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Relationship Between Student Motivation, Teaching Methods, and Academic Performance in Biology at Tepa Senior High School, Ghana

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Abstract: This study investigated how different teaching methods and levels of student motivation affect academic achievement in learning the respiratory system in biology at Tepa Senior High School, Ghana. Employing a quasi-experimental design, 120 Form Three biology students were divided into experimental and control groups. Data were gathered through questionnaires, document reviews, and pre- and post-tests. The experimental group was instructed through practical, hands-on activities, while the control group received traditional lecture-based teaching. Findings indicated that 90% of students favored the practical approach. The overall mean score of 4.155 reflected high motivation among learners. Post-test results further showed that students in the experimental group outperformed those in the control group, with average scores of 73.60 and 53.40, respectively. ANOVA analysis revealed a statistically significant difference between the groups ($F(3,36) = 17.606$, $p < .001$), signifying that the practical teaching method substantially enhanced both motivation and academic performance. The study concludes that incorporating practical, activity-oriented methods in biology instruction promotes deeper understanding, engagement, and achievement among students. It recommends that Ghanaian schools adopt student-centered, experiential learning strategies, equip laboratories adequately, and encourage teachers to integrate hands-on techniques to make science learning more effective and enjoyable.

***Keywords*:** *Motivation; Teaching Methods; Practical Learning; Academic Performance; Biology Education.*

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I. INTRODUCTION

Biology education, particularly topics such as the respiratory system, plays a fundamental role in students' overall scientific literacy and academic success. However, student performance in biology has been declining in recent years, as evidenced by examination outcomes such as the West African Examinations Council (WAEC) results [28]. Despite various educational reforms and initiatives by the Ghana Education Service [10] and Ministry of Education [14], challenges persist in enhancing students' understanding and motivation in learning science. Students often rely on rote memorization when learning tasks lack relevance, which limits their conceptual understanding and critical thinking development [17]. Motivation is recognized as a critical factor influencing students' engagement and achievement in science education. It energizes and directs goal-oriented learning behaviors, sustaining effort and guiding focus toward academic

objectives [4, 22]. Various psychological constructs such as curiosity, interest, and learning orientation interact with motivation to enhance learning outcomes [23]. Moreover,

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motivation stimulates active participation, reducing boredom and fostering appreciation of science's relevance [16,8].

Teaching methods significantly affect students' motivation and academic performance. Practical, hands-on approaches have been found to better engage students in complex biological topics by promoting experiential and collaborative learning opportunities. Such methods support the development of problem-solving and critical thinking skills essential to science learning [6,16]. Studies have shown that students prefer active learning strategies, which positively influence their motivation and performance compared to traditional lecture-based instruction [24, 29].

The relationship between student motivation, teaching approaches, and academic achievement is complex and context-dependent.

Motivational orientations, such as intrinsic and extrinsic motivation, interact with instructional methods and classroom environments to influence learning outcomes [19], [25]. Because student motivation influences conceptual understanding, critical thinking, and academic success, it is essential to investigate these relationships within specific contexts to create effective teaching methods. This study, therefore, aims to investigate the relationship between student motivation, teaching methods, and biology performance in learning the respiratory system at Tepa Senior High School, Ghana. Understanding how practical teaching methods enhance motivation and academic outcomes will contribute to improving biology instruction in similar educational settings.

II. LITERATURE REVIEW

Since biology was introduced into the senior high school curriculum, students' performance, especially in topics like the respiratory system, has declined in WAEC examinations [28], despite several educational reforms and initiatives by the Ghana Education Service [10] and the Ministry of Education [14], such as the Science Resource Center, USAID Science, and SEEP Projects [3]. When students encounter meaningful learning activities, they connect new information to their prior experiences and engage actively in the learning process. However, when the learning tasks lack relevance, they tend to rely on lower-level strategies such as rote memorization to grasp the content [17]. Motivation serves as the driving force that sustains goal-oriented activities in science learning [17]. A key objective of science education is to enhance students' scientific literacy [15]. Motivation can be defined as an internal process leading a human to behave in a particular way [4]. Various definitions are used to describe the concept of motivation in the literature. For instance, Ainley defined motivation as energy and direction as well as the reasons for behaviors [1]. Motivation is a multifaceted concept used to explain human effort and behavior across various activities and the underlying causes of such behavior [27]. Ryan and Deci define motivation as the driving force or the desire that compels an individual to take action [19].

Brophy linked motivation to goal-directed behavior, explaining that it drives the initiation, direction, intensity, and persistence of actions toward achieving goals [4]. In essence, motivation energizes an individual to begin an activity, sustains their effort, and guides their focus toward a specific objective [22]. Overall, motivation is closely associated with several psychological factors, including curiosity, interest, learning, performance, and goal orientation [23]. It is also a crucial component in education, as it stimulates, directs, and sustains learning behavior [16]. From a psychological perspective, motivation is essential for behavioral change, and learning itself represents a form of such change [4]. Slavin explained that motivation plays a key role in the learning process, encompassing learning, unlearning, and relearning by encouraging the development and application of new skills and behaviors [22]. Driscoll emphasized that teachers should consider learners' characteristics and integrate motivational elements into their instruction [8]. Motivation in science education is crucial, as it inspires students to actively engage with the subject, reducing boredom and allowing them to appreciate its relevance and beauty [16]. Students who exhibit higher levels of interest and motivation tend to achieve better academic results in biology, with their performance significantly enhanced when they are strongly motivated to learn [5].

According to constructivist learning theory, learners build new knowledge through their experiences and interactions with their environment, making them active participants in the learning process. When students encounter meaningful learning activities, they connect new ideas with prior knowledge through active engagement [17]. Von Glasersfeld emphasized that students' motivation is shaped by their learning goals, as these goals guide their engagement in the learning process [26]. Motivation serves as the driving force that sustains purposeful scientific activities [17]. A key objective of science education is to enhance students' scientific literacy [15]. Students are expected to grasp key scientific concepts, connect scientific knowledge to real-life situations, appreciate the nature and beauty of science, and develop an interest in pursuing science-related studies at higher levels. Research in science education should go beyond assessing academic achievement to also explore the factors that motivate students to learn [11]. Therefore, the affective domain—encompassing attitudes, emotions, and motivation—should be valued as much as the cognitive domain [11]. Previous studies have demonstrated that motivation plays a vital role in science learning, influencing conceptual understanding, critical thinking, learning approaches, and overall academic achievement [4]. Motivation plays a crucial role in helping students actively build their own understanding of scientific concepts [5]. By combining constructivist learning theory with motivation theory, Chin and Sheh identified six essential factors that influence students' motivation in studying biology, especially in learning about the

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respiratory system [6]. These include self-efficacy, active learning strategies, the value placed on science learning, performance goals, achievement goals, and stimulation from the learning environment. Among these, self-efficacy, active learning strategies, and the value of biology learning are considered intrinsic motivators, as they relate to students' internal perceptions of their abilities, the importance they assign to learning, and the strategies they employ to succeed. On the other hand, performance goals, achievement goals, and stimulation from the learning environment are classified as forms of extrinsic motivation. These factors drive students to learn in order to gain approval from parents or teachers or to outperform their peers [25]. Research further indicates that students' motivation levels significantly impact their academic performance, with higher motivation generally leading to improved achievement [2, 21].

Altun found that students with lower levels of motivation are more likely to fail in the subject, while those with higher motivation tend to achieve better results in biology [2]. Likewise, Shih and Gamon highlighted that the level of student motivation has a significant impact on their academic performance [21]. A study conducted in Sindh, Pakistan, investigated the effects of various science teaching approaches on the academic performance of secondary school students. Employing a survey design, the findings revealed that methods such as practical activities, teacher support, class discussions, demonstrations, and project-based learning significantly enhanced students' achievement in science [24]. Furthermore, a quasi-experimental study examined how instructional methods, including the multiple intelligences approach, peer teaching, and problem-based learning, influenced higher-order skills like critical thinking, metacognitive abilities, and scientific process skills [18]. Comparative studies highlight that active learning techniques, including case studies, group projects, role plays, technology integration, and cooperative learning, consistently contribute to higher student performance in science [29, 6, 16]. The effectiveness of teaching methods significantly affects student learning experiences and outcomes [13]. Additionally, teacher motivation and instructional methodologies have been shown to influence student outcomes in biology, particularly in Tepa Senior High School of Ghana.

➢ *Research Gaps and Justification for the Study*

Although extensive research has examined student motivation and teaching methods, several gaps remain. Firstly, there is a limited understanding of how student motivation interacts with teaching methods specifically within science education. Few studies have explored this relationship in depth. Secondly, the dynamics among student motivation, teaching approaches, and science performance may differ depending on the educational context, underscoring the importance of investigating these factors within specific settings for a more nuanced understanding.

➢ *Objectives of the Study*

The objective of this research specifically aims to:

- Examine the method of teaching that motivates students to learn the respiratory system.
- To examine how the use of practical teaching methods enhances students' motivation to learn the respiratory system in biology.
- Assess the impact of teaching methods that enhance student motivation on their performance in learning the respiratory system.

➢ *Research Questions*

- What method of teaching motivates students to learn the respiratory system?
- In what ways does the use of practical teaching methods enhance students' motivation to learn the respiratory system in biology?
- To what extent does a motivating teaching method affect students' performance in learning the respiratory system?

A null hypothesis was formulated from Research Question 2 to provide a basis for addressing that research question.

- H_0: There is no significant difference in the post-treatment mean scores of students in the control group and those in the experimental group.

III. METHODOLOGY

➢ *Research design*

In order to investigate the effectiveness of improvised materials in biology instruction, a mixed-method research approach was employed. Both quantitative and qualitative data were collected to answer research questions. The study employed a quantitative quasi-experimental research design, specifically a one-group pretest-posttest approach, to assess the impact of the teaching intervention on students' learning outcomes. Cohen, Manion, and Morrison highlight that this research design is particularly effective for collecting data on attitudes and behavioral changes. It offers valuable insights into the ways specific educational approaches enhance problem-solving skills and learning outcomes within a controlled classroom setting [7].

➢ *Population*

Population encompasses the whole group of individuals or items that possess shared characteristics pertinent to a research study [20]. The target population for the study was 1200 students. The study employed purposive sampling to select 120 Form Three biology students, consisting of 64 females and 56 males, who were students of the researcher at Tepa Senior High School for the study.

➢ *Validity*

The study's validity was confirmed through a pilot study that tested the questionnaire and interview schedule prior to their administration to the sampled students. To establish

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reliability, the test-retest method was used to evaluate the consistency of the students' responses over time.

➢ *Ethical Considerations*

The researcher obtained permission from the headmaster and staff of Tepa Senior High School to conduct the study. The objectives and significance of the research were clearly explained to both the staff and the students. This study was conducted in accordance with ethical principles to protect the rights and welfare of participants. Prior to data collection, participants were fully informed about the purpose of the research, the procedures involved, and how their information would be used. Additionally, the researcher protected participant privacy and confidentiality, minimized the risk of harm, and ensured bias and fairness in the test [12], [9]. Obtaining informed consent is a fundamental principle, where the researcher must fully inform participants about the purpose of the test, procedures, and potential risks and benefits [12]. Anonymity and confidentiality were strictly maintained by excluding names or other personal identifiers from data collection, analysis, and reporting. All information provided was treated with discretion to ensure privacy and security. The research instruments, including tests, Likert-scale questionnaires, and evaluation surveys, were carefully designed to be fair, unbiased, and respectful [12]. Measures were taken to minimize any potential risks, and participants were treated with dignity and fairness throughout the study.

IV. RESULTS

This chapter presents the results gathered from the respondents on the questionnaire items and test. It also contains the discussion of various responses from the respondents.

To address Research Question One, *"What method of teaching motivates students to learn the respiratory system?" Data* were collected from students to determine their views on various teaching methods and how these methods influenced their motivation to learn the topic. The responses were analyzed and summarized in the table below.

To explore students' views on which teaching approach best enhances their motivation in learning the respiratory system, data were gathered by comparing the lecture and practical methods. Students were requested to specify which of the two methods most effectively motivated their learning.

Table 1: Students' Perspectives on Teaching Methods that Motivate Learning of the Respiratory System in Biology.

Respondent	Frequency	Percent(%)
Practical	108	90
Lecture	12	10
Total	120	100

From Table 3, The findings indicated that 108 students, representing 90% of the sample, expressed a strong preference for the practical method of teaching, while only 12 students (10%) showed a lower preference for the traditional lecture method.

This implies that practical, hands-on approaches are far more effective in engaging students when learning complex biological concepts such as respiration. Through active learning, students are able to visualize and interact with the structures and functions of the respiratory system, enhancing their understanding. It stimulates students' curiosity and sense of exploration, deepens conceptual understanding through experiential learning, fosters peer collaboration for more relatable learning experiences, and strengthens problem-solving and critical thinking abilities.

To address Research Question Two, *"In what ways does the use of practical teaching methods enhance students' motivation to learn the respiratory system in biology?" Data* were gathered from students to explore how practical, hands-on learning experiences influence their interest and motivation in studying the respiratory system. The responses were analyzed to determine the extent to which the practical method contributes to increased motivation and engagement. The results are presented in the table below.

Table 2: Students' Views on How the Practical Teaching Method Influences their Motivation and Interest in Learning the Respiratory System in Biology

Statement	Mean	Verbal interpretation
1. The practical method makes the topic of respiration more interesting to learn.	4.34	High
2. I feel more motivated to learn biology when practical activities are used.	4.56	Very High
3. Conducting experiments on respiration helps me understand the topic better	4.34	High

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4. Practical lessons make me more curious about how the respiratory system works.	3.41	Moderate
5. I prefer practical sessions to traditional lectures in learning about respiration.	4.08	High
6. Hands-on activities increase my confidence in answering biology questions on respiration.	4.20	High
Overall	**4.155**	**High**

NB: 1-1.49=very low/strongly disagree; 1.50-2.49=low/disagree; 2.50-3.49=moderate/neutral; 3.50-4.49=high/agree; 4.50-5.49=very high/strongly agree

The table presents the findings on students' perceptions of how the practical method of teaching influences their motivation to learn the respiratory system in biology. The overall mean score of 4.155, rated as high, indicates that students strongly agreed with the statements highlighting the positive impact of practical teaching on their motivation. Among the items, statement 2 recorded the highest mean (4.56), followed by statements 1 and 3 (each with 4.34**).** Statements 6 and 5 had mean scores of 4.20 and 4.08, respectively, while statement 4 recorded the lowest mean (3.41), categorized as moderate.

The generally high mean values demonstrate that students perceive practical teaching as highly effective in enhancing their motivation and interest in learning biology, especially in complex topics such as the respiratory system. This suggests that hands-on approaches make abstract concepts more tangible and comprehensible, thereby promoting greater engagement. The few neutral or negative responses observed could be linked to factors like individual learning styles, the quality or consistency of practical sessions, or limited availability of resources.

To address Research Question Three, *"To what extent does a motivating teaching method affect students' performance in learning the respiratory system?" A post-test* was administered to both the control group (taught using the lecture method) and the experimental group (taught using the practical method). The purpose was to determine the effect of the motivating (practical) teaching method on students' academic performance in the topic. The results of the post-test comparison between the two groups are presented in the table below.

Table 3: Post-Treatment Test Between Control and Experiment

Group	Test items (N)	Mean	Std. Deviation	Std. Error Mean
Control	10	53.40	8.215	2.598
Experiment	10	73.60	8.942	2.828

The experimental group recorded a higher post-test mean score **(**M = 73.60**)** than the control group **(**M = 53.40**),** suggesting that the intervention, likely the practical teaching method, had a positive impact on students' academic performance. The smaller standard error values indicate that the group means are reliable estimates of the true population means.

Table 4: Comparison of the Pre-Treatment and Post-Treatment Test Results of the Control and Experimental Groups Using ANOVA

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	3576.875	3	1192.292	17.606	.000
Within Groups	2437.900	36			
Total	6014.775	39			

The one-way ANOVA results show a statistically significant difference among the group means**,** (3, 36) = 17.606, p < .001. Since the p-value (.000) is less than the alpha level of 0.05**,** the null hypothesis, which stated that there is no significant difference in the post-treatment mean scores between the control and experimental groups, is rejected**.**

This means that the teaching method used, which is the *practical teaching method,* had a significant effect on students' post-test performance. The high F-value (17.606) indicates that the variation in mean scores between the groups is much greater than the variation within the groups.

V. DISCUSSION

The study revealed that the practical teaching method and motivation play a key role in improving students' performance in the respiratory system in biology. This finding supports Jorkiranta (2014), who identified interest, motivation, and effective teaching methods as major factors influencing learning outcomes. As indicated in Table 1, 90% of the students favored the practical method, while Table 2 shows an overall

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mean score of 4.155, reflecting strong agreement that this approach enhanced their interest in learning biology, especially the respiratory system.

The study found that motivation is multidimensional, involving factors such as interest, school environment, rewards, and practical teaching methods that enhance student performance. As shown in Table 3, the experimental group taught through practical methods achieved an average score of 73.60%, compared to 53.40% in the control group. This supports [9], who stated that science is best learned through practical and well-motivated approaches. These factors collectively influence students' motivation to learn, with performance goals and awareness of expectations serving as key determinants. When students have clear academic goals or understand what is expected of them, it greatly enhances their motivation to learn. Additionally, factors such as self-confidence (self-efficacy), active learning strategies, the value placed on science learning, a supportive learning environment, and achievement goals all contribute to learning motivation. This aligns with [16], who emphasized that encouraging students to explore their own questions stimulates natural curiosity and promotes meaningful learning through personal effort. Data for this study were collected from Tepa Senior High School, where both physical and human support for student learning are below satisfactory levels. Like many schools in Ghana, Tepa SHS faces challenges such as limited resources, unmotivated teachers, poorly equipped classrooms, and authoritarian teaching styles focused mainly on exam preparation [20]. These environmental factors discourage learning rather than motivate it. Although the learning environment was not the strongest determinant of motivation, its statistical significance highlights its important role in fostering students' interest. As shown in Table 10, students confirmed that a conducive environment supports biology learning, aligning with Mary [13]. Therefore, schools should be made more engaging, open to dialogue, and equipped with necessary learning resources.

VI. LIMITATION OF THE STUDY

The quasi-experimental design used in this study provides valuable practical insights into the effect of practical teaching methods on student motivation and performance. However, the absence of random assignment introduces the possibility of selection bias, which may compromise the internal validity of the findings by allowing unmeasured differences between groups. Moreover, the use of a single school as the sample limits how broadly the results can be generalized to other educational settings with different characteristics. Therefore, future research should consider employing randomized controlled trials across multiple schools or regions to enhance the strength and applicability of the evidence. Additionally, while this study relied on quantitative measures to assess motivation, such data may not fully capture the nuanced experiences and attitudes of students toward science learning. Employing mixed-method research designs that include qualitative data would provide a more comprehensive understanding of student motivation. Finally, although the statistical analyses showed significant differences between groups, reporting effect sizes would provide a clearer picture of the practical significance and impact of the teaching interventions. Including such analyses in future studies would strengthen the interpretation and relevance of the outcomes.

VII. CONCLUSIONS

The study concludes that practical teaching methods greatly enhance student motivation and academic performance in biology, particularly in learning the respiratory system. Motivation, when supported by engaging instructional methods, fosters deeper understanding, curiosity, and confidence among students.

VIII. IMPLICATIONS

- Practical, activity-based teaching should be central to biology instruction.
- Student motivation can be improved through experiential and participatory learning.
- Educational stakeholders should invest in laboratory and instructional resources.

RECOMMENDATIONS

- Teachers should minimize lecture-based instruction and adopt practical approaches.
- School management should provide adequate science equipment and materials.
- Future research should employ randomized controlled trials across multiple schools to enhance the robustness and generalizability of findings.
- Further studies should use mixed-methods designs that incorporate qualitative data to gain richer insights into student motivation in biology education.
- Future studies should extend the intervention period to evaluate its long-term effects on student motivation and achievement.

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