



## Effect of Concept Mapping Instructional Strategy on Students Attitude and Motivation to Genetics Among Senior Secondary School Students in Bauchi Metropolis

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### Abstract

This study investigated the effect of Concept Mapping Instructional Strategy (CMIS) on Attitude and Motivation to Genetics among SSII in Bauchi Metropolis. Quasi-experimental design with pretest and posttest control group was used with population of 1,109 (555 male and 554 female) SSII students. Simple random sampling was used to select two schools and a sample of 100 SSII students (46 male and 54 female). The sample was divided into experimental and control groups. Attitude to Genetics Questionnaire ( $r=0.78$ ) and Students Motivation to Genetics Questionnaire ( $r=0.88$ ) were used in data collection. After the pre and post- test intervention, research questions were analyzed using mean and standard deviation while hypotheses were tested using Analysis of Co-variance (ANCOVA) and t-test at  $P \leq 0.05$  level of significance. Findings revealed that students show positive attitude to CMIS and were motivated by it. Biology teachers were urged to use CMIS to improve students attitude and motivation in learning genetics.

**Keyword:** attitude, concept map, genetics, motivation and traditional method of teaching.

### Introduction

Biology occupy a unique position in secondary school curriculum, which is central to many sciences related professional courses expected to be studied in tertiary institutions. It is therefore becomes binding on any one who wish to study sciences to offer Biology so as to acquire pre-requisite knowledge to enable them to study courses such as Medicine, Pharmacy, Agriculture, Nursing, Dentistry, Biochemistry, Micro-biology, Ecology, Zoology, Forestry, Laboratory technology, Botany etc. Despite that, there had been rapid declining on ability and capability of the present days secondary school students in applying the biological principles and concepts learnt from school into real life situations, which led for a concern on the method of instruction that will be best for teaching biological concepts (Ajaja, 2014). This is because one of the major aims of learning biology at secondary school level is to

enable one to acquire adequate laboratory and field skills in Biology, meaningful and relevant knowledge in Biology as well as the ability to apply scientific knowledge to everyday life in matter of personal and community health and agriculture, reasonable and functionable scientific attitudes (Omole 2015). It was observed that this problem was caused due to poor methods of instructions used by many biology teachers usually inform of lecture method, expository, discussion method which are teacher centered in nature (Ajaja, 2014). Researchers suggested that traditional methods of instructions are not effective in teaching scientific concepts (Nwagbo, 2014). In an attempt to solve this problem, some methods of instructions that are learner-centered in nature including concept mapping instructional strategy where recommended to be among the best method in teaching genetics (Jibrin & Zayum, 2012).

Concept mapping instructional strategy is a strategy of teaching used to organize related information in a visual manner (Maps) through which when the map is studied clearly and concisely it pictures and demonstrate hierarchical relationship among the topic or main idea (Tambaya, 2015).

Using learner- centred method of instruction such as concept maps is associated with a means of arousing the students interest and motivate them due to its graphics nature (Suleiman, 2015). It is also capable of organizing and presenting knowledge contained in circles or boxes of special types in which the relationship between the concepts is linked up with a linking words and linking phrases which specify the real meaning of a particular process (Suleiman, 2015 )

The result of several meta-analysis shows that using concept mapping was associated with increased knowledge retention of the concept been taught and high students achievement which tend to motivate students to develop positive attitudes to learning sciences (Tambaya, 2015). Motivation and attitude are two related factors in which development of positive attitude towards science can motive students interest on sciences (Festus,2017). Attitude is a concept which defines emotional trends in response to affairs, person, location or ideas (Omole, 2015). They include such phrases like; I like science, I enjoyed science courses or I dont like Sciences enumerated as attitude (Omole, 2015). It was observed that teaching genetics using concept maps motivate students to develop positive attitude to learning (Jibrin & zayum, 2012). Teaching and learning Biology and Biological concepts like genetics require the use of graphical model (i.e Map) that can bridge or show two or more concepts in some meaningful way through link and sublinks (Okoye & Okechukwu, 2006) as cited in Omole (2015). The link need to make sense which may make students to actively construct maps showing the relationship between concepts and sub-concepts as proposed by constructivists (Tambaya, 2015). Scientists and Science educators came with a decision that concept mapping generally had positive

effects on both students attitude and motivation to easily understand scientific concepts and ideas (Ajaja, 2013). It was reported that students taught using concept mapping motivated more than those taught using lecture or expository method (Jibrin & Zayum, 2012).

Some of the biological topics such as Genetics, Reproduction, Evolution, Homeostasis, Ecology and Nervous co-ordination required to be taught using learner-centred method of teaching due to their complex nature (Okoye & Okechukwu, 2006) as cited in Omole,2015. It was reported that students taught genetics using concept mapping were motivated due to the manner through which the genetics concepts were presented, explained or taught using concept mapping strategy (Okoye & Okechukwu, 2006) as cited in Omole (2015). This is because they were motivated,and motivation is an impulse giving to an individual to action toward a desired goal (Cook, 2017). Therefore, Knowledge of genetics has a lot of advantages for each and every individual as it is used in marital counseling, sex determination, blood transfusion, crime detection, hybridization etc. When one has acquired adequate knowledge in genetics, he or she will become a tool planning for his sustainable health and that of other individuals.

### Research Questions

1. What is the effect of concept map instructional strategy on Attitude of senior secondary school students in genetics?
2. What is the effect of concept map instructional strategy on Motivation of senior secondary school students for genetics?
3. What is the effect of concept map instructional strategy on Motivation of males and females senior secondary school students in genetics?
4. What is the effect of concept map instructional strategy on Attitude of males and female senior secondary school students



in genetics?

### Research Hypotheses

1. There is no significant difference between the Motivation of senior secondary school students taught genetics using concept map instructional strategy and those taught without concept map instructional strategy.
2. There is no significant difference between the Attitude of senior secondary school students taught genetics using concept map and those taught without concept instructional strategy
3. There is no significant difference between the Motivation of males and females senior secondary school students taught genetics using concept map instructional strategy.
4. There is no significant difference between the attitude of males and female senior secondary school students taught genetics using concept map instructional strategy.

### Methodology

The design adopted for the study was quasi experimental with pre-test and post-test control group design. The study area was Bauchi metropolis. The Population of this study comprised 1109 of senior secondary school II (SS 2 students in 2021/2022 academic session) that are offering biology in the study area. A sample of one hundred (100 SS2 secondary school students consisting of 46 male and 54 female) were selected using multistage sampling involving purposive sampling in the first stage, and simple randomly sampling in the second stage. One class from each chosen school was randomly sampled in the third stage, dividing them into experimental and control groups. Three instrument were used for the collection of data namely; Genetics Performance Test (GPT), Attitude toward Genetics Questionnaire (ATGQ) and students motivation to Genetics Questionnaire (SMGQ). Three experts validated the instrument. The reliability co-efficient value of 0.87 was obtained using Kuder-Richardson formula 21 for GPT, while the reliability index of SAGQ was 0.78 and SMGQ

was 0.88 which were obtained using Cronbach's alpha. The researcher, alongside the biology teacher, conducted a pre-test for both the experimental and control groups which served as pre-test. Subsequently, the experimental phase commenced immediately after the pre-test. A trained biology teacher utilized the concept map instructional strategy for the experimental group and the lecture method for the control group over a four-week teaching period. Following this teaching phase, the researcher administered a GPT test to both groups to assess their performance in genetics. Simultaneously, the biology teacher administered two questionnaires, focusing on students' attitudes and motivation towards genetics, to both the treatment and control groups. The research questions were answered using mean and standard deviation. Analysis of Covariance (ANCOVA) and t-test were used to test the research hypotheses. The hypotheses were tested at significance level of 0.5.

The procedure for the experiment involved the researcher with the help of biology teacher in the school to give equal treatment for the two groups, one using concept mapping instructional strategy (treatment group) and other using lecture method (control group). Teaching was started immediately after pre-test. The researcher was monitoring the teaching, and hence the teaching was done using different periods within the week for the two groups.

In the first week, the researcher and biology teacher used concept mapping instructional package as an advance organizer before the explanation for the lesson and instruct them to apply the concept for all sub-topics in genetics. While the control group started receiving lecture in genetics.

In the second (2<sup>nd</sup>) week the researcher used the concept maps to explain the principles of heredity to the experimental group, while the control group was taught the same topic using lecture method.

In the third week, the trained biology teacher used concept maps to explain the types of cell, functions of cell, mitosis and meiosis for the control group and experiment group.

In the fourth week the researcher and the

biology teacher used the concept map to teach experimental class on variation and how it occurs among individuals, and teach the control class using lecture method. At the end of the fourth week, the trained biology teacher administered the GPT for the

treatment and the control group, while the researcher administered the two questionnaires to the treatment and control groups.

### Results

**Table 1: Effect of concept mapping instructional strategy on Attitude of senior secondary school students to genetics**

group and test types	N	Mean	Std. Deviation	Mean Rank
Pretest control group	46	1.75	1.174	3 <sup>rd</sup>
Pretest experimental group	54	1.71	1.350	4 <sup>th</sup>
posttest control group	46	2.32	.667	2 <sup>nd</sup>
posttest experimental group	54	4.20	.789	1 <sup>st</sup>
Tests of Between-Subjects Effects				
	Df	F	Sig	Partial Eta squared
Test	1	13.500	.001	.273
Group	1	3.375	.074	.086
Test and group	1	3.375	.074	.086

Table 1 above revealed the effect of concept mapping instructional strategy on attitude of senior secondary school students in genetics, the result as presented in the above table revealed the mean score of pretest control group as 1.75 which is the 3<sup>rd</sup> ranking, Pretest experimental group is 1.71 the 4<sup>th</sup> in ranking, posttest control group is 2.32 the 2<sup>nd</sup> in ranking and posttest experimental group is 4.20 the 1<sup>st</sup> in ranking. That the mean score of posttests of both control and experiment groups are greater than the mean score of pretest mean score of both control

and experimental groups indicating that both of the control and the experiment groups improve as a result of treatment, However, the posttest mean score of experimental group is 4.20 greater than 2.32 which is posttest mean score of the control group. Furthermore, Eta for the test was about .273, which, according to Cohen (1988), is a large effect. Which means concept mapping instructional strategy on attitude of senior secondary school students in genetics has large effect than the traditional method

**Table 2: Effect of concept mapping instructional strategy on Motivation of senior secondary school students to genetics**

group and test types	N	Mean	Std. Deviation	Mean Rank
Pretest control group	50	1.70	.823	3 <sup>rd</sup>
Pretest experimental group	50	1.20	.422	4 <sup>th</sup>
posttest control group	50	2.90	.876	2 <sup>nd</sup>
posttest experimental group	50	4.60	.843	1 <sup>st</sup>
Tests of Between-Subjects Effects				
	Df	F	Sig.	Partial Eta Squared
Test	1	55.543	.000	.607
Group	1	.171	.681	.005

Test and group	1	6.171	.018	.146
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Table 2 above revealed the effect of concept map instructional strategy on motivation of senior secondary school students to genetics, the result as presented on the above table revealed the mean score of pretest control group as 1.70 which is the 3rd in ranking, Pretest experimental group is 1.20 the 4th in ranking, posttest control group is 2.90 the 2nd in ranking and posttest experimental group is 4.60 the 1st in ranking. That mean score of posttests of both control and experiment groups are great than the mean score of pretest mean score of both control and

experimental groups indicating that both of the control and the experiment groups improve as a result of the treatment, However, the posttest mean score of experimental group is 4.60 greater than 2.90 which is posttest mean score of the control group. Furthermore, Eta for test was about .607, which, according to Cohen (1988), is a large effect. Which means concept mapping instructional strategy on motivation of senior secondary school students in genetics has a large effect than the traditional method.

**Table 3: The effect of concept mapping instructional strategy on Motivation of males and females senior secondary school students to genetics**

group and test types	N	Mean	Std. Deviation	Mean Rank
Pretest female control group	23	1.75	14.02175	6 <sup>th</sup>
Pretest male control group	23	1.85	11.60166	5 <sup>th</sup>
pretest female experimental group	27	1.65	13.06964	8 <sup>th</sup>
pretest male experimental group	27	1.74	10.89042	7 <sup>th</sup>
Posttest female control group	23	2.66	26.17710	4 <sup>th</sup>
Posttest male control group	23	2.71	25.93920	3 <sup>rd</sup>
posttest female experimental group	27	3.42	12.74299	1 <sup>st</sup>
posttest male experimental group	27	4.14	23.27975	2 <sup>nd</sup>
<b>Tests of Between-Subjects Effects</b>				
	Df	F	Sig.	Partial eta squared
Test	1	6.659	.014	.156
Group	1	12.719	.001	.261
Test and group	1	.229	.635	.006

Table3 above revealed the effect of concept mapping instructional strategy on Motivation of males and females senior secondary school students to genetics t, the result as presented in the above table revealed the following mean score and rank positions as follows: pretest female control group with the mean score of 1.75 at 6th position, pretest male control group with the mean score is 1.85 at 5th position, pretest female experimental group has the mean score of 1.65 at 8th position, pretest male experimental group with mean score of 1.74 at 7th position, posttest female control group with

mean score of 2.66 at 4th position, posttest male control group with mean score of 2.71 at 3rd position, posttest female experimental group with mean score of 3.42 at 1st position, posttest male experimental group with mean score of 4.14 at 2nd position. That the mean score of posttests of all of the control and experimental groups are greater than the mean score of pretest mean score of all the control and experimental groups indicating that both the control and the experiment groups improve as a result of the treatment. However, the posttest mean score of experiment groups are 3.42 and 4.14 with



1st and 2nd at positions are greater than 2.71 and 2.66 with 3rd and 4th positions respectively which is the mean score of posttest of the control group. Furthermore, Eta for test was about .0156, which, according to Cohen (1988), is a significant effect.

Which mean concept mapping instructional strategy has high effect on motivation among males and female senior secondary school students to genetics than traditional method.

**Table 4: Effect of concept mapping instructional strategy on Attitude of males and female senior secondary school students to genetics**

Groups and Tests Types	N	Mean	Std. Deviation	Mean Rank
Pretest female control group	23	1.59	14.02175	8 <sup>th</sup>
Pretest male control group	23	1.88	11.60166	5 <sup>th</sup>
pretest female experimental group	27	1.75	13.06964	7 <sup>th</sup>
pretest male experimental group	27	1.84	10.89042	6 <sup>th</sup>
Posttest female control group	23	2.56	26.17710	3 <sup>rd</sup>
Posttest male control group	23	2.41	25.93920	4 <sup>th</sup>
posttest female experimental group	27	4.39	12.74299	1 <sup>st</sup>
posttest male experimental group	27	4.31	23.27975	2 <sup>nd</sup>
Tests of Between-Subjects Effects	Df	F	Sig.	Partial Eta Squared
Test	1	.968	.332	.026
Gender	1	53.309	.000	.597
Test and gender	1	3.382	.074	.086

Table 4 above revealed the effect of concept mapping instructional strategy on attitude of males and females senior secondary school students to genetics, the result as presented in the above table revealed the following mean scores and rank positions as follows: Pretest female control group with mean score of 1.59 at 8th rank position, Pretest male control group with mean score of 1.88 at 5th rank position, pretest female experimental group with mean score of 1.75 at 7th rank position, pretest male experimental group with mean score of 1.84 at 6th rank position, Posttest female control group with mean score of 2.56 at 3rd rank position, Posttest male control group with mean score of 2.41 at 4th rank position, posttest female experimental group with mean score of 4.39 at 1st position and posttest male experimental group with mean score of 4.31 at 2nd rank position. That mean score of posttests of all of the control and experimental groups are great than the mean score of pretest mean score of all of the

control and experimental groups indicating that both of the control and the experimental groups improve as a result of treatment, However, the posttest mean score of experiment groups are 4.39 and 4.31 with 1st and 2nd at positions are greater than 2.56 and 2.49 with 3rd and 4th positions respectively which is the mean score of posttest of the control. Furthermore, Eta for the test was about .261, which, according to Cohen (1988), is a large effect. Which means concept mapping instructional strategy has a high effect on attitude among males and female senior secondary school students to genetics.

### Discussions

This study explored the impact of concept mapping instructional strategy on the performance, attitude, and motivation of senior secondary school students in genetics within Bauchi metropolis, Bauchi state. The findings, outlined in Tables 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 13, revealed noteworthy

outcomes. Notably, Table 2 and 8 demonstrated that students taught using concept mapping exhibited significantly better performance compared to those instructed through conventional lecture methods, aligning with Okoronko (2018), who underscored the efficacy of concept mapping in enhancing academic performance. However, this contrasted with Omole (2015), whose study found similar retention levels between concept mapping and lecture methods post-test.

Moreover, Tables 3 and 9 revealed heightened motivation among students exposed to concept mapping compared to lecture methods, supporting Almisad's (2019) contention that concept mapping enhances motivation. Conversely, Sulaiman (2015) proposed that experimental techniques could outperform concept mapping due to increased student engagement. Additionally, Tables 4 and 10 indicated a more positive attitude among students using concept mapping, corroborating Candan's (2016) assertion of its efficacy in improving attitudes. However, this contrasted with Omole's (2015) findings of a preference for experimental strategies over concept mapping in terms of attitude.

Further analysis in Tables 5, 6, 7, 11, and 13 highlighted gender-based differences. Both male and female students displayed enhanced performance, motivation, and positive attitudes when exposed to concept mapping, resonating with Akeju (2017) and Kacha (2018), who emphasized concept mapping's effectiveness for both genders. Nonetheless, Ahmed (2021) found a gender disparity, with female students outperforming males under concept mapping, diverging from the observed results. Ajaja (2013) also provided contrasting views, suggesting that concept mapping did not significantly motivate students in study skills or serve as a suitable alternative for Biology studying.

### Conclusion and Recommendations

The study investigated the effect of concept mapping instructional strategy on attitude and motivation to genetics among senior secondary school students in Bauchi Metropolis and found that

Concept Mapping Instructional strategy improve students attitude and motivate them in learning genetics. It was found that gender did not affect them in any way in all the teaching strategies. We advocate that the findings of this study can be generalized in other parts for smooth integration into the national curriculum. Based on the findings of this study the following were recommended:

1. For positive attitudinal change of students, genetics concepts should be taught using the concept mapping instructional strategy.
2. Teachers should be encouraged to use concept mapping instructional strategy in teaching of genetic concepts over lecture method to improved academic performance.

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