Teaching strategies impact on students' self-efficacy development, a case of Ashanti Mampong municipality, Ghana high schools

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ABSTRACT

This research study investigated the impact of concept mapping and cooperative instructional methods for enhancing students' self-efficacy development towards biology in two selected Senior High Schools in Ashanti Mampong municipality of Ghana. The study utilized quasi-experimental research design involving a 3 x 2 multi-factorial analysis. The sample was obtained by using purposive sampling technique to select from an already existing six classes across the two selected schools to make a total of 500 participants for the study. Three adapted and modified instruments used for the study included student's biology self-efficacy questionnaire (BSQ), Student verbal ability test items and the Students' Biology Performance test (BPT). The data obtained were analyzed using the analysis of Covariance (ANCOVA). The results indicated that, the treatment enhanced biology students' self-efficacy development toward the subject Results again indicated that biology students' performance had an impact on their self-efficacy development toward learning biological concepts. The effect of treatment interaction with student verbal ability test was observed not statistically significant for enhancing biology students' self-efficacy development. The concept mapping and the cooperative learning methods therefore, improved biology students' self-efficacy towards the subject in the two selected institutions. Hence, these two instructional strategies should be emphasized and enforced in the teaching and learning of biological concepts among all deprived science-based senior high school students in Ghana and where appropriate learning and teaching resources to solve the related problems are scarcely available.

Contribution/Originality: The study made the students to appreciate the importance of words relationship in the conceptual framework of scientific ideas and how they depend on each other's to bring about understanding.

1. INTRODUCTION

The knowledge of biology presented at the Senior High School level forms the major basis for many sciences related fields of academic study at the higher learning institutions in Ghana. These includes related branches like zoology, botany, molecular biology, biochemistry, ecology, physiology, biotechnology and engineering (Ameyaw & Okyer, 2018). These branches of science learning provide occupations in many developmental areas namely food and nutrition, health, pharmacy, processing industries and many others (Ameyaw & Okyer, 2018; Zeidan & Jayosi, 2015). Therefore, it appears from some discussions that for any developing country, like Ghana to advance socio-

economically, an average number of its school candidates should be enrolled in biology and biology–related fields of studies. This can be achieved, if biology candidates develop appropriate self-efficacy toward the learning of biology.

The significance of students' high self-efficacy development towards a particular subject motivates them to learn and motivate them to persist in their efforts to achieve a higher mastery in the subject matter (Njoku & Nwagbo, 2020; Omeize, 2019). Students' ability to show high level of self-efficacy towards particular subject of study is also a due reflection of the way they manage their belief, perception and behaviour towards the subject content they learn in schools (Njoku & Nwagbo, 2020). Thus, learner level of self-efficacy does not only act as a modulator of their learning, but they are considered as a product of students' effort and effective learning booster (Wang, Chiou, Lee, & Tien, 2017). Self-efficacy may again be explained as the individual's perception in demonstrating fluency and efficiency in undertaking a learning task. The individual responding in a way that is either determined to be favorable or unfavorable in relation to a certain instructional method prompt one's interaction in the teaching and learning process.

This study is based on the premise that concept mapping and other interactive learning methods, support students' affective domain and are important in helping their learning (Comek, Akinoglu, Elmaic, & Gundogdu, 2016). Besides some school factors like the teachers teaching methods, students' individual factors like students' previous knowledge or their performance play a significant role in influencing students' Moreover, self-efficacy also hints at the belief development of learners towards a subject.

Student verbal communication competency is also another greatest fundamental assets of human learning (Etobro & Fabinu, 2017). It is the medium through which the individuals expresses their understanding, feelings and thoughts during classroom instruction discussion in spoken or written words. 'It refers to the level of students' communicating using conventional language in his inter and intra-personal communications'. Students' verbal ability helps them during instructional concept understanding as evidenced by their oral or written introductory skills. Students need to properly convey their opinion and feelings related to the new concept to be learned. It is based on the individual level of intellectual development and the ability to reason abstractly. In science, the concept of student's verbal ability competency can help an individual in explaining the findings of an experimental results and the appropriate conclusions needed from such experimentation (Comek et al., 2016). They discussed further that, since learners reasoning ability and level are very essential and scientific knowledge not static, student's communication skills (Etobro & Fabinu, 2017) enables individuals to argue and make propositions on their findings objectively.

Despite its significant importance and application in various fields of studies, the learning of biology is not attractive to most students, and their performance in science even at the Junior High School level in general is much observed to be lower than the expected. This has indeed affected students' participation in biology related programmes of studies and their performance has been consistently poor over the years (Ameyaw & Okyer, 2018). As shown and indicated in studies in Ghana (Ameyaw & Okyer, 2018) the percentage of student who performed poorly in biology in the Senior High Schools West-African examination was 32.5% and 34.2% in 2015 and 2016 respectively (Ameyaw & Okyer, 2018). These poor performances were again evident even in the years of 2018 up to 2020 (West African Examinations Council, 2012).

Biology as one of the major science subject requires relevant previous knowledge 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, to give detailed explanations, and also analyze their answers and findings (Njoku & Nwagbo, 2020; Omeize, 2019). This knowledge enables the science learners to communicate among themselves and with their teachers, express their understanding, and share ideas as well as for learning. Despite the fact that concept mapping, co-operative learning and student's verbal ability have an effect on students' learning outcomes in science in general and biology in particular, they have not received much attention from researchers as expected which this study seeks to investigate.

1.1. Research Aim and Research Questions

The problem of learners' poor self-efficacy belief towards biology and science in general has been a major source of worry to many researchers (Njoku & Nwagbo, 2020; Omeize, 2019). Poor self-efficacy belief demonstration indicates the individuals' interest in the learning task and how the person shows his commitments to achieve success in performance. According to Dainton research report of the United Kingdom in the Department of Educational Science (Etobro & Fabinu, 2017), students' poor and interest in science, which is elaborated and called as "swing from science" has been much alarming as a result of teachers' poor teaching methods in science education. This has been seen and so reported even in such developed and advance part of the world, that drastic weakening in students' poor self-efficacy and interest ratio in science has been so frustrating that, even many tertiary institutions have now increased their quotas of admitting less academically performed science students which has not yielded positive and deserving response.

The poor performance of students in science subjects has been sweeping across countries in both global north and south dimensions. Poor teaching methods has been identified as a factor which has contributed to students' low participation in science programmes. The authoritative traditional mode of classroom learning and teaching concepts and impacting knowledge without taking the students interest into account might have further resulted in students' decline of interest and performance in science programmes of learning and participation over the years.

A need was therefore felt to examine and appropriate research findings on students' performance related to their self-efficacy, to ascertain how it evolved as a target area of study because researchers have examined the role self-efficacy contributing towards students' academic achievement scores (Zeidan & Jayosi, 2015) and Wang et al. (2017). Furthermore, in order to increase and stimulate students' interest and participation in science courses, academic institutions need to change from less stimulating and motivating mode of lesson delivery to active learner-centered interaction. These methods encompass instructional methods that shifts and divert the focus of teaching and learning from the teacher dominated approach to the student and teacher equal dominance interaction. This study therefore, also investigated the impact of the instructional methods, with student verbal ability as the moderating factor on students' self-efficacy development towards biology and its related activities.

1.2. Research Hypotheses

The research study investigated the following three research hypotheses:

1. There exists no significant effect of the research treatment on the students' self-efficacy development towards biology.
2. There exists no significant effect of the student's test of verbal ability competence on students' self-efficacy development towards biology.
3. There exists no significant interaction effect of the research treatment and students' test of verbal ability competence on their self-efficacy development towards biology.

2. LITERATURE REVIEW

2.1. Self Efficacy

The concept of self-efficacy has been emphasized in many research studies (Bandura, 1997, 2002) often highlighting a particular subject with respect to some activities like biology teacher's instruction, relevant concepts taught in school biology periods, teachers' assessment procedures, laboratory scheduled experiments, biological concept discussions, and biotechnological innovation (Ameyaw & Okyer, 2018). From these factors that may affect students' self-efficacy development, several reasons were proposed and given for enhancing students' self-efficacy development towards biology as well as science development (Njoku & Nwagbo, 2020). First, it was believed that self-efficacy as a factor for learning describe can be linked with academic success of an individual (Zeidan & Jayosi, 2015). Secondly, there exists a positive correlation between students' self-efficacy belief and performance in science

learning, which was supported by a few major research reports (Wang et al., 2017; Zeidan, 2010; Zeidan & Jayosi, 2015). There were other studies like Njoku and Nwagbo (2020) which substantially buttressed the conclusions of Omeize (2019) and agreed that students' performance and achievement in science has a strong positive correlation with their attitude and have a value ranging from 0.24 to 0.48.

Wang et al. (2017) in a similar related study, explained and discussed that the integrated science students with low positive concept of self-efficacy belief always had poor and low performance score in their overall assessment scores in all the related sciences subjects' examinations. On the contrary, the major findings of Bandura (1997) on the principle of self-efficacy belief impact on learning, also elaborated that although there is always a strong significant relationship between students' self-efficacy development and their achievement scores, it may not mostly be the case that, students' positive attitude can bring about an enhanced and improved performance score in the individuals' assessment in question. They further discussed, confirmed and questioned that, there might be a likelihood for a learner who has developed a significant positive attitude towards a course of study but may not be able to achieve a better score in spite of varied authentic assessment process used to ascertain their progress in academics and vice versa. This suggests that, the concept of self-efficacy might influence one's academic achievement and performance (Andrew, 1998) but their effective impact on learning outcome and indications may not always be a determined factor to conclude that high performance scores are always influence by students' Self-efficacy.

2.2. Self Efficacy for Students' Performance

Omeize (2019) proposed, in the midst of this debate, that if individuals' concept of self-efficacy is given its due consideration as needed, the long awaiting change in cognitive skill and domain anticipated for, may be achieved resulting in enhanced performance among students. The most significant reason acclaimed for developing students' self-efficacy towards science and Biology to be specific is its unique ability to predict learners process skill (Zeidan & Jayosi, 2015). Notwithstanding the fact that not enough attention had been given to self-efficacy and its development over the past forty years now (Omeize, 2019). Self-efficacy significance and its impact has almost been played down in comparison to performance when it comes to assessing needed standards for measuring educational outcome and achievement (Zeidan & Jayosi, 2015). This is summarized by Wang et al. (2017) and Patrick (2011) as "The likelihood of the student putting his knowledge to use is influenced by his develop self-efficacy in the subject and its significance in society".

Research on students' self-efficacy belief development towards one's programme of learning ought to be an important factor to consider during teaching and learning. It should be mandatory for programmes and courses instructors to identify their learners conceived interest towards their subject matter and impact on their life for ensuring the success of their delivery. For the teacher to accomplish this purpose, they must be ready to prepare and employ an effective pedagogy as possible to bring about change in their learner's behaviour.

According to Wang et al. (2017) one of the factors that explains student's belief of perceptions and possibly determine their self-efficacy belief towards science programmes in a science classroom is the impact of teachers' methods of teaching which buttress the findings of Patrick (2011). A classroom environment with arieties of innovative teaching strategies coupled with students' high level of involvement, support and active interaction and participation among class members may create strong positive attitude of students towards science learning and builds their confidence. This was strongly supported by Zeidan and Jayosi (2015) when they commented by saying "measures that positively affect students' attitude and Self-efficacy development include, teaching methods that emphasize learners' active learning and the significance of science to one's daily life".

There had been wide-range of research that has explained in detailed the impact of students' attitude and self-efficacy development towards science (Wang et al. (2017) but majority of them had failed to discuss it significance with respect to students' conduct of science education with particular reference to biology (Nja et al., 2022; Patrick,

2011). In some of these few findings where significant Self-efficacy of students has been well explained and discussed, it only centered on a change in students' Self-efficacy as a result of only one instructional method but not in comparative methods on students' performance as in this study.

A related study by highlights the importance of effectively examining students' self-efficacy belief in science learning, due to its unique significance compared to the cognitive abilities which was likewise confirmed by Patrick (2011). Several research findings have critically examined and emphasized the influence of varied instructional methods and pedagogical merit on students learning Self-efficacy (Zeidan, 2010; Zeidan & Jayosi, 2015) but only few have stressed on the effect of using two constructivists' teaching and learning methods on students' performance, which this study seeks to investigate.

However, the research findings and conclusions to be discussed from these research studies are as varied in addressing the needs for change as the findings themselves from the research conducted by Comek et al. (2016). According to the nature of instructional methodology students went through in the classroom has influence on their self-efficacy belief development towards their chosen programme of study (Andrew, 1998) but the findings of Wang et al. (2017) concluded otherwise.

2.3. Concept Mapping and Cooperative Teaching and Learning Strategy

In order to effectively contribute to the influence of teaching methods for promoting and enhancing students' self-efficacy development towards biology (Comek et al., 2016), this research study employed two constructivist teaching strategies, namely concept mapping and cooperative teaching and learning strategy, on students' activities in biology.

Concept mapping is a form of collaborative learning strategy of helping students to demonstrate their cognitive understanding in hierarchical pattern of web-link concept maps (Novak & Gowin, 1984). It has been very helpful for enhancing learner's performance in sciences particularly Biology education. This instructional methodology has been emphasized and supported in many educational researches especially Biology education (Ameyaw, 2012; Patrick, 2011). The process of constructing these concept maps and their applications assists students for better understanding of related concepts relationship in science. Concept mapping construction techniques also help shape and builds students' self-efficacy and opinions, and for the enhancement of their performance and achievement rather than evaluation (Comek et al., 2016). The concept mapping learning and teaching method afford the learners the chance to discuss, share and construct meaningful ideas and link these concepts of the lesson together using agreed nodes and prepositional link with the instructor's assistance.

On the other hand, co-operative teaching and learning strategy helps and allows students to critically listen, think and reflect on learned concept and prepare effective notes afterwards. This manner is achieved with much attention during group work assigned responsibility. It makes the students happy and active during the instructional period at the same time work together and find needed solutions to assigned task. Student's works are monitored closely and are guided to organize their understanding in a meaningful manner to discuss the important concept of the lesson during instruction time. It is thus an instructional strategy that assists students to understand and develop both social relationship and academic progress, as well as, achieving shared academic goals, (Nja et al., 2022; Wang et al., 2017). It is a learning and teaching method which encompasses students to discussing and work cooperatively as they reflect on assigned learning tasks discussed forehand in the classroom. It therefore, means that cooperating and reflecting on the lesson allows students to think about the learned classroom task as they learn together in a group after post instructional discussion.

Cooperative learning facilitates interdependent relationship among students and their instructor (Ameyaw, 2012; Patrick, 2011). This gives the students the chance to discuss, share and critique one another's ideas .By these processes, and developed a kind of independent relationship, self-concepts and positive attitude among themselves.

This builds the students confidence and enable them to be responsible of their own learning. From the findings of Ameyaw (2012) this method provides the students a sense of belongingness of their own understanding.

Concepts of science and most specially in biology, require adequate conceptual understanding of related abstraction on concrete, semi-concrete or abstract experiences of students (Wang et al., 2017). It is a practical description and organization of biological knowledge, ideas or relations (Zeidan, 2010) and Zeidan and Jayosi (2015) in a conceptual web network using nodes and links. It has been 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 concepts interpretation. It uses meaningful learning materials and the choices of the learner in questioning knowledge formulation. It also helps students connect newly developed ideas to old existing concepts and discard the conventional teaching techniques (Ameyaw, 2012; Patrick, 2011).

Notwithstanding, the lecture method as often regarded as conventional teaching method, which has been emphasized as one of the many researched methods of all instructional methods (Ameyaw & Okyer, 2018). Most teachers have failed to plan it well, thus, have not yielded its expected outcome collaboratively (Wang et al., 2017). Lecture instructional method helps students to work hard and become resourceful, if it is appropriately planned and implemented well. It enables learners to work together and ensure efficiency of assigned task accomplishment in less duration. This requires small groups for task discussion, which maximize each other's potential to find out the truth in knowledge. It increases concentration and attention in classroom. This gives the learners the chance to carefully listens, share and contribute in class discussion between one another. This is due to the active attention and the care each student displays towards one another through attentiveness in listening to teachers' ideas in passive mode and writing silent notes.

There is a dearth of studies on the importance of students' self-efficacy belief using combined forms of teaching methodologies of concept mapping and inquiry-based instructional strategies (Wang et al., 2017; Zeidan & Jayosi, 2015). Nevertheless, only a few studies have been conducted on the effect of concept mapping and co-operative mastering instructional strategies in enhancing students' attitude (Zeidan, 2010). According to Ameyaw and Okyer (2018) not many studies have been conducted on the impact of instructional strategies that have been recorded using concept mapping. Studies have though investigated the impact of making meaningful educational innovations; however, only few of these researches have categorically emphasized that concept mapping process should be applied and adopted as one of the constructivists innovations (Ameyaw & Okyer, 2018). They further discussed that, there are a number of limitations of the suggested findings on the benefits and impact of the concepts mapping and its variants to the confine of the instructor's classroom which cast some doubt on the generalizability of the strategy's significance. This is so because there has never been structured and formulated studies with defined objectives that have attempted to examine and investigate the efficacy of concept mapping strategy on students' self-efficacy development towards biology using comparison groups in science learning environment.

Cooperative learning strategy of teaching tries to associate both features of active cooperation and reflective discussion approach (Ameyaw & Okyer, 2018). The direction of the current study is therefore to take advantage and examine the influence of teaching and learning methods combined with constructivists learning techniques on students learning potential prompted researchers like Ameyaw and Okyer (2018) and Ameyaw (2012) to combine self-efficacy and unique educational strategies like cooperative learning method.

3. RESEARCH METHODOLOGY

3.1. Research Design

This research study used pre-test and post-test experimental quantitative design involving the use of 3x2 factorial method. 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 prevented to the minimum. The intervention application in this study was the administration of instructional strategies at three levels, concept mapping strategy (CMS), cooperative learning strategy (CLS) and conventional teaching strategy (CTS). The moderator variable was student's verbal ability at three levels (low, medium and high). The student's self-efficacy belief development towards biology was the dependent variable.

3.2. Instrumentation and Procedure

The targeted populations for this study were the two Senior High Schools in the Ashanti Mampong municipality, Ghana. The total sample comprised 498 (273 male and 225 female) students. The study made use of both pre- and post-intervention students' performance test with two instruments, namely Biology Self-efficacy Questionnaires (BSQ) and Student Verbal Ability Test (SVAT), adopted and modified for the purpose of this study.

The self-efficacy questionnaire was adopted from Baldwin, Ebert-May, and Burns (1999) and modified for use while the student verbal ability test was adapted from Australian council for Educational Research (ACER). The self-efficacy questionnaire aimed to investigate the student's competency 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 (37) items, placed on a Likert scale ranging from strongly Agree (SA), Agree (A), Neutral (N), Disagree (D) and Strongly Disagree (SD) developed on four dimensions. The scale was not intended to measure absolute self-efficacy towards biology but was structured to detect and measure changes in students' self-efficacy belief with respect to the two instructional methods used in the learning and teaching of photosynthesis, a concept in biology. The items contained an equal number of positive and negative items, which were shown to three science educators with expertise in biology for its appropriateness in terms of clarity of ideas, language presentation, class levels, relevance and application of the study. For the purpose of this study, the reliability coefficient of the instrument was determined again using Cronbach alpha measure, and it yielded 0.86 which confirmed the acceptable limit proposed by Field (2013).

In addition, Students Verbal Ability Test (SVAT) was adopted and modified to assess student's verbal ability competence 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 its suitability for this study. It was trial tested on twenty students of equivalent academic group but non research participants who were not chosen for the actual study. The collected data was critically analyzed using Kuder-Richardson formula 20(Kr20) and a reliability of 0.86 was obtained. Kr20 was utilized as a result of the inequality of the difficulty level of the items in the SVAT. The SVAT was administered on the participants once before the intervention administration.

3.3. Analysis of Data

The scores obtained after the intervention administration were subject to a two-way analysis of covariance (ANCOVA) utilizing the pre-test as the covariates. The analysis of covariates was used to examine the main and interaction effect of the categorical variables on the dependent variable, controlling for the effect of selected other continuous variables, which co-vary with the dependent variables. These control variables were called the "covariates" and were 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 by statistical techniques rather than by experimental procedure (Wang et al., 2017). The Bonferroni post-hoc test was again used to investigate which of the groups actually made a significant effect, while the interaction effect was explained with the aid of a graph. In order to ascertain and confirm that, the intervention (concept mapping and cooperative learning strategy) strategies had a more positive impact on the students' Self-efficacy in comparison to the conventional method of teaching, Bonferroni post-hoc test was further utilized to determine that effect.

4. RESULTS

4.1. Hypothesis1

The deliberations tested the first hypothesis, "There exists no significant effect of the research treatment on the students' self-efficacy development towards biology." A summary of the findings of the first hypothesis is presented and given in Table 1.

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

Source	Type III sum of squares	Degree of freedom	Mean square	F	Sig.	Partial eta squared
Corrected model	32677.547[a]	6	1210.280	3106.441	0.000	0.994
Intercept	23.455	1	23.455	60.203	0.000	0.114
Pre-self-efficacy	131.285	1	131.285	336.971	0.000	0.418
Treatment	4.049	2	2.024	5.196	0.006	0.022
Verbal ability	818.984	1	37.227	95.550	0.000	0.817
Treatment * Verbal ability	1.835	2	0.918	2.355	0.096	0.010
Error	183.114	470	0.390			
Total	2071005.000	498				
Corrected total	32860.661	497				

Note: a. R squared = 0.994 (Adjusted R squared = 0.994). *. factors interaction.

Table 1 indicates that there is a major significant effect of the treatment's administration on the students' self-efficacy belief towards biology (F $_{(2,497)}$ =5.196; p<.05, partial n²=0.022). The effect size, of 20.0% indicated a small magnitude of effect. Notwithstanding, it depicted a statistical difference among the students in the treatment or intervention group from the conventional group. As a result, the hypotheses 1, was rejected.

In order to examine the magnitude of the significant effect across the two intervention groups, the estimated marginal means of the intervention groups were compared and investigated, and the result is presented in Table 2.

Table 2. Estimated means compared for post-self-efficacy scores of treatment and control groups.

Treatment	Mean	Std. error	95% Confidence interval	
			Lower bound	Upper bound
CTS	64.949[a, b]	0.705	63.562	66.335
CLS	62.296[a, b]	0.128	62.044	62.547
CMS	65.327[a, b]	0.385	64.571	66.084

Note: CTS=Conventional teaching strategy, CLS= Cooperative learning strategy, CMS= Concept mapping strategy
a. Covariates appearing in the model are evaluated at the following values: pre-self-efficacy = 34.8614.
b. Based on modified population marginal mean.

Table 2 shows students in the CMS group three obtained the highest adjusted mean score in their post-self-efficacy belief towards biology (65.327) followed by those in the CTS control group (64.949) and their counterparts in the CLS intervention group (62.296).

Table 3 presents the results from the Bonferroni post-hoc test conducted to determine exactly which of the groups really was responsible for the main significant effect of the intervention on students' self-efficacy belief development towards biology, and the analysis is presented in Table 3.

Table 3 shows that the post self-efficacy means scores among biology students in CMS significantly differ from those that were taught with the CLM and those exposed to CTM. Although there was some estimated mean difference between all the three groups, there were no statistically significant difference in the post self-efficacy means scores of students that were taught using the concept mapping strategy 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 also between the CLS and the control group, exposed to CTM, as evidenced by students' post Self-efficacy scores in biology.

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

Treatments	Treatments	Mean difference	Std. error	Sig.[d]	95% confidence interval for difference[d]	
					Lower bound	Upper bound
CTS	CLS	2.653[*, b, c]	0.707	0.000	1.264	4.042
	CMS	-0.379 [b, c]	1.085	0.727	-2.512	1.754
CLS	CTS	-2.653[*, b, c]	0.707	0.000	-4.042	-1.264
	CMS	-3.032[*, b, c]	0.415	0.000	-3.847	-2.216
CMS	CTS	0.379 [b, c]	1.085	0.727	-1.754	2.512
	CLS	3.032[*, b, c]	0.415	0.000	2.216	3.847

Note: CTS=Conventional teaching strategy, CLS= Cooperative learning strategy, CMS= Concept mapping strategy.
*. The mean difference is significant at the 0.05 level.
b. An estimate of the modified population marginal mean (I).
c. An estimate of the modified population marginal mean (J).
d. Adjustment for multiple comparisons: Least Significant Difference (Equivalent to no adjustments).

4.2. Hypothesis 2

Hypothesis 2 states that "There exists no significant effect of the student's test of verbal ability competence on students' self-efficacy development towards biology." The results in Table 1 have already revealed that there was a significant major impact of students' verbal ability test scores on their post self-efficacy scores in biology (degree of freedom 497; F=95.550; P<.05, partial η2=0.10). Hence, from the analysis of the covariance shown in Table 4 with all the three groups having a higher mean score, the effect size of 82.0%, indicated a large marginal effect. Therefore, the hypothesis 2 was rejected. This shows that student verbal ability has a major significant effect on their self-efficacy towards biology irrespective of their intervention effect (Table 4).

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

Verbal ability groupings	Mean score	Standard error	95% C.I for difference	
			Lower	Upper
Low	62.296	0.128	62.044	62.547
Medium	64.949	0.705	63.562	66.335
High	65.327	0.385	64.571	66.084

Table 4 shows that students that demonstrates high verbal ability test scores had a higher adjusted mean score in the post self-efficacy score in the biology (65.327) than students with low verbal ability test (62.296). This suggest that students with high verbal communication skills would show a higher self-efficacy belief towards biology than their students' counterpart with low verbal abilities, and this difference was significant.

4.3. Hypothesis 3

There was no significant effect of the research treatments application and students' test of verbal ability on their self-efficacy development towards biology." The findings suggest that there was no significant interaction effect of treatments and verbal ability on students' self-efficacy towards biology. The interaction effect of the instructional interventions and students' verbal ability on students' self-efficacy belief towards biology was statistically observed not to be significant (F (2,497), =2,355, P>.05; partial η2=0.01), as indicated in Table 1. The hypothesis 3 was therefore accepted. This shows that the interaction between the instructional interventions and the verbal ability of students did not jointly enhance students' self-efficacy belief towards biology.

5. DISCUSSION

The study investigated the impact of concept mapping and co-operative learning method on students' self-efficacy belief development towards biology. The research findings indicated that students in the intervention groups demonstrated a high self-efficacy belief towards biology than their counterpart in the control group, even though, the self-efficacy belief of students in the concept mapping group and those found in the control group were determined not significantly different. This finding and conclusion were reviewed to be consistent with Uitto (2014)

and Umar (2011) who discussed and explained that while the general students' self-efficacy belief towards biology was indeed significant, it was not enough to confirm that a significant difference between students exposed to the concept mapping strategy and those expose to the cooperative learning method (Zeidan, 2010) are the same in construct (Zeidan & Jayosi, 2015) and Wang et al. (2017). These findings resulted due to the fact that only three of the four components of the self-efficacy dimensions measured by the Self-efficacy Towards Biology Scale (STBS) indicated a significant difference (Mastery experiences, vicarious experiences and Verbal/social persuasion). They argue that the lack of significance could be as a result of the study's short duration and the instructional method uniqueness.

Concept mapping instructional approach, however, has the possibility to enhance student's self-efficacy development towards biology since it emphasizes on student's cooperation and collaboration, gender inclusivity, concepts relationship building, and respect for all points of view (Umar, 2011). The self-efficacy belief of students in cooperative learning strategy significantly differs 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 concepts delivery with concept mapping combined with co-operative learning strategy.

This may be as a result of the fact that as students learn in groups, they reflect and share ideas together and influence one another by doing so (DeBacker & Nelson, 2000). As a result of these findings, the two instructional methods increased social interaction among the students if it is well planned and between students and teachers, consequently enhancing enhance self-efficacy belief development towards biology. The interactive nature of the strategies creates a calm and conducive environment in the classroom, allowing students to communicate more effectively and fluently. These strategies place the individual's responsibility for learning in the hands of each and every student in the classroom. Students collectively developed a positive and better 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 and a higher self-efficacy belief while progressing with their studies.

The study recorded a significant main effect of students' verbal ability on students' self-efficacy belief towards biology instructional activities. The students with such high post-intervention performance show a high self-efficacy belief and more positive attitude towards biology as compared to the low performing students among the experimental students. This result confirms the related findings of Comek et al. (2016) and Wang et al. (2017) who reported that students' performance improved students' self-efficacy towards biology and science as a whole. Their report indicated that the performance of the students increased more positive self-efficacy belief compared to the low performance of students. The result of this study is therefore not in support of the findings of Oghenevwede (2019) who both indicated that student's communication and verbal ability shows less or no effect on their learning attitude towards English Literature as a subject.

According to related findings, high students' verbal ability, irrespective of their research nature, has a positive self-efficacy belief towards biology learning, while poor performing learners with less Verbal communication skills may demonstrate a low and poor self-efficacy belief and less negative attitude toward biology and science in general. Poor performance among students might have been resulted as a result of their negative learning self-efficacy belief and their less interaction with their colleagues and inability to express oneself clearly to share their learning problems with their teachers. High performance students, on the contrary, were able to effectively talk about their academic needs among themselves due to their strong competencies and self-efficacy developed, resulting in their high self-efficacy development in learning toward biology activities after the intervention. Notwithstanding, it was shown that there was no meaningful significant 'interaction effect of research treatment and students' Verbal ability on the self-efficacy development of students towards biology 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 self-efficacy development towards biology learning.

This research study supports the related findings of Uitto (2014); Comek et al. (2016) and Wang et al. (2017) whose studies shows not at all significant interaction impact of research interventions and students initial verbal skills on their low attitude to high efficacious interest towards Literature in Prose and Reading Comprehension respectively.

These results have indeed showed 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 better learning attitude and confidence. This can or may prevent the high margin of difference existing between learners with better and poor performance abilities level, as their self-efficacy belief and attitudes toward biology activities have altered and increase.

Some essential limitations of the strategies are that, if not properly managed and controlled well in the classroom, it could result and bring about a situation where students with better verbal communication skills development may potentially monopolized and control all the class discussions at the detriment of the less performing and verbal ability students. This condition could lead to another negative attitude build-up towards biology activities by some less academically oriented students if not well handled.

6. CONCLUSION AND IMPLICATIONS

This research study empirically highlighted the use of students' self-centred and motivated instructional strategies that is capable of promoting students' self-efficacy development towards biology. The research study specified that concept mapping and co-operative learning technique were both effective in enhancing and developing students' self-efficacy towards biology than the conventional teaching method. Although, students in the concept mapping instructional strategy group demonstrated highly self-efficacy than those in co-operative learning method, notwithstanding, both teaching methods showed the potential in contributing to enhancing students' self-efficacy development towards biology.

Students' level of verbal ability and articulation impact on their self-efficacy development towards biology learning cannot be under-estimated. It contributes significantly to the students' classroom participation and plays a significant role in enhancing students' motivation and high self-efficacy towards biology as the students need to constantly share and discuss ideas in biology among themselves and with the teacher as the case may be. Students with high and better verbal ability are able to express their feelings and receive feedbacks from peers and teacher unlike those with low and poor verbal ability that found it difficult and feels shy to communicate and express their opinions during group activity to their peers and teachers, thereby not receiving appropriate positive feedbacks, which invariably and negatively affect their self-efficacy belief development towards biology subject and it related activities.

7. RECOMMENDATIONS

From the findings discussed in this study, the following suggestions and recommendations were made:

- The teachers must be encouraged to integrate the use of concept mapping and well plan structured co-operative instructional interventions as they demonstrate the potential of developing students' attitude 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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