades. In E. Seymour & A. B. Hunter (Eds.), *Talking about leaving revisited*. Springer. https://doi.org/10.1007/978-3-030-25304-2_3
32. Ishida, K., & Sekiyama, R. (2024). Variables influencing students' learning motivation: Critical literature review. *Frontiers in Education*, 9. <https://doi.org/10.3389/feduc.2024.1445011>
33. John, D., Hussin, N., Zaini, M., Ametefe, D., Aliu, A., & Caliskan, A. (2023). Gamification equilibrium: The fulcrum for balanced intrinsic motivation and extrinsic rewards in learning systems. *International Journal of Serious Games*, 10(3), 83–116. <https://doi.org/10.17083/ijsg.v10i3.633>
34. Karakolidis, A., Pitsia, V., & Emvalotis, A. (2019). The case of high motivation and low achievement in science: The role of students' epistemic beliefs. *International Journal of Science Education*, 41(11), 1457–1474. <https://doi.org/10.1080/09500693.2019.1612121>
35. Kim, K. J., Hwang, J. Y., & Kwon, B. S. (2016). Differences in medical students' academic interest and performance across career choice motivations. *International Journal of Medical Education*, 7, 52–55. <https://doi.org/10.5116/ijme.56a7.5124>
36. Kıran, D., & Sungur, S. (2012). Middle school students' science self-efficacy and its sources: Examination of gender difference. *Journal of Science Education and Technology*, 21, 619–630.
37. Kışoğlu, M. (2018). An examination of science high school students' motivation towards learning biology and their attitude towards biology lessons. *International Journal of Higher Education*, 7, 151–164. <https://doi.org/10.5430/ijhe.v7n1p151>
38. Koballa, T. R., & Glynn, S. M. (2007). Attitudinal and motivational constructs in science learning. In S. Abell & N. Lederman (Eds.), *Handbook of research on science education* (pp. 75–102). LEA Publishers.
39. Lai, E. R. (2011). Metacognition: A literature review. *Pearson Research Report*, 24, 1–40.
40. Lang & Šorgo, A. (2024). Motivation to learn biology: Adaptation and validation of a science motivation questionnaire with Slovene secondary school students. *International Journal of Instruction*, 17, 137–156. <https://doi.org/10.29333/iji.2024.1738a>