

Effect of Cooperative Learning Strategy on Biology Students' Academic Performance in Senior Secondary School in Rivers State.

ABSTRACT

Aims: This study investigated the effect of cooperative learning strategy on students' academic performance in biology in Senior Secondary Schools in Rivers State.

Study design: Quasi-experimental design.

Place and Duration of Study: Port Harcourt, Rivers State, located in the South-South geopolitical zone of Nigeria, West Africa.

Methodology: The population consist of 2,150 Senior Secondary three biology students out of which 120 students of intact classes in selected schools formed the sample. Three research questions and three hypotheses guided the study. The instrument used in data collection was Biology Performance Test developed by the researchers. The test items were selected from standardized past questions of Senior School Certificate Examinations conducted by The West African Examinations Council and validated by two lecturers in Science Education and one lecturer in Measurement and Evaluation. The reliability coefficient was determined by test retest method using Pearson Product Moment Correlation Coefficient to be 0.78. Mean, standard deviation and t-test at .05 level of significance were used for data analysis.

Results: The results of the study revealed a significant difference in performance between students taught biology with cooperative learning strategy and those taught with conventional lecture method. Students in the experimental group where cooperative learning teaching strategy was adopted scored significantly higher in biology performance test than those in lecture method group. There was no significant difference in performance based on gender (male and female) and school type (public or private).

Conclusion: Cooperative learning strategy is more effective in teaching and enhances biology students' performance than the conventional lecture method.

Keywords: cooperative learning, lecture method, biology, academic performance senior secondary school

1. INTRODUCTION

Biology as a subject is the science of life and deals with the study of living things. The knowledge of biology prepares students to apply basic scientific concepts in dealing with numerous issues encountered on daily basis and comprehend the natural world. There are three main divisions of biology – ecology, morphology (organism structural aspects) and physiology (organism functional aspects). Several methods are available for teaching biology in senior secondary schools. The suitability of a given method depends on the concept in

24 consideration and works together with other components of learning to enhance students
25 understanding and performance in examinations. One of the methods that is widely used by
26 teachers is cooperative learning.

27

28 Cooperative learning is a student-centered instructor-facilitated instructional strategy in
29 which small group of students are responsible for their own learning and learning of all group
30 members [1]. It is an instructional strategy where the teachers organize students into small
31 groups which work together and help one another to learn academic content and reach a
32 common goal. The teacher maintains and controls the learning environment, designs
33 learning activities and social interactions, and structure work teams. In this strategy every
34 student participates in the team and there is cooperation among team members as well as
35 collective effort which facilitates understanding of subject matter. That is why Slavin [2]
36 argues that a critical element of cooperative learning is group team work and team goals.
37 Cooperative learning can be formal or informal, but often involves specific instructor
38 intervention to maximize student interaction and learning. In formal cooperative learning,
39 students work together for one or more class periods to complete a joint task or assignment,
40 while in the informal cooperative learning small, temporary, ad-hoc groups of two to four
41 students work together for brief periods in a class, typically up to one class period, to answer
42 questions or respond to prompts posed by the instructor.

43

44 The advantages of cooperative learning are numerous. First, cooperative learning uses both
45 goal interdependence and resource interdependence to ensure interaction and
46 communication among group members. Changing the role of the instructor from lecturing to
47 facilitating the groups helps foster this social environment for students to learn through
48 interaction. Cooperative learning develops more friendly relation of students with their
49 classmates and provide for development of social and communication skills, increased
50 tolerance and acceptance of diversity. It promotes active participation of students in the

51 process of knowledge construction which in turns help to develop their interest in the subject
52 [3]. Cooperation in learning is different from competition. Cooperation which is positive
53 interdependence, results in resourceful interaction during which individuals facilitates each
54 other's learning effort. On the other hand, competition which is negative interdependence,
55 usually results in oppositional interaction, during which individuals obstruct each other's
56 learning effort leading to decreased achievement and negative relationship. Cooperative
57 learning is designed to offer incentives to group of students who work together as a group to
58 achieve a group task as opposed to non-cooperative activity where individuals are not
59 intrinsically motivated to help their classmate towards a common goal. Cooperative learning
60 finds its usefulness in the teaching of various science subjects including biology at both the
61 secondary and tertiary levels of education.

62

63 There are different methods and models of cooperative learning. Cooperative learning
64 methods can be classified into two main categories: structured team work and informal
65 group method. The structured team learning involves rewards based on learning progress of
66 their members and is characterized by individual's accountability which means that success
67 depends on individuals learning not group product. Models of structured team learning are
68 Student Teams–Achievement-Division (STAD), Teams–Games-Tournament((TGT) and
69 Cooperative Integrated Reading and Composition (CIRC). The informal group method
70 focuses more on social dynamic of, projects, and discussion than mastery of well specified
71 content. Examples of models of informal group learning methods are Jigsaw, learning
72 together, think-pair-share and group discussion [1].

73 **Student Teams-Achievement Division (STAD):** This model is most appropriate for
74 teaching well-defined objectives, such as mathematical computations and applications,
75 language usage and mechanics, geography and map skills, and science facts and concepts
76 [2]. Student Teams-Achievement Division model (STAD) proposed by Slavin in 1995
77 consists of four steps which include, whole-class presentation, group discussion, test and

78 group recognition

79 **(1) Whole-class presentation:** At this level, teachers present materials to the whole class
80 with the aid of technology and questioning techniques as used in any other teaching
81 methods.

82 **(2) Group discussion:** Afterwards, heterogeneous teams of four are formed, based on
83 students' performance level, ability, sex, ethnicity and social economic status, to study the
84 materials and do the worksheets. Students work within their teams to make sure that all
85 team members have mastered the lesson by questioning and giving elaborated
86 explanations, as they know they are interdependent and accountable for themselves and the
87 whole group

88 **(3) Test:** After the group discussion, all students take individual test on the material, at which
89 time they cannot help one another. Usually, the quizzes are in the form of multiple-choice
90 questions. Students test scores are compared to their own past averages, and points are
91 awarded based on the degree to which students can meet or exceed their own earlier
92 performances. The difference between the test score and the base score is then checked
93 against the Improvement Score Conversion Table can be used to determine the individual
94 improvement score which is then entered into the Test Score.

95 **(4) Group recognition:** These points are then summed to form team scores, the group with
96 the highest average group improvement score receives a group reward. Alternatively, any
97 group which has its group score reaching a pre-determined level can receive a group reward
98 The whole cycle of activities, from teachers' presentation to team practice to quiz, usually
99 takes 3-5 class period. In Cooperative learning environment there is positive
100 interdependence and students perceive that better performance by individuals produces
101 better performance by the entire group. [4] proposed several features that can help these
102 groups work well:

- 103 • The instructor defines the learning objectives for the activity and assigns students to
104 groups.
- 105 • The groups are typically heterogeneous, with particular attention to the skills that are
106 needed for success in the task.
- 107 • Within the groups, students may be assigned specific roles, with the instructor
108 communicating the criteria for success and the types of social skills that will be needed.
- 109 • Importantly, the instructor continues to play an active role during the groups' work,
110 monitoring the work and evaluating group and individual performance.
- 111 • Instructors also encourage groups to reflect on their interactions to identify potential
112 improvements for future group work.

113

114 Motivational and social cohesion theories provide theoretical basis for this study. The two
115 theories focus on the interactions among groups of students and holding these interactions
116 themselves for better learning and achievement. The motivational perspective presumes that
117 motivation is the single most important part of learning process asserting that motivation
118 motivates self-interest. The scholars holding to this believe focus on reward or goal structure
119 under which students operate, even going so far to suggest that in some circumstance's
120 interactions may not be necessary for the benefits of cooperate goal structure to manifest.
121 By contrast the social cohesion perspective known as social interdependence theory
122 proposed by [5] in 1989 suggest that the effect of cooperative learning is largely dependent
123 upon the cohesiveness of the group. In this perspective, students help each other to learn
124 because they care about the group and its members and come to derive benefit of self-
125 identity from group membership [6]. There are two types of social interdependence.
126 Positive interdependence which occurs when the actions of individuals promote the
127 achievement of joint goals and negative interdependence which occurs when the actions of
128 individuals obstruct the achievement of each other's goals. Cooperative learning follows the
129 idea that groups work together to learn or solve a problem. Conflict occurs in the process of

130 cooperation between one individual and another [7]. This conflict creates cognitive
131 dissonance which in turns encourages learning in different perspective and cognitive
132 development which accelerates students' intellectual development by forcing them to reach
133 a consensus with other students whose points of view differ on the educational task in
134 consideration [8]. Furthermore, [9] posited that human mental functions and
135 accomplishments have their origins in social relationships, and that knowledge is socially
136 constructed through cooperative efforts to learn and solve problems.

137

138 Several studies have explored use of cooperative learning strategy and its effect on
139 students' academic performance. For instance, [10] investigated the effect of cooperative
140 learning strategy on biology students' academic achievement in Yola educational zone of
141 Adamawa State, Nigeria. The sample of the study was 372 biology students and Biology
142 Achievement Test (BAT) the instrument. Results of the study revealed a significant
143 difference between performance of students in experimental group taught with cooperative
144 learning strategy and control groups taught with conventional lecture method in favour of
145 experimental group. Students in the experimental group performed better than those in
146 lecture method group. Further evidence from the study showed that cooperative learning
147 strategy produced positive effect on students' academic achievement. [11] investigated the
148 effects of cooperative learning strategy on biology achievement of secondary school
149 students in Machakos District, Kenya using 183 students as sample and Solomon 4 design
150 with biology achievement test as instrument. [22] Results of the study revealed that
151 cooperative learning strategy caused significantly higher mean achievement scores
152 compared to regular teaching method. Students who were taught through cooperative
153 learning strategy attained significantly higher achievement scores in biology achievement
154 test compared to those who were taught through the regular teaching method. Further
155 findings revealed that gender had no significant influence on achievement.

156

157 [12] investigated the effect of cooperative learning strategy on students' acquisition and
158 practice of scientific skills using 120 grade 7 Lebanese biology students. Results of the study
159 showed that cooperative learning strategy had a significant effect on students' achievement
160 in learning and practicing scientific skills. Further findings revealed that cooperative learning
161 improve students thinking since it allows students to communicate actively with each other.
162 [13] examined the effect of cooperative learning instructional strategy on senior secondary
163 school students' achievement in biology in Anambra State Nigeria. The study adopted quasi-
164 experimental design using 111 seniors secondary (SS1) students in Nnewi Local
165 Government Area of Anambra State as sample and Biology Achievement Test (BAT) as
166 instrument. The results of the study revealed that students taught using cooperative learning
167 instructional strategy performed better in biology achievement test than those taught using
168 lecture method of instruction. There was no interaction between method and gender on
169 students' biology achievement test.

170

171 [14] evaluated the impact of cooperative learning strategies on students' academic
172 achievement and laboratory proficiency in biology subject in selected rural schools in
173 Ethiopia. The researcher utilized 369 biology students and 18 biology teachers for the study.
174 Finding of the study revealed a considerable increment in biology achievement and
175 laboratory competence in students exposed to cooperative learning strategy. Further
176 evidence showed that there was significant relationship between students' academic
177 achievement and laboratory proficiency. [15] examined the effect of cooperative learning
178 method on biology achievement of rural and urban students at Secondary School Level in
179 India. 63 class IX students and Biology Achievement Test (BAT) were used as sample and
180 instrument respectively. The results of the study revealed that cooperative learning strategy
181 method enhanced students' achievement in biology in favour of rural students. Further
182 finding revealed that cooperative learning strategy had positive effect on every student
183 irrespective of their locality. Students enjoyed group discussion, team work and group

184 debate. [16] examined the effect of gender on the achievement of students in biology using
185 the jigsaw method and 87 students in SS1 in a secondary school. Results of the study
186 showed that there was a significant difference between the mean scores of male and female
187 students in biology in favor of the males. This showed that the males gained more from the
188 jigsaw method compared with the females.

189

190 Cooperative learning strategy has also been explored in other subject areas. [17] for
191 example studied the effectiveness of cooperative learning strategies on Nigeria Junior
192 Secondary Students academic achievement in Basic Science. The sample was 120 students
193 and instruments Achievement Test for Basic Science students (ATBSS) and Basic Science
194 Anxiety Scale (BSAS). The results of the study showed that two cooperative learning
195 strategies (learning together and jig-saw II groups) had higher immediate and delayed
196 academic achievement mean score than the students in the conventional lecture group.
197 Learning together and jig-saw II cooperative teaching strategies were found to be more
198 effective in enhancing students' academic achievement and retention of information in basic
199 science more than the use of conventional lecture. According to them when friendliness is
200 established, students are motivated to learn and are more confident to ask questions from
201 one another for better understanding of the task being learnt. [18] examined how the
202 adoption of cooperative learning as instructional strategy for teaching integrated science
203 influences students' achievement and attitude towards the subject. The results indicated
204 significant higher achievement test scores of students in cooperative learning group than
205 those in the conventional classroom. [3] examined cooperative learning strategy and
206 students' academic achievement in home economics in Oredo Local Government Area of
207 Edo State. The sample was 169 home economics students and instrument Home
208 Economics Achievement Test (HEAT) the instrument. Findings of the study revealed that
209 there was a significant difference in the achievement of home economics between students
210 exposed to cooperative learning strategy and lecture method.

211

212 [19] investigated the effects of cooperative learning on the academic achievement and
213 retention of 110 first –year primary education students of Giang University, Vietnam
214 towards the psychology subject and found that students who were instructed using
215 cooperative learning strategy achieved significantly higher scores on the achievement test
216 and knowledge retention than students who were instructed using lecture-based teaching.
217 The study supported the effectiveness of cooperative learning in Vietnamese higher
218 education. [20] in their study to determine the effect of cooperative learning on the
219 academic achievement and self-concept of the students at elementary school level using 40
220 students in the 5th class discovered that cooperative learning method was better than lecture
221 method in development of academic achievement and academic self-concept of students.
222 Across the gender, self-concept of female was significantly better than the male while there
223 was no difference on academic achievement across gender and class. There was no
224 significant difference in achievement test scores between male and female students in
225 cooperative learning group and interaction effect between sex, and ability, sex and method,
226 ability and method among method, sex, and ability and achievement.

227

228 **1.1 Statement of the Problem**

229 Despite the numerous applications of biology in provision of basic need of man, poor
230 performance of biology students in Senior School Certificate Examinations has persisted
231 over the years. Instructional materials and other learning facilities which constitutes the
232 school environment blended with appropriate teaching method facilitate teaching and
233 learning process. The use of inappropriate method in teaching biology renders adequate
234 facilities unproductive and promote concept difficult, which constitutes a problem. Several
235 attempts geared toward the discovery of appropriate method for optimum learning of biology
236 have been made. Specifically, studies have considered the use of different models of
237 cooperative learning such as jig saw to establish the effect of cooperative learning on

238 students' academic performance without looking at the Student Team- Achievement Division
239 (STAD) model, thereby leaving a gap in knowledge. This study is therefore carried out to fill
240 this gap in knowledge by investigating the effect of Student Teams-Achievement Division
241 (STAD) model of cooperative learning on students' academic performance in biology in
242 Senior Secondary Schools in Rivers State.

243 **1.2 Purpose of the Study**

244 This study was carried out to investigate the effect of cooperative learning strategy on
245 students' academic performance in biology in Senior Secondary Schools in Rivers State.
246 Specifically, this study tends to provide answers to the following questions:

247 **1.3 Research Questions**

248 The following research questions were proposed to guide the study.

- 249 1. What is the difference between the performance of students taught biology using
250 cooperative learning strategy and those taught using conventional lecture method in
251 Senior Secondary Schools in Rivers State?
- 252 2. What is the difference between the performance of male and female students taught
253 biology using cooperative learning strategy in Senior Secondary Schools in Rivers
254 State?
- 255 3. What is the difference between the performance of public and private school
256 students taught biology using cooperative learning strategy in senior secondary
257 schools in Rivers State?

258 **1.4 Hypotheses**

259 The following hypotheses were developed to answer the research questions.

- 260 **HO₁.** There is no significant difference between the mean performance of students taught
261 biology using cooperative learning strategy and those taught using conventional
262 lecture method in senior secondary schools in Rivers State.

263 **HO₂**. There is no significant difference between the performance of male and female
264 students taught biology using cooperative learning strategy in senior secondary
265 schools in Rivers State.

266 **HO₃**. There is no significant difference between the performance of public and private
267 school students taught biology using cooperative learning strategy in senior
268 secondary schools in Rivers State.

269

270 **2. MATERIAL AND METHODS**

271

272 This study adopted quasi- experimental design. The population consist of 1,897 Senior
273 Secondary 3 biology students in 25 Senior Secondary Schools of Port Harcourt Local
274 Government Area of Rivers State. 102 Senior Secondary 3 biology students comprising of
275 47 male and 55 female students of intact classes in the selected schools formed the sample.
276 53 students were in the experimental group and 49 students in the control group. The
277 selected classes were randomly assigned experimental and control group in each school.
278 The instrument was Biology Performance Test (BPT) developed by the researcher which
279 contains 25 multiple choice questions based on the contents of the Senior Secondary School
280 Biology Curriculum. The items were selected from the West African Examinations Council
281 Senior Secondary School Certificates Examination (WASSCE) past question papers. The
282 instrument was given to two lecturers in science Education Department and one lecture in
283 Measurement and Evaluation for face and content validation while the reliability coefficient
284 was determined by test –retest method and calculated to be of 0.78 using Spearmen’s Rank
285 Order Correlation Coefficient. Mean, Standard Deviation and t-test of independent were
286 statistical tools used for data analysis and hypotheses tested at .05 level of significance.
287 Students in the experimental group were taught using cooperative learning strategy and
288 those in control group were taught using conventional lecture method. The lesson lasted for

289 4 weeks of 2 units each. Before treatment, the instrument was administered to the
290 experimental and control group as pre-test and after treatment as post-test.

291

292 3. RESULTS

293

294 3.1

295 Research Question 1.

296 What is the difference between the performance of students taught biology using
297 cooperative learning strategy and those taught using conventional lecture method in Senior
298 Secondary Schools in Rivers State?

299

300 From Table 1, the pretest mean score of the experimental and control groups were 38.20
301 and 39.50 while the posttest mean performance score of experimental and control groups
302 were 77.5 and 42.30. Students in the cooperative learning classroom had higher mean
303 performance score than those in the lecture method.

304

305 **Table 1: Mean score of students in biology before and after lesson using cooperative**
306 **learning strategy and lecture method.**

307

Teaching method	N	Pretest mean	Posttest mean	Mean difference (within)
Cooperative learning	53	38.20	58.50	20.30
Lecture	49	39.20.	45.30	6.10
Mean difference (between)		1.00	13.20	14.20

308

309

310 3.2 Research Question 2

311

312 What is the difference between the performance of male and female students taught biology
313 using cooperative learning strategy in Senior Secondary Schools in Rivers State?

314

315 From the Results in table 2, the mean score of male students taught biology using
 316 cooperative learning strategy was 53.25 with standard deviations of 1.98 while those of their
 317 female counterparts was 45.39 with standard deviations of 2.13. Male students taught
 318 biology using cooperative learning strategy had higher mean performance score and higher
 319 standard deviation than public secondary school students.

320

321 **Table 2. Mean score of male and female students taught biology using cooperative**
 322 **learning strategy.**

Gender	N	\bar{X}	SD
Male	31	53.25	1.98
Female	22	45.39	2.13

323

324

325

326

3.3 Research Question 3.

327 What is the difference between the performance of public and private school students taught
 328 biology using cooperative learning strategy in senior secondary schools in Rivers State?

329

330 From the Results in table 3, the posttest mean score of private senior secondary school
 331 students taught biology using cooperative learning teaching strategy was 68.25 while those
 332 of their counterparts in public secondary schools was 55.63. students in private secondary
 333 school taught biology using cooperative learning strategy had higher mean performance
 334 score than public secondary school students.

335

336 **Table 3. Mean and standard deviation of the performance score of public and private**
 337 **school students taught biology with cooperative learning strategy.**

338

School Type	N	\bar{X}	SD
Private	25	68.25	2.16
Public	28	55.63	1.21

339 **3.4**

340

341 **Hypothesis 1**

342 There is no significant difference between the mean performance of students taught biology
343 using cooperative learning strategy and those taught using conventional lecture method in
344 senior secondary schools in Rivers State.

345

346 From Table 4, the t-calculate value of $t = 2.342$ which is greater than the critical or table
347 of 1.960 ($p < 0.05$). Therefore, the null hypothesis which states that there is no significant
348 difference in performance between students taught biology using cooperative learning
349 strategy and those taught using conventional lecture method is rejected. This mean that
350 there is a significant difference in performance between students taught biology using
351 cooperative learning strategy and those taught using conventional lecture method.

352

353 **Table 4. t-test analysis of post-test mean performance score of students taught**
354 **biology using cooperative learning strategy and those taught using conventional**
355 **lecture method.**

356

Teaching Strategy	N	\bar{X}	SD	df	t-cal.	t – crit.	p	Decision
Cooperative learning	53	77.50	5.82	100	2.342	1.960	0.05	Rejected
Lecture method	49	42.30	4.11					

357 From Table 5, the t-calculate value of $t = 1.025$ which is greater than the critical or table of
358 1.960 ($p < 0.05$). This mean that there is no significant difference in mean performance
359 score between students taught biology using cooperative learning strategy and those taught
360 using conventional lecture method and confirms the group equivalence showing that the
361 students in the control and experimental group possess equal strength before the treatment

362

363 **Table 5. t-test analysis of pre-test mean performance score of students taught biology**
 364 **using cooperative learning strategy and those taught using conventional lecture**
 365 **method.**

366
 367

Teaching strategy	N	\bar{X}	SD	df	t-cal.	t – crit.	Sig. level	Decision
Cooperative learning	57	30.20	2.82	118	1.025	1.960	0.05	Rejected
Lecture	63	39.50	1.11					

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371 **3.5 Hypothesis 2**

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There is no significant difference between the performance of male and female students taught biology using cooperative learning strategy in senior secondary schools in Rivers State.

377 From Table 6 above, the calculate value of $t = 1.542$ is less than the critical or table value of
 378 1.960 ($p < 0.05$). Therefore, the null hypothesis which states that there is no significant
 379 difference in performance between male and female students taught biology using
 380 cooperative learning strategy in senior secondary schools in Rivers State is accepted. This
 381 means that there is no significant difference in performance score between male and female
 382 students taught biology using cooperative learning strategy in senior secondary schools in
 383 Rivers State.

384
 385
 386

Table 6.t-test analysis of the post-test mean score of male and female students taught biology using cooperative learning strategy.

Gender	N	\bar{X}	SD	df	t-cal.	t - crit	Sig. level	Decision
Male	31	45.39	2.13	118	1.542	1.960	0.05	Accepted
Female	22	53.25	1.98					

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 388
 389

390 **3.6 Hypothesis 3**

HO₃. There is no significant difference between the performance of public and private
 391 school students taught biology using cooperative learning strategy in senior secondary
 392 schools in Rivers State

393

394 From Table 6, the calculate value of $t = 0.596$ is less than the critical or table value of 1.960
 395 ($p < 0.05$). Therefore, the null hypothesis which states that there is no significant difference
 396 in mean performance between public and private school students taught biology using
 397 cooperative learning strategy is accepted. This indicates that there is no significant
 398 difference in performance between public and private school students taught biology using
 399 cooperative learning strategy in senior secondary schools in Rivers State.

400

401 **Table 7. t-test analysis of mean score of public and private school students taught**
 402 **biology using cooperative teaching learning strategy in senior secondary schools in**
 403 **Rivers State**

404

School Type	N	\bar{X}	SD	Df	t-cal.	t - crit	Sig. level	Decision
Private	20	68.25	3.16	188	0.596	1.960	0.05	Accepted
Public	33	55.63	1.21					

405

406 **4. Discussion of Results**

407

408 The results of test of hypothesis 1 (Table 4) revealed that there was a significant difference
 409 in performance between students taught biology using cooperative learning strategy and
 410 those taught using conventional lecture method. Students taught using cooperative learning
 411 strategy performed significantly better than those taught using lecture method. The results of
 412 this study corroborate the findings of studies by [13], [14], [10], [15], [11] and [12] where
 413 students instructed with cooperative learning strategy achieved significantly higher in score
 414 than those instructed using lecture method in independent studies on effect of cooperative
 415 learning strategy on students' academic performance in biology. This results further supports
 416 the findings of studies on the effect of cooperative learning strategy on students' academic
 417 performance in basic science by [19], [17], [18] and [20] where the effectiveness of

418 cooperative learning teaching strategy in teaching basic science were found. The agreement
419 of the finding of this study with other studies confirms the effectiveness of cooperative
420 learning instructional strategy in teaching biology. The higher performance of students In the
421 experimental group where lessons were delivered by cooperative learning teaching strategy,
422 could possibly be due to the fact that students took active part in the learning as they work in
423 groups and exchange ideas during lessons. This process fosters positive and independent
424 thinking, enhance their abilities to integrate and synthesize academic materials and enhance
425 understanding as reflected in higher performance scores. Furthermore, students in the
426 cooperative learning strategy, work together in small groups to maximize each other's
427 learning potentials as they help one another and share ideas for their mutual benefits which
428 enhances understanding of concepts.

429

430 These features are uncommon in the conventional lecture group where there is complete
431 absence of cooperation and exchange of ideas as the students work independently without
432 any assistance from each other as they spend more time listening to what the instructor
433 says. This explains why [19] advocated for cooperative learning on the grounds that
434 cooperative learning stimulates cognitive activities, promotes higher level of achievement
435 and knowledge retention. Students in the lecture method classroom depend on the
436 information from the teacher and as such remain passive during the learning process giving
437 room and only answer questions on teachers' demand. There is complete absence of social
438 interaction among students and teachers. This could possibly create avenue for unhealthy
439 competition instead of cooperation which does not foster proper understanding of facts and
440 information. This affirms [21] assertion that competition is negative interdependence, usually
441 results in oppositional interaction, during which individuals obstruct each other's' learning
442 effort leading to decreased achievement and negative relationship.

443

444 The results of test of hypothesis 2 (Table 6) revealed that there was no significant difference
445 in performance between male and female students taught biology using cooperative learning
446 strategy. The findings of this study is in agreement with the results of [13] and [20] where no
447 significant difference in students' performance based on gender was established in their
448 independent studies on the effect of cooperative learning strategy on students' academic
449 performance. The findings of this study, however disagree with the results of [16] who found
450 significant difference in performance between male and female students taught biology using
451 cooperative learning strategy with male students having higher scores than the female
452 students. The evidence in this study affirm gender equality in performance and gives
453 credence to cooperative learning teaching strategy in bridging the disparity gap in
454 performance with regards to gender. This possibly could be the consequence of interaction
455 and exchange of ideas between boys and girls which foster common understanding of
456 concepts by both sexes. This is opposed to lecture method classroom where individuals
457 work independently without any exchange of ideas. The results of test of hypothesis in
458 Table 7 showed that there was no significant difference in performance between private and
459 public schools students taught biology using cooperative learning strategy. This implies that
460 the cooperation and team work in this strategy of learning cuts across bot he private and
461 public sector.

462

463 **4. CONCLUSION**

464

465 Evidence from the results of this study showed that cooperative learning strategy is effective
466 in teaching biology. The use of this strategy enhanced students' understanding of concepts
467 and caused a significant improvement in their performance in biology in senior secondary
468 schools. There was significant difference in performance between students taught biology
469 with cooperative learning strategy and those taught with conventional lecture method.
470 Students taught using cooperative learning strategy obtained higher test scores than those

471 taught with conventional lecture method. There was no significant difference in performance
472 based on gender (male and female) and school type (public or private).

473

474 **6. Recommendations**

475 The following recommendations were made based on the findings of the present study.

476 Teachers should:

- 477 1. adopt cooperative learning teaching strategy in teaching biology to enhance
478 students understanding.
- 479 2. endeavor to motivate students towards the learning of biology.
- 480 3. encourage students to work together and discourage independent learning strategy.
- 481 4. Government should organize workshop for training of teachers on the use of
482 cooperative learning strategy

483

484

485 **COMPETING INTERESTS**

486

487 The authors have declared that no competing interest exist

488

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606 **Term:** Definition for the term

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APPENDIX