

Evaluation of the Teaching Methods Used in Teaching Senior High School Biology

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ABSTRACT

This study was conducted in Bolgantanga Senior High School, located in the Upper East Region of Ghana in the Talensi district. The study's aim was to evaluate the teaching methods used in teaching Senior High School biology as teacher's skills in conducting lesson and choice of teaching methods play an essential role in improving students' interest and understanding in biology concepts at the Senior High School level. A total of 520 biology students comprising of 296 males and 224 females were used to carry out this study. The responses revealed that 302 students representing 58% of students find biology lessons interesting and 218 students representing 18% of students indicated that their interest in biology lessons depends on the task the teacher presents to them during lessons and the method used by the teacher, and 24% regarded biology uninterested subject. However, all students prefer watching the teacher presentation, listening to their teacher telling them about the concepts, and performing laboratory practices. Many students find biology interesting and participate effectively when the teacher uses discussion method in delivering lessons, and when the lesson is hands-on practices. The study also revealed that the methods used by teachers most frequently are explanation, demonstration, and discussion. Students prefer laboratory work, discussions and listening to their teacher and watching presentations than other methods. Findings also indicated that students desire that theory is linked with practical and involve information technologies. For this reason, it is advised that when teaching biology, the content- or context-specific-specific approach or teaching technique be utilized. This can improve learning outcomes, engagement, and attitudes in the classroom, but it needs to be implemented carefully and supported by both teachers and students.

KEYWORDS : Biology, Evaluation of teaching methods, Laboratory work, Senior High School

INTRODUCTION

The success of students in academics depends greatly on teacher's ability to use the appropriate methodologies in delivering lessons. A method that will engage students and improve their interest in the learning process. Successful application of appropriate teaching methods helps students to better acquire the knowledge and skills in the subject. This study evaluated this teaching methods used in teaching biology especially at the SHS level. Evaluating the methods used, their strengths and weaknesses is crucial

for improvement to be made. A number of methods used in teaching biology were identified; lecture, demonstration, teacher explanation, observation, hands-on practical are methods used in teaching biology. Biology lessons that are taught to pupils are greatly influenced by the methods used. It has been discovered that students' learning capacities are enhanced by differentiated learning tactics, such as setting up learning stations, employing task cards, and focusing on various senses throughout sessions. Higher marks and a greater appreciation from students for instructional flexibility have been attained through the very formative planning and teaching of topics, which allows students to plan their working methods and examination formats. Furthermore, research has shown that inquiry-based instruction combined with student-centered, engaging, and interactive strategies improves students' attitudes towards learning biology. Additionally, a teacher's creative and critical thinking teaching methods are very important in fostering a positive learning atmosphere in the classroom and enhancing student performance. Overall, the selection of instructional strategies can have a significant impact on the biology learning experiences and achievements of students.

Knowledge of these instructional methods will inform teachers to strategize and adopt appropriate methods in biology classroom. The effectiveness of a teaching methods is assessed based on students' involvement, and overall learning outcomes. Questionnaires were used to collect responses from students regarding the methods used in teaching them and the methods they wish were used in teaching biology. A sample size of 520 students in Bolgatanga SHS was used, results indicated that out of the several methods used by teachers, students prefer hands-on practice and the use of information technology in teaching and learning biology.

Again, effective communication between students and their teacher should be encouraging (Crista & Savesco, 2014). A biology teacher who is motivated to ensure a successful learning process can be of great help to his students (Akobirova & Sayfiyeva, 2022; Zion & Sadeh, 2007). An experienced teacher, who understands their students' interests and knows how to choose appropriate methods, can greatly influence the development of students' interest in biology. The aim of the work was to evaluate the most successful methods applied in teaching biology and make biology lessons more interesting.

LITERATURE REVIEW

Teaching biology in the Senior High School level requires effective methods that will actively engage students and facilitate students' interest in biology and during biology lessons. Various approaches have been employed by educators to enhance comprehension, critical thinking, and practical application of biological concepts. This literature review examines prominent methodologies used in teaching biology in Senior High Schools, highlighting their effectiveness and implications for student learning outcomes.

Inquiry-Based Learning (IBL): Inquiry-based learning encourages students to actively explore biological concepts through questioning, investigation, and problem-solving. By engaging in hands-on activities, experiments, and real-world applications, students develop a deeper understanding of biological principles (Bondarenko, 2020; Rodrigues, 2017). IBL fosters curiosity, critical thinking, and collaboration, promoting a student-centered approach to learning (Krajcik et al., 2014; Sarioglan & Can, 2021; Thangjai & Worapun, 2022).

It has been demonstrated that teaching biology through inquiry-based learning is a successful strategy. Developing students' critical thinking, problem-solving, and scientific research skills is one of the main advantages of implementing IBL in biology classes (Rau, 2022). IBL surpasses traditional lecture-based instruction in terms of increasing student motivation and engagement (Susuoroka et al., 2022 ; Verma et

al., 2023). IBL enables students to “learn by doing” and improves their comprehension of biological ideas and ability to draw connections between them by imitating the scientific research process (Johnson & Cuevas, 2016).

Cooperative Learning: Cooperative learning strategies promote peer interaction, collaboration, and shared responsibility in the learning process. Through group discussions, problem-solving tasks, and collaborative projects, students develop communication skills, teamwork, and a sense of collective achievement (Johnson et al., 2014; Sari, 2019 ; Susuoroka et al., 2023). Cooperative learning enhances student engagement and motivation, leading to improved academic performance in biology (Tarmizi & Bayat, 2016).

It has been demonstrated that teaching biology through cooperative learning is a successful strategy. According to Armstrong et al. (2023), encouraging students to think critically, solve problems, and conduct scientific research is one of the main advantages of implementing cooperative learning in biology classes. In addition to raising student enthusiasm and engagement, cooperative learning surpasses standard lecture-based teaching methods. Cooperative learning makes it possible for students to learn from one another and have a deeper understanding of biological topics by encouraging them to collaborate in small groups and exchange ideas.

Alruwaili and Templin (2021) assert that while there are always issues in the field of education, educators and researchers are always looking for new and efficient strategies to improve student outcomes and accomplishment. But biology education is a serious issue that has to be resolved. Issues with science education are particularly severe when it comes to the function that teaching and learning methods play. Because cooperative learning inspires students in ways that traditional learning does not, it has been used in this research to address the issue of teaching cell biology. Students have the chance to improve their social, critical thinking, communication, and problem-solving abilities through cooperative learning. Unlike traditional learning, where students have a passive function to play, this approach assigns students active learning roles, which makes it suited for effective teaching. This excerpt contains a detailed implementation strategy for cooperative learning in cell biology education that will be helpful to scientific educators and leaders in education.

Use of Technology: Integration of technology, such as multimedia presentations, simulations, virtual labs, and online resources, enriches biology instruction by providing interactive and multimedia-rich learning experiences (Gbordzekpor et al., 2023). Technology enhances visualization of abstract concepts, promotes self-directed learning, and facilitates access to diverse educational materials (Lopez et al., 2019). Digital tools offer opportunities for personalized instruction, adaptive feedback, and remote learning, catering to diverse learning styles and preferences (Chen & Jones, 2018).

Technology is becoming a more and more valuable instrument in the biological sciences. Students can study biology ideas at their own pace with the help of platforms such as Khan Academy, which offer an abundance of online materials such as articles, videos, and interactive activities (Biology Library|Science|Khan Academy, n.d). The biology community is also kept informed about new discoveries and methods by scientific magazines such as the Quarterly Review of Biology and the Annual Review of Cell and Developmental Biology, which publish the most recent studies and developments in the field (Pearl, 1927).

Technology has not only improved instructional materials but also changed biological research methods. Scientists may now examine biological systems in unprecedented depth because to sophisticated cell

imaging and analysis techniques, robust computer models, and simulations (Lehmann, 2019). These technological advancements have sped up scientific research and increased our grasp of the basic processes underlying life. Technology will probably have an even greater influence on biology in the years to come as it develops further.

Concept Mapping: Concept mapping is a visual learning tool that organizes and represents biological concepts hierarchically, illustrating relationships and connections between ideas. By constructing concept maps, students engage in active sense-making, identify key concepts, and integrate prior knowledge with new information (Novak & Cañas, 2008). Concept mapping promotes metacognitive skills, enhances conceptual understanding, and aids in the retention and retrieval of biological knowledge (Daley et al., 2015).

It has been demonstrated that concept mapping is a useful teaching tool for biology courses. Concept mapping, which uses diagrammatic representations to show relationships between concepts, can aid in students’ comprehension and retention of biological concepts. According to research, idea mapping can help biology students become more successful and develop their metacognitive abilities as well as their sense of self-efficacy. Concept mapping makes students’ understanding apparent so that peers and teachers may spot and clear up any misunderstandings (Anthony & Chinonyelum, 2022).

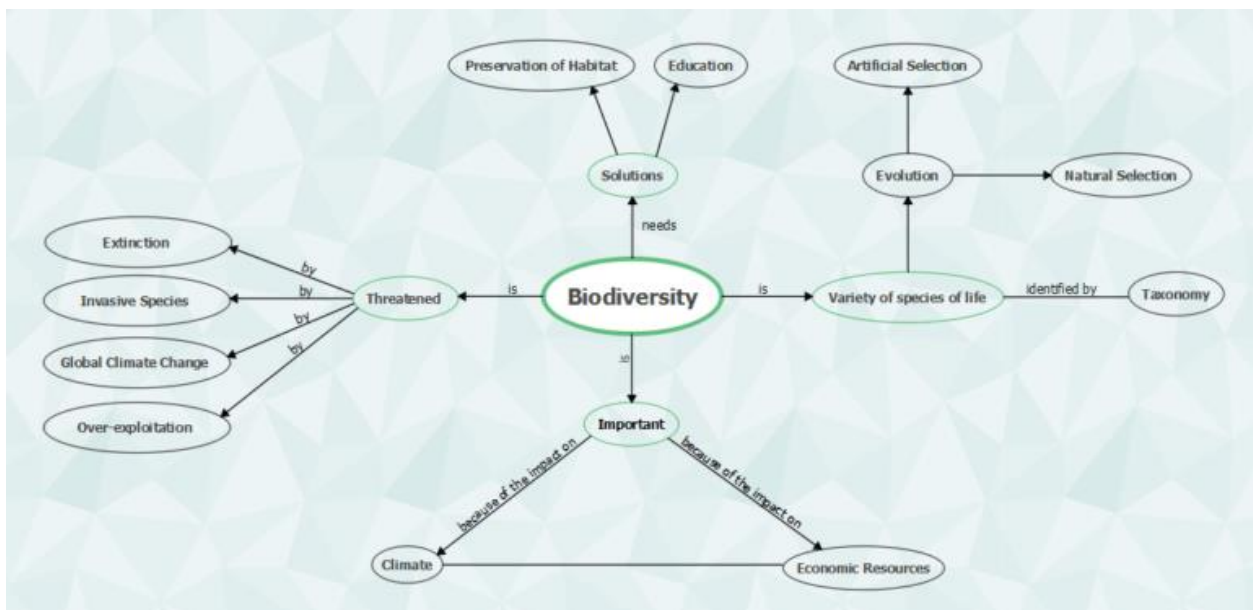


Figure 1: An example of concept map in biology

Different from more passive learning approaches like traditional lectures, the process of building and refining idea maps encourages active engagement with the content, which can result in deeper learning. For biology, which is a vocabulary-rich topic that is frequently taught by rote memorization, concept mapping is very helpful. Concept mapping can help students, as shown in Figure 1, go beyond simple memorization and gain a more comprehensive comprehension of the material by illuminating the connections between biological concepts. Overall, the research suggests that idea mapping can improve student learning and performance when used in biology classroom (Cahyawati et al., 2023).

Experiential Learning: Experiential learning approaches, such as field trips, outdoor education, and laboratory experiments, provide authentic and immersive experiences that connect theoretical knowledge with real-world phenomena. Through hands-on exploration and observation, students develop scientific inquiry skills, environmental awareness, and appreciation for the complexity of biological systems (Guzmán-González et al., 2020). Experiential learning fosters a deeper connection to nature, promotes ecological literacy, and cultivates a sense of stewardship towards the environment (Safrudiannur & Rott, 2020).

The application of diversified learning strategies in the seventh-grade biology curriculum of the CBSE is examined (Haig, 2014; Zaphiris & Ioannou, 2022). The learning outcomes of students taught utilizing differentiated instruction against traditional teaching approaches were compared by the researchers using a quasi-experimental design. To address the various learning needs of students, the varied instruction technique included setting up learning stations, assigning tasks, and focusing on various sensory modalities. According to the findings, pupils who received differentiated instruction outperformed the control group, which received instruction using standard approaches, in terms of learning outcomes and attitudes towards biology. The study emphasizes the advantages of using varied teaching techniques in biology classes since they can improve students' engagement with the material, critical thinking, and conceptual understanding. According to the findings, biology teachers should think about using differentiated instruction strategies to better meet the various learning needs of their students while adhering to the CBSE curriculum.

Methodology

Questionnaire as a data collection method was adopted in this study to obtain information from Bolgatanga Senior High School students' regarding the teaching methods used in teaching biology and the most successful teaching methods used in during biology lessons. The questionnaires were given to a total of 520 students biology students comprising of 296 males and 224 female students to obtain information of the teaching methods used in teaching biology. The questionnaire included closed-ended and Likert scale questions in collecting data on the methods used in teaching biology in Bolgatanga SHS located in the Upper East region of Ghana in the Bolgatanga municipality. These questionnaires were administered to students during class sessions after consulting the Science Head of Department Bolgatanga Senior High School, students were educated briefly on the purpose of the study.

Results

Table 1 shows the methods used in teaching biology and the number of students who preferred those instructional methods. The choice was taken between lecture method, teacher demonstration, explanation, and hand-on practical.

Table 1: Students preference regarding the teaching methods used in teaching biology

S/N	Teaching method	Number of students	Percentage (%)
1	Lecture method	30	6
2	Teacher demonstration	182	35
3	Teacher explanation	96	19
4	Hand-on practical	210	40

Table 2 shows the perception and the interest that the students had towards the teaching and learning of the subject, Biology at the senior high school level.

Table 2: Students' perception/interest towards biology

S/N	Students perception	Number of students	Percentage (%)
1	Interesting	302	58
2	Depends on instructional method	94	18
3	Not interesting	124	24

Table 3 shows the choices that most teachers use in the classroom in teaching biology and the students' views about them. These are the most successful teaching methods that are used in the classroom.

Table 3: Students' choice of most successful teaching method for teaching biology

S/N	Teaching method	Number of students	Percentage (%)
1	Lecture method	0	0
2	Teacher demonstration	106	20
3	Teacher explanation	120	23
4	Hand-on practical	294	57

Table 4 shows the most popular teaching methods that the teachers use in teaching biology in the classroom.

Table 4: Students' choice of most popular teaching method used by biology teachers

S/N	Teaching method	Number of students	Percentage (%)
1	Lecture method	3	1
2	Teacher demonstration	110	21
3	Teacher explanation	356	68
4	Hand-on practical	51	10

Discussion

Evaluation of the teaching methods in Senior High School biology is essential for improving student learning experiences. The findings from this study highlighted students' preferences, perceptions, and the effectiveness of various methods used in teaching senior high school biology. In Table 1, it is seen that a number of teaching methods are explored in teaching biology, however, 40% (representing 210 students) being the highest preferred hand-on practical as used in teaching biology, followed by teacher explanation, also a method used in teaching biology which consist of 35% (representing 182 students). This preference suggests that students value active learning experiences that involves them directly with the subject matter. Explanation method is also significant as 182 students preferring that method. These findings have revealed the importance of incorporating interactive and visually stimulating elements into biology lessons to enhance student understanding and appreciation of biology concepts.

Table 2 also revealed that 58% of students found biology an interesting subject, 18% depends on factors e.g. depends on the topic, depends on complexity, or the method used, and the remaining 24% found it uninteresting. The majority of students; 302 out of 520 find biology interesting indicates a positive attitude towards biology. Nevertheless, a portion of students (124 out of 520) expressed a lack of interest in biology and 94 students indicated that their interest in biology depends on the instructional method used. This suggests that the teaching method employed by teachers can influence students' attitudes and involvement

with the subject matter. Hence, teachers should try and employ teaching methods that involve students actively during biology lessons. Again, in Table 3, it is clearly seen that students consider hand-on practical as the most successful teaching method in teaching biology. 57% representing 294 students preferred hand-on practices in biology, followed by teacher explanation which also consist of 120 students being 23% of the sample size. Therefore, hands-on practical activities emerged as the most successful method of teaching biology as viewed by students. This result is in alignment with students' preferences highlighting the importance of providing opportunities for active learning and experimentation in biology. Teacher explanation and demonstration methods were also perceived as successful by a few numbers of students, also emphasizing the value of clear explanations in teaching biology. The results from Table 4 also revealed that the most popular teaching method used by teachers in teaching biology is teacher explanation with 356 students of the 520 representing 68% of the sample size, followed by demonstration which comprised of 110 students (represent 21%) of the total sample size.

Conclusion

58% of students-respondents find biology lessons interesting. Most of all during biology lessons students like to watch teachers' presentations and listen to them explaining the material. Students also like laboratory work and group-work. Most of them highly value discussions. Relatively fewer like completing exercises, doing individual work and project work, and filling out worksheets. Least of all students like working with textbooks. Students believe that biology lessons could be made more interesting by introducing more laboratory work, research and experiments as well as conducting lessons in the open air. Students are interested in the recent scientific discoveries in the field of biology and they would love to discuss those during lessons. Methods most frequently applied by teachers are: lecture, explanation, demonstration and discussion. Teachers use also research work, practical tasks and solving problems. Less frequently applied methods are: working with texts, group-work and individual work. Teachers believe that during biology lessons students prefer doing laboratory work and engaging in discussions as well as listening to the teacher and watching presentations and films. They consider that least of all students like completing exercises and working with textbooks.

Teachers try to keep students interested during biology lessons by ensuring such working environment that their students could feel like researchers. Additionally, they consult students and conduct the teaching learning process. Teachers' aim is to establish connection between knowledge and real life and develop interest in processes taking place in the nature. From the results and discussion of the evaluation of teaching methods in Senior High School biology, more light is thrown into students' preferences, perceptions, and the various methods used in teaching biology. It is concluded that hands-on practical activities are highly favored by students and perceived as the most successful method for teaching biology. However, teacher explanation and demonstration methods are also crucial in enhancing student learning experiences in biology. Teachers should incorporate a different instructional strategy of that cater to different learning styles and preferences. In doing so, they can create dynamic and engaging learning environments that promote student interest, understanding, and achievement in biology at the Senior High School level.

Recommendations

Results have indicated that, among other things, integrating IBL, cooperative learning, technology utilization, and idea mapping in biology may present some difficulties. At least at first, it might not be as

time-effective as direct instruction, and some students could refrain from participating fully in class in favour of waiting for the teacher to answer their questions. Some students could find the tasks too challenging, in which case the teacher would need to provide appropriate scaffolding. For this reason, it is advised that when teaching biology, the content- or context-specific approach or teaching technique be utilized. This can improve learning outcomes, engagement, and attitudes in the classroom, but it needs to be implemented carefully and supported by both teachers and students.

Author Contributions

Thomas Nipielim Tindan – Conceptualization, formal analysis, data curation, methodology development, writing, review and editing, validation, investigation, visualization, supervision

Amadu Sharifatu – Conceptualization, formal analysis, data curation, methodology development, writing, review and editing, validation, original draft

Dennis Offei Kwakye – Writing, review and editing, validation, original draft

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