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Comparing the efficacy of two teaching strategies on students' attitudes towards biology: A case in Ashanti Mampong municipality, Ghana

Michael Adiyiah[1]✉
Mutangana Dieudonne[2]
Yaw Ameyaw[3]


(✉ *Corresponding Author*)

[1]*University of Rwanda, African Centre of Excellence for Innovative Teaching and Learning of Science and Mathematics, Rwanda.*
Email: michaeladiyiah@gmail.com
[2]*Department of Biology, University of Rwanda, College of Science and Technology, Rwanda.*
Email: d.mutangana@ur.ac.rw
[3]*Department of Biology Education, University of Education, Winneba, Ghana.*
Email: syameyaw@yahoo.com

Abstract

Biology is an essential and compulsory subject offered at all senior high schools in Ghana. However, the level of students' attitude towards biology has been seen to be a result of the use of less motivating teachers' instructional strategies. This research study examined the effect of concept mapping and cooperative learning strategies on enhancing students' attitudes towards the development of biology in two selected deprived science-based senior high schools within the Ashanti Mampong municipality of Ghana. The study used a quasi-experimental design involving a 3 x 2 multi-factorial analysis with a positivist paradigm. A purposive sampling technique was used to obtain 498 biology students for the study. Three research instruments, the biology attitude questionnaire (BAQ), student verbal ability test items and the students' performance test (SPT) were used in collecting the data. The results showed that the intervention improved students' attitudes towards learning biology and the development of biology activities using analysis of covariance (ANCOVA) in a statistical package for social science version 20. Therefore, the two strategies enhanced students' attitudes towards the subject in the two selected institutions within the Ashanti Mampong Municipality of Ghana. The two instructional strategies should therefore be emphasized, adopted and enforced in the teaching and learning of biological concepts among all deprived science-based senior high school students in Ghana where appropriate learning and teaching resources are scarcely unavailable and elsewhere in related challenges.

Keywords: Attitude, Concept mapping, Conventional strategy, Cooperative learning, Students' performance.

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Contents

Contribution of this paper to the literature
The contribution of this manuscript is that concept mapping as an instructional strategy has not been used before in the teaching process in an attempt to evaluate biology student performance in Ashanti Mampong Municipality in Ghana.

1. Introduction

The content of biology taught at the senior high school level forms the prerequisite for many sciences-related fields of study at the tertiary institutions of education in Ghana such as biochemistry, ecology, physiology, zoology, botany, molecular biology, biotechnology and engineering (Ameyaw & Okyer, 2018). These fields offer jobs in many economic sectors specifically food and nutrition, health, pharmacy, processing industries and many others (Ameyaw & Okyer, 2018; Zeidan & Jayosi, 2015).

The discussion above suggests that many students should enroll in biology and biology-related fields of study in Ghana and other developing countries to improve socioeconomically. This could be realized and achieved if biology students develop a positive attitude towards the learning of biology. Even though biology is clearly important and useful in many fields of study, most students find it uninteresting and as a result, they perform below expectations in general science classes at the junior high school level. These have drastically affected students' participation in biology and their performance has been poor over the years (Ameyaw & Okyer, 2018).

For instance, in Ghana, the percentage of students who failed biology in senior high school in the final examination was 32.5% and 34.2% in 2015 and 2016 respectively (Ameyaw & Okyer, 2018). The poor performance continued even in the years 2018-2020. Besides these problems of instructions that affect students' performance, there is also the challenge of some biology-related graduates staying in the house waiting for posting which is enough to frustrate potential candidates who offered biology (Ameyaw & Okyer, 2018).

The significance of students' positive attitudes towards a particular course of study motivates them to pursue and persist in their efforts to achieve higher mastery in the subject matter (Njoku & Nwagbo, 2020; Omeiza, 2019). When students express a specific kind of attitude towards a programme of study or a subject, it is also a true representation of how they manage their beliefs, perceptions and behaviour towards the subject content they are taught in school (Njoku & Nwagbo, 2020). Thus, attitudes do not only act as a facilitator of learning, they are also considered a product of students' effort and a learning booster (Wang, Chiou, Lee, & Tien, 2017). Attitude may again be referred to as the predisposition of an individual to respond in a way that is either favourable or unfavourable in relation to a certain instructional method encountered.

This concept of attitude is stressed towards a particular subject that may range with respect to activities such as biology teachers' instruction, relevant concepts taught in school biology periods, teachers' assessment procedures, laboratory scheduled experiments, biological knowledge in research publications, biological concept discussions and biotechnological innovation (Ameyaw & Okyer, 2018). Two essential reasons were proposed for enhancing students' attitudes towards biology as well as their science development. First, attitude as a factor for learning is described as being linked with the academic success of an individual (Zeidan & Jayosi, 2015). According to some major research findings by Zeidan (2010) and Zeidan and Jayosi (2015) which were confirmed by Wang et al. (2017), there exists a positive relationship between students' attitude and performance in chemistry. It was again supported by the findings of Njoku and Nwagbo (2020) which support the conclusions of Omeiza (2019) that students' performance and achievement in chemistry have a strong relationship with their attitude and have a value ranging from 0.24 to 0.48. According to Wang et al. (2017), integrated science students with a low positive concept of attitude always had poor and low performance scores in their overall assessment scores in all the related sciences. On the other hand, the major findings of Russell and Hollander (1975) on the principle of attitude impact on learning also elaborated that although there is always a strong and significant relationship between students' attitude development and their achievement scores, it may not mostly be the case that positive attitude can be a result of the individual performance score in question. They further discussed, confirmed and questioned that there might be a likelihood that a learner who has developed a significant positive attitude towards a programme of study may not be able to achieve a better score in spite of the varied authentic assessment processes used to ascertain their progress in academics and vice versa. This suggests that the concept of attitude might influence one's academic achievement and performance but these effective learning outcome indications may not always be a determining factor to conclude that high performance scores are always influenced by students' attitudes (Shruba, 2008). According to Omeiza (2019), if individuals' concepts of attitude are given due consideration as needed, the long-awaited change in cognitive skill and domain may be achieved resulting in enhanced performance.

The other significant reason for developing students' positive attitudes towards science and biology to be specific is its unique ability to predict learners' behaviour (Zeidan & Jayosi, 2015). According to the study conducted by Ajaja (2011), the preference of some high school British students for a selected school subject was considered on the merit of the individual's likeness to the subject under consideration. Some socialist researchers in society have minimized its significance and its impact in favour of performance when determining the necessary standards for measuring educational outcome despite the fact that attitude has received sufficient attention over the past forty years. According to Wang et al. (2017) and Ajaja (2011), "the student's attitude towards the subject and its importance in society have an impact on how likely they are to use what they have learned".

Research on students' attitudes towards the development of a programme of study is an important factor to consider during teaching and learning. It should be mandatory for programme and course instructors to identify their learners' perceived attitudinal disposition towards their subject matter and impact on their lives to ensure the success of their delivery. The teacher must be prepared to use the most effective pedagogy to influence the behaviour of their students in order to achieve this goal. A classroom environment with a variety of innovative teaching strategies coupled with students' high levels of involvement, support and active interaction and participation among class members may create a strong positive attitude among students towards science learning (Shruba, 2008). This was strongly supported by Zeidan and Jayosi (2015) when they stated that "teaching strategies that emphasize students' active learning and the importance of science to daily life are examples of measures that favourably affect students' attitude development".

There has been a wide range of research that has explained in detail the impact of students' attitudes towards science (Wang et al., 2017) but the majority of it has failed to discuss its significance with respect to students conduct of science education with particular reference to biology (Ajaja, 2011; Nja, Orim, Neji, Ukwetang, & Ideba, 2022). In most of these few findings, the significant attitudes of students have been explained as "research findings on students' performance related to their attitude towards biology have evolved as a target area of study because researchers have examined the role attitude contributes towards students' academic achievement scores" (Wang et al., 2017; Zeidan & Jayosi, 2015). A related study by Shruba (2008) stressed the importance of effectively examining students' attitudes towards science learning due to its unique significance compared to cognitive abilities which was likewise confirmed by Ajaja (2011). This explains why attitude has been a difficult concept to develop but once formulated and developed; it becomes important component of an individual life. A significant factor that influences students' attitudes towards biology is the quality of the instructional methods applied in the classroom by the teacher during his professional practice. Several research findings have critically examined and emphasized the influence of varied instructional strategies and pedagogical merit on students learning attitudes (Zeidan, 2010; Zeidan & Jayosi, 2015) but only a few have stressed the effect of using two constructivists' learning and teaching methods on students' performance.

1.1. Research Focus

However, the findings and conclusions to be discussed from these research studies are as varied as the findings themselves from the research conducted by Çömek, Akınoğlu, Elmacı, and Gündoğdu (2016). According to Shruba (2008), the nature of the instructional methodology students go through in the classroom has influence on their attitudes towards their chosen programme of study but the findings of Wang et al. (2017) concluded otherwise. This study employed two teaching strategies: concept mapping and cooperative teaching and learning strategies in order to effectively contribute to the influence of teaching methods on enhancing students' attitudes towards biology (Çömek et al., 2016).

Research findings on students' attitudes using combined forms of teaching methodologies such as concept mapping and inquiry-based instructional strategies are scarce in the literature (Wang et al., 2017; Zeidan & Jayosi, 2015). Nevertheless, only a few studies have been conducted on the effect of concept mapping and cooperative mastering instructional strategies on enhancing students' attitudes (Zeidan, 2010). Concept mapping is a form of collaborative learning strategy that helps students demonstrate their cognitive understanding in a hierarchical pattern of web-link concept maps (Novak & Gowin, 1984). It has been very helpful for enhancing learners performance in sciences particularly biology education. This instructional methodology has been emphasized and supported in many educational research especially biology (Ajaja, 2011; Ameyaw, 2012). The process of constructing these concept maps and their applications assists students in better understanding related concepts and dissimilar ideas in science. Concepts of science especially in biology require adequate conceptual understanding of related abstraction in the concrete, semi-concrete or abstract experiences of students. It is a practical description and organization of biological knowledge, ideas or relations (Zeidan, 2010; Zeidan & Jayosi, 2015) in a conceptual web network using nodes and links. It has been a practically needed and most helpful strategy for students with challenges with low retention in developing rational and conceptual understanding of concepts. It engages students in meaningful learning which requires the use of relevant and adequate previous knowledge (PK) application and effective concept interpretation. It uses meaningful materials and the choices of the learner in question knowledge formulation. It also helps students connect newly developed ideas to existing concepts (Ajaja, 2011; Ameyaw, 2012).

Concept mapping construction techniques shape students' attitudes and opinions and enhance their performance and achievement rather than evaluate them (Çömek et al., 2016). Research literature groups concept mapping applied in the classroom into two instructional models: the whole class concept delivery model and concept mapping discussion within groups and sub-divisions of class interactions. The concept of mapping learning and teaching offers learners the chance to discuss, share and construct meaningful ideas and link these concepts of the lesson together using agreed nodes and prepositional links with the instructor's assistance.

There are many studies that have struggled to apply this method to meaningful educational innovations. However, only a few of these studies categorically emphasized that the concept mapping process was applied and adopted as one of the constructivist innovations (Ameyaw & Okyer, 2018). They further discussed that there are a number of limitations to the suggested findings on the benefits and impact of concept mapping and its variants within the confines of the instructor's classroom which cast some doubt on the generalizability of the strategy's significance because there have never been structured and formulated studies with defined objectives that have attempted to examine and investigate the efficacy of the concept mapping strategy on students' attitudes towards the development of biology using comparison groups.

The cooperative learning strategy of knowledge delivery tries to combine both the features of active cooperation and a reflective discussion approach (Ameyaw & Okyer, 2018). Cooperation and reflective discussion strategies have helped and allowed students to critically listen, think and reflect on learned concepts and prepare effective notes during assigned group work. It makes the students happy and active during the instructional period at the same time, they work together and find needed solutions to assigned tasks. Students work is monitored and they are guided to organize their understanding in a meaningful manner to discuss the important concept of the lesson during instruction time. It's an instructional strategy that assists students in understanding and develop both social relationships and academic progress as well as achieving shared academic goals (Nja et al., 2022; Wang et al., 2017).

It is learning and teaching method that encompasses students discussing and working cooperatively as they reflect on assigned learning tasks discussed in the classroom. Therefore, cooperating and reflecting on the lesson allows students to think about the learned classroom task as they learn together in a group after the post - instructional discussion. Cooperative learning facilities foster an interdependent relationship among students and their instructors (Ajaja, 2011; Ameyaw, 2012). As they went through these processes, they developed a kind of independent relationship of positive attitude development among themselves. This builds the students confidence

and enables them to be responsible for their own learning. According to the findings of Ameyaw (2012), this method provides the students with a sense of belongingness to their own understanding.

The lecture method is sometimes regarded as a conventional teaching method (CTM) which has been emphasized as one of the many researched methods of all instructional methods (Ameyaw & Okyer, 2018) over the years. Most teachers have failed to plan it well thus, not yielded the expected outcome collaboratively (Wang et al., 2017). The lecture instructional method helps students work hard and become resourceful if it is appropriately planned and implemented well. It enables learners to work together and ensures the efficiency of assigned task accomplishment in less duration in small groups for task discussion. It increases concentration and attention in the classroom.

Ameyaw and Okyer (2018) state that few research have been done on the effects of instructional techniques that have been investigated using concept mapping. As a result, researchers such as (Ajaja, 2011; Ameyaw & Okyer, 2018) have combined cooperative learning with other modern educational strategies like the cooperative learning method to examine the impact of teaching and learning methods combined with constructivist learning techniques on students' learning potential.

The study supported that concept mapping and other interactive learning methods support student's affective domains and are important in helping their learning (Çömek et al., 2016). Students' individual variables such as their performance or prior knowledge (PK) in addition to some school-related elements like the teacher's teaching techniques have significant effects on students' attitudes towards a subject. Student verbal communication is also one of the greatest fundamental assets of human learning (Etobro & Fabinu, 2017). It is the medium through which the individual expresses their understanding, feelings and thoughts during class discussion in spoken or written words. It refers to the level of students' expressing or communicating using conventional language in their inter and intra-personal communications. Students' oral or written introduction skills demonstrate how their language competence aids them in capturing the instructional topic. Students must effectively express their ideas and feelings in relation to the new concept they are learning. It is based on the individual level of intellectual development and the ability to reason abstractly. In science, the concept of a student's verbal ability (SVA) can help an individual in explaining the findings of an experimental results and the appropriate conclusions needed from such experimentation (Çömek et al., 2016). They discussed further that students' communication skills enable individuals to discuss and make propositions on their results objectively since reasoning ability and communication level are highly important for learners and scientific information is not static (Etobro & Fabinu, 2017). Biology as one of the major science subject requires relevant previous knowledge (PK) acquisition and utilization and some level of verbal ability competence as students are expected to make meaning and undertake due interpretation of concepts that are possibly found in their environment, give detailed explanations and also analyse their answers and findings (Njoku & Nwagbo, 2020; Okoro, 2011; Omeiza, 2019). This knowledge enables the science learners to communicate among themselves and with their teachers, express their understanding, share ideas and learn from each other (Okoro, 2011). Despite the fact that concept mapping, cooperative learning and student's verbal ability have an effect on students' learning outcomes in science and biology, they have not received as much attention from researchers as expected which is what this study seeks to investigate.

1.2. Research Aims and Research Questions

The problem of students' poor attitudes towards biology and science in general has been a source of worry for many science researchers (Njoku & Nwagbo, 2020; Okoro, 2011; Omeiza, 2019). In 1968, Dainton of the United Kingdom in the Department of Educational Science reported that students' poor attitudes and interest in science have declined dramatically worldwide. As a result, many tertiary institutions have increased their quotas for admitting less talented science students but this has not yet produced any positive results. It is spreading throughout countries. A factor that has been classified as poor teaching strategies adopted by the teacher contributed to students decline in science programmes. The old traditional mode of classroom authoritative learning and teaching of transmitting concepts and impacting knowledge without taking the students interests into account might have resulted in students' decline in science programmes of learning and participation over the years. Institutions are now changing from a less stimulating and motivating mode of lesson delivery to active learner-centred interaction in order to stimulate students' interests and participation in science courses. These methods encompass instructional approaches that shift and divert the focus of teaching and learning from the teacher-dominated approach to the student-teacher equal dominance interaction. This study tested the efficacy of two teaching strategies with student verbal ability as the moderating effect on students' attitudes towards biology and its related activities.

1.3. Research Hypotheses

The following three research hypotheses were tested:

- There is no significant effect of the intervention on the students' attitude towards biology.
- There is no significant effect of the student's verbal ability test on the students' attitude towards biology.
- There is no significant interaction effect between the interventions and students' tests of verbal ability on their attitude towards biology.

2. Research Methodology

2.1. Background of the Study

The research study adopted both pre- and post-tests quasi experimental quantitative design approaches. It involves the use of a 3x2 factorial design. The reason for adapting this research design was that research participants were selected from intact classes in their school settings where undue randomization was practically impossible and the interruption of class structure was kept to a minimum. The intervention application in this study was the administration of instructional intervention strategies at three different levels: Concept mapping strategy (CMS), Cooperative learning method (CLM) and Convectional teaching method (CTM). The moderator

variable was the student's verbal ability at two levels (low and high). The students' attitude change towards biology learning was the dependent variable.

2.2. Instruments and Procedure

The targeted populations for this study were the two senior high schools in the Ashanti Mampong municipality, Ghana. The total sample population was 480 (284 male and 196 female) students. The study made use of both pre-and post-intervention students' performance test scores with two instruments which are the Biology attitude Questionnaires (BAQ) and the student verbal ability test (SVAT) were adopted and modified for the purpose of this study. The attitude questionnaire was adopted and modified from Prokop, Tuncer, and Chudá (2007) and Russell and Hollander (1975) while the student verbal ability test was from the Australian Council for Educational Research (ACER). The attitude questionnaire was designed to investigate the student's affective domain in relation to the two instructional strategies in the teaching and learning of photosynthesis as a biological concept. The questionnaire consisted of thirty-seven items placed on a Likert scale ranging from strongly agree (SA), agree (a), neutral (n), disagree (D) and strongly disagree (SD). The scale was not intended to measure absolute attitudes towards biology but was structured to detect and measure changes in students' attitudes with respect to the two instructional methods used in the learning and teaching of photosynthesis. The items contained an equal number of positive and negative items which were shown to some science educators with a special bias in biology for their appropriateness in terms of clarity of ideas, language presentation, class levels, relevance and application of the study. The reliability coefficient of the study instrument measured by Shruba (2008) averaged 0.85.The reliability coefficient of the instrument was determined again using the Cronbach alpha measure and it yielded 0.88 which confirmed the acceptable limit proposed by Wang et al. (2017) for the purpose of this study.

In addition, the Students Verbal Ability Test (SVAT) was adopted and modified to assess students' verbal ability or communication fluency. It has gone through several modifications and re-validation for use by many researchers (Etobro & Fabinu, 2017). However, the researchers re-validated the test items to be sure of their suitability for this study. It was again trial tested on twenty students from an equivalent academic group but non-research participants were not chosen for the actual study. The collected data was critically analysed using Kuder-Richardson formula 20(Kr20) and a reliability of 0.86 was obtained. Kr20 was used as a result of the inequality of the difficulty levels of the items in the SVAT. The SVAT was administered to the participants once before the intervention administration.

2.3. Analysis of Data

The scores obtained after the intervention were subject to a two-way analysis of covariance (Ancova) using the pre-test as the covariate. The analysis of covariates was used to examine the main and interaction effects of the categorical variables on the continuous dependent variable controlling the effect of selected other continuous variables that co-vary with the dependent variables. Those control variables are called "covariates". It is also used to control factors that cannot be sampled by means of randomization but instead can be used to measure an interval scaled in an experimental design. The ANCOVA reduces experimental error through statistical techniques rather than experimental procedures (Wang et al., 2017). The Bonferroni post-hoc test was again used to investigate which of the groups actually had a significant effect while the interaction effect was explained with the aid of a graph. The Bonferroni post-hoc test was further used to establish and validate that the intervention techniques (concept mapping and cooperative learning approach) had a greater beneficial influence on the students' attitudes than the conventional method of teaching.

3. Discussion of Research Results

3.1. Hypothesis 1

There was no significant effect of the treatments on students' attitudes towards biology. A summary of the result is given in Table 1.

Table 1. Covariance analysis (ANCOVA) of post- attitude by performance and treatment.

Index source	Sum of square	Degree of freedom	Mean square	F	Sig.	η^2
Model	20314.199	6	883.226	582.658	0.000	0.966
Intercept	106.946	1	106.946	70.552	0.000	0.130
Pre-attitude	661.958	1	661.958	436.689	0.000	0.480
Treatment	16.361	2	8.191	5.397	0.005	0.022
Verbal test	166.132	1	11.075	7.306	0.000	0.188
Treatment x Verbal test	12.804	2	2.561	1.689	0.136	0.018
Error	718.516	473	1.516			
Total	1462636.000	498				
Corrected	21032.715	497				

Note: R-square=0.966 (Adjusted R-square=0.964) denotes significant $p<0.05$.

Table 1 indicates that there was a major and significant effect of the interventions or treatments on the students' attitude towards biology ($F_{(2,497)}=5.397$; $p<.05$, partial $n^2=0.022$). The effect size of 20.0% indicated a small effect size. It depicted a statistical difference among the students in the intervention group and the conventional group. As a result, the hypothesis one was rejected.

The estimated marginal means of the intervention groups were compared and investigated and the results are presented in Table 2 in order to examine the magnitude of the significant effect across the two intervention groups.

Table 2. Estimated means compared for post-attitude scores of the intervention and control groups.

Intervention groups	Mean scores	Standard error	95% C.I for difference	
			Lower	Upper
CTM	45.548	0.254	45.049	46.047
CLS	52.444	.211	52.030	52.859
CMS	60.340	.203	59.941	60.739

According to Table 2, the students in the Concept Mapping Strategy (CMS) intervention group 3 obtained the highest adjusted mean score in their post-attitude towards biology (60.340) followed by those in the Cooperative Learning Method (CLM) intervention group 2 (52.444) and their counterparts in the CTM control group (45.548).

Results from the Bonferroni post-hoc test were again used to determine exactly which of the groups was really responsible for the main significant effect of the intervention on students' attitudes towards biology and the analysis is presented in Table 3.

Table 3. Bonferroni post-hoc analysis of post-attitude of intervention and control groups.

Compared interventions		Mean diff.(I-J)	SE	P	95% confidence interval for difference	
(I)	(J)					
CTS	CLS	-6.896	0.330	0.000	-7.545	-6.247
	CMS	-14.792	0.325	0.000	-15.431	-14.153
CLS	CTS	6.896	0.330	0.000	6.247	-14.153
	CMS	-7.896*	0.293	0.000	-8.471	-7.321
CMS	CTS	14.792	0.325	0.000	14.153	15.431
	CLS	7.896*	0.293	0.000	7.321	8.471

Note: *= the mean difference is significant at the 0.05 alpha level.

Table 3 again indicated that there was no significant difference in the post-attitude mean scores of students that were taught using the cooperative learning method and their counterparts in the CTM. This suggests that the ANCOVA result revealed a significant difference not only between the intervention group (CMS and CLM) but between the CMS and the control group (CTM) as evidenced by students' post-attitude scores in biology.

3.2. Hypothesis 2

There is no significant effect of the students' verbal ability test scores on the students' attitudes towards the development of biology. The results from Table 1 revealed that there was a significant major effect of students' verbal test scores on their post-attitude scores in biology ($F(1,498) = 7.306$; $p<.05$, partial eta square of 0.188) from the analysis of the covariance shown in Table 4. The effect size of 19.0% indicated a small marginal effect. Therefore, hypothesis 2 was rejected. This shows that student's verbal ability has a significant effect on their attitudes towards biology irrespective of their intervention effect as indicated in Table 4.

Table 4. Estimated marginal means of post-attitude scores compared with students' verbal ability test.

Groups	Verbal ability test	Means scores	Standard error	95% C.I for difference	
				Lower	Upper
One	Low	45.548	0.254	45.049	46.047
Two	Medium	52.444	0.211	52.030	52.859
Three	High	60.340	0.203	59.941	60.739

Table 4 shows that students with high verbal ability test scores had a higher adjusted mean score in the post-attitude score in biology (60.34) and the medium group (54.44) than students with low verbal ability tests (45.55). This suggests that students with high verbal communication skills would demonstrate and have a more positive attitude towards biology than students with medium and low verbal abilities.

3.3. Hypothesis 3

- There is no significant interaction effect of the intervention's application and the students' test of verbal ability on their attitude towards biology.

There was no significant interaction effect between treatments and verbal ability on students' attitudes towards biology. The interaction effect of the interventions and students' verbal ability on students' attitude towards biology was statistically observed not to be significant ($F(2,497), = 1.689$, $P>.05$; partial $\eta^2=0.018$) as indicated in Table 1. Therefore, hypothesis 3 was not rejected. This shows that the interaction between the interventions and the verbal ability of students did not enhance students' attitudes towards biology.

4. Research Discussion

The research study investigated the impact of concept mapping and cooperative learning methods on students' attitudes towards the development of biology. The research findings indicated that students in the intervention groups demonstrated more positive attitudes towards biology than their counterparts in the control group even though the attitudes of students in the concept mapping group and those found in the control group were not significantly different. This finding and conclusion were seen to be consistent with Uitto (2014) and Umar (2011) who discussed and explained the students' attitudes towards biology. According to Zeidan (2010) and Zeidan and Jayosi (2015), it was insufficient to demonstrate a discernible difference between students exposed to the idea mapping technique and those participating in cooperative learning. The fact that only three of the four attitudes assessed by the attitude towards biology scale (ATBS) (biology in society, teacher's teaching and pleasure of biology) showed a significant difference led to these conclusions. They argue that the lack of significance could be as a result of the study's short period and the instructional method. However, concept mapping emphasizes student

cooperation and collaboration, gender inclusion, idea relationship construction and respect for various points of view which may improve students' attitudes towards the evolution of biology (Umar, 2011). The attitudes of students in the cooperative learning strategy significantly differ from those in the conventional teaching method. This result is consistent with the findings of Uitto (2014) and Umar (2011) in which students expressed extreme positive satisfaction and feeling (f=76) compared to (f=34) expressing negative satisfaction and feeling after conducting a content analysis of students opinion on the satisfaction received from instructional concept delivery with concept mapping combined with co-operative learning strategy.

When students learn in groups, they reflect, share ideas and influence one another. As a result of these findings, the two instructional methods increased social interaction among students if they were well-planned and between students and teachers, consequently enhancing students' attitudes towards biology. These strategies create a calm and conducive environment in the classroom allowing students to communicate more effectively and fluently. They place individual responsibility for learning in the hands of each and every student in the classroom. Students collectively developed a good mindset as a result of this effect. Individual's infamy and guilt are reduced as a result of this social interaction and students have a more positive attitude while progressing with their studies. The study recorded a significant main effect of students' verbal ability on their attitude towards biology instructional activities. The students with such high post-intervention performance show a more positive attitude towards biology as compared to the low performing students among the experimental students. This study supports the findings of Çömek et al. (2016) and Wang et al. (2017) who found that improving student performance enhanced attitudes towards biology and science. Their report indicates that the performance of the students increases with a more positive attitude compared to their low performance. The results of this study contradict Okoro (2011) and Oghenevwede's (2019) claims that students' verbal and communication skills have no influence on how they perceive and approach the study of English literature.

According to related findings, high students' verbal ability, irrespective of their research cluster has a positive attitude towards biology learning while poor-performing learners with less verbal communication skills may demonstrate a low and less negative attitude towards biology and science. Poor performance among students might have been a result of their negative learning attitude and their lack of interaction with their colleagues and their inability to express themselves clearly enough to share their learning problems with their teachers. On the other hand, high-performance students were able to effectively talk about their academic needs among themselves due to their strong competencies and self-efficacy resulting in their positive attitude towards learning about biology activities. It was shown that there was no meaningful and significant 'interaction effect between research treatment and students' verbal ability on the attitude development of students towards learning. It therefore shows that when students are given equal chances, students with either poor or good verbal ability skills would have the same learning attitude development towards biology learning. This research study supports the related findings of Uitto (2014); Çömek et al. (2016) and Wang et al. (2017) who found no interaction between research interventions and students' beginning verbal skills and attitudes towards literature in prose and reading comprehension. These results have indeed shown that when science learners are given equal access and adequate opportunity to effective and quality science learning instructional activities, students will learn biology with the same positive attitude. This can or may prevent the high margin of difference existing between learners with better and poor performance abilities in their attitudes towards biology activities. Some essential limitations of the strategies are that if not properly managed in the classroom, it could lead to a situation where students with better verbal skills may show off which could lead to another negative attitude build-up towards biology activities.

5. Conclusions and Implications

This research study empirically emphasis the use of students' self-centred and motivated instructional strategies as capable of promoting students' attitudes towards the development of biology. The research study indicated that concept mapping and the cooperative learning method were both effective in enhancing and developing students' attitudes towards biology than the conventional teaching method. Students in the concept mapping instructional strategy group demonstrated a more positive attitude than those in the cooperative learning method. Both teaching methods showed the potential to enhance students' positive attitudes towards the development of biology.

It is impossible to overestimate the importance of a student's language and communication skills in determining how they feel about learning biology. It contributes to the students' classroom participation and plays a significant role in enhancing students' attitudes towards biology. Students with high and better verbal ability are able to express their feelings and receive feedback from peers and teachers unlike those with low and poor verbal ability who do not receive appropriate positive feedback which negatively affects their positive attitudes towards biology and its related activities.

6. Recommendations

The following recommendations and suggestions were made as a result of the study's findings:

- The teachers must be encouraged to integrate the use of concept mapping and well -planned or structured cooperative instructional interventions as they demonstrate the potential of developing students' attitudes towards biology positively.
- Practising teachers should try as much as possible to encourage students' development of verbal ability and competencies by involving students in regular reading of their biology textbooks and active participation in all interactive practical works.

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