

Impact of Team-Teaching Strategy on Academic Performance and Retention of Biology Concepts among Secondary School Students in Effutu Municipality.

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Abstract. This study examined the impact of team-teaching on academic achievement and retention of biology students in the first year of Winneba Senior High School, Effutu Municipality, Ghana. The reason for this study was the persistent low performance in biology, especially on complex concepts such as the mammalian system, and the need to explore more effective teaching methods beyond the traditional lecture. A quasi-experimental research design was used, based on a random sample of 150 SHS 1 biology students. The sample was divided into experimental and control groups, which were taught using team and conventional single-teacher methods, respectively. The Biology Achievement and Retention Test (BART) was employed to collect data, administered as a pre-test, post-test, and delayed retention test. The instrument was validated by experts and pilot tested, yielding a Cronbach's alpha reliability coefficient of 0.78. Descriptive statistics and independent samples t-tests were used to analyse the data at a 0.05 significance level. The results indicated that students taught using team teaching outperformed their counterparts in academic performance, with the experimental group having a significantly higher mean score ($M = 15.31$) than the control group ($M = 10.56$). Additionally, the experimental group scored significantly higher on retention of biology concepts ($M = 14.01$) than the control group ($M = 8.27$). The study found that team teaching is a more effective instructional method than the traditional lecture approach for improving academic achievement and retention in SHS biology students in the long run. It is recommended that biology teachers and education policymakers encourage the incorporation of team-teaching approaches in biology instruction to enhance learning outcomes.

Keywords: *Team Teaching, Academic Performance, Knowledge Retention, Biology Education. Experimental group*

1. Introduction and background

Education is the basis of national development and it equips a person with knowledge, skills and competencies that he/she needs to make a difference in society. Instructional approaches used in the classroom directly determine the quality of education a nation offers, as they shape the degree of student comprehension, academic performance, and knowledge retention (Anaeto et al., 2016). The quality of education is especially important in science education, as scientific literacy is key to a country's development, health, and technological progress. Biology as one of the most important sciences subjects takes an irreplaceable place in the school curriculum, providing students with basic understanding of living organisms, ecosystems, disease prevention, and

biotechnology that is important not only in real life but also in higher education (Okenyi, 2022).

Although the role of biology education is recognised, the performance of students in the subject at the secondary school level in Sub-Saharan Africa including Ghana is a longstanding cause of worry. According to reports published by the West African Examinations Council (WAEC, 2015-2020), the low academic performance in biology is recorded annually, especially in aspects of the concepts that require abstract thought and critical thinking and the practical use of theoretical knowledge on real-life scenarios. This wider national pattern is replicated in Ghana, where students in the Effutu Municipality are showing signs of problems in learning complex biological concepts and indicate long-term knowledge retention. These issues are exacerbated by the fact that the most common instructional model, the traditional single-teacher model, where a single teacher plans, delivers and assesses all classroom instruction, is predominantly used.

Although common, the approach is quite lecture-driven and teacher-centred and, thus, provides the students with minimal chances to engage in any active process; to ask significant questions and to interact with a complex subject matter meaningfully (Behlol, 2020; Noreen & Rana, 2019). The shortcomings of traditional unidirectional instruction have compelled educational scientists and educators to seek alternative, more cooperative and student-focused methods of teaching. Of these, team teaching has received an increasing scholarly attention as a potential strategy in improving academic performance, and knowledge retention especially in science education. Co-teaching, also known as team teaching, is a method that entails two or more teachers who plan, deliver, and assess learning to a common group of students (Ezenwosu et al., 2015; Goetz et al., 2023). The strategy builds on the complementary nature of various teachers, resulting in a more diverse and dynamic learning experience in which students are exposed to a variety of teaching perspectives and receive more immediate and personalised academic support (Davis, 2021; Haruna, 2021). Team teaching also contributes to the professional development of teachers since teachers can enhance the quality of their instructions through collaborative planning and reflection in the long term (Awodun & Alake, 2023).

The idea of team teaching originated historically in the mid-twentieth century, and the first programme to implement it in 1955 was the supervised internship programme introduced by Harvard University (Hooda & Sharma, 2016). By the 1970s, team teaching was becoming quite popular in the Western world, and its applicability to the modern educational settings has only intensified since then, with studies proving its effectiveness in a variety of subjects and schooling systems. According to Hellier and Davidson, (2018), team-teaching was defined as teamwork of qualified educators who plan, organise and teach with a common goal. Most recently, Jang (2021) highlighted the fact that team teaching is a unique type of instruction that involves teachers in shared decision-making and responsibility as they strive to achieve shared learning objectives.

A number of empirical studies have been conducted to investigate the impacts of team teaching on the student outcomes with a uniform positive outcome. Akpan et al., (2021) demonstrated that team teaching significantly improved student performance in Introductory Technology at the Junior Secondary School level in Akwa Ibom State, Nigeria, with students taught in teams outperforming those taught individually. Ajayi and Ayeni (2019) also found that team teaching resulted in much better achievement of biology among students in Lagos State, Nigeria, than in students taught using the traditional single-teacher method. As far as knowledge retention is concerned, Akinbode et al. (2020) established that the use of team-teaching enhanced students' retention of secondary school biology concepts, such as cell biology and human physiology, in Ibadan. Zhang et al (2022) generalized these results to the international level, revealing

that team teaching improved the understanding and retention of ecology and genetics concepts in students studying in rural schools in China.

Additional indicators of the Nigerian context are the study by Abdullahi et al., (2026), which indicated that students who studied the Nervous System in Biology taught using Team-Based Learning scored significantly higher and remembered content better than students taught using the traditional lecture approach in the state of Niger. Awodun and Alake (2023) also affirmed that team teaching had a significant effect on academic performance in Basic Science among Junior students. The students in Ekiti State in Secondary School, where gender was identified as a non-significant variable in the gains in the performance. Jang (2021) showed that students taught Biology using the team-teaching method scored significantly higher on the post-test compared with students taught using the conventional single-teacher approach, with a large effect size supporting the collaborative teaching method. In the recent studies, Iyabo and Olajumoke (2025) presented very strong evidence in Ogun State, Nigeria, on which Team-Based Learning had a statistically significant and large effect size ($\eta^2 = 0.745$), meaning it accounted for about 74.5% of the variance in the post-test performance of the Senior secondary students in Ecology.

Collectively, these results highlight the pedagogical importance of team teaching in science education and provide empirical evidence to support the increased use of team teaching. A significant learning is indicated by retention which is the ability to recall and apply learned information after a short period of time (Ibok & Unoh, 2019). In a team teaching, students will receive deeper encoding of information, they will be more involved, engaged and willing to collaborate and learn in multiple perspectives, and students will be more willing to remember the information in later assessment. By contrast, the shallow learning combined with high turnover rate has been blamed time and again on the current, passive and teacher-centred approach to teaching (Goetz et al., 2023).

Although the traditional single teacher model is being adopted to run the secondary schools in the Central Region of Ghana, the teaching of biology still has a high dependency ratio and the student's achievement and retention in the complex aspects of biology is still far from the desired standards. Although there is a growing body of international and Nigerian evidence to support the effectiveness of team teaching, considerable lack of empirical research to investigate the effects of team teaching in the Ghanaian secondary school system. The literature is lacking in this knowledge, which is the impetus behind the present research. This research, thus, aims at exploring the role that team teaching strategy plays in academic performance and retention of biology concepts in secondary school students in the Effutu Municipality, Ghana. The study will provide empirically based information to guide policy and practice in teaching biology in Ghanaian secondary schools by exploring the impact of a collaborative, multi-instructor approach on students' understanding and long-term retention of biological material. The outcomes will be incorporated into the overall science teachers' professional development program aimed at improving science teaching and learning outcomes and will consider team teaching as an alternative pedagogical approach to the existing single-teacher approach in the municipality's schools.

1.1 Research objectives

- What is the difference in academic performance between secondary school students taught mammalian system using team teaching and those taught with the conventional (lecture method) approach?

- What is the difference in retention between secondary school students taught mammalian system concepts using team teaching and those taught with the conventional (lecture method) approach?

1.2 Hypothesis

The following null hypotheses were stated at 0.05 confidence level, to carry out the study:

H₀₁: There is no significant difference in the academic performance of secondary school biology students taught mammalian system concepts using team teaching compared to those taught using the conventional lecture approach.

H₀₂: There is no significant difference in the retention of mammalian system concepts among secondary school biology students taught using team teaching compared to those taught using the conventional lecture approach.

2. Research design and methods

2.1 Research Design

The study focuses on the senior high school (SHS 1) biology students of one senior high school (SHS) in Effutu Municipality Central Region in Ghana and its limited focus was on students studying biology as one of the elective science subjects. This study was quasi-experimental research design, which was appropriate for the study because the researcher could not use a full randomisation because of the use of intact classroom groups. It was determined that this would be a suitable approach because it would provide an opportunity to investigate the effectiveness of the intervention in a real classroom setting where it would be impractical to randomize the students, thus increasing the ecological validity of the findings.

2.2 Population and Sampling

The number of the target population for the study was a sample of all the students in the SHS 1 biology program of one senior high school in the academic year 2024/2025, which totalled 600 students. Stratified random sampling of 150 students from this population was used to obtain a sample that has a balance of male and female students. The sample size was 80 male students and 70 female students who were taken from the existing classes of the school. The stratified approach was used to obtain good gender balance in the study to improve the representativeness and generalisability of the results in the study population.

2.3 Research Instruments

The researcher created an instrument for measuring academic achievement and retention, called the Biology Achievement and Retention Test (BART). The instrument consisted of 20 multiple-choice questions that covered the objectives of the biology Syllabus for the SHS 1, with a concentration on the topic of the mammalian system. They were arranged in the sequence of four alternatives (A-D) and the test was presented as a pre-test, post-test and a delayed retention test at the data collection points. Also, a small demographic survey was conducted to collect the following background information about the respondents: Age and Gender.

2.4 Data Collection Procedure

The students sampled (150) were split into two groups, experimental group (75) and a control group (75). The experimental group was taught biology based on team teaching method which was a method that two qualified biology teachers designed, delivered, and evaluated the same set of students at the same time. The control group was taught the

traditional single teacher approach, which is the standard approach for teaching in the current situation at one senior high school. The two groups were randomly chosen from two intact classes to minimize contamination between treatment groups. It was stressed that both groups should be given the same amount of instructional time and the same content of the program, except in the method of instruction used.

2.5 Data Analysis

Descriptive and inferential statistics were used to analyse the data collected in the pre-test, post-test and retention test. The research questions were answered by calculating descriptive statistics in terms of mean scores and standard deviations. To test the null hypotheses by determining whether or not the statistically significant differences between the academic performance of the team teaching and conventional teaching groups existed, independent samples t-tests were used at the level of 0.05. All statistical analyses were performed with the help of the Statistical Package for the Social Sciences (SPSS) Version 25.

2.6 Instrument Validity and Reliability.

The BART was validated by expert and peer review. It was subjected to the scrutiny of experienced teachers of biology and science education specialists for content coverage, clarity of items, language and correspondence with the SHS 1 biology curriculum objectives. The outcome of these evaluators were incorporated into the final instrument and there was satisfactory interrater agreement (80%), which is considered as acceptable. The pilot study was then conducted with a sample of SHS 1 biology in a school in the Effutu Municipality (which was not part of the main study) to ascertain clarity and reliability. The reliability coefficient of Cronbach's alpha for the instrument obtained was 0.78, which was higher than the minimum value of 0.70, so that the instrument had good internal consistency.

2.7 Ethical Considerations

The study was conducted after obtaining ethical clearance from the Ghana Education Service (GES), the administration of the Effutu Municipal Education Directorate, and the administration of a senior high school. Prior to the commencement of data collection, all participants and their guardians received an informed consent letter detailing the purpose, procedures and voluntary nature of the study. Informed consent was obtained in writing prior to the start of data collection from participants and from all their guardians. The ethical principles of anonymity, confidentiality, and free participation were upheld throughout data collection, analysis, and reporting.

3. Findings

Research Question 1: What is the difference in academic performance between secondary school students taught mammalian system using team teaching and those taught with the conventional (lecture method) approach.

To answer this research question, the mean academic performance scores and standard deviations for both the team teaching (Experimental) and conventional (Control) groups were calculated from the post test results.

Table 1: Mean Academic Performance Scores of Team Teaching and Conventional Groups.

Group	N	Mean	Std.Dev
Experimental	75	15.31	1.20
Control	75	10.56	1.08

Source: Field data, 2026

The descriptive statistics of academic performance on the post-test indicate that the experimental group (N = 75) taught by the team-teaching strategy has a mean post-test score of 15.31 out of 20 (SD = 1.20) which is a 76.5 percent accuracy. Conversely, the control group, which received the traditional single-teacher method (N = 75), had an average of 10.56/ 20 (SD = 1.08) or 52.8 percent accuracy. The average of 4.75-mark difference in favour of the experimental group shows that learners who were taught using team teaching were significantly better in biology in the post-test, compared to the students in the conventional group. This indicates that team teaching has a positive influence on studying performance among biology concepts in students.

Table 2: Mean Retention Scores of Team Teaching and Conventional Groups.

Group	N	Mean	Std.Dev
Experimental	75	14.01	1.56
Control	75	8.27	1.46

Source: Field data, 2026

Table 2 shows the average retention score of the two groups in Biology Achievement and Retention Test (BART) that was done three weeks after the end of the instruction. The experimental group, whose teaching strategy was the team teaching one (N = 75), achieved a mean score of 14.01 (SD = 1.56) in retention which is equivalent to a retention rate of about 70.1 percent of the overall marks. The control group, which was taught by the traditional single-teacher approach (N = 75), had a significantly smaller mean retention score of 8.27 (SD = 1.46), which is the retention rate of about 41.3 percent. The mean difference of 5.75 marks between the experimental and the control groups in favour of the former group implies that students who were taught by team teaching retained much more biological knowledge at the end of the three weeks period compared to those in the control group. This is shown by the slightly larger standard deviation of the experimental group (SD = 1.56) over the control group (SD = 1.46), as a consequence of the natural variation of individual learners in the rate of forgetting, which is consistent with anticipated results of retention studies. A preliminary analysis of these means indicates that the team-teaching technique is positively affecting the retention of biology concepts among SHS 1 students of Winneba Senior High School in the long term with the experimental group significantly doing better than the control group.

Hypothesis 1

H₀₁: There is no significant difference in academic performance of secondary school biology student taught mammalian system concepts using team teaching and those taught using conventional (single teacher) approach

To test this hypothesis, an Independent Samples t-test was conducted to compare the mean academic performance scores of the experimental (team teaching) group and the control (conventional) group on the post-test. The significance level (α) was set at 0.05.

Table 3: Independent Samples t-test to compare the academic performance

Group	N	Mean	SD	df	t-value	P-value	Decision
Experimental	75	15.31	1.20	148	25.492	<.001	Rejected
Control Group	75	10.56	1.08				

Source: Field data, 2026

Table 3 shows the outcome of the independent samples t-test that was used to test whether a statistically significant difference existed in the academic performance of students taught using the team-teaching strategy and those taught through the traditional single-teacher approach on the post-test. The group that was taught using the team teaching method (N = 75) had a mean post-test score of 15.31 (SD =1.20), and the group that was taught using the conventional approach (N = 75) had a significantly lower mean post-test score of 10.56 (SD = 1.08). The average difference of 4.75 marks between the two groups determined using the post-test scores gives us a first hint that students in the team teaching group had better performance in biology in comparison with their counterparts in the conventional group.

To find out whether this difference was statistically significant, independent samples t-test was performed at a level of significance of 0.05. The test result obtained was $t(148) = 25.492$, $p < .001$. As the p-value obtained is significantly less than the required significance level of 0.05, the null hypothesis according to which the performance of the students in the secondary schools in the study, when it comes to teaching about the mammalian system, is significantly different when the teacher is using team teaching compared to when the teacher was using the traditional single-teacher method is rejected. This conclusion shows that the variation in the means of post-test scores between the experimental and control groups was not chance but an actual and direct effect of the instructional strategy used.

Hypothesis 2

H_{02} : There is no significant difference in retention of secondary school biology student taught mammalian system concepts using team teaching and those taught using conventional (single teacher) approach.

To test this hypothesis, an Independent Samples t-test was conducted to compare the mean retention scores of the experimental (team teaching) group and the control (conventional) group on the post- test for retention. The significance level (α) was maintained at 0.05.

Table 4: Independent Samples t-test to compare the Retention Scores of the experimental and Control Groups.

Group	N	Mean	SD	Df	t-value	P-value	Decision
Experimental	75	14.01	1.56	148	23.298	< .001	Rejected
Control Group	75	8.27	1.46				

Source: Field data, 2026

The findings of the independent samples t-test used to ascertain the presence of a statistically significant difference between the retention scores of the students taught the team teaching strategy and those taught the conventional single-teacher strategy are in table 4. The experimental group (N = 75) had a mean retention score of 14.01 (SD = 1.56) and the control group (N = 75) had a lower mean retention score of 8.27 (SD = 1.46). The independent samples t-test showed that the retention scores in the two groups had a statistically significant difference ($t(148) = 23.298$, $p < .001$). The p-value of less than .001 is less than the level of significance of 0.05 and thus, the null hypothesis that there was no significant difference between the retention of biology concepts taught using team teaching and that taught using the conventional approach is rejected. These findings show that the team teaching approach led to a much higher rate of knowledge retention among SHS 1 Biology students at the Winneba Senior High School than the traditional one, which proves that team teaching is a more effective teaching approach that can be used to enhance long term retention of biological concepts.

4. Discussion of findings

The results of this study are discussed in relation to the two hypotheses, which are tested with references to the existing empirical literature on team teaching and its impacts on academic achievement and knowledge acquisition in biology education.

The initial discovery of this research is that the students that were taught the mammalian system in biology by applying the team teaching strategy fared much better than the students that were taught by the use of the conventional lecture approach. The mean score in the experimental group (15.31 SD = 1.20) was 76.5% accurate, as opposed to 10.56 (SD = 1.08) accurate in the control group. The first null hypothesis was rejected as the independent samples t-test proved the difference between the two to be statistically significant ($t(148) = 25.492$, $p < .001$). Similarly, the second finding shows that the experimental group retained much more biological knowledge than the control one, with a mean retention score of 14.01 (SD = 1.56) in comparison to the control group (8.27 (SD = 1.46) and that also the t-test shows that there is a statistically significant difference between both groups ($t(148) = 23$). The average difference of 5.75 marks on the retention test in favour of the experimental group, which was significantly higher than the difference of 4.75 marks on the retention test at post-test, only serves to emphasize the increasing and long lasting benefit of team teaching over the traditional method in fostering long-term knowledge retention among SHS 1 Biology students at one senior high school.

These results align with the findings of Goetz et al. (2023), who established that team teaching has a significant effect on academic performance and retention of biological concepts among secondary school biology students in Sokoto State, Nigeria. The current results are also consistent with Akpan et al., (2021), who established that team teaching increased student performance significantly in Introductory Technology among students in the Junior Secondary School in Akwa Ibom State, Nigeria, and Ajayi and Ayeni (2019), who found that team teaching resulted in much better biology assessment scores among students in the senior secondary school in Lagos State. In terms of retention, in particular, the results are similar to those of Akinbode et al., (2020), who found that team teaching made students better retain the biological concepts, especially cell biology and human physiology, among secondary schools students in Ibadan et al. (2022), who reached a similar conclusion, as team teaching improved the understanding and retention of The high performance/retention of the experimental group in the current study is explained by the collaborative and multi-perspectival character of team instruction that provides students with different teaching methods, immediate feedback, and active involvement in the lessons, thus, allowing them to think deeper and to encode biological material in the long-term memory more effectively (Haruna, 2021; Davis, 2021; Ibok & Unoh, 2022). In contrast, the traditional lecture style, which is passive and teacher-centred, hinders students' active participation, weakens the memory effect, and is prone to time constraints (Behlol, 2020; Noreen & Rana, 2019).

However, the findings of the present study do not support the findings of Ahmed et al. (2022), who found no significant difference in the achievement of team teaching. The difference indicates that there are positive aspects of team teaching, but there is no certainty that it will be effective, since if team teaching is not applied in a consistent and effective manner, the gains may be restricted.

The aggregate results of this research suggest that team teaching is a better pedagogical approach than the traditional lecture method to improve both the short-term academic achievement and long-term knowledge acquisition of SHS 1 Biology students at one senior high school in the Effutu Municipality of Ghana, which adds to the existing literature of this topic that supports the wider use of collaborative teaching methods to teach science in secondary schools.

5. Recommendations

Based on the study findings, the following recommendations were made:

Biology teachers in senior high schools should utilise team teaching methods more frequently, especially when teaching complex biological topics, as a means of enhancing academic performance and retention among students

School authorities and educators must also institute periodic in-service training, workshops, and seminars to help biology teachers acquire the skills and collaborative competencies needed to implement team teaching effectively.

The Municipal Education Directorate and curriculum planners must include team teaching in instructional policy frameworks and provide institutional support, such as flexibility in scheduling and resource allocation, to enable its effective application in science instruction in secondary schools.

6. Conclusion

The study has conclusively established that team teaching is a more effective approach for improving the academic performance and retention of biology concepts among SHS 1 students at one senior high school in the Effutu Municipality. Students who were exposed to team teaching had better academic performance and were better able to retain biological knowledge than students who were taught using the traditional lecture method. Team teaching, in its collaborative form, fosters student participation, instructional diversity, immediate feedback, and conceptual understanding by integrating the knowledge of a group of teachers. These benefits can be seen in team teaching, an extremely effective pedagogical approach for enhancing the outcomes of science education. Since the team-teaching group scored higher on both performance and retention outcome measures, the research provides a significant empirical basis for implementing team teaching as a feasible instructional method to improve the teaching of biology in Ghanaian secondary schools.

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Use of AI: This study used AI (Perplexity) for language refinement and paraphrasing

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