

# Using Consensus and Cooperative Reflective Journal Writing Instructional Strategies to Enhance Students' Achievement in Biology

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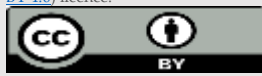
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**Abstract:** Teachers are supposed to adapt their teaching-learning process based on classroom interaction to suit the learning conditions of learners to produce a complete learning community that is intellectually and behaviourally sound. This can only be achieved in a serene, friendly, and collaborative environment. This study determined the effects of consensus and cooperative reflective journal writing instructional strategies on students' achievement in biology, with gender moderating at two levels. A pretest-posttest control group quasi-experimental design with a 3X2 factorial matrix was adopted. The treatment lasted for six weeks. The sample consisted of 305 senior secondary school II students in Ibadan metropolis, Oyo state, Nigeria. The instrument for data collection was the Students' Biology Achievement Test (SBAT). The generated data were analysed using a two-way analysis of variance (ANCOVA) and the Bonferroni post-hoc test. The results of the study revealed that consensus and cooperative reflective journal writing strategies improved students' achievement in biology. The results also revealed that gender affected students' achievement in biology. Treatment and gender did not affect students' achievement in biology. The study concluded that the strategies adopted enhance students' achievement in biology and, therefore, recommended to be adopted in biology classrooms.

**Keywords:** Student achievement, consensus strategy, cooperative reflective journal, writing strategy, gender.

## 1. Introduction

One of the important outcomes of science education, which has been a growing concern among practitioners for years, is students' dwindling academic achievement. Poor achievement by secondary school students in biology as a science subject has been reported by researchers (Ofonime, 2007; Okoli, 2006; Nwagbo & Obiekwe, 2010). Studies on students' poor achievement in science stem from their inability to comprehend scientific concepts (Koba & Tweed, 2009; Ogunniyi, 1999; Sesen, 2013; Svandova, 2014). Poor achievement in science generally, and biology in particular can be attributed to the naivety of the students to science concepts (Mumba et al., 2002; Potgieter et al., 2005) coupled with the teaching strategies adopted by the teachers (Auwal, 2013; Kurt et al., 2013) to introduce these concepts to the students. This indicates the teaching strategies adopted by teachers can either improve or mar students' achievements in any discipline.

Teaching can generally be categorised as content-, teacher-, or student-centred. The content-centred teaching strategy covers the length and breadth of the studied material, while the teacher-centred strategy sees the teacher as an infallible expert who can never be wrong (Hilario, 2015). These two strategies share similar characteristics, giving little to no consideration to the students' thoughts and feelings. Student-centred teaching strategies place emphasis on students as the central focus of the teaching/learning process. In these strategies, students are provided with opportunities to be involved in decision-making related to their learning. The students plan their learning sequence, identify the goals to be achieved and ways to achieve them, reflect on their learning patterns, consult

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the teachers when necessary, deliberate among themselves, and reach a consensus among themselves and with the teacher. These strategies ensure that the students are actively engaged in their learning.

Researchers have identified several student-centred strategies, including problem-based learning, project-based learning, consensus, cooperative learning, and reflective journal writing, cooperative reflective journal writing. Consensus is a form of cooperative, non-coercive decision-making. It is a model used to arrive at decisions agreeable to all by ancient people and is being embraced by organisations, communities, and groups (Schutt, 2001). In the classroom, consensus is achieved when decisions are agreed upon by everyone, including teachers (Sartor & Sutherland, 1992). Two forms of consensus models can be applied to make informed and sound judgments in the classroom. These are the whole-class consensus model and within-group consensus model (Bline, 2013; Inoue, 2010; Macdougall, 2013; Mitchell et al., 2009; Sartor et al., 2004). These two models can be applied separately or simultaneously in the classroom. Students raise an issue, negotiate, or provide an alternative, engage in discussions, seek a consensus decision, and follow the agreed-upon process in the whole-class consensus model (Bline, 2013; Mitchell et al., 2009; Sartor & Sutherland, 1992; Sartor et al., 2004).

In the other model, consensus within a group, the teacher poses an interesting focus issue that calls for individual or group problem solutions. Next is student-to-student interaction or a class debate, which is followed by a consensus resolution to the focus issue (Inoue, 2010; MacDougall, 2013). Consensus fosters shared authority and accountability in the classroom. It promotes the growth of a conscious community, fosters student participation, enhances self-expression, inspires creative decision-making, and shows that learning can be a practice of freedom. It also helps students build positive self-concepts, raise their level of engagement, and enhance their capacity to apply what they have learned in new contexts (Blinne, 2013; MacDougall, 2013; Mitchell et al., 2009; Sartor & Young Brown, 2004). It promotes a democratic and student-centred approach to learning, which is in line with the ongoing call for a more vibrant, democratic, and equal learning environment that is believed to improve student outcomes (Omodan, 2022).

Despite the reported benefits derived from the consensus strategy that allows participants to negotiate and decide the outcome of their deliberation, their documented application in educational settings is still very low. According to Fetalvero (2017), few studies have elaborated on the process through which consensus decisions are made in the classroom. Moreover, most of the studies on the benefits and effects of consensus strategy were carried out within the confines of the researchers' classrooms, which cast aspersions on the generalisation of the benefits of the strategy, as there was no comparison group to compare the effects of these strategies with. Furthermore, according to Fetalvero (2017), consensus-based education demonstrated the potential to increase students' academic achievement in bioenergetics, even though there was no significant difference in academic achievement between students exposed to it and conventional education.

Cooperative reflective journal writing strategies involve the integration of cooperative learning and reflective journal writing strategies. This enables students to reflect collectively while engaging in a cooperative manner. According to Ige and Adu (2016), cooperative reflective journal writing is an approach that allows learners to reflect together while working together on projects inside or outside the classroom. Consequently, a cooperative reflective journal enables learners to reflect collectively in classrooms while learning within a group setting. This type of group activity allows students to work together in small groups to maximise one another's abilities (Johnson et al., 2008). It is a pedagogical approach that assists learners in forming and maintaining academic and social interactions, as well as achieving common objectives (Johnson & Johnson, 2002).

According to Güvenç (2010), there is currently no research on the effects of teaching methods supported by learning journal writing. The drive to implement or seek the effects of instructional strategies supported by learning journals on students' learning outcomes prompted researchers such

as Güvenç (2010) and Ige and Adu (2016) combined cooperative learning and reflective journal writing instructional strategies. In contrast to individualised reflective journal writing and traditional instructional strategy, Ige and Adu (2016) found that cooperative reflective journal writing increases students' achievement. Also, according to Güvenç (2010), students exposed to cooperative learning along with reflective journal writing performed better academically than those exposed to only cooperative learning. The results of these studies underpin the importance of combining strategies to achieve good learning outcomes.

Aside from teaching strategy, gender is another factor that affects student achievement. Gender is the role assigned or performed by individuals, as ascribed by society as being male or female. These roles can be social, cultural, or biological. According to Ebinuwa-Okoh (2016), gender is a resident of a learner. Borgatta and Montgomery (2000) referred to gender as the categorisation of people into "male" and "female" through interaction with caretakers, socialisation in childhood, peers pressure in adolescence, and gendered work and family roles of which women and men are socially constructed to be different in behaviour, attitudes and emotions. According to Abubakar and Uboh (2010), gender is a characteristic that distinguishes organisms based on their reproductive roles as females or males.

The role of gender in science education is key. According to Archer et al. (2012, 2013) and Avraamidou (2013), science is seen as a male enterprise by society, and scientists are usually depicted with male characteristics. This assertion was corroborated by the studies of Ballen et al. (2018) and Wright et al. (2016), who reported that male students outperform female students in higher-order cognitive skills and that female students perform better or equally with male students in lower-order cognitive skills. Duyilemi (2007) believes this may be due to the innate and societal norms and values placed on the female gender, which may affect their aspirations. However, research proves that the difference in achievement based on gender cognitive, affective, and psychomotor skills is rapidly disappearing (Fetalvero, 2017 & Lauer et al., 2013). The market in Jegede (2013) states that there is no innate sex difference that affects people. One sex is not more brilliant than another, and if there are innate differences in ability, they are not absolute.

Despite the belief and evidence by some researchers that the achievement gap based on gender is rapidly disappearing, there are still conflicting results on the effects of gender on students' achievement in science in general and biology in particular. Eddy et al. (2014), Mohammed et al. (2014), and Sakiyo et al. (2018) reported that male students outperformed female students. In contrast, the studies by Jegede and Olu-Ajayi (2017) and Varughese (2010) reported that females had higher achievement than males. Ajaja (2013), Ayeni (2020), and Jia et al. (2020) reported no significant differences or gaps in student achievement based on gender. However, these conflicting reports are expected as the studies vary in their learning contexts, which include the methodology, populations, locations, research tasks, and classroom settings (teacher's instructional strategy, students' population, types of interaction between teacher and student-student, among others).

This study, therefore, examined the effects of consensus and cooperative reflective journal writing strategies on students' achievement in biology as moderated by gender. The inclusion of gender as a moderator/moderating variable becomes imperative, as, according to Amelink (2009) and Jegede and Olu-Ajayi (2017), each gender probably reacts differently to different instructional strategies. The study is significant because it adds to the plethora of instructional strategies at the beckon of biology teachers in Nigeria. There have not been many empirical studies on the effect of consensus and cooperative reflective journal writing instructional strategies on students' achievement in Nigerian secondary schools. The study also shed more light on the interaction between instructional strategies and students' gender on students' achievements in biology.

## **1.1 Theoretical framework**

The theory upon which this study is anchored is the Social Interdependence theory (SIT). It has roots in Gestalt psychology and Lewin's Field Theory (Johnson & Johnson, 2012). Social interdependence occurs when the goal attainment of an individual is influenced by the actions of other individuals (Johnson, 2003; Johnson & Johnson, 2005a, 2009a). Two types of social interdependence are positive (cooperation) and negative (competition) interdependences. Positive interdependence is a positive relationship between an individual's goal attainment and their perception that they can only succeed if and only if the other person(s) with whom they are working with succeeds. Negative interdependence occurs when there is a negative relationship between individuals' goal achievement; individuals feel they can only succeed in achieving their goals if and only if others with whom they are competitively paired fail to succeed (Johnson & Johnson, 2005a, 2006, 2012; Johnson et al., 2014; Johnson et al., 2012).

"Each type of interdependence creates certain psychological processes and interaction sequences that, in turn, determine the outcomes of the situation, including the moral socialisation and education of the individuals involved" (Johnson & Johnson, 2012, p 11). These psychological processes are substitutability, inducibility, and cathexis (Deutsch 1949a). The degree to which one person's behaviour can be substituted for that of another person is known as substitutability. Cathexis is the investment of psychological energy in objects other than oneself, such as family, friends, and work, while inducibility is the willingness to influence others (Deutsch 1949a, 1962). Positive interdependence leads to promotive interaction in the interaction sequence, where individuals strive to support one another's efforts to succeed. Contrient/oppositional interaction is the result of negative interdependence, and individuals often work against each other to achieve success. (Deutsch 1949a). Promotive interactions tend to breed a range of outcomes that may be subsumed into the categories of high effort to achieve positive relationships and psychological health. Oppositional/contrient interactions tend to breed low effort to achieve negative relationships and low psychological health (Johnson & Johnson, 2012).

According to this theory, a group of students assume a form of interdependence when it dawns on them that working collectively on a classroom assignment will increase their probability of achieving their joint goals. The significance of the theory to this study is premised on its five elements, as enunciated by Johnson and Johnson (2002, 2013), which aim to maximise the collaborative potential of students working in groups in a classroom setting. They are: 1) Positive interdependence – the perception of being linked to other students in a group within a classroom and the psychological realisation that is achieved through the pursuit of common goals and joint rewards; 2) Individual accountability – in which each student is responsible for his/her share of the work and has a willingness to help other students in the group; 3) Face-to-face promotive interaction – where students encourage each other's efforts through discussions and explanations and in general show a willingness to throw in their lot with their peers; 4) Interpersonal and small group skills – which enhance the degree of trust among students and improve their communication skills and their ability to resolve conflicts when differences occur in the classroom; 5) Group processing – which involves students discussing and evaluating their work; this is crucial for promoting, affirming and maintaining effective working relationships among students in the classroom setting.

## **1.2 Problem statement**

A teacher's role includes but is not limited to developing a range of skills such as critical thinking, negotiation, compromise and collaboration, as well as modelling interpersonal relationships among learners (Horner et al. 2015). Teachers should always adapt their teaching/learning process based on classroom interaction to suit the learning conditions of the learners in order to produce a complete learning community that is intellectually and behaviourally sound. This can only be achieved in a serene, friendly, and collaborative environment. However, our observations confirmed that in most

classrooms, the atmosphere is individualistic and competitive, and individuals struggle to improve each other. The traditional mode of instruction still prevails in classrooms; the teacher acts as a dispenser of knowledge, and the students are seen as consumers. There seems to be no teacher-student or student-student interaction. This attitude, if continued, will hinder all-inclusive equitable quality education that will promote lifelong learning opportunities for all, irrespective of gender and/or race. Therefore, the study explored the effect of consensus and cooperative reflective journal writing instructional strategies on students' achievement in biology, with gender as a moderator variable.

### **1.3 Hypotheses**

The following three null hypotheses were tested in the study:

- Consensus and cooperative reflective journal writing instructional strategies had no significant main effects on students' biology achievement.
- Gender had no significant main effect on students' biology achievement.
- The interaction between treatment and gender had no significant effect on students' biology achievement.

## **2. Materials and Methods**

The study adopted a positivist paradigm within quantitative approach. A pretest-posttest, control group quasi-experimental design involving a 3X2 factorial matrix was employed. This design was adopted because random allocation to treatment was not possible or beyond the control of the researchers. This was due to practical, ethical, social, and/or logistical considerations (Handley et al., 2018), as classes were formed before the commencement of the study. The treatments were the instructional strategies manipulated at three levels (consensus, cooperative reflective journal writing, and conventional). The moderator variable was gender at two levels (male and female). The measured variable was the students' biology achievement. The procedure followed during the study were: first week: training of research assistants (classroom teachers); second week: administration of pre-tests; third-eighth week: treatments carried out; ninth week: administration of posttest. The two-way analysis of covariance (ANCOVA) was performed on the students' posttest scores, their pre-test scores serving as covariates. ANCOVA reduces experimental error statistically rather than experimental procedure (Coolican, 1994). The Bonferroni post-hoc test was used to determine which of the groups caused a significant main effect, while the interaction effect, if present, was explained using a graph.

### **2.1 Participants**

All senior secondary school students in Ibadan metropolis, Oyo State, Nigeria were eligible to participate in the study. A total of 305 students were selected using a multi-stage sampling procedure. Two of the five local governments in the metropolis (Ibadan North and Ibadan Northwest) were chosen at random in the first stage of sampling. In the second stage, three distantly located coeducational schools were purposefully selected in each of the selected local government areas totalling six schools. This was performed to minimise experimental contamination. The treatment and control groups were assigned randomly to each school. Intact classes were engaged in all schools. This study focused on the effects of consensus and cooperative reflective journal writing instructional strategies on students' achievement in some biology concepts, using gender as a moderating variable. Ecological management and nutrient cycling in nature were the two topics covered in this study.

### **2.2 Research instruments**

The following were the data collection tools:

- Students' Biology Achievement Test (SBAT).
- Consensus Instructional Strategy Teacher's Instructional Guide (CISTIG).
- Cooperative Reflective Journal Writing Instructional Strategy Teacher's Instructional Guide (CRJWISTIG).
- Conventional Strategy Teacher's Instructional Guide (CSTIG)

### 2.3 Students' Biology achievement test

The researchers developed the students' Biology Achievement Test (SBAT) instrument to assess the students' knowledge of ecological management and nutrient cycling in nature before and after the implementation of the intervention. The test has forty (40) multiple-choice questions with choices ranging from A – D. The SBAT awarded one mark for each correct response, for a total of 40 marks. A copy of the instrument was given to science education experts to ascertain its face validity and determine its suitability. A reliability coefficient of 0.74 was obtained using the Kuder-Richardson formula- 20 (KR-20). The choice of KR-20 was premised on inequality in the level of difficulty of the items in the biology achievement test.

### 2.4 Teachers' Instructional Guides

Consensus Instructional Strategy Teachers' Instructional Guide (CISTIG), Cooperative Reflective Journal Writing Instructional Strategy Teachers' Instructional Guide (CRJWISTIG), and Conventional Strategy Teachers' Instructional Guide (CSTIG) were the lesson notes prepared each week for the six weeks of the treatment period. Each lesson lasted 80 minutes (double periods). The essence of these instruments was to guide the research assistants (teachers) on the steps and procedures to follow during the treatment.

**Table 1:** Description of experimental procedures

Treatments	Procedures
Consensus Instructional Strategy	<ol style="list-style-type: none"> <li>1. Division: Divide a class into small groups, usually of about 5 learners.</li> <li>2. Provision (Assignment) of task: Assigned a task, usually designed ahead of time, for the small groups to work on.</li> <li>3. Deliberation takes place among group members.</li> <li>4. Group members reach a consensus.</li> <li>5. Teacher reconvenes students into a plenary session to hear the reports from the small groups and negotiate a consensus of the class as a whole.</li> <li>6. Lead students to compare the class's plenary consensus with the current consensus of the knowledge community in order to arrive at a better consensus/decision/judgement.</li> <li>7. Evaluate explicitly the quality of students' work.</li> </ol>
Cooperative Reflective Journal Writing Instructional Strategy	<ol style="list-style-type: none"> <li>1. Teacher presents the topic.</li> <li>2. Teacher tells the students the task to be done.</li> <li>3. Teacher highlights the major idea within the topic to be taught.</li> <li>4. Teacher groups the students in five-member heterogeneous teams by gender only.</li> <li>5. Each group appoints a leader and a clerk.</li> <li>6. Teacher gives group some few minutes to review the lesson and share their views.</li> <li>7. The team writes a group journal based on the following guidelines:             <ol style="list-style-type: none"> <li>a. What question do you have about this lesson?</li> <li>b. What have you learned in the lesson?</li> <li>c. What areas did you find difficult?</li> <li>d. What areas did you find interesting?</li> <li>e. How do you think this lesson will be useful for you to apply outside the classroom?</li> </ol> </li> <li>8. Teacher collects the group journal for compilation of entries.</li> <li>9. Raised group questions were thrown to the groups for answer in the next lesson.</li> <li>10. Students learning were evaluated based on group entries.</li> </ol>

Conventional Strategy	1. The teacher introduces the lesson by asking questions based on the students' previous knowledge.
	2. Teacher presents instructional aid and discusses the contents of the lesson with the students.
	3. Teacher directs students to write the chalkboard summary in their notebooks.
	4. Teacher evaluates the lesson by asking students some questions in class, later on homework/assignment.

### 3. Presenttion of Results

**Hypothesis 1:** Treatment had no significant main effect on students' biology achievement. A summary of these results is given in Table 2.

**Table 2:** Analysis of Covariance (ANCOVA) of Post-Achievement by Treatment and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6615.908	6	1102.651	174.632	0.000	0.779
Intercept	12366.919	1	12366.919	1958.601	0.000	0.868
Pre-Achievement	1240.930	1	1240.930	196.531	0.000	0.397
Treatment	4144.688	2	2072.344	328.206	0.000*	0.688
Gender	203.325	1	203.325	32.201	0.000*	0.098
Treatment x Gender	18.667	2	9.334	1.478	0.230	0.010
Error	1881.620	298	6.314			
Total	278635.000	305				
Corrected Total	8497.528	304				

R Squared = 0.78 (Adjusted R Squared = 0.77) \*denotes significant  $p < 0.05$

Table 2 shows that treatment had a significant main effect on students' achievement in biology ( $F_{(2, 304)} = 328.21$ ;  $p < 0.05$ , partial  $\eta^2 = 0.69$ ). The effect size (69.0%) was medium. This revealed a moderate statistical difference between the students in the treatment and control groups. Hence, hypothesis 1 was rejected. The estimated marginal means was conducted to investigate the extent of the significant main effect across the treatment groups, and the results are presented in Table 3.

**Table 3:** Estimated Marginal Means for Post-Achievement by Treatment and Control Group

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
CIS	32.80	0.28	32.26	33.34
CRJWIS	33.42	0.26	32.90	33.94
CS	25.37	0.23	24.91	25.83

According to Table 3, students in the CRJWIS treatment group 2 had the highest adjusted mean score in their post-achievement score in biology (33.42), followed by those in CIS treatment group 1 (32.8) and their counterparts in the CS control group (25.37). A Bonferroni post-hoc test was conducted to establish which of the groups accounted for the significant main effect of treatment on students' achievement in biology. The results are presented in Table 4.

**Table 4:** Bonferroni Post-hoc Analysis of Post-Achievement by Treatment and Control Group

Treatment	Mean	CIS	CRJWIS	CS
CIS	32.80			*
CRJWIS	33.42			*
CS	25.37	*	*	

Table 4 shows that the post-achievement mean score in biology of students in CRJWIS did not differ significantly from those taught with the CIS but differed significantly from those exposed to CS. Table 4 further shows that there was a significant difference in the post-achievement mean scores of students exposed to CIS and their counterparts in CS. This shows that the significant difference revealed by the ANCOVA result is not attributed to the difference between the treatment groups (CRJWIS and CIS) but rather between the treatment groups and the control group as students' post-achievement scores in biology is concerned.

**Hypothesis 2:** Gender had no significant main effect on students' biology achievement.

The result of the analysis of covariance from Table 2 reveals a significant main effect of gender on students' posttest achievement scores in biology ( $F_{(1, 304)} = 32.20$ ;  $p < 0.05$ , partial  $\eta^2 = 0.10$ ). An effect size of 10.0% indicated a small effect size. Therefore, hypothesis 2 was rejected. This implies that gender had a significant main effect on students' achievement in biology irrespective of the treatment group.

*Table 5: Estimated Marginal Means for Post-Achievement by Gender*

Gender	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Male	31.37	0.23	30.93	31.82
Female	29.68	0.19	29.31	30.06

According to Table 5, male students had an adjusted mean score in post-achievement in biology (31.37) greater than that of female students (29.68). This implies that differences exist between male and female students scores in biology and this difference is significant.

**Hypothesis 3:** The interaction between treatment and gender had no significant effects on students' biology achievement.

The results in Table 2 reveal that the interaction between treatment and gender on students' achievement scores in biology ( $F_{(2, 304)} = 1.48$ ,  $p > 0.05$ ; partial  $\eta^2 = 0.01$ ) was not significant. An effect size of 1.0% revealed a small (insignificant) effect size. Therefore, Hypothesis 3 was supported. Treatment and gender had no significant interaction effect on students' biological achievement.

#### 4. Discussion

This study examines the effect of consensus groups and cooperative reflective journal writing instructional strategies on secondary school students' achievement in biology. It was found that the achievement of students in the experimental groups (consensus and cooperative reflective journal writing) improved significantly compared with students in the control group. The results of the study showed that the consensus group instructional strategy was more effective than the conventional strategy at improving students' achievement in biology. The results of this study contradict the findings of Fetalvero (2017), who reported that the achievement of students taught with consensus-based education was not different from those taught with conventional education in bioenergetics. However, the consensus-based education showed a promising/prospect of improving students' achievement when students' gained scores were categorised on a five-point interval scale and an item-by-item analysis was carried out across the bioenergetics achievement scores by topic and cognitive domain.

However, the result supported the finding of Adejimi et al (2021), who found that students exposed to the consensus strategy outperform those taught with the conventional strategy. This can be a result of the beliefs of Pearce (2002) and Sartor and Young Brown (2004), who claimed that consensus possesses the requisite model and serves as an avenue for producing critical-thinking citizens. This assertion was also corroborated by Smith (2003) and Smith and Dirks (2007), who concluded that



consensus made students learn more about content than they would have learned individually, as it broadened their horizons to look at issues from different perspectives. The cooperative reflective journal writing instructional strategy was also found to improve students' achievement in biology compared with the conventional strategy. This result is consistent with the findings of Adejimi et al. (2021), Guvenç (2010) and Ige and Adu (2016). This may be attributed to the strategy promoting students' reflection and enhancing their performance (Ige & Adu, 2016; Guvenç, 2008, 2010). The results indicate that if these strategies are carefully and properly deployed, they can greatly improve students' achievements in biology.

There was a significant main effect of gender on students' achievement in biology. Male students outperformed female students on the biology achievement test. This study supports the findings of Mohammed et al. (2014), Creech and Sweeder (2012), Odagboyi (2015) and Opara (2011). This contrasts with the findings of Ahmad (2013), Narmadha and Chamundeswari (2013), Reddy and Mint (2017), and Varughese (2010), who reported that female students achieved more than male students. It is also against the findings of Agboghroma and Oyovwi (2015), Ajaja and Eravwoke (2012), Ayeni (2020), Fetalvero (2017), Gambari et al. (2016), Ige and Adu (2016) and Olatoye (2017) who found no difference in the achievement of students based on gender. These contrasting results may be due to the differences in the context (geographical space, time, classroom tasks, participants, and methodology) of the study. The result also calls for caution on the part of the teachers when deploying them, as they are gender sensitive as it favours the male students. They should ensure that all students in the classroom are taught during the process of instruction.

There was no significant interaction between treatment and gender on student achievement in biology. This implies that the combination of treatments and gender does not influence students' achievement in biology. This means that students who are exposed to the same learning conditions can perform equally on a given task, irrespective of their gender. This study supports Ajaja (2013), Ajaja and Eravwoke (2012), Fetalvero (2017), Sakiyo et al. (2018), and Umoke and Nwafor (2014). However, this is contrary to the findings of Varughese (2010), who found a significant interaction between treatment and gender in favour of female students. This finding is apt, as there is a conscious attempt to close the gap between male and female achievement and representation in science.

The results from the study indicated that students' achievement in biology was enhanced after the intervention. This may be probably due to the fact that there was an improvement in communication and interaction between students and teachers, individuals becoming responsible to and trusting one another, promotion and maintenance of relationships, encouraging one another and the pursuit of common goals by group members. These observations are the premises of the Social Interdependence Theory according to Johnson and Johnson (2002, 2013), which are positive interdependence, promotive interaction, individual responsibility/accountability, group processing and appropriate use of social skills.

## **5. Conclusion and Recommendations**

The discovery and application of innovative strategies can contribute to the improvement of students' achievements in biology or other disciplines. The findings from this study show that the consensus group and cooperative reflective journal writing instructional strategies were more effective than the conventional strategy in improving students' achievement in biology. The effectiveness of these strategies may stem from the fact that they increase students' active participation during teaching/learning, improve students' social interaction skills, and encourage the spirit of cooperation among students, which may even be useful in their future engagements. The shared knowledge during the interaction might have led to an improvement in students' achievement in the study. The result of the study gives credence to the age-long belief that science and biology are inclusive of gender bias. The results showed that male students achieved higher scores than female students. However, there was no interaction between the treatments and gender;

treatments and gender did not combine to determine student achievement. This means that the strategies are suitable for both sexes, as it is not a gender bias. Based on the findings of this study, the following recommendations were made.

- Both strategies (consensus groups and cooperative reflective journal writing) should be incorporated into the Nigerian educational system.
- In-service training should be organised to keep teachers abreast of innovative strategies that can improve students' learning outcomes.
- Although male students outperform female students, both strategies should be adopted in the classroom, as they are not gender biased.
- Adequate care should be taken while using the strategies to ensure that a certain set of individuals does not dominate the group discussion to the detriment of others.

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7. **Conflict of Interest:** Authors declare no conflict of interest whatsoever.

8. **Data availability:** Data for the study is available from the corresponding author on request.

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