UNIVERSITY OF EDUCATION, WINNEBA

COMPARATIVE ANALYSIS OF CONCEPT MAPPING AND TRADITIONAL METHODS IN TEACHING SELECTED TOPICS IN BIOLOGY

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A Dissertation in the Department of Science Education, Faculty of Science, submitted to the School of Graduate Studies, University of Education, Winneba in partial fulfilment of the requirements for award of the Master of Education (Science) degree.

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DECLARATION

STUDENT'S DECLARATION

I, Nartey Esther Dorcas hereby declare that this Dissertation, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: ……………………………………….

DATE: ……………………………………………….

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and the presentation were supervised in accordance with the guidelines for supervision of Dissertation as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: ………………………………………..

SIGNATURE: ……………………………………………………..

DATE: …………………………………………………………….

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DEDICATION

This dissertation is dedicated to my loving HEAVENLY FATHER whose amazing grace and mercy has brought me this far.

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ABSTRACT

The aim of this study was to compare the effects of concept mapping and traditional methods on students' performance in some selected topics in Biology in the Kwaebibirem District in the Eastern Region. Asuom Senior High School was the experimental school while Kade Technical Senior High School was the control school in this study. A pre-test – post-test non-equivalent quasi-experimental design was used for the study. The sample size was 124 students. The experimental group consisted of 60 students while the control group consisted of 64 students. The students in the experimental group were instructed with concept mapping while the control group were instructed with the traditional method. Both groups were taught the same content which was on biological classification and ecology. Three instruments were used for the data collection in this study. These were a biology achievement test (BAT), a questionnaire on students' perception towards concept mapping (QCM) and a structured interview. Descriptive statistics, paired and unpaired t-test were used to analyse the data for answering the research hypotheses. The results indicated that those instructed with concept mapping did better than those instructed with the traditional method. It was also found that both males and females constructed concept maps alike. It has been recommended that the concept mapping method should be encouraged in science lessons especially biology classes at the Senior High School

CHAPTER ONE

INTRODUCTION

Overview

This chapter includes the background of the study, statement of the problem, the purpose of the study, objectives of the study, research questions, research hypotheses, and the significance of the study, rationale for the study, limitations, and delimitations.

Background to the Study

Science and technology play an important role in the modern world. Science is believed to serve as the foundation of technological development and a key factor in economic growth (Letao & Bradley, 2015). The process of science is a way of building knowledge about the universe, and constructing new ideas that illuminate the world around us. These ideas are inherently tentative, but as they cycle through the process of science again and again and are tested and retested in different ways, we become increasingly confident in them (Appaw, 2011). Biology, which is a branch of science, is defined by Oxford Dictionary of biology as the study of living organisms, which includes their structure, functioning, origin and evolution, classification, interrelationships, and distribution. Biology is difficult to teach and to learn because it consists of unfamiliar concepts which involve complex relations (Adlaon, 2012). The highly conceptual nature of biology makes it particularly difficult for students. Meanwhile the present instructional strategies used in the classroom have not sufficiently eased the learning process. Although biology has become an integral part of almost all public and private examinations, the subject biology has become a rather unpleasant task for most students. Yet, in many respects it is a very crucial prerequisite to science for any young would-be scholar of the arts or the sciences especially biology. Naturally, some people find it easy to understand concepts in biology, whereas others find it difficult. However, the fact still remains that biology demands careful thoughtfulness, a creative mind, and conscious thinking from learners which has been difficult for some students (Letao & Bradley, 2015). For the past decade candidates have not been performing well in biology. For instance, in 2002, out of 8922 candidates who sat for the West African Examination Council (WAEC) examination in biology nationwide, only 3476 (39%) passed with grades A to D. In 2003, 3772 (39.4%) out of 9581 candidates passed with grades A to D. In 2004 out of 10546 candidates, 5051(47.9%) passed with grades A to D. While in 2005, 5803 (40.7%) passed with grades A to D out of 14176 candidates (Anthony–Krueger, 2007). The Chief Examiner's Report released by the West African Examination Council (WAEC, 2000, 2001, 2002, 2003, 2004, 2005, 2006 and 2007) indicated that students' general performance was not good in biology. Students showed poor performance in providing answers for questions based on genetics and evolution, ecology, internal respiration, co-ordination in mammals, classification, protein synthesis, secondary growth, and auxins (WAEC, 2000, 2001, 2002, 2003, 2004, 2005, 2006 and 2007). The Researcher has over the period of four years (2010 to 2014) observed through practice in the teaching service within part of the Kwaebibirem District that most biology students perform poorly in the subject. Researchers have identified some reasons to be the contributory factors in the underachievement of Senior High School (SHS) elective biology students. Some students see the subject to be difficult. Mashile (2001), pointed out that family aspects such as parenting style, socioeconomic status (SES), parental involvement, and parental belief and attitude are particularly related to students' biology achievements and academic attitudes. Some students also have the notion that biology involves a lot of reading, and so it is difficult for them to read a lot of text and comprehend adequately (Mucherah, 2008). Inadequate and poor practical sessions in the laboratory may be contributing factors to students' poor performance in biology (Anthony–Krueger, 2007). Mynt and Goh, (2001), noticed in their study that the class sizes in biology classroom environments also influence the achievement of students. Considering students' performances, it is quite apparent that there are root causes to these poor performances which are encountered by the students. Some of these could be caused by the way and manner biology is taught. This means that, most teachers in the senior high schools are still using the traditional techniques of teaching which means teacher centred method of teaching. When biology is taught through the traditional method, students may not sufficiently participate in the lessons or understand the concept because it will be teacher centered; therefore students will not have interest in the subject and hence perform poorly. Concept mapping is one of the constructivists' methods recommended for teaching science in all levels of education in order to improve upon teaching and learning (Rye & Rubba, 2002). Concept maps have been found to promote the understanding of science concepts; hence many studies have been, and are still being conducted in the use of concept maps to enhance students' conceptual understanding. The extent to which concept mapping could influence students' achievement in biology is consequently worth exploring.

Statement of the Problem

The problem with biology students of Asuom Senior High School and Kade Technical Senior High School in the Kwaebibirem District is that for several years candidates have not been performing well (WAEC, 2000, 2001, 2002, 2003, 2004, 2005, 2006 and 2007). Through the Researchers' classroom interactions with some students during lessons, it became apparent that most students had problems with their understanding of biological concepts. These concepts seemed abstract to them. Though the students were aged between 15 to 18 years, and were expected to reason in abstract or manipulate ideas in their minds because they were in the formal operational stage, it was not so (McLead, 2015). They behaved as students in the concrete operational stage, because they mostly wanted to see or handle concrete materials before they could understand basic concepts. The Researcher also encountered similar problems during her study of biology as a young student. Most teachers in the senior high schools are still using the traditional techniques of teaching (Wood, 2007). The traditional technique of teaching is mainly taught in abstract and besides it has a lot of terminologies which may be difficult to pronounce. Concept mapping as a method of instruction is not used in senior high schools in Kwaebibirem District. Hence our senior high school students may not be benefiting from the advantages of concept mapping. This study therefore, was designed to explore the comparative benefits of concept mapping to find out how it would enhance students' understanding of biological classification and ecology.

Purpose of the Study

The main purpose of this study was to compare the effectiveness of the concept mapping method as opposed to the traditional technique method for teaching and learning some selected topics in biology at the senior high school level in the Kwaebibirem District. This study focused on finding out whether the concept mapping technique could positively affect students' achievement in biology and enable them to learn meaningfully.

Objectives

The study aimed to:

1. Find the significant difference in achievement between students taught through concept map technique and those taught with the traditional technique method.
2. Find the significant difference in achievement between males and females taught with the concept mapping method.
3. Find out the students' perceptions towards concept mapping?

Research Question

1. Is there a significant difference in achievement between students taught with concept map technique and those taught with the traditional technique method?
2. Is there a significant difference in achievement between males and females taught with the concept mapping method?
3. What are the students' perceptions towards concept mapping?

Significance of the Study

The outcome of this study could inform biology teachers in the SHS about the effectiveness of the concept mapping technique, in order to help them improve upon their skills in their delivery of biology lessons. The concept mapping technique would also help students to summarise, organise and logically present their work. This could hopefully help students learn how to learn meaningfully, thereby improving their academic performance, not only in biology but in other subjects as well. It would serve as a reference for further studies or research. The study could give useful information to the Ministry of Education and other educational authorities to undertake interventions to promote the use of concept maps in biology lessons. Furthermore, the findings of this study could serve as a useful material for the organization of workshops, seminars and in-service training for biology teachers.

Limitation of the Study

The nature of the research involved investigation into pedagogical issues for first hand information. The research involved observation, discussions and interaction with learners in order to get reliable data. One limitation was that only Asuom senior high school and Kade Technical Senor High School were selected out of the several senior high schools in Ghana for the study since the study was time bound. Some students were not present at school during the period of intervention, due to absenteeism, and this could affect the result of the study. Since only two schools were selected out of the schools in Ghana for the study, there is a constraint on the scope to which the findings can be generalized to other schools outside Kwaebibirem District. Generalisation of the outcome of this study therefore should be done with circumspection.

Delimitation of the Study

Only elective biology students in the Kwaebibirem District could be considered for the study since the topics selected were open to only elective biology students.

General Layout of the Study

Chapter one dealt with the introduction of the study. It highlighted on the background of the study, statement of the problem, purpose of the study, research question, significance of the study, delimitation, limitation, definition of terms and organisation of the rest of the study.

Chapter two is a review of literature relevant to the study. The review focused on concept maps and their uses, construction of concept maps, scoring of concept maps, the theoretical framework, concept mapping and gender, traditional method of teaching, and summary of review of related literature.

Chapter three described the methodology used in the study. This chapter would highlight on the research design, population, sample and sampling techniques, instruments, data collection procedures and data analysis.

Chapter four presents and describes the results in reference to the purpose of the study and findings of other researchers as reviewed in chapter two.

Chapter five presents the overview of the research problem and methodology, summary of the key findings, draws conclusions and offers recommendations as well as suggestions.

Definition of Term

Traditional method or abstract teaching method: In this study, this is referred to as the teacher centred method of teaching. The teacher explains concepts, demonstrates, occasionally asks questions and answers students' questions without the students' active participation or involvement in practical work.

CHAPTER TWO

LITERATURE REVIEW

Overview

This chapter deals with the review of related literature relevant to the study. It covers the features of concept maps and their uses, construction and scoring of concept map, effects of concept mapping on students' achievement in biology, theoretical framework of concept maps, concept mapping and gender, traditional method of teaching, and summary of reviewed related literature.

Concept Maps

Pedagogy is very important in the teaching and learning of science. They serve as paths leading to the understanding of concepts taught to students and so form an integral part of classroom experiences. Various methods are open to teachers to use to teach, from kindergarten to tertiary levels to enhance students' understanding of scientific concepts. Coll, France, and Taylor (2005), pointed out that the use of analogies and mental models can enhance students understanding of complex and abstract scientific conceptions. Studies by Hilbert and Renkl (2008), have shown that concept mapping fosters meaningful learning. They added that, concept mapping is one teaching method which has gained grounds in the teaching and learning of biology and other related science subjects in the western countries. Concept mapping has been reported to provide a very effective strategy to help students learn meaningfully by making explicit the links between scientific concepts (Fisher, Wandersee, & Moody, 2000). It has also been reported that concept maps improve students' problem solving capabilities and aid collaborative learning (Omotayo, 2013). Concept maps are tools for organizing and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts or propositions, (indicated by a connecting line and a linking word) between two concepts. Linking words on the line specify the relationship between the two concepts (Novak & Canas, 2008). A concept map is a tool for showing the conceptual structure of a course or subject in a two dimensional form which is analogous to a road map. A concept map is a way of representing relations between ideas or words, in the same way that a sentence diagram represents the grammar of a sentence, a roadmap represents the locations of highways and towns, and a circuit diagram represents the workings of an electrical appliance (Novak & Canas, 2008). In other words, a concept map provides a visual roadmap showing the pathways that we may take to construct meanings of concepts and proposition (Kinchin, 2000). Concept maps are a way to develop logical thinking and study skills, by revealing connections and helping students see how individual ideas form a larger whole. “Concept mapping is a learning technique which employs graphical representations to assist the learners organise information about science concepts in a meaningful manner to facilitate learning” (Omotayo, 2013, p.150).

Features of Concept Maps

A key feature of concept maps is that they are constructed to represent text structure patterns which serve to help students’ mental constructs or schemata of how texts are organized. Novak and Canas (2008), p.2, identified three characteristic features of concept maps as indicated below:

1. Concept Maps are represented in a hierarchical structure with the most inclusive, and general concept at the top of the map, while the more specific, less general

concepts are arranged hierarchically below. The hierarchical structure for a particular domain of knowledge also depends on the context in which that knowledge is being applied or considered.

2. There is the inclusion of cross links. These are relationships of links between concepts in different segments or domains of the concept maps. Cross links help us to see how a concept in one domain of knowledge represented on the map relates to a concept in another domain shown on the map.
3. The final feature is specific examples of events or objects that help clarify the meaning of a given concept. Normally these are not included in the ovals or boxes, since they are specific events or objects and do not represent concepts.

Uses of Concept Maps

Concept mapping has been shown to help in various ways such us to help learners learn, researchers to create new knowledge, and evaluators assess learning. Concept maps have been used for many instructional purposes, in many subjects, and with many levels of students (Stoddart, Abrams, Gasper, & Canaday, 2000). Concept maps are used to stimulate the generation of ideas, and are believed to aid creativity. Gururao (2013), p. 9, states the following as major uses of concept mapping:

1. Curriculum Development
2. Strategy for learning, teaching & collaborating
3. Explanations of various concepts
4. Relate concepts in hierarchical manner
5. Evaluation
6. Note taking during field trip, brain storming

How Teachers Use Concept Maps

Concept maps are used to clarify and arrange difficult concepts in a systematic order. Using concept maps to teach, helps teachers to be more aware of the key concepts and relationships among important concepts in a topic. Teachers are able to present a clear and general picture of the concepts and their relationship to students when they use them as teaching tools. In the view of Safdar (2010), if teachers learn how to construct concept maps and use them for planning and assessing lessons, they will be able to teach students better how to make concept maps to organize their thoughts and ideas. He added that using concept maps reduce the likelihood of teachers missing or misinterpreting any important concepts. In presenting concepts to students, teachers should never ask students to memorize prepared concept maps. This could merely promote rote learning and so defeat the purpose of encouraging active meaningful learning on that part of the learner.

How Students Use Concept Maps and Their Effect on their Achievement

Using concept maps reinforces students' understanding and learning. This enables visualization of the concepts and summarises the relationships among them. Many students have difficulty identifying the important concepts in a text, lecture or other form of presentations. Such students fail to construct powerful concepts and propositional frameworks, leading them to see learning as a blur of myriad facts, dates, names, equations, or procedural rules to be memorized. For these students, the subject matter of most disciplines, and especially science, is a cacophony of information to memorize, and they usually find this boring. Many feel they cannot master knowledge in the field because they have to personally construct and understand many unfamiliar concepts. Bunting, Coll, and Campbell (2006), observed that students who attended biology lesson or tutorial using concept mapping achieved significantly higher marks than those who attended a convectional tutorial or no tutorial. If concept maps are used in planning instruction and students are required to construct concept maps as they learn, previously unsuccessful students would become successful in making sense out of science and any other discipline (Novak & Canas 2008). As indicated by Barber, Pearson and Cervetti (2008), concept map supports students in making connections between known information and new information. Oloyede (2010), asserted in a research that concept mapping strategy improved students' performance than other methods of teaching science. Most researchers on concept mapping ascribe it to having the potential of making learners to remember information longer and being able to use them more effectively because it moves information into the long-term memory (Ajaja, 2011). By creating concept maps, students clarify their understanding of a topic and integrate new ideas into their thinking.

How Concept Maps are used as Evaluation Tool

One of the powerful uses of concept maps is not only as a learning tool but also as an evaluation tool (Mintzes, Wandersee, & Novak, 2000). The use of concept maps could assist teachers in evaluating the process of teaching (Appendix F to H). They could assess students' achievement by identifying their misconceptions and missing concepts. Mintzes, Wandersee, and Novak (2000), emphasised that there is nothing written on stone that says that multiple choice test must be used from grade schools to the university. In other words, there is no hard and fact rule for educational institutions to use only multiple choice or essay tests for evaluation. National achievement examination bodies like the West African Examination Council (WAEC) could utilize concept mapping as a powerful evaluating tool for assessing students' performance; but this can be when concept maps are accepted as evaluation tools.

Construction of Concept Maps

According to Stoica, Moraru, and Miron (2011), drawing a concept map can be compared to participating in a brainstorming session. As one puts down ideas, these ideas may also trigger new associations leading to new ideas. Koc (2012), noted that the ability to construct good concept maps is not limited to brilliant students. Ng (2014), found out that while most high-scoring students constructed good concept maps a few of them constructed poor ones. On the other hand, while a few low scoring students constructed good concept maps, many of them constructed poor concept maps. This means that concept mapping can be used by all manner of students irrespective of their academic capabilities. However since few of the low scoring students could construct good concept maps, Ng (2014), suggested that they ought to be given enough time and exercises as well as boost up their cognitive efforts to make them construct good concept maps. To construct good concept maps, it is imperative for students to be conversant with the steps for constructing concept maps (Saroyan & Amundsen, 2004). Adiyiah (2011) produced a list of important things to note when constructing a concept map. They include the following: choosing a passage from a science textbook, underlining the main concepts in that passage, listing all the concepts on paper, writing or printing the concepts on small cards or stickers so that the concepts can be moved around, placing the most general or all-inclusive concept on the top of the paper, and arranging the concepts from top to bottom. In this way a hierarchy is indicated. He suggests place concepts next to each other horizontally if they are considered to have equal importance or value, relating concepts. This is done by positioning linking verbs and connecting words on directional arrows. The concept is then supported with examples, having members of a cooperative group critically analyze the concept map to improve on and further extend your ideas. Novak and Canas (2008), p. 11, suggested that learners must

1. Begin with the domain of knowledge that is familiar
2. Identify the context of the text, the field of activity or the problem
3. Construct focus questions.

   Focus questions are those that clearly specify the problem or issue that a concept map helps to resolve. Every concept map responds to a focus question. A good focus question can lead to a richer concept map by identifying key concepts that apply to this domain. These key concepts could be listed at first, and then ranked from most general and most inclusive at the top to the most specific and least general at the bottom of the list. This list of concepts is called ‘parking lots’.

4. Construct preliminary concept map
5. Make crosslink.

   These are links between concepts in different segment or domain of knowledge on the map to illustrate how these domains are related to one another. Cross links are important to show whether the learner understands the relationship between the sub-domains in the map.

6. Revise the map by repositioning the concepts

7. Construct the final map

Gururao (2013), p. 16 also suggested the steps as those used in making a concept map

a) Write down major terms or concepts about a topic.

b) Identify the most general, intermediate, and specific concepts.

c) Begin drawing the concept map:

d) Concepts are circled

e) Place the most general concepts at the top

f) Place intermediate concepts below general concepts

g) Put specific concepts at the bottom of concept map.

h) Draw lines between related concepts.

i) Label the lines with linking words to indicate how the concepts are related.

j) Revise the map.

Figure 1 is an example of a concept map. The figure shows how a concept map is constructed and illustrates the above characteristics as stated by Novak and Canas (2008).

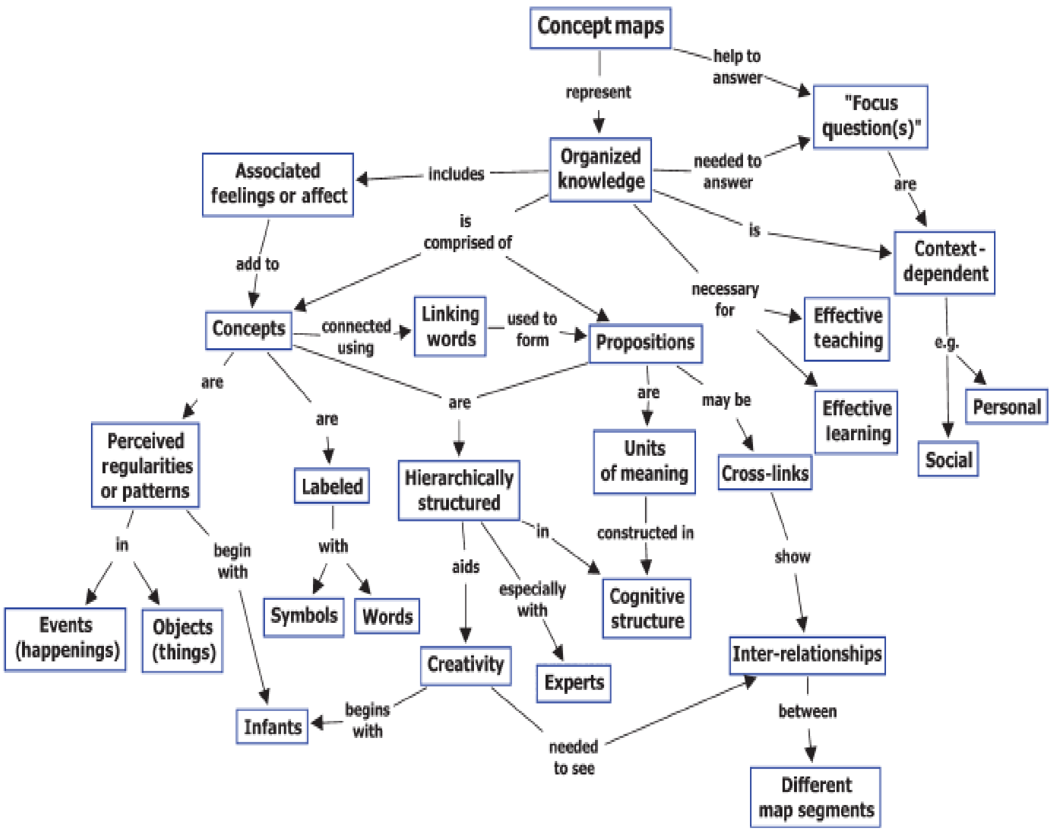

Figure 1: A Concept Map that describes the key features of Concept Maps

The concepts were represented in a hierarchical fashion with the most inclusive and general concepts at the top of the map and the more specific, less general concepts arranged hierarchically below. There were lines between related concepts with linking words which indicated how the concepts were related.

How to Score Concept Maps

Generally speaking, there are three major approaches (Ruiz-Primo, Shavelson, Li, & Schultz, 2001b) for the scoring of concept mapping in science. The first one is scoring a student's map component, like propositions, hierarchy and cross links. The second approach is using a criterion map and comparing students' maps with that criterion map. The third approach combines both the component of a generated map and a criterion map. Scholars have proposed various scoring schemes for assessing and scoring concept maps. Closeness index is that type of the weighted scheme of scoring that takes into account a number of students and teachers instructional needs. Teachers need to determine the importance of each proposition based on their professional knowledge, by giving propositions weights which range from 0 to 1. A concept map which uses weighted propositions is term a "weighted concept map." The higher a proposition ranks in importance, the higher the weight assigned to it. The quantitative analysis is a similarity value found in the comparison of concept maps drawn by students and an expert concept map drawn by a teacher. To address this problem, this study proposes the use of a new style of concept map scoring technique called the weighted concept maps which are closeness index and similarity index developed by Goldsmith, Johnson, and Acton (1991).

Other Methods of Scoring

The traditional method of concept map scoring was proposed by Novak and Gowin, (1984) as cited in Adiyiah (2011), and is based on the components and structure of the concept map. Novak and Gowin's system assigns points for valid propositions and other points for the remaining stages are indicated below:

1. levels of hierarchy (5 points for each level),
2. number of branching (1 point for each branch),
3. cross links (10 point for each valid cross-link), and
4. Specific examples (1 point for each example).
5. The number of hierarchical levels addresses the degree of subsumptions,
6. The number of branching indicates progressive differentiation, and the number of cross-links indicates the degree of integration of knowledge.

Some other scoring techniques have been developed as extensions or variations of Novak and Gowin's system. For example Kinchin (2000) and Klein, Chung, Osmundson, Herl, and O'Neil (2001) explored different systems of scoring the same components of map but weighed them differently. Some researchers are pursuing the possibility of providing automated assessment of the structural components of concept maps (Yin, Vanides, Ruiz-Primo, Ayala, & Shavelson, 2005). Ruiz-Primo, Schultz, Li, and Shavelson (2001a), describe methods to compare a student's map to that of an expert's. A computerized technique could be used to simplify the comparison of maps, and this possibility has been explored by researchers. Clariana, Koul, and Salehi (2006), confirmed that computer-based approach that could be used to score concept maps. They used the computer-basd approach to compare a student's map to that of an expert's. These automated scoring systems are typically based on propositional matching within limited sets of concepts and linking phrases. Holistic or structural comparisons are more difficult to automate, as they often require human judgment. Some researchers have experimented with the combination of methods based on components, and methods in comparison to a criterion map. One example of this approach is to use traditional component-based scoring combined with some comparison to a criterion map, by assigning more weight to propositions that were considered to be critical by experts.

Theoretical Framework of Learning with Concept Maps

Concept mapping is grounded in a sound cognitive learning theory. According to Ausubel's Assimilation Theory (Novak & Cañas, 2006), new knowledge can be learned most effectively by relating it to previously existing knowledge. Concept maps may be viewed as a methodological tool of assimilation theory that displays fundamental elements of the theory such as subsumption, integrative reconciliation and progressive differentiation. The idea of a concept is defined as a perceived regul arity in events or objects, or a record of events or objects, designated by a label, symbols and so on (Cañas, Valerio, Lalinde-Pulido, Arguedas, & Carvalho, 2003). The fundamental idea in Ausubel's cognitive psychology is that learning takes place by the assimilation of new concepts and propositions into existing concepts and propositional frameworks held by the learner. This knowledge structure held by a learner is also referred to as the individual's cognitive structure. One of the most fundamental goals in the use of concept maps is to foster meaningful learning. Ausubel made a very important distinction between rote learning and meaningful learning, and stated that meaningful learning requires three conditions:

1. The material to be learned must be conceptually clear and presented with language and examples relatable to the learner's prior knowledge. Concept maps can be helpful to meet this condition, both by identifying general concepts prior to instruction in more specific concepts, and by assisting in the sequencing of learning tasks through progressively more explicit knowledge that can be

anchored into developing conceptual frameworks.

2. The learner must possess relevant prior knowledge.
3. The learner must choose to learn meaningfully. The one condition over which the teacher or mentor has only indirect control is the motivation of students to choose to learn by attempting to incorporate new meanings into their prior knowledge, rather than simply memorizing concept definitions or propositional statements or computational procedures. The creation of concept maps supports the incorporation of new meanings into prior knowledge.

Concept map is as an evaluation tool, thus encouraging students to use meaningful-mode learning patterns (Mintzes, Wandersee, & Novak, 2000). Concept maps are also effective in identifying both valid and invalid ideas held by students. Rote learning contributes very little to our knowledge structures, and therefore cannot underlie creative thinking or novel problem solving. Concept mapping is an excellent studying-exercise for the promotion of creative thinking and identification of new problem-solving methods.

Concept Mapping and Gender

Novak and Musonda (1991), indicated that female students tend to construct less integrated and less complex or poor concept maps than their male counterparts. However, Bilesanmi-Awoderu (2002), conducted a study on concept -mapping, students' locus of control and gender as determinants of Nigerian high school students' achievement in biology. The study indicated that ability to construct properly integrated and complex concept maps was observed among both male and female students. Although the percentage of male students who constructed good concept maps was slightly higher than their female counterparts, the study indicated that there was no significant main effect of gender on the treatments. It is important to explicitly indicate that concept map construction processes are free from sex related skills hence no particular gender has an advantage over the other. Cañas, Hill, Carff, Suri, Lott, Eskridge, and Carvajal (2004), asserted that concept mapping requires logical and analytical thinking skills to construct a reasonable relationship among concepts in a hierarchical order. Bilesanmi-Awoderu (2002), further recommended the use of concept mapping in schools as an effective means of achieving high performance in high school. He further found no significant difference in achievement in the mean scores between male and female students who were taught using the concept mapping method. It was therefore concluded that concept mapping as an instructional strategy could be used in mixed gender classroom situations. It is therefore important to encourage teaching techniques that place more emphasis on collaboration and hands-on learning. A study by Bello and Abimbola (1997) and Parker and Aggleton (2000) found out the effect of concept mapping on students anxiety and achievement in biology indicated that female students had anxiety in the use of concept mapping; however there was a statistical reduction in anxiety of the part of the male counterparts. They explained that the statistical difference in anxiety against the females should be seen within the context of the pressures this society exerts on females who opt to study science in 'male dominated' society in which science is seen as "masculine". They also found out there was no statistical difference in achievement of biology between male and female with the use of concept mapping. They gave a reason that, the metacognitive strategy of concept mapping can be used to overcome differential gender-related performance with respect to learning and achievement in science and technology.

This means that concept mapping and other metacognitive techniques of teaching and learning biology should be encouraged in biology and other science lessons.

Traditional Method of Teaching

This method of teaching is also referred to as the conventional or expository method of teaching. It is also referred to as the lecture method of teaching. It is mostly described as teacher-centred, teacher dominated, or teacher activity method. The role of the student is less active and more passive in the teaching and learning interaction. Teachers occasionally may demonstrate a process for students to observe, engage students in brief discussion and questioning, and often use illustration from diagrams, and charts. The teacher mostly does the talking. Wood (2007), observed that biology teachers in the secondary schools introduce lessons followed by explanations and demonstrations. Meanwhile according to Maryellen (2013), students often prefer to participate in a lesson rather than to be passive learners in a lecture or teacher dominated lesson. During activities, students work alone, and collaboration is discouraged. Teachers must recognize that students can learn from each other and that the deepest learning happens when students have the opportunity to practice and obtain feedback (Maryellen, 2013). Wood (2007), noticed that most schools had inadequate charts and diagrams hence sometimes illustrations were missing from teaching. He observed that few questions are allowed from students of which teachers answered. After each explanation, the teacher dictated copious notes for students to write. He reported that during his research, he inspected the notebooks of the students and found out that all of them had the same notes, indicating that they had their notes solely from their biology teachers. He reported that teaching was direct from teacher to learner. According to Tamakloe, Amedahe, and Atta

(2005), for students to benefit fully from such a method which is teacher centered, the teacher must prepare adequately, reading from many sources to get quality information. This will help the teacher get mastery over the method. Larbi (2005), conducted a study in the eastern region of Ghana comparing the indigenous method approach to the traditional method of teaching. He found out that students taught with indigenous method of teaching science achieved significantly higher marks than those taught with the traditional method. Likewise, Wood (2007), reported that students who were exposed to the constructivists approach achieved significantly higher marks than their counterparts exposed to the traditional method. Research shows that those exposed to concept mapping achieved significantly higher scores than those exposed to the traditional method (Bunting, Coll, & Campbell, 2006; Asan, 2007; Akpinar & Ergin, 2008).

Effect of Traditional Method on Students Achievement

Knight, and Wood, (2005), carried out an experiment to determine whether students learn best through the use of the traditional method or interactive teaching style in biology lesson. In two successive semesters, they presented the same course syllabus using the two different teaching styles. They used performance on pretests and posttests, and on homework problems to estimate and compare student learning gains between the two semesters. Their results indicated significantly higher learning gains and better conceptual understanding in the more interactive course than the traditional method.

Charlton (2006), on the other hand thinks the traditional method is probably the best teaching method in many circumstances and for many students; especially for communicating conceptual knowledge, and where there is a significant knowledge gap between teacher and students. It is effective because they exploit the spontaneous human aptitude for spoken (rather than written) communications.

Merits of Traditional Method

Tamakloe, Amedahe, & Atta (2005) enumerated the following as merits of the traditional method.

The traditional method provides great opportunity for students to learn to take down notes.

The teachers have greater control over what is being taught in class.

The traditional method enables a great amount of course content to be covered in the face of a heavy loaded syllabus or programme of instruction.

The traditional method makes for economy since a large number of students can be taught at a time in one classroom. It is a straight forward way to impart knowledge into students.

It is more helpful for teaching specific facts, concept or laws.

Ormrod, (2015), outlines the following as pros of traditional method of teaching

When education is teacher-centered, the classroom remains orderly. Students are quiet, and the teacher retains full control of the classroom and its activities.

Because students learn on their own, they learn to be independent and make their own decisions.

Because the teacher directs all classroom activities, they don’t have to worry that students will miss an important topic.

Demerits of Traditional Method of Teaching

Tamakloe, Amedahe, and Atta (2005), pointed out the following disadvantages of the traditional method. Generally, the traditional method is not suitable for students who are low on the academic ladder. They find it difficult to listen and take notes at the same time. It does not take into consideration individual differences.

The traditional method in most cases encourages rote learning.

It does not give the students enough chance to develop their oral skills.

Teacher activity overshadows that of students making them play comparatively passive role in the teaching and learning process.

On the spot feedback is usually very scanty and unreliable.

There is little scope for student activity; hence the traditional method goes against the principle of learning by doing.

In the traditional method, the teacher to a large extent spoon feeds the students and does not allow them to develop their powers of reasoning.

Ormrod, (2015), outlines the following as cons of traditional method of teaching

When students work alone, they don't learn to collaborate with other students, and communication skills may suffer.

Teacher-centered or traditional instruction can get boring for students. Their minds may wander, and they may miss important facts.

Teacher-centered or traditional instruction doesn't allow students to express themselves, ask questions and direct their own learning.

Since science mainly involves activities to help students explore facts about the world in which they live, the traditional method is therefore not the best for solely teaching science. As already stated, the traditional method rather promotes rote learning. Wood (2007) indicated that biology teachers resort to the traditional method because of the work load. He reported that the enrolment in most science classes is about 50 to 70 students, making it difficult for teachers to resort to the use of more competitive methods. Biology teachers can enrich traditional methods of teaching by using more teaching and learning materials, slides and overhead projectors if not concept maps.

Summary of Review of Related Literature

Reviewed literature has shown that concept maps are graphical tools for organising and representing knowledge. Concept maps can be used in all levels of education. Concept maps enable an individual to present concepts hierarchically from the most inclusive and most general at the top, to the more specific and less inclusive. It is a good technique for teaching both sexes in the classroom. Finally, the literature reviewed revealed that the traditional method is teacher centered and encourages rote learning.

CHAPTER THREE

RESEARCH METHODOLOGY

Overview

This chapter covers the research design, population, sample and sampling procedure, instrument, data collection procedure, description of treatment/ interventions and data analysis.

Research Design

A pre-test - post-test non-equivalent quasi-experimental design was used for the study since the subjects were not to be assigned randomly to the experimental and control groups (Cohen, Manion, & Morrison, 2000). In a typical school situation, classes cannot be disrupted or reorganized for the Researcher to conduct a study; therefore in such a case, it is better to use groups that are already organized or intact (Ary, Jacobs, & Razavieh, 2002). Even though this design suits this study, it has some weaknesses. The major weakness lies in its inferiority to randomized experiments in terms of internal validity (Trochim, 2000). Hence some extraneous factors such as age, ability, maturation and previous learning experiences were not controlled in this study. The two groups who participated in the study were about 10km apart. Both qualitative and quantitative data were used for the study. Scores of students' achievement tests for pre-test and post-test constituted the quantitative data while the interview and questionnaire on students' perceptions towards concept mapping constituted the qualitative data. The achievement tests which were Pre-test- Post-test were administered to both the control and experimental groups. The experimental group received treatment using the concept mapping method while the control group received treatment using the traditional method.

Both groups however covered the same content in biological classification and ecology. In this study, the achievement of the students was the dependent variable while the teaching approaches (concept mapping and the traditional method) were the independent variables.

Population

The target population for the study was all SHS students offering elective Biology in the Kwaebibirem district. There are two public SHSs in the Kwaebibirem district. It is estimated that about 300 students offer elective biology in the Kwaebibirem district. However the accessible population was SHS 2 elective biology students whose population was 124. This number consists of 58 boys and 66 girls

Sample and Sampling Procedure

For the purpose of this study, the Researcher selected all SHS 2 biology students in Asuom Senior High School as the experimental group, through a purposive sampling technique. This school was purposively chosen due to its proximity to the Researcher. Besides the proximity, the school was selected because of willingness of the school to accommodate the study and the availability of a reasonable number of biology students in the school (at least two intact classes of about 30 students in each year group). The Researcher administered the pre-intervention biology test, post-intervention biology examination and questionnaire to all the selected SHS 2 students. Ten students were selected randomly for the interview. SHS 2 biology students in Kade Senior High Technical School were purposely selected as the control group. The experimental group was made of 60 students with 28 boys and 32 girls, while the students in the control group were 64 in number with 30 boys and 34 girls. Therefore, the sample size for the study was 124 SHS 2 elective biology students. The two schools selected were about 10km apart so; this reduced interaction between the control and experimental groups.

Instruments

Three instruments were used for the data collection in this study. These were a biology achievement test (BAT), questionnaire on students' perception towards concept mapping (QCM) and a structured interview.

Biology Achievement Tests (BAT)

The Biology achievement test was categorized into BAT1 (Appendix C) and BAT2 (Appendix D). The BAT1 which comprised twenty objective questions and four essay test items was used as the pre-test and post-test for both the control and experimental groups. The BAT1 had a total duration of one hour. The pre-test was used to ascertain the amount of knowledge the students had on biological classification and ecology and to determine the homogeneity or the heterogeneity of the control and experimental groups. Students have had lessons on biological classification and ecology in their first and second year in the senior high school respectively in integrated science. The post-test was administered after the treatment had been given. The achievement of the post-tests between the experimental and the control groups were compared. The BAT2 was administered to only the experimental group to ascertain how they answered essay questions and how they constructed their concept maps. BAT2 section A comprised an essay question, while BAT2 section B students were to construct a concept map on that same question. The BAT2 exercise lasted for a duration of one hour. The test items were developed based on the SHS biology syllabus and textbooks, and some modified past questions of the West African Examinations Council (WAEC) biology test items. To ensure content and face validity of the instrument, the test items were subjected to expert judgment by a biology teacher with five years of experience for corrections and suggestions to improve upon the instruments. Scoring rubrics were developed for both BAT1 and BAT2 to facilitate the scoring. For the BAT1 objective questions, each correct answer or response was assigned one mark while a wrong response was assigned a zero mark. The total mark for the BAT1 was 100. Thus, the objective questions were scored over 20 marks and the essay 80 marks. BAT2A had a maximum score of 25 marks and BAT2B had a maximum sore of 75. For BAT2B, four areas were looked at; the hierarchies, the concepts, the propositions and cross links. In order to ensure internal consistencies of the achievement tests, the assistance of examiners were sought, one for BAT1 pre-test, one for BAT1 post-test and another for BAT2. The examiners for BAT1 had between 6 to 10 years of teaching experience as biology tutors and serve as assistant examiners for the West African Examination Council. The examiner for BAT1 and the Researcher discussed the scheme and agreed on the marks to be awarded. Five photocopies of the students' script were marked and the scores compared so that the differences in scoring could be discussed for agreement to be reached before the live scripts were scored. One week was spent in marking the scripts. The second examiner was recruited specifically for scoring the students' constructed concept maps because of his experience. The second examiner being a graduate student of the Department of Science and Mathematics Education, Cape Coast, had taken a semester's course on concept mapping and so did not require much training in scoring concept maps. The scoring rubric was adapted from Novak and Gowin, (1984), as cited in Adiyiah, (2011). Five marks were allocated for each correct hierarchy and zero for an incorrect hierarchy, one mark was allocated for each correct concept and zero for an incorrect concept; one mark was also allocated for each correct proposition and zero mark for an incorrect proposition.

Questionnaire on Perception of Students towards Concept Mapping (QCM)

The questionnaire was developed to find out the perceptions of students in the experimental group towards concept mapping (Appendix A). Since the introduction of concept mapping was a novel method in the selected school, it was important to find out from students who were exposed to this treatment what their perceptions towards this new method were. The QCM consisted of two sections; the first was to get background information about the students while a second section consisted of 13 items based on a five-point Likert scale with 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree'. Scores of 1,2,3,4, and 5 were assigned, respectively to negative worded items. Scores of 5,4,3,2, and 1 were assigned, respectively to positive worded items. For each item, students were requested to indicate their responses by ticking the appropriate column. Likert-type scale appears easy to construct, produces more homogeneous scales, permits spread of variance and allows subjects to indicate their degree of feeling or opinion; this makes it one of the most popular methods of perception and attitudinal scale constructions (Lehmann & Mehrens, 1991). Additionally, likert scales are often found to provide data with relatively high reliability (Fraenke & Wallen, 2000.). Cronbach's coefficient alpha was deemed suitable for measuring the reliability of QCM because it is used when measures have multiple-scored items such as perception and attitudinal scales (Payne & Payne, 2005).

Structured Interview

A structured interview was further used to find out students' opinions on the concept mapping approach (Appendix B). Four areas were covered; interest in concept mapping, performance in class, class participation and construction of concept maps. Only ten students were randomly selected for the interview.

Validity and Reliability

The content validity of the instruments was determined by subjecting them to expert judgment (Rye & Rubba, 2002). The instruments (BAT, QCM and structured interview outline) were subjected to inspection by experts including the supervisor of this project, who is a lecturer at the University of Education, Winneba, and two SHS biology teachers who had 5 to10 years of teaching experience, for their judgments on the content and the level of language. To ensure validity of the interview, the transcribed responses were read back to the students who were interviewed to ascertain from them whether the responses were exactly what they said. The reliabilities (internal consistencies) of the two tests were determined and the reliability co-efficient (Cronbach's alpha) were calculated using SPSS Version 16.0. The interrater reliability of the BAT1 pre-test was 0.88 and 0.89 for the post-test. BAT2A and BAT2B had interrater reliabilities 0.88 and 0.89 respectively.

Pilot Testing

A pilot test was conducted in Kwabeng Anglican Senior High School in the Atiwa district, in the Eastern Region, in order to check for the appropriateness of the instrument for data collection. The students of the school in Atiwa took a pre-test before a treatment was administered, and then wrote a post-test after a lapse period of one week. The students who received instruction through concept mapping approach were given questionnaires to respond to on their perceptions towards concept mapping after they had taken the post-test. The interrater reliability of the BAT1 pre-test and post-test were 0.88 and 0.89 respectively. Cronbach alpha coefficient of reliability for QCM was 0.80.

Data Collection Procedure

A letter of introduction from the Researcher was sent only to the headmaster of Kade Senior Technical School, since Asuom SHS is where the Researcher teaches and a letter was not required by the headmaster before the start of the study. The Researcher met the headmaster of Kade Senior Technical School who introduced the Researcher to the head of science department, after explaining the rationale of her study to him. The Researcher was then introduced to the teacher who taught SHS 2 biology by the head of the science department. This was followed by interactions with the SHS 2 biology teacher to know from him the method that he most often used for teaching the students in his class. It came to light that the method mostly adopted by the teacher for teaching was the traditional method of teaching where the lesson is introduced followed by expository explanation. Students also had to write copious notes given by the teacher. After going through the note books of the students it was realised that they all had the same notes, indicating that they copied their notes from their teacher. The Researcher took time to observe the teacher while he taught, but this was done with his consent. This action helped to know how to exactly teach the control group. The Researcher also took time to familiarise with the students as well. The rapport which was created between the teacher and the students created a congenial atmosphere throughout the period of data collection. During the familiarisation session, the experimental group was introduced to concept mapping. The topic on the cell was used to teach students the various stages of concept mapping. The topic on cell was not one of the topics to be treated in the main study. This topic was chosen because it was treated in the first year of SHS 1 and so served as revision for them. Students were given photocopies of a concept map of the cell (Appendix E). The explanation mainly centered on linkages between concepts (propositions) and the hierarchical arrangement of concepts on the concept map. Also cardboards where cut into circles and rectangles on which were written concepts and proposition respectively. Students were to arrange the circles and the rectangles to form concept maps. The Researcher gave students various exercises to make them conversant with concept mapping. The control group was also taught the same topic. Students were briefed on how they could benefit from lessons taught using the expository method. They were told to pay attention to the voice variation of the teacher and certain phrases like, ‘the most important’ ‘the two main stages are’. At the end of the three days of familiarisation, a pre-test on the biology achievement test (BAT 1) was administered to both the control and experimental groups. The test comprised items on the topics *biological classification and ecology*. The pre-test was to ascertain the homogeneity of the experimental and control groups, and also to know the level of knowledge each group had on biological classification and ecology before the intervention was given. Students were encouraged to do independent work. The class teacher helped in the sitting arrangement and the supervision of students. After the pre-test, the treatment followed. Students in both the control and the experimental groups were taught for two weeks. The Researcher, being a qualified biology teacher taught both groups. Researcher bias, which is often associated with this type of design, was thought to be a risk worth taking. The treatment covered 120 minutes for each day. The experimental group had biology on

Monday and Wednesday 7:00am to 9:00am, while the control group had biology on Tuesday 9:30 to 11:20 and on Thursday 11:20 to 1:30. The flexibility of the time table made it possible for the Researcher to commute between both schools. The Researcher went to the experimental school first followed by the control group the following day. The Researcher alternated between both schools two times in a week. The first week was for familiarisation, the other two weeks was for teaching the topics and the last week was for administration of the achievement post-tests, questionnaires and the interview. Both the control and the experimental group were taught the same content, had the same instructional objectives, same lesson duration and class assignment.

Description of Treatments/Interventions

The treatment started with the experimental group who were taught using the concept map approach. This approach was based on the constructivist's view of learning where learners take active role in learning to ensure meaningful learning. Before the start of the lesson, students were put into groups which comprised four members each. Each group selected their own leaders and secretaries. The groups engaged in collaborative learning, which allowed students to agree by consensus on tasks assigned. The lesson, which involved the use of concept maps were executed in three stages. These were:

1. The introductory stage.

   At this stage students' previous concept maps are reviewed. During the review, the validity of the hierarchical arrangement of concepts and propositions were discussed.

2. The presentation stage.

At this stage the major and sub concepts of the topic were written on the board. This was followed by explanation of the concepts and concept map illustrations of the ideas. During this period the students were engaged in a discourse or discussion involving questioning and answering of questions and expression of opinions. This helped the student to have pictorial presentation of ideas to boost their understanding of the topics that were taught. Concepts were explained to students using concept maps.

3. The practice/application stage.

   At this stage students were asked to construct their own concept maps in groups or individually using pencils or pens. The students were provided with sheets of papers to construct the concept maps. The secretaries in each group constructed the maps as they were fed with information from peers in the group while the chair moderated the activities in the group. The Researcher went round to provide help to students or groups who had some difficulties. Students were also given assignments to do either individually or in groups.

During the first and second sessions, the topic which was treated was biological classification. The students' ideas on concept map were refreshed before the lesson continued. The lesson ended with a concept mapping exercise. Students were put into their groups and given a focus question with a list of concepts, and sheets of papers to construct concept maps. Groups submitted their maps for scoring after the exercise. On the third and fourth days the concept of ecology was treated. Students were made to construct concept map individually or sometimes in groups on those days. The control group was taught the same content and in the same sequence as the experimental group.

However, they were taught using the traditional method. The traditional method involved teaching topics in a regular biology class where teaching and learning activities were mainly teacher-centered. Students occasionally asked questions which were answered by the Researcher who was the teacher for the lesson. The Researcher explained associated concepts to students followed by writing main ideas on the board for them to copy. Each lesson ended with a summary. After each lesson was taught, students were given assignments. After the intervention to the experimental group, both the experimental and the control groups, they were given the same biology achievement test administered in the pre-test, as the post-test the following week. The experimental group did BAT1 on Monday and BAT2 on Wednesday. The BAT2 was to compare the males and females in their concept map construction and also to correlate the concept map scores to their essay scores. After the BAT2, the experimental group was given the questionnaires to respond to. They were given 15 minutes to answer the items but most of them finished within 10 minutes. After the administration of the questionnaire, 10 of the students comprising six females and four males in the experimental group were randomly selected for the interview. The questionnaire and the interview were to find out students perceptions towards concept mapping. The control group did only BAT1 and this was administered to them on Thursday. The biology teacher in the school helped in the administration and the supervision of the test. After the test, the scripts were collected for scoring.

Data Analysis

The data received were entered separately into Microsoft excel for data output. The scores from the pre-test and post-test in BAT 1 and scores of students in BAT 2 were subjected to descriptive and inferential statistics. Descriptive statistics used included mean and standard deviation frequencies and percentages. Depending on the result of the normality test, the statistical tools, t – test (Paired and Unpaired), which allow for the testing of the statistical significance at 0.05 alpha levels were employed for the analysis of data. When the P values from the results of these statistical tools are above 0.05, then there is no significant difference, but if the P values are less than 0.05, then there is significant difference. Unpaired t - test was used to compare the pre-test scores in achievement for the experimental and control groups to ascertain the entry behaviour of the students. Also unpaired t-test was used to compare the post-tests scores in BAT1 between the experimental and control groups in order to test hypothesis 1. The group on which the teaching methods were used on was the independent variable because it had effect on the dependent variables. Paired t - test was used to compare the BAT 2 scores in achievement for the experimental group to ascertain the difference in gender. Thematic content analysis was used to analyze student responses to the questionnaire and the structured interview to answer the third research question. By this, the major area of the questionnaires and the interview were put into themes to determine the perception of students about the concept map approach to teaching and learning.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

In this chapter the results from the study were presented, analysed and discussed in relation to the three stated research questions.

Findings Related to the Research Questions.

Research Question One

Is there a significant difference in achievement between students taught with concept map technique and those taught with the traditional method?

The question above sought to test whether there was any statistical significance difference in achievement between students taught with the concept map technique and those taught with the traditional method. Preliminary analysis was done by comparing the control and the experimental groups' scores from the pre-test using unpaired t – test. The pre-test was used to ascertain the amount of knowledge the students had on biological classification and ecology. The pre-test was also to determine the homogeneity or the heterogeneity of the control and experimental groups before the intervention was given.

Table 1 presents the data indicating the amount of knowledge the students had on biological classification and ecology before the treatment.

Table 1: Pre-test Results of Experimental and Control Groups in BAT 1

Group	N	Mean Score	p-value
Experimental	**60**	**26.10**	**0.84**
Control	**64**	**25.78**	

When the P-value is less than 0.05 it means there is a significant difference between the tests, but when the P-value is greater than 0.05 then there is no significant difference between the tests. Results from Table 1 indicate that the P value was 0.84. This shows that there was no statistically significant difference between performance of students in the experimental group and control group. The mean ranks (control group was 25.78 and experimental group was 26.10) showed that both the experimental and the control groups performed almost at the same level. This indicated that students in both groups had similar knowledge about biological classification and ecology, which were the biology content examined in this study before the interventions began.

Table 2 shows data that indicated that there is statistical difference in achievement between students taught with concept map technique and those taught with the traditional method.

Table 2: ***Post-test Results of Experimental and Control Groups in BAT 1***

Group	N	Mean Score	p-value
Experimental	**60**	**82.08**	**2.53×10^{-33}**
Control	**64**	**55.78**	

Results in Table 2 clearly show that both the concept mapping and traditional approaches to teaching had significant effect on students' achievement in biological classification and ecology. The P value was 2.53×10^{-33}. This meant that there was a statistical significant difference between performance of students in the experimental group and control group. The mean scores for the post-test of the experimental group are 82.08, and that for the control group is 55.78. The large difference in mean scores for the experimental group indicated that when concept mapping was used as an instructional strategy in teaching biological classification and ecology, students easily understood the concepts. The corresponding increase in the mean score of the control group also showed that they also understood the concept of biological classification and ecology.

Research Question Two

Is there a significant difference in achievement between males and females taught with the concept mapping?

The second question sought to test whether there was any statistical significance difference between males and females taught with concept mapping method. This was done because most of the females were in the Home Economic class who offered General Knowledge in Arts (G.K.A.) as one of their elective subjects, which involves drawing. Concept maps also involve drawing; thus, it was presumed that the drawing skill which the females had acquired from their art drawing class could influence the score of the females. An independent sample t-test was used to ascertain this presumption. The result of paired t-test for males and females in the experimental group is shown in Table 3.

Table 3*: Achievement of Males and Females in the Experimental Group*

Group	N	Mean Score	p-value
Male	**28**	**82.93**	**0.23**
Female	**32**	**78.81**	

Table 3 indicated that the students performed quite similarly on the concept map and essay items which were designed to measure similar content. In BAT 2 the p-value was 0.23 which shows that there was no significant difference between males and females taught with concept mapping. Some males and females constructed good concept maps while others constructed bad ones. It could therefore be said that the ability to construct good concept maps is not restricted to gender. This study was also in line with Bilesanmi-Awoderu's (2002), and Bello and Abimbola's (1997), findings from studies conducted in Nigeria that the ability to construct a good concept map is not limited to a student's gender. Nevertheless, as students construct concept maps, it helps them to summarise, organize and present ideas logically and this can enhance concept formation for both males and females equally to create their own knowledge so as to understanding of content in biology.

Research Question 3

What are the perceptions of students towards concept mapping?

Responses from the questionnaire on students' perception towards concept mapping were used to see if there was consensus of opinion about the use of concept maps. A 5-point Likert scale with 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree' with scores of 1,2,3,4, and 5 were assigned, respectively to negative worded items. Also scores of 5,4,3,2, and 1 were assigned, respectively to positive worded items. The scores were used on the questionnaire to determine the degree of agreement with statement about concept mapping. Mostly, strongly agree and agree were considered to be positive perceptions, undecided was considered neutral while disagree and strongly disagree were considered negative perceptions.

Responses of students' perceptions towards concept mapping are presented as Table 4.

Table 4: The Responses of Students' Perceptions towards Concept Mapping

Statement	SA n(%)	A n(%)	N n(%)	D n(%)	SD n(%)
5. I was more enthusiastic and motivated during the use of concept maps in the teaching and learning.	50(83.33)	5(8.33)	1(1.67)	2(3.33)	2(3.33)
6. The use of concept maps as instructional techniques is an effective strategy for students of all abilities.	42(70.00)	14(23.33)	1(1.67)	2(3.33)	1(1.67)
7. Concept map helps me to see the links between concepts	55(91.67)	3(5.00)	2(3.33)	0(0.00)	0(0.00)
8. Concept mapping stimulates me to learn biology.	44(73.33)	14(23.33)	1(1.67)	0(0.00)	1(1.67)
9. The use of Concept mapping instruction would promote the student understanding of concepts and do away with rote learning or memorization of facts.	47(78.33)	10(16.67)	1(1.67)	1(1.67)	1(1.67)
10. Concept maps hinder students' ability on learning tasks.	3(5.00)	3(5.00)	7(11.67)	8(13.33)	39(65.00)
11. The use of Concept mapping instruction is an effective means of helping students to understand relationships among concepts.	45(75.00)	12(20.00)	2(3.33)	1(1.67)	0(0.00)
12. The use of Concept maps for learning almost and always reduces the personal undue forgetfulness and recitation of mnemonics as well as acronyms during examinations.	47(78.33)	7(11.67)	3(5.00)	2(3.33)	1(1.67)
13. I feel the use of concept maps for instruction would affect my learning during my private time in a positive way.	48(80.00)	8(13.33)	4(6.67)	0(0.00)	0(0.00)

Acronyms

SA = Strongly agree, A =Agree, N= Neutral, D = Disagree, SD = Strongly disagree.

Table 4 indicated the ratings of the experimental group's perceptions about the effectiveness of integrating concept mapping as an instructional strategy in biology lessons. The responses of students have been illustrated using graphs and charts.

Majority of the participants (83.33 %,) strongly agreed with item 5, which indicated that: They were more enthusiastic and motivated during the use of concept maps in the teaching and learning and this is graphically shown in Figure 2.

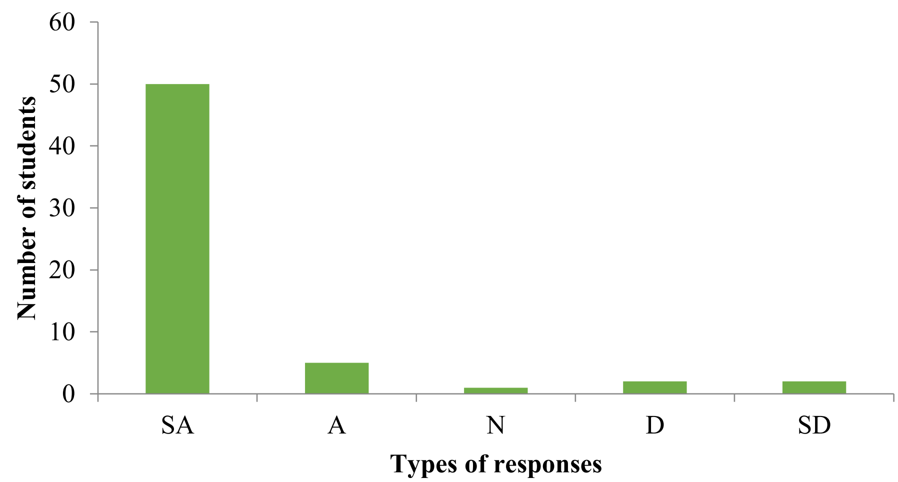

Figure 2: Concept maps lessons makes students more enthused and motivated

As seen from Figure 2, students who strongly agreed that the use of concept maps make them more enthusiastic and motivated during teaching and learning had the highest peak of 50.

Majority of the participants (70.00 %,) strongly agreed with item 6, which indicated that: “The use of concept maps as instructional techniques was an effective strategy for students of all abilities” and this is graphically shown in Figure 3.

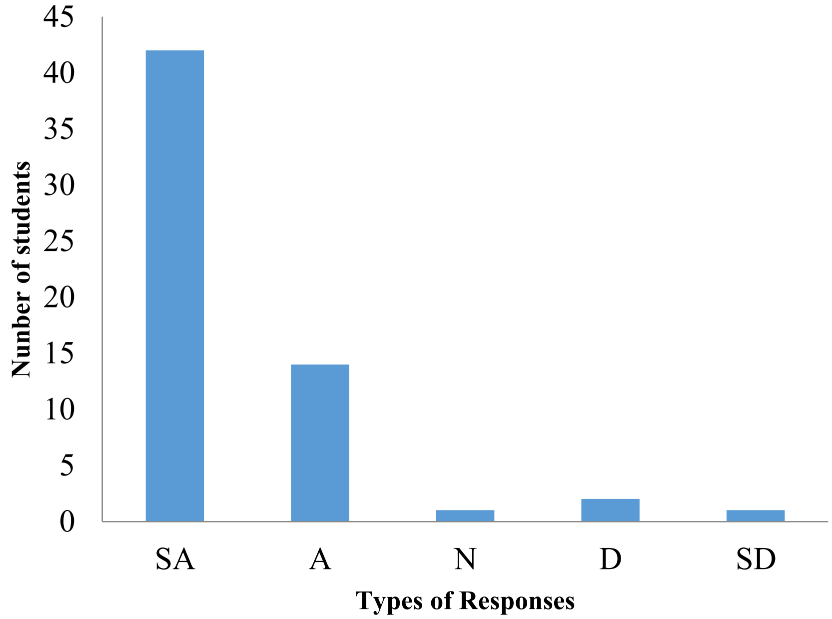

Figure 3: Concept map is better for students of all ability level

As seen from Figure 3, students who strongly agreed that the use of concept maps as instructional techniques was an effective strategy for students of all abilities had the highest peak of 43.

Majority of the participants (91.67 %,) strongly agreed with item 7, which indicated that: Concept map helps students to see the links between concepts and this is graphically shown in Figure 4

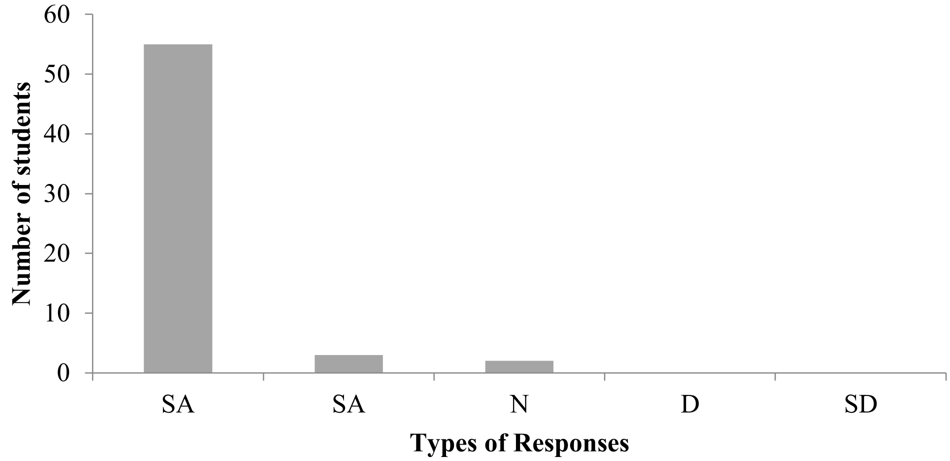

Figure 4: Concept map helps me to see the links beteen concepts

As seen from Figure 4, students who strongly agreed that the use of concept map helps them to see the links between concepts had the highest peak of 55.

In Item 8, 73.33% of the participants perceived that concept mapping stimulates them to learn biology. This perception is captured in Figure 5.

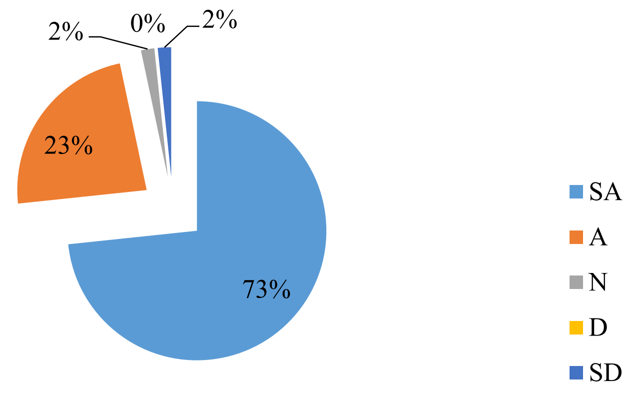

Figure 5: Concept mapping stimulates me to learn biology.

As seen from Figure 5, students who strongly agreed that concept mapping stimulate them to learn biology had the largest sector of 73%.

In Item 9, 78.33% of the participants perceived that concept maps for instruction would promote students' understanding of concepts and do away with rote learning and memorization of facts. This perception is captured in Figure 6.

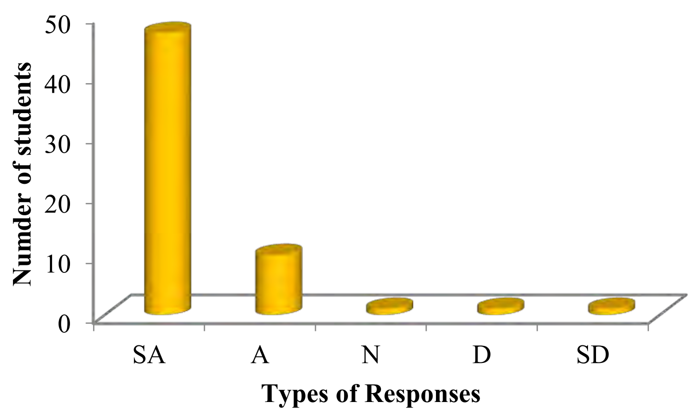

Figure 6: Concept map prevent rote learning and facts reciting

From Figure 6, 49 students strongly agreed with the proposition that concept map prevent rote learning and fact reciting. This means that teaching with concept maps promote students' understanding of concepts.

Item 10 was negatively coded, with 65.00% of the respondents strongly disagreeing with the statement that concept maps hindered their abilities with learning tasks, as shown in Figure 7. It shows that many of the students or respondent perceived that concept mapping does not hinder their ability with learning tasks.

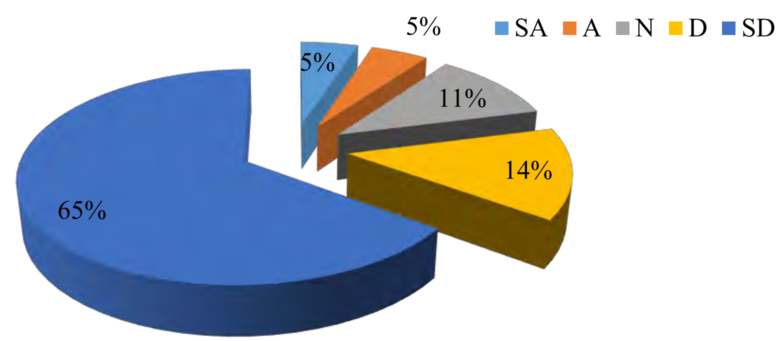

Figure 7: Concept map does not hinder student's ability with learning tasks

As seen from Figure 7, students who strongly disagreed that concept maps hindered their ability with learning tasks had the largest sector of 65%. It means that many students perceived that concept mapping does not hinder their ability with learning tasks.

In Item 11, 75.00% of the participants perceived that the use of concept mapping instruction is an effective means of helping students to understand relationships among concepts. This perception is captured in Figure 8.

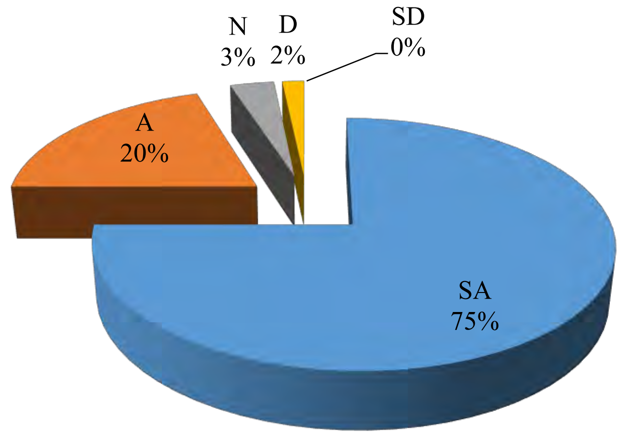

Figure 8 : The use of concept mapping helps students to understand relationships among concepts.

As seen from Figure 8, students who strongly agreed that concept mapping instruction is an effective means of helping students to understand relationships among concepts had the largest sector of 75%. This means that concept mapping helps students to understand the relationships among concepts.

Majority of the participants (78.33 %,) strongly agreed with item 12, which indicated that: “The use of concept maps for learning almost and always reduces the personal undue forgetfulness and recitation of mnemonics as well as acronyms during examinations” and this is graphically shown in Figure 9.

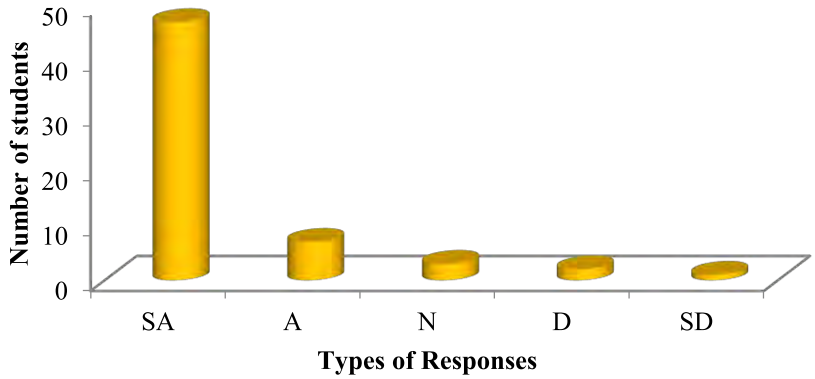

Figure 9: The use of concept maps for learning almost reduces forgetfulness and recitation.

As seen from Figure 9, students who strongly agreed that the use of concept maps for learning almost and always reduces the personal undue forgetfulness and recitation of mnemonics as well as acronyms during examinations had the highest peak of 47. This means that concept map reduces the personal undue forgetfulness and recitation.

Majority of the participants (80.00 %,) strongly agreed with item 13, which indicated that: The students feel the use of concept maps for instruction would affect their learning during their private time in a positive way and this is graphically shown in Figure10.

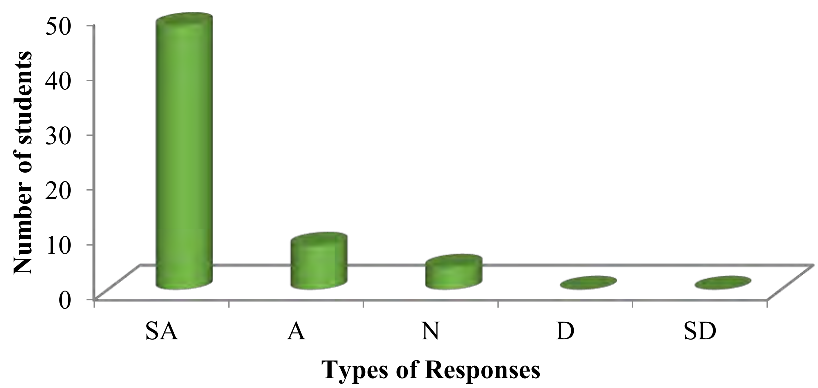

Figure 10: The use of concept maps would affect my private learning in a positive way.

From Figure 10, 49 students strongly agreed with the proposition that the use of concept maps for instruction would affect students learning during their private time in a positive way. This means that concept maps affect students learning during their private time in a positive way.

In summary, most students had positive perceptions towards concept mapping. It could be said categorically that, the students' positive perception towards concept mapping might have caused them to achieve higher in the post-test. Outcomes of this study was consistent with studies conducted by Bunting, Coll, and Campbell, (2006), Asan, (2007), and Scagnelli, (2010), who also found out that students who showed positive attitudes and perceptions towards concept mapping achieved higher in their post-test.

Interest in Concept Mapping

An interview was conducted to corroborate the responses from the questionnaire. Many of the students who were interviewed said that teaching and learning with concept mapping was interesting. When a student was asked whether he found concept mapping to be an interesting learning technique, he said "Yes. It made me get vivid understanding about the topic we treated". Others also responded "It was very good; I enjoyed it because it was new; it was easy for presenting knowledge and answers but it was time consuming". It was noticed that the students developed interest in concept mapping because of how it gave them clear understanding of the biology content. Student H commented, "It is interesting because it's a new way of learning". Student D said "it makes one creative, makes one know what he/she doesn't know. The method was good, arrows and propositions made everything like a note". Student E said "I am happy constructing concept maps". Student A commented, "It was a good and nice thing to use. After using it, one finds out that he/she gains a wide collection of information and knowledge of the topic of study."

Summary of the Significant Ideas from the Findings

A summary of significant ideas obtained from the major findings during the discussion of the research question of this study are:

1. There was a significant difference between the performance of students taught with concept map technique (experimental group) and those taught with the traditional method (control group).
2. There was no statistically significant difference between males and females taught with concept mapping.

3. Most students had positive perceptions towards concept mapping.

Summary

The findings of this study tend to suggest that concept mapping, when efficiently used as a teaching strategy and study skill, could enhance performance in post achievement test scores and retention of biology knowledge as compared to the traditional method of teaching. In addition, it could be concluded that the probability of achieving gender equality in science education rests on hard work on the part of students and the use of an appropriate teaching strategies, such as concept mapping. This is because concept mapping brings about meaningful conceptual understanding to students of different sexes. Based on these findings in the study, it can be concluded that there is no gender influence on ability to construct concept maps. Male and female students are all capable of constructing well-integrated concept maps.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

This is the concluding chapter of the dissertation where the key findings of the research are presented. Recommendations and suggestions for future research have also been made.

Summary

A quasi-experimental design involving two intact classes from two different schools were used. The two schools were purposively selected from the Kwaebibirem district. By purposive sampling Asuom SHS was assigned the experimental group and Kade Senior High Technical School the control group. SHS 2 students were selected for the study because the topics under consideration were in the SHS 2 syllabus. The experimental group was taught using concept mapping while the control group was taught using the traditional method. Two achievement tests BAT1 and BAT2 were used to assess students. The BAT1 was pre-test-post-test. The BAT2 comprised an essay and concept map test items. The two groups were given the same pre-test and post-test. The pre-test was to identify the entry behaviour of students in the two groups. However the BAT2 was administered to only the experimental group. The interrater reliability of the pre-test = 0.88 while that of the post-test = 0.89. The interrater reliability for BAT2A = 0.88 and that of BAT2B (concept map scores) = 0.89.

Summary of Key Findings

Comparison between the pre-test and post-test of each group showed that each group achieved significantly higher marks in the post-test. Analysis of the post-test scores, using independent sample t-test, indicated there were statistically significant differences between the mean scores of the experimental and the control groups after the treatment. The experimental group out scored those in the control group. This implies that the use of concept mapping approach was successful and boosted students' understanding in biological classification and ecology than the traditional method. There was no statistically significant difference between the mean scores of the males and females. This implies that male and female construct concept maps alike. It was found that the ability to draw good concept maps is not dependent on the gender of the student. Students had positive perceptions towards concept mapping. Students indicated that they had interest in concept mapping. Also, students indicted that concept mapping helped them to summarise, organise and logically present their work. It helped them to contribute in class, socialize and ask questions in class. However, they indicted that concept mapping was time consuming.

Conclusion

There were statistical differences between the experimental and the control groups in favour of the experimental group. The results of the study in chapter four showed that concept mapping is more effective for teaching elective biology at the SHS than the traditional method. Concept mapping has the ability to improve students' achievement in biology. The females however performed almost at the same level as the males in concept mapping.

Also, biology students have positive perceptions towards concept mapping. Students are able to summarise, organise and logically present their work effectively using concept mapping. Concept mapping helps students to contribute and socialize in biology class.

However, in this study constructing concept map was found to be time consuming for biology students. Findings from this study show that concept mapping can be effective for teaching biology in the classroom, and also assist students to learn meaningfully and achieve significantly in their examination.

Recommendations

1. Concept mapping is worth adopting as a teaching method by biology teachers at the SHS level in the Kweabibirem District because of its effectiveness.

2. The concept mapping method should be encouraged in many biology classes since it gives students opportunity to see links between concepts, summarise and organise their works and thoughts logically and sequentially.

3. Both genders must be encouraged to use concept maps for studying biology.

4. In view of the immense versatility of concept mapping, it should be incorporated into teacher education programmes in order to equip biology student teachers with adequate instructional strategies that could make them effective teachers.

5. It was also found in the study that students generally have positive perceptions about the pedagogical usefulness of concept mapping in the teaching and learning process. Therefore, it is recommended that the Curriculum Research Development Division (CRDD) of the Ghana Education Service must as a matter of necessity re-examine the biology curriculum incorporate concept mapping instructional tool in the teaching and learning processes for biology.

Suggestions for Further Research

1. The study may be replicated in other districts and regions of Ghana
2. The period for the intervention may be extended to cover a whole term to incorporate the teaching of other topic with concept maps.
3. Future research can be carried out with four different groups at the same level. One group may be taught with concept mapping strategy, another group with collaborative concept mapping, and a third group with interactive computer animation accompanied by concept mapping, and the last group traditional method.
4. Prospective teachers in the University of Education, Winneba and other teacher training institutions, as such Colleges of Education should be taught how to use of concept map as a basis for integration and enforcement of concept mapping in their curriculum during instruction processes.

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APPENDICES

APPENDIX A

QUESTIONNAIRE ON PERCEPTION OF STUDENTS TOWARDS CONCEPT MAPPING

Introduction

A research is being conducted to find out students perception towards concept mapping in the teaching and learning of biology. I have the honour to involve you in this research. Kindly read the questions carefully and tick/write in the appropriate box or make a response against each question. Copying your friend's opinion will make this work worthless. Confidentiality of your responses is assured. Thanks for your co-operation.

A. Background information

1. Students' Code……………..
2. Sex: Male…………… Female……………….
3. Age…………………………………
4. Class/Form…………………………

B. Perceptions of the effectiveness of Concept mapping on teaching and learning.

Please respond to each of these items in this section by ticking (√) the appropriate response. Strongly agree (SA), agree (A), Neutral (N), disagree (D), strongly disagree

APPENDIX B

Statement	SA	A	N	D	SD
5. I was more enthusiastic and motivated during the use of concept maps in the teaching and learning.					
6. The use of concept maps as instructional techniques is an effective strategy for students of all abilities.					
7. Concept map helps me to see the links between concepts					
8. Concept mapping stimulates me to learn biology.					
9. The use of concept mapping instruction would promote the student understanding of concepts and do away with rote learning or memorization of facts.					
10. Concept maps hinder students' ability on learning tasks.					
11. The use of concept mapping instruction is an effective means of helping students to understand relationships among concepts.					
12. The use of concept maps for learning almost and always reduces the personal undue forgetfulness and recitation of mnemonics as well as acronyms during examinations.					
13. I feel the use of concept maps for instruction would affect my learning during my private time in a positive way.					

STRUCTURED INTERVIEW ON CONCEPT MAPPING

1. Did you find teaching and learning with concept mapping interesting?
2. How did you find concept mapping as a teaching method?
3. How did you find your performance in biology after being exposed to concept mapping?
4. What did you like or dislike about concept mapping?
5. What is your opinion on construction of concept map?

APPENDIX C

BIOLOGY ACHIEVEMENT TESTS (BAT 1)

ANSWER ALL QUESTIONS 1 HOUR

1. The term ecosystem refers to the
   a. Ecological system.
   b. Living organisms and their offsprings
   c. Living organisms and the abiotic components.
   d. Interaction between the biotic components.
2. Which of the following relationships is not symbiotic?
   a. Tapeworm living in the gut of man.
   b. Nitrogen-fixing bacteria in the root nodules of legumes.
   c. Bacteria in the intestine of ruminants.
   d. Formation of lichen by alga and fungus.
3. A group of organisms living together and relating with one another and with their environment could be referred to as a/an
   a. Population
   b. Species
   c. Community
   d. Ecosystem
4. Cold-blooded vertebrates that have part of their life in water and part on land but return to water to reproduce belong to the class
   a. Reptilia
   b. Mammalia
   c. Amphibia
   d. Pisces
5. The main difference between plants and animals is in their
   a. Movement
   b. Colour
   c. Mode of feeding
   d. Growth

6. Which of the following groups of organisms is unicellular?
   a. Platyhelminthes
   b. Protozoa
   c. Coelenterate
   d. Mollusca
7. Which of the following arthropods possesses two pairs of antennae?
   a. Cockroach
   b. Crayfish
   c. Millipede
   d. Spider
8. Yeast belong to the phylum
   a. Ascomycota
   b. Basidiomycota
   c. Oomycota
   d. Zygomycota

9. In ecological study, small animals like ants found on leaves and crevices can be collected by
   a. Pooter
   b. Sweep net
   c. Wicker
   d. Transect

Use the information below to answer questions (10 to 12)

A food chain is illustrated by: $A \rightarrow B \rightarrow C \rightarrow D$

10. The organism designated A is sustained by energy from
    a. mineral salts
    b. carbohydrates
    c. the sun
    d. grass

11. The organism designated C is a

a. primary producer
b. primary consumer
c. secondary consumer
d. tertiary consumer

12. Which of the organisms will receive the least energy?

a. A
b. B
c. C
d. D

13. Which of the following statements is true?

a. Food chains are usually short because there is progressive loss of energy
b. Food chains are usually short because there is progressive gain of energy
c. Food chains are usually long
d. Food chains begin with herbivores

Use the information below to answer questions 14 to 16

Consider the features below

I. Absence of a definite membrane bound nucleus
II. Presence of chlorophyll
III. Unicellular
IV. Cell wall is made up of cellulose
V. Exhibit locomotion

14. Which of the features above are exhibited by plants?

a. I and II only
b. II, IV and V only

c. II and IV only

d. III only

15. Which group of organisms' exhibit feature I?

a. Plants

b. Animals

c. Fungi

d. Bacterial

16. Organisms belonging to the kingdom Animalia exhibit feature

a. I

b. II

c. IV

d. V

17. Rural-urban migration is mainly caused by

a. the absence of Agriculture

b. extension officers in rural area

c. lack of social amenities in the rural areas

d. numerous chieftaincy disputes

18. Wind speed is measures with the

a. anemometer

b. wind vane

c. photometer

d. intensity probe

19. The correct sequence of classifying living organism is

a. Kingdom→ phylum →class → order →family →genus →species

b. Kingdom→ phylum→ class→ order → family→ species→ genus

c. Kingdom→ class → species →order→ family →species→ phylum

d. Kingdom →phylum→ order→ class →family →genus →species

20. The first biologist to make an attempt to classify living things was

a. Ray John
b. Aristotle
c. Charles Darwin
d. Carolus Linnaeus

SECTION B

1a. Name the four (4) major components of the ecosystem.

a. Explain briefly the interaction among the major components of the ecosystem.

2a. Classify the following organisms into producers, primary consumers, secondary consumers and decomposers;

Bacterium, Frog, Grass, Groundnut plant, Hawk, Rhizopus

b. Choose any four (4) organisms listed in above to construct a food chain.

3. List three (3) general characteristics of organism in the following kingdoms;

i.Prokaryotae ii. Protoctista iii. Fungi

4. a. Mention five (5) reasons why scientists need to classify living organisms.

b. State two factors each which results in:

i. Increase in population density
ii. Decrease in population density

APPENDIX D

BIOLOGY ACHIEVEMENT TESTS (BAT 2)

TIME: 1 HOUR

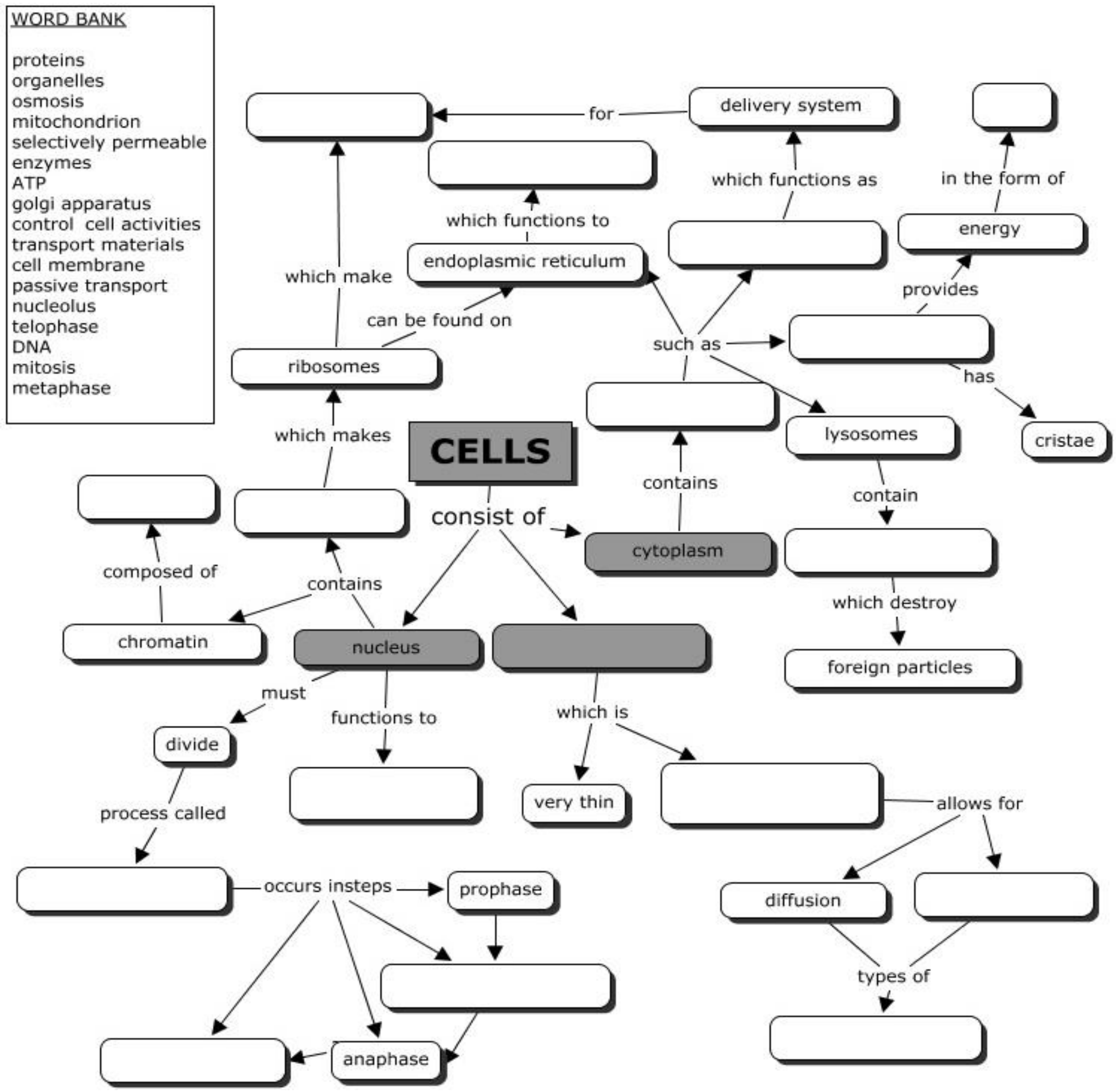
Answer all questions

1. a. What is ecology?

b. Construct a concept map to the answer in question 1.a

APPENDIX E

CELL CONCEPT MAP

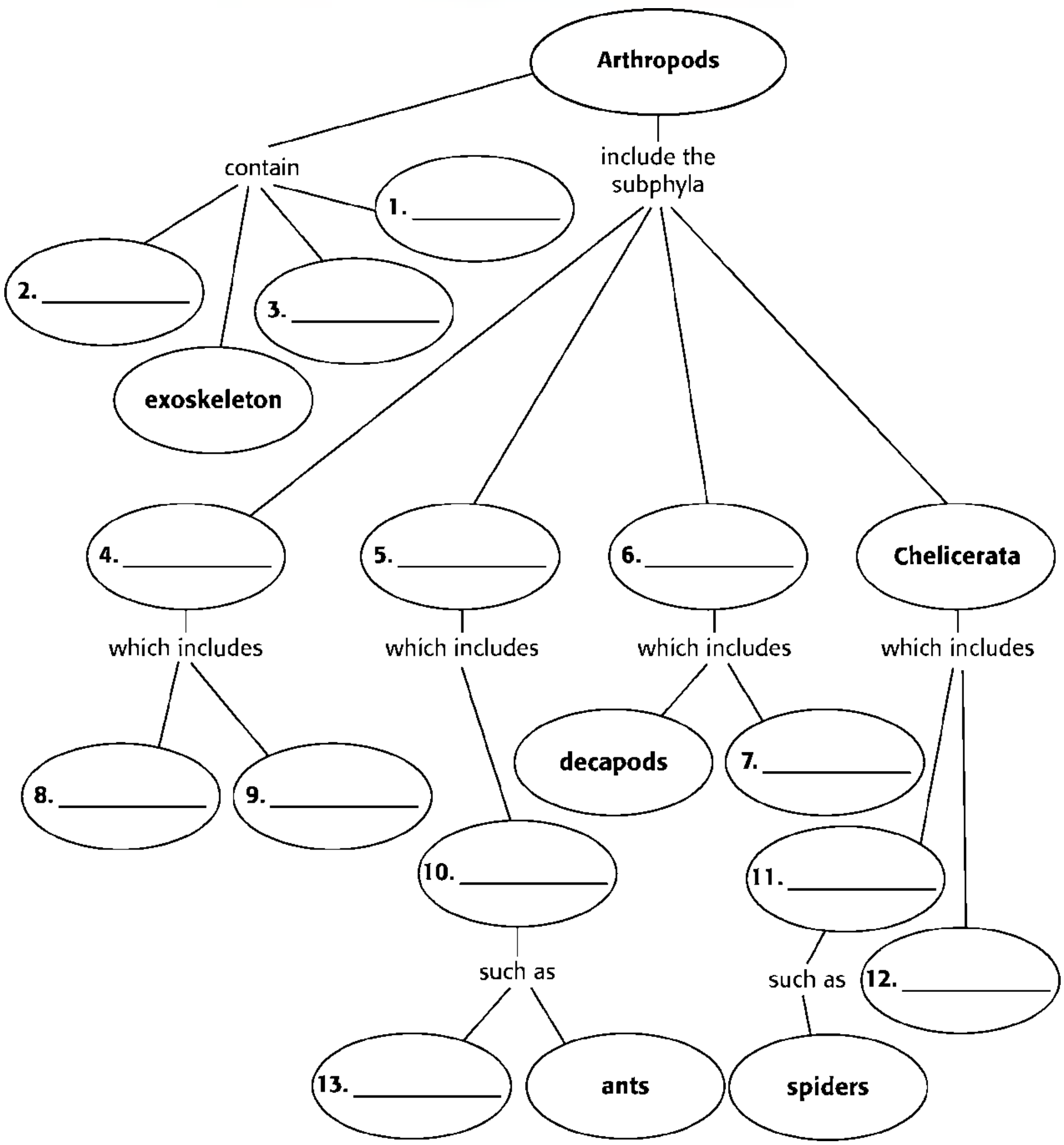


APPENDIX F

A CONCEPT MAP EXERCISE ON ARTHROPODS AND ECHINODERMS

Using the terms and phrases provided below, complete the concept map showing the characteristics of arthropods.

arachnids	horseshoe crab	millipedes
butterflies	insects	Myriapoda
centipedes	isopods	open circulatory system
Crustacea	jointed appendages	
Hexapoda	Malpighian tubules	

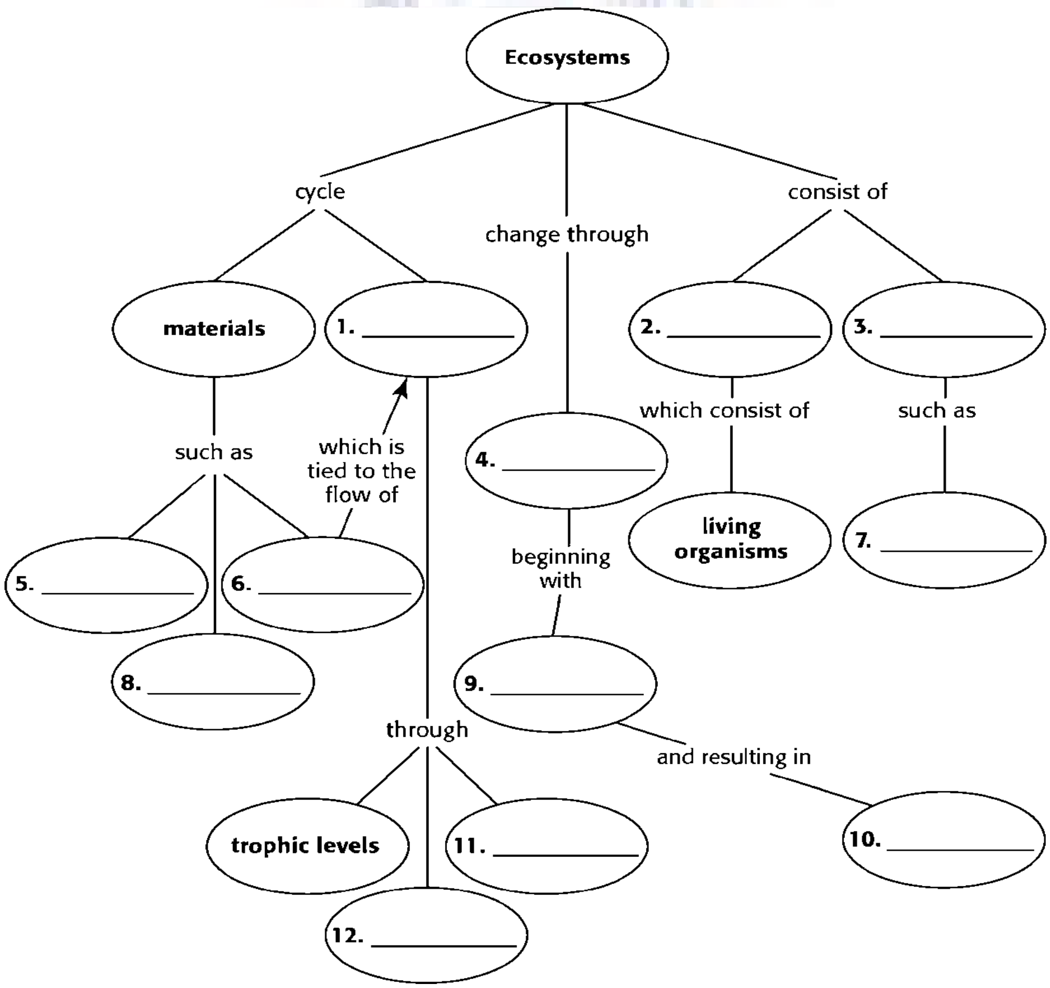


APPENDIX G

A CONCEPT MAP EXERCISE ON ECOLOGY

Using the terms and phrases provided below, complete the concept map showing the characteristics of ecosystem

abiotic factors	energy	food webs	soil
biotic factors	equilibrium	nitrogen	succession
carbon	food chains	pioneer plants	water



APPENDIX H

A CONCEPT MAP EXERCISE ON MOLLUSKS AND ANNELIDS

Using the terms provided below, complete the concept map showing the characteristics of invertebrates.

bivalves	gastropods	oysters
cephalopods	leeches	polychaetes
clams	mollusks	slugs
coelom	oligochaetes	squids
earthworms