

## EFFECTS OF CONCEPT-MAPPING INSTRUCTIONAL STRATEGY ON PERFORMANCE AMONG BIOLOGY SCHOOL STUDENTS' OF AKKO LGA, GOMBE STATE, NIGERIA

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### Abstract

*The study was carried out to investigate the Effects of Concept Mapping Instructional Strategy on Performance among Biology Students in Akko Education Area, Gombe State, Nigeria. Concept mapping instructional strategy is one of the innovations in the teaching and learning of science and biology in particular. Previous studies have reported that teachers and students experienced difficulties in the use of concept mapping. The study adopted quasi experimental control group design comprised pre-test and post-test. The population of the study comprised of two thousand one hundred and five (2105) SSII Biology Students of Public Secondary Schools in Akko Education Zone. Two intact classes of SS II students were involved and randomly selected in the study with the sample size of sixty five (65) SSII students from two (2) Schools. The two (2) Schools were designated as the experimental group and the other School was the control. The research instruments used was Biology performance Test (BPT) with a reliability coefficient of 0.79. It was used to measure the performance. The experimental groups were taught using concept mapping Instructional Strategy (CMIS) while the control group was taught using the lecture method (LM). Two research questions were answered using descriptive statistics, mean and standard deviations and two null hypotheses were tested at  $P \leq 0.05$  the data collected were analysed using  $t$  –test to indicate the significant among the groups. Among the other results revealed shows: (a) A significant difference exist in the mean performance scores between the Experimental group and the control group (b) no significant difference exist in the mean performance score of the male and female students. Based on these finding, it was concluded that CMIS enhanced the performance of senior secondary school biology students in ecology. Based on these findings, the research recommends (a) Concept Mapping should be used to help learners learn effectively (b) Workshops and seminars should be organized to train teachers on how to teach using Concept Mapping Instruction Strategy.*

**Keywords:** Concept Mapping, Gender, Performance and Lecture method

### Introduction

Biology is a broad field that offers a lot of opportunities to science students and also provides the society with lots of benefits. Biology is a very important subject that enables one to understand oneself and the environment, which the national curriculum emphasizes

both foundational knowledge and its practical application, hence there is a need for the effective teaching of biology in our secondary schools to better harness its benefits. Biology as a branch of science is a study of living organisms and vital processes (Twan & Useni, 2022). The knowledge of biology is vital to the study of medicine, pharmacy, nursing, dentistry and agriculture, industry, biotechnology, and other fields like genetic engineering and hybridoma technology (Abimbola & Omosewo, 2006). Due to high number of field of studies in which biology has been link to them, Biology has witnessed high enrolment compared to any other science subject in the final year Senior School Certificate Examinations (SSCE). This increase in the SSCE candidates, has not indicates any corresponding increase in students' academic performance (Sakiyo, 2014; Twan, Danjuma & Useni, 2022). Despite the efforts of both federal and state governments to encourage biology education, students' failure in biology in Senior School Certificate Examinations (SSCE) is still high (Agboghoroma & Oyovwi, 2015; Twan & Useni, 2022). The major reasons for this poor performance was attributed to negative attitude of teachers and students, poor reading habit, the nature of the curriculum which is overloaded and poor methodology in science education (Kingaru, 2014; Twan & Useni, 2022). In a bid to cover the syllabus, teachers result to limiting themselves to the traditional way of teaching (lecture method) which involves mostly the cognitive domain of learning to the detriment of affective and psychomotor domains (Arokoyu & Obunwo, 2014). The performance of Biology students at the SSCE level continues to be abysmal. Aside the above reasons for students' underperformance, the approach to teaching and learning of Biology have also been identified as a contributing factor (Twan et al., 2022). Most teachers in the secondary schools are still using the traditional techniques of teaching the subject. This seems to cause students to inadequately understand the lessons they are taught hence, might cause them to memorize facts only for examinations and thereafter promptly forgetting what they have learnt. The teaching approach that is widely used in the Western countries and in this 21st century in presenting science concepts to students is concept mapping. Some studies have revealed that concept maps have been effective for performance and retention and comprehension of concepts, and that there have been significant differences between concept map groups with lecture method and other non-Concept maps technique also known as cognitive maps or organizers, semantic networks, visual or graphic organizers make use of figures, lines, arrows, and spatial configurations to show concept map groups (Ahmed & Abdelraheem, 2016; Novak and Canas, 2008; Twan & Kuboye, 2018).

Concept mapping as a method of instruction, however, is not widely used in secondary schools in Nigeria. Therefore, this study was designed to compare the concept mapping approach which is based on constructivist with traditional approach which commonly used in Nigerian schools. Concept map according to Novak and Gowin (1984) is a graphical tool for representing knowledge. It is also tool that illustrates the interconnection ideas between and among individual concepts dimensional hierarchical diagram. Jonassen (2000) state that concept map is a visual representation of concepts and their interrelationship; how content ideas and concepts are organised and related. The process of concept mapping involves representing with a diagram the logical relationships among concepts in an orderly, sequential or hierarchical manner such that the most broad or general concepts are at the top and the most specific ones are at the bottom of the map.

Novak and Gowin (1984) developed the technique of concept mapping which has had significant impact on education. Concept maps are now widely used in various education

settings to promote meaningful learning and visual thinking (twan and Kuboye, 2018). It has subsequently been used as a tool to increase meaningful learning in the sciences and other subjects as well as to represent the expert knowledge of individuals and teams in education, government and business. Concept maps have their origin in the learning movement called constructivism. Novak's work is based on the cognitive theories of Ausubel, who suggested that learn meaningfully by building knowledge on the bases of their prior knowledge. Ausubel, (1968, as cited in Novak and Canas 2008) stated that "the most important single factor influencing learning is what the learner already knows, ascertain this and teach accordingly". The fundamental idea in Ausubels' cognitive psychology is that, learning takes place by the assimilation of new concepts and propositions into existing concept and prepositional framework by the learner. This knowledge structure as held by the learner is also referred to as the individual's cognitive structure (Ausubel et al., 1978).

### **Research Question**

- I. What is the difference between the mean performance scores of SSII Biology Students taught Ecology Concept using Concept Mapping and those taught using Lecture Method?
- II. What is the difference between the mean performance Score of male and female SSII Biology students taught Ecology Concept using Concept Mapping and those taught using Lecture method?

### **Research Hypotheses**

- H01: There is no significant difference between the mean performance scores of SSII Biology students taught Ecology Concept using Concept Mapping and those taught using Lecture Method.
- H02: There is no significant difference between the mean Performance Scores of SS II Biology Students' taught Ecology Concept using Concept Mapping and those taught using Lecture method with regard to their Gender

### **Methodology**

This study adopted a quasi-experimental research design with pre-test post-test experimental and control group. The population of the study comprised of two thousand one hundred and five (2105) of all Biology students in public senior secondary schools in Akko LGA Gombe state, Nigeria (Ministry of Education Gombe, 2020). Simple random sampling technique was used to select two intact classes from two schools which gave a sample of 65 students were used: 35 in the control group and 30 in the experimental group. One intact class served as experimental group while the other class in a different school served as the control group. The choice of the schools was based on the fact that they shared the same characteristics in terms of the entry condition of students, geographical location, and presentation of candidates for external examinations. One instrument was used for data collection, namely: Biology Performance Test (BPT) for pre-test which was administered prior to the treatment while a post-test was administered after the treatment. The BPT used for the pre-test was renumbered for the post-test to avoid testing experience, it has 40-item multiple-choice objective test with four options (A-D). The instrument was adapted from the West African Examinations Council

(WAEC) biology past questions from 2017 to 2021 with little moderation, hence, there was need for validation and reliability. To ensure the reliability of the research instrument, the instrument was pilot tested. The test-retest method was used to determine the reliability coefficient and results yielded 0.79. Data collected were analysed using descriptive statistics and independent sample t-test. The analysis was done using the Statistical Package for the Social Sciences (SPSS) software version 20.0. The first week was used to administer the pre-test to both experimental and control groups before the treatment. The second and third week was used to administer the instructional method meant for each group with the help of the research assistants in a two 40 minutes lesson per week. The control group was taught ecology concept without the use of the treatment Concept Mapping Instructional strategy (CMIS) but with Lecture method, while the experimental group was taught with the usage of CMIS. The Post-test (BPT) was administered to the students in both the experimental group and the control group after the six weeks treatment. The hypotheses were tested at 0.05 level of significance using t-test.

## **Result**

The results were analysed and presented in tables.

**Research Question One:** *What is the difference between the mean performance scores of SSII Biology Students taught Ecology Concept using Concept Mapping and those taught using Lecture Method?*

**Table 1:** Summary of Posttest Mean and Standard Deviation Scores for Experimental and Control Group

<b>Groups</b>	<b>N</b>	<b>Mean Score</b>	<b>Std. Dev.</b>	<b>Std. Err</b>	<b>Mean Diff</b>
Experimental	30	30.10	6.48	1.18	6.81
Control	35	23.29	8.84	1.50	
Total	65				

Table 1: shows the Summary results of Posttest Mean and Standard Deviation Scores for the Students in Experimental Groups and those in Control Group. The experimental group had posttest mean score of 30.10 with a standard deviation of 6.48 while the Control group had a mean score of 23.29 with a standard deviation of 8.84. The mean difference between Experimental and Control groups is 6.81 this means that the students who were taught using the Concept Mapping had higher mean score than those who were taught using the Lecture Method.

**Research Question Two:** *What is the mean difference between the Gender performance Score of SSII Biology students taught Ecology Concept using Concept Mapping and those taught using Lecture method?*

**Table 2:** Summary of Posttest Mean Score for the Students with regard to Gender

Gender	N	Mean	Std. Dev.	Std. Err	Mean Diff
Male	38	26.89	9.01	1.37	0.61
Female	27	25.78	7.90	1.505	
Total	65				

The result in Table 2 revealed the mean and mean difference in the gender of the students exposed to Concept mapping and those taught Lecture Method. The Male had mean score of 26.89 while the Female had a mean gain score of 25.78; the mean difference between male and female is 0.61. This implies that the male students had better performance than the female students.

### Hypotheses Testing

*H01: There is no significant difference between the mean performance scores of SSII Biology students taught Ecology Concept using Concept Mapping and those taught using Lecture Method.*

To test for the hypothesis, students’ performance scores in the posttests were computed and subjected to t-test Analysis. The summary of the result Analysis of the statistics is presented in table 3.

**Table 3:** Independent t-test Statistics on the Students’ Performance in Cooperative Learning and Lecture Groups

Groups	N	Mean	Mean Dif	T	Df	p	Remark
Experimental	30	30.10	6,8	3.49	63	0.001	Sig
Control	35	23.29					

### Sig at $\alpha \leq 0.05$

Results in Table 3 Shows that mean posttest scores of the participants in the experimental group had more significant effect when compared with their counterpart in the control group. The significant value obtained 0.001 was less than  $\alpha \leq 0.05$ . Since the p-value is less than the set level of significance, then Independent t-test shows significant difference exists in the academic performance of students in the experimental group and those of control group, in favour of the experimental group. The results therefore, reveal the null hypothesis, which stated that there is no significant difference in academic performance of Biology students taught Ecology concept using Concept Mapping (CP) and those taught using lecture Method is hereby rejected, implying that CP Model of Instructional Strategy significantly enhances secondary Schools Biology Students performance in Ecology than the Lecture Method.

## Null Hypotheses Two

*H<sub>02</sub>: There is no significant difference between the mean Performance Scores of SS II Biology Students' taught Ecology Concept using Concept Mapping and those taught using Lecture method with regard to their Gender*

**Table 4:** Independent t-test Statistics on the Students' Gender Related Scores in the Experimental and Control Group

Groups	N	Mean	T	Mean Dif	Df	p	Remark
Male	38	26.89	0.52	0.61	63	0.606	Not Sig.
Female	27	25.78					
Total	65						

### Sig at $\alpha \leq 0.05$

Table 4 reveals a t-test analysis of students' performance based on the gender with a p-value of 0.606. The p-value is greater than the set level of significance,  $\alpha \leq 0.05$ . This indicates non-significant difference between the mean of male students with their female counterpart. Therefore, the null hypothesis which stated that, *There is no significant difference between the mean Performance Scores of SS II Biology Students' taught Ecology Concept using Concept Mapping and those taught using Lecture method with regard to their Gender* is therefore accepted, implying that Concept Mapping significantly enhances secondary Schools Biology Students' performance without given any preferential advantage to any gender.

## Discussions

This study which dealt with the effect of concept mapping teaching learning techniques on students' performance in Biology among senior secondary schools in Gombe state, Nigeria is quite timely considering the importance of Biology in the admission into the universities and other higher institutions to study virtually all science related courses. Since it has been observed that lecture method is the most dominant methodology used in the teaching of Biology science, and it has also been observed that its usage is one of the major problems of teaching sciences at the senior secondary school level. The findings from the study revealed that students who were taught ecology using concept-mapping instructional strategy perform better than those taught using the lecture method. This means students' performance significantly differed based on the teaching methods used in the study. It was found that the mean score of students who were taught ecology using concept-mapping was higher than that of the control group. The pedagogical implication of this finding is that concept mapping instructional strategy can be employed by biology teachers to teach biology and other difficult biology concepts that have been identified in literature. This finding agrees with the findings of Eravwoke, (2017) that found significant difference between experimental and control groups in favour of concept mapping group. Dhaaka (2012) recommended the use of concept mapping as an effective tool for biology teaching. Along the same vein Ahmed and Abdelraheem (2016) maintained that, concept mapping strategy promotes meaningful learning as well as students' academic achievement. The result is also in agreement with the previous studies

of other researchers (Twan and Kuboye 2018; Okoronka, 2018; Meheux, 2017; Ogonnaya et al., 2016; Arokoyu & Obunwo, 2014) whose findings indicated that concept mapping instructional strategy is more effective in teaching abstract and difficult science concepts than the traditional teaching method. The finding also revealed that concept-mapping instructional strategy helped to improve students' academic performance in the target concept, this might be due to the fact concept mapping-instructional strategy is interactive, student-centred in nature, and allows for students' participation.

The second finding of the study showed no gender difference in the students' performance in biology. That means statistically does not indicate a significant difference in the performance of males and female students taught with concept mapping teaching techniques. The finding concurs with that of Eravwoke, (2017) who found no significant difference among the genders; these indicate the effectiveness of concept mapping teaching technique which is flexible to all gender. Sakiyo (2008) also, reported no gender difference in the acquisition of science process skills when students are taught using student-centred teaching methods. Sakiyo (2007) suggested that, gender differences can be eliminated when teachers used certain teaching strategies that can bring about gender equity in science education. The implication of this finding is that concept maps can be employed in teaching science concepts as it has the tendency of enhancing conceptual understanding by the students without minding their specific gender, which in turns allow the students to perform better by having strong memory of retaining concepts that have been taught earlier. The findings is also in disagreement with the findings of Cheema and Mirza (2013) who found out that male students significantly performed better than the female students.

Furthermore, the findings of the study showed significant effect among method whereas, there is no significant difference in the gender of biology students' performance. This shows that the concept mapping influenced biology students' performance independent of gender. This agrees with the findings of Eravwoke, (2017) who found no significant interaction effects among gender on students achievement in mathematics and basic science respectively. This study shows that, Concept mapping strategy promotes students' academic performance in biology. The indication of no gender difference in students' performance, the results show that the increase in students' performance does not depend on gender, and this means concept mapping is an effective to tool for both male and female students.

## **Conclusion**

The study investigated the effects of concept mapping instructional strategy on students' performance in ecology. Based on the findings from the research, it was concluded that concept mapping instructional strategy had a significant effect on students' performance in biology. The use of concept map as an instructional strategy was, therefore, deemed to be more effective than the use of the lecture method. Also, the finding concluded that male and female students benefitted almost equally when concept-mapping instructional strategy was used in teaching biology.

## **Recommendations**

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

- I. Teachers should use many activity-based strategies such as concept mapping and cooperative learning instruction strategies while teaching biology because those strategies are learner center which it has been proven to increase students' better performance.
- II. The instructional strategy should be used in mixed-gender classrooms, as it has been established by these findings to be gender friendly.
- III. Workshops should be organized and made compulsory for practicing teachers so that they can embrace the skills of concept mapping teaching method.

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