UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

THE LEARNING STYLES OF BIOLOGY STUDENTS AND THEIR ACADEMIC PERFORMANCE: A CASE STUDY AT WESLEY GRAMMAR SCHOOL, DANSOMAN-ACCRA

DEBORAH BOYETEY

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(8120130001)

A Thesis in the Department of SCIENCE EDUCATION, Faculty of SCIENCE EDUCATION submitted to the School of Graduate Studies, University of Education, Winneba, in partial fulfilment of the requirements for award of the degree of MASTER OF PHILOSOPHY (SCIENCE EDUCATION).

DECEMBER, 2015

DECLARATION

Candidate's Declaration

I, BOYETEY DEBORAH, declare that this thesis, with the exception of quotations and references contained in published works which had all been identified and acknowledged, is entirely my own original work, and has not been submitted, either in part or whole for another degree elsewhere.

Candidate's Signature : **……..……**

Date : **……..……**

Supervisors' Declaration

We hereby declare that the preparation and presentation of the dissertation was supervised in accordance with the guidelines for the supervision of dissertations laid down by the University of Education, Winneba.

…….. **……..**

(PROF. M. K. AMEDEKER) **DATE**

(Principal Supervisor)

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DEDICATION

This work is dedicated to my husband, Mr Justice W. Ben-Acquaah, my Lovely boys (Ryan Zoe Ben-Acquaah and Adriel Aaron Ben-Acquaah) and my family.

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ABSTRACT

The purpose of the study was to determine the learning styles of biology students and their influence on students‘ academic performance. The population for the study comprised of all first year Home Economics students. A purposive sampling method was used to select one intact first year (SHS 1) Home Economics class with a class size of 50 as the sample for the study. Four research instruments were used in the data collection process for this study to obtain the scores necessary to perform the indicated statistical analyses. The processes were lesson plans, learning packages, observational check-list and learning style inventory. Three research questions offered the framework for presenting the findings. Descriptive and correlation statistics were used in the analysis of the data collected. To determine the dominant learning style preferences of students, descriptive statistics was used to substantiate findings. The findings revealed that students in SHS1 had diversity of learning styles. Fifty-six percent of the learners being Global, thirty percent Analoglobal and only fourteen percent being Analytical. The findings also indicated that there was slightly difference between students learning styles and their academic performance with respect to learning biology. Finally, it was also found out that boys were more analytical than girls. Conclusions drawn from the study showed that students in 1 Home Economic1 had diversity of learning styles. The findings also indicated that there was significant difference between students learning styles and their academic performance and finally, the intervention strategies yielded positive results by improving students‘ academic performance in Biology. Based on the findings of the study, it is recommended among others that innovative and more effective learner-centered instructional strategies, such as ICT integration instructional activities as well as other multimedia strategies should be used by biology teachers to promote meaningful learning of difficult concepts to enhance performance.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter covered the background into the various ways students learn science, especially Biology at the Senior Secondary School (SHS) level in Ghana. The Researcher from her teaching observation and experiences in Wesley Grammar School, in the Greater Accra Municipality has observed how students find it difficult to recall, understand and solve questions either practical or theory which involve logical reasoning. Also, discussions were made on the statement of the problem, purpose of the study, where the Researcher sought to unearth how biology students at the Wesley Grammar School used different learning styles (analytical or global) in their learning and how these affect their academic performance. In addition, discussions were made on the rationale, significance of the study, research questions, limitations, delimitations, the assumptions as well as the summary and finally the organisation for the study and abbreviation.

1.2. Background to the Study

Evolution had led to adaptations and humans have adapted to their environments throughout history to allow for survival. Among these include learning styles. Every person has a learning style and all have at least some preferences – the result of many influences. Certain learning style characteristics are biological, whereas others are developed through experiences.

Learning according to Santrok (2001), is a relatively permanent change in behaviour that occurs through experiences. Farvant (2002), also describes it as the process by which an individual acquires and retains attitude, knowledge, understanding, skills and capabilities that cannot be attained by inherited behaviour patterns or physical

growth. Thus, learning is relating what one learns to his/her experience and to the experience of others. Consequently, effective learning is learning which leads to success in a course.

Individuals learn best in many different ways, sometimes using a variety of styles. Teachers and trainers may not always present information and learning experiences in the way that best suits the learners. Forms of learning like workshops, practical activities, group discussions or informal methods might suit some learners better than other. Dunn & Dunn (2000) ascertain that, when teaching, a look at the students reveals that not only do they look and dress differently but have prior knowledge, misconceptions and naive theories. They also react very differently to instructions, which they learn differently. It is evident that all learners have individual attributes relating to their own learning process and learn differently, because of their biological and psychological differences.

Research on student learning has discovered significant differences in the way individuals process information and retain it. The Dunn and Dunn Learning Styles Model have one of its elements being Psychological, which describes how a student processes information (Searson & Dunn, 2001). The model defines two primary psychological modalities for acquiring and using new information: the global and the analytical. Again researching into how people learn has revealed that every student has a unique profile of skills and strengths, and identifying and supporting these strengths lead to better outcomes. A key distinction in Dunn and Dunn's Psychological domain, global and analytical learning styles, defines how the brain processes information based on the right or left hemisphere dominance.

Indeed, learning style of student may not be a panacea for non-performance, but whatever small the variance may be in students‘ achievement counts (Tachie Young, 2009). Brown (2003) stresses that student learning styles and achievement usually improves when the learning and teaching styles match. Hence, students learning in biology may be affected positively or negatively depending on how well the teacher is able to integrate the process of teaching styles that demand for the individuals learning styles. For this reason, the study is to enable science teachers and for that matter biology teachers, in Ghana, who by the nature of their subject, cater for analytical and global learners and also gain some insight into SHS students‘ preferred mode of perceiving information for learning biology.

1.3. Statement of the Problem

An anecdotal evidence in Ghana shows that most science teachers do not consider the learning styles of their students. They are, therefore, not able to orient students to good learning practices which will positively impact their academic performance. Brown (2003) acknowledged that students‘ achievement improved when the learning and teaching styles matched. Learning styles may affect students in their subject areas. Biology is a subject where students have to be more analytical to determine details about species and concepts learnt. The students‘ inability to solve basic questions on biological concepts and other related work in biology might be as a result of the students not using the appropriate learning styles. The use of the appropriate learning styles leads to higher academic achievement (Lehman, 2007). This study thus sought to explore the learning styles used by biology students and also match their academic performances with their learning styles.

1.4. Purpose of the study

The study sought to determine the learning styles of biology students and their influence on students‘ academic performance at the Wesley Grammar SHS in Ghana. Investigating the learning styles used by students in learning of SHS biology is crucial, because this knowledge could provide guidance for ways to enhance and encourage greater use of learning style preferences among students in learning Biology.

1.5. Objectives of the Study

Specific objectives for the research were to determine the:

1. type of learning styles students exhibit in learning science (Biology);
2. relationship between the learning styles of students and their academic performance; and
3. effect of intervention teaching strategies on students‘ academic performance.

1.6. Research Questions

The study sought to answer the following questions;

1. What learning styles do students exhibit in learning science (Biology)?
2. What is the relationship between the learning styles of students and their academic performance?
3. What is the effect of intervention teaching strategy on student‘s academic performance?

1.7. Significance of the study

The research would offer the opportunity for teachers/educators to use a wide range of methods in order to cater for the different learning styles of students in their classroom. This is because sticking to just one model unthinkingly would create a

monotonous learning environment. In other words, learning and teaching would be just words and not rooted in reality. This study was also intended to assist teachers who have no or little understanding on the various learning styles preferred by themselves and their students. Secondly, the instruments employed in the study could then become a means to assist teachers in continued self-reflection as they monitor their instructional strategies and attempt to incorporate a wider variety of methods in their teaching list. Thirdly, being aware of students‘ learning styles, psychological qualities and motivational differences would help teachers to regulate lessons appropriately. Furthermore, the outcome of the research would at the long run improve the performance of students and ultimately that of the other students in science education. Finally, it would serve as a base for further research work for those who would want to.

1.8. Delimitation

Delimitations according to Simon (2011) are those characteristics that limit the scope and define the boundaries of a study. The author further stated that delimitations are in the control of the researcher. The following factors were identified by Simon (2011) as delimitations in a social research: the choice of the problem for investigation, objectives, the research questions, variables of interest, theoretical perspectives that the research adopted and the selected population. Thus, stating delimitations are ways of trying to bring the problem into accurate and sharp focus. In the light of this the following delimitations were treated to help the Researcher prepare adequately to alleviate their effects on the study.

The study was limited to Wesley Grammar School, Dansoman - Accra. Wesley Grammar School was chosen for the study because the researcher had been teaching in the school for the past five (5) years and was familiar with the academic environment in the school. The researcher also chose these students because the students were newly enrolled into the course and they were offering biology as one of their major subjects. The researcher also had enough instructional contacts with the classes in order to gather enough data for the research.

It was also restricted to the use of global and analytical learning styles in the learning of biology and to the biology students only at Wesley Grammar School, Dansoman - Accra. This is due to the fact that there are many learning styles and strategies of which the students themselves are familiar with some of them.

1.9. Limitations of the study

Limitations are matters and occurrences that arise in a study which are out of the researcher's control. They limit the extent to which a study can go, and sometimes affect the end result and conclusions that can be drawn (Simon & Goes, 2013). Also according to Simon (2011) limitations are potential weaknesses in a study and are often out of control of the researcher. These weaknesses which may hold back the progress of the study are factors that are external to the chosen topic of the research. In this study the researcher was financially handicapped in many instances and thus decided to use students of the school in which she was teaching in order to reduce cost. The size of the sample used in this study was only 150 students; this was to limit the researcher from making underlying conclusions from the results.

Furthermore, the results of the study were influenced by certain occurrences, such as the respondents‘ preference for the use of learning styles (global or analytical) in learning. Also, the outcome was influenced by materials and time availability and learner‘s interest in knowing and mastering a particular style. Moreover, this study could not be carried out in all the SHSs in Ghana due to inadequate resource as time for the study.

1.0.1 Assumptions of the Study

A couple of assumptions were made in this study. It was assumed that as students progress through higher educational levels, they move away gradually from concrete operational stage to the formal operational stage. It was also assumed that the students, as individual as they are, had their own way of grasping information and learning. Furthermore, there was an assumption that people who are analytic (critical thinkers) would perform better in science (Biology) than those who are global. Moreover, learner-centered methods in teaching science would allow students to explore and build science concepts with ease as compared to the teacher-centered methods of teaching science.

1.0.2. Organisation of the Thesis

This study was organised into five chapters. Chapter one is the introduction which deals with the rationale of the study. It also identifies the importance of knowing one‘s learning style among Ghanaian SHS students in learning biology. Four research questions were addressed to guide the study. Chapter two covers a review of the theoretical perspectives of learning and learning styles, analytical and global learning styles, characteristics and preference as well as their influence on student‘s academic performance in biology. In chapter three, there is a detailed description on the

methodology used for the study. Areas looked at included research design, population and sample, research instrument, data collection procedures as well as data analysis. Chapter four presents the demographic description of the study and the analysis of the collected data. Each analysis is followed by some discussions from the results obtained. Chapter five, which is the final chapter, answers the research questions, and also presents the summary, conclusions and recommendations of the study.

1.0.3 Abbreviation

SHS	Senior High School
JHS	Junior High School
MOE	Ministry of Education
LS	Learning Styles
ICT	Information and Communication Technology

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

The purpose of this chapter is to review literature on subject areas relevant to the research topic and questions of the study. Wiersma and Jurs (2005), state that reviewing literature helps a researcher to put the proposed study in proper context and to devise inquiries that have not been conducted before. The review was directed towards identifying important themes, concept, and variables leading to the development of a conceptual framework. The available literature connected to the topic has been, therefore, reviewed from both international and local backgrounds to permit an adequate coverage of the topic and to place it within the Ghanaian context. Hence, the literature was reviewed under the following headings: concept of learning and learning styles, comparing learning styles and learning strategies, a brief review of models of learning styles; teaching methods used; influence of learning styles on education, the influence of global and analytical learning styles on students' performance, the intervention strategies and finally a conceptual framework.

2.1 Concepts of learning and learning styles

Since the time of Aristotle, people have been interested in how people learn and today everyone, teachers, parents and children, should be interested in how they learn as an individual (Tachie Young, 2009). Learning according to Santrok (2001), is a relatively permanent change in behaviour that occurs through experience. Farvant (2002) also has defined learning as the process by which an individual acquires and retains attitude, knowledge, understanding, skills and capabilities that cannot be attained by inherited behaviour patterns or physical growth. Kolb and Kolb (2009), remark that, learning is the process whereby knowledge is created through the

transformation of experiences. Thus, learning is being able to relate what students learn to their experiences and to the experiences of others; and effective learning is learning which leads to success in a course. Furthermore, Parks (2002) defines learning as the gain of knowledge through study, experience, or research. Therefore, learning can be said to be the process by which a relatively lasting change in potential behaviour occurs as a result of practice and or experiences.

Style can be defined as consistent and rather enduring tendencies or preference within an individual. Therefore, Brown (2000) defines learning style as the manner in which individuals perceive and process information in learning situations. Brown further argues that learning style preference is one aspect of the learning styles, and refers to the choice of one‘s learning situation or condition. Celce-Marcia (2001) also identified learning style as the general approaches; for example, global or analytic, auditory or visual, that students use in acquiring a new language or in learning any other subject. Thus, the manner in which a learner perceives, interacts with, and responds to the learning environment is said to be his/her learning style.

Brown (2000) states that ―the characteristic cognitive, affective, social, and physiological behaviour that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" is termed learning style. Dunn et al. (2009) described learning style as the way that students begin to concentrate on, process, internalized, and remember new and difficult academic information. It is composed of both biological and developmental characteristics that make the individual instructional environments, methods, and resources effective for some learners and ineffective for others" (Dunn & Griggs, 2000).

Furthermore**, t**he concept of learning styles has received considerable attention in the empirical literature and many theories have been proposed in order to better understand the dynamic process of learning. It has also been argued for many years that people learn in a variety of different ways with different teaching techniques deployed to ensure all are able to progress with their learning (Copeland, 2013; Dunn et al., 2009). It is important for teachers to be aware of these different learning styles available and those which are more widespread in their classes to allow the appropriate adaptation of activities and resources in the classroom (Copeland, 2013). McLeod (2013) however, acknowledges that it is important to remember that some researchers' dispute there is little validity that can be attributed to learning styles, and these different concepts will be addressed.

According to Young (2004), a learning style is a student's personal preference for one or more particular ways for learning. These preferences are usually informal and contained, and have evolved throughout a student's life. To Pashler, McDaniel, Rohrer, and Bjork (2009), learning styles are the view that different people learn information in different ways and also refer to the concept that individuals differ in regard to what mode of instruction or study is most effective for them. Gregoric (2006) describes learning styles as consisting of distinctive behaviours which serve as stable indicators of how a person learns from and adapts to his/her learning environment and also give clues as to how a person's mind operates. Landrum and McDuffie (2010) further describe learning styles as combination of environmental, emotional, sociological, physical, and psychological elements that permit individuals to receive, store, and use knowledge.

2.2 Comparing learning styles and learning strategies

For the purpose of this study, the terms *"learning style"* and *"learning strategy"*, though often used interchangeably, must be differentiated.

Strategy is the method or plan chosen to bring about a desired future such as achievement of goal or solution to a problem. Learning strategies are therefore specific procedures or techniques or methods a person consciously uses in solving a problem or in working through an assignment. Thus, learning strategy instruction focuses on making the students more active learners by teaching them how to learn and how to use what they have learnt to solve problems and be successful. A close look at the curriculum and the syllabus for teaching biology in SHS in Ghana, suggests that teaching biology should be student - centred and activity - oriented. This means that teaching strategies should include practical lessons, field trips, used of charts, pictures, real objects, Power Point presentations among others (Ministry of Education, 2008). When students are exposed to concepts in these manners, it leads to higher outcome which eventually affects their academic performance.

Learning Styles - An individual's preferred learning environment or the ability to adapt to a specific learning environment based on the way the individual processes information (Allen, Nieter, & Sheave, 2010). Learning styles are also said to be the approaches by which students prefer to learn (Dunn et al., 2009). Although students have the ability to adapt or have the capabilities of learning independent of their preferred learning styles, dominant learning styles refer to the student's choice in the way he or she processes information, concrete or abstract; sequential or random (Parks, 2002).

From the above it could be concluded that learning styles are the general approaches — for example, global or analytic, auditory or visual — that students use in acquiring

a new language or in learning any other subject (Celce-Marcia, 2001). Learning styles are constant and innate, and difficult to be changed, whereas learning strategies can be learned and consciously applied in different learning situations. Also learning styles typically refer to individual preferences for responding to situations and data and for comprehending experiences and developing knowledge from them (Cuthbert, 2005).

2.3 Review of models of learning styles

In theory, there exist as many learning styles as there are learners (Tachie Young, 2009). Psychologists and educators have different classification and therefore, different names for learning styles. Learning style model has several proponents, each with a distinctive twist on the same basic concept that individuals have preferences for the ways in which students learn (Kold & Kolb, 2009). Researchers describe the characteristics of learners in many different ways; these include auditory, visual, kinaesthetic, active or reflective, global or analytical, field - dependent or field - independent among others. These models of classification of learning styles may be totally different, similar or overlapping. This segment of the study discusses some popular models identified by some psychologists and educators and from which researchers have often developed instruments to classify learning styles preferences of students. The models reviewed are Dunn and Dunn model, Kolb‘s Model of Experiential Learning, Fleming‘s VAK model, Gradner‘s Multiple Intelligence, Bernice McCarthy‘s 4MAT and Gregoric Style Delineator.

2.3.1 Dunn and Dunn model

One particularly well-known model is that of Dunn and Dunn, which describes learning style as the way in which each person begins to concentrate on, process, internalize, and remember new and difficult academic content (Dunn et al., 2001). The Dunn and Dunn learning Styles Model have one of its elements being

psychological which describes how a student processes information (Searson & Dunn, 2001). The model identified two primary psychological modalities for acquiring and using new information: the global and the analytical. A global learner sees the ~~"b~~ig picture" or overall view, while the analytical learner focuses on the parts that make up the big picture. Global learners hear new information by listening to the "gist" of what is being communicated, quickly getting the main idea or topic. To the global learner remembering the details may be fairly difficult. In following directions the global learner listens to "what is supposed to be done", not necessarily "how to do it". In contrast to the global, an analytical learner hears new information and tends to listen for specific details. Getting the overall concept that the details describe may be sometimes difficult for the analytical learner. In following directions, the analytic learner listens for details and may become particularly frustrated if instructions are repeated (Dunn & Burke, 2006).

2.3.2 Kolb's Model of Experiential Learning

Kolb's Experiential Learning Theory was reviewed for the purpose of this study since it has specific theories on learning styles (Cuthbert, 2005; Davis, 2007; Kolb & Kolb, 2009). Kolb's model focuses on how students grasp and transform experiences (Kolb & Kolb, 2009). Kolb's Experiential Learning Theory incorporates the concept that individual learning differences influence the learning process and the effectiveness of various learning experiences. However, Davis (2007) ascertain that Kolb's model differs in that it classifies students into four types of learners based on their preferences for how they take in information and how they process information. Individual combinations of these preferences yield the following four learning styles: accommodator, diverger, assimilator, and converger (Loo, 2004).

Divergers grasp a learning experience by concrete methods and transform it through reflective observation. Assimilators grasp the experience through abstract conceptualization and transform it through reflective observation. The convergers on the other hand gain experience through abstract conceptualization and transform it through active experimentation. Finally, the accommodators acquire the learning experience by concrete methods and transform it through active experimentation (McCarthy, 2010).

Loo (2004) asserts that the effectiveness of these learning styles are based upon the ability to respond to various learning situations by successfully utilising each style as opposed to simply employing the preferred style regardless of the circumstances. Thus, Kolb's experiential learning model attempts to incorporate each style of learning into the four-stage cycle that systematically guides students from concrete experiences to the development of concepts that would then serve as the springboard for new experiences (Loo, 2004). A circle divided in quadrants represents each stage, all of which are important for experiential learning; however, most proponents of this theory agree that individuals typically have a preferred stage in which they learn most comfortably (Goby & Lewis, 2000). Therefore, it is important to note that any stage preferred by an individual can serve as the starting point for learning (Tachie Young, 2005; 2009).

2.3.3 Fleming's Visual, Auditory and Kinaesthetic (VAK) Model

Honey and Mumford (2006) have noted that most people will have a range of learning styles, but it is usual that one will dominate. Fleming's VAK model which splits learners into three distinct categories; visual, where students learn best through looking at a piece of work though videos, diagrams or handouts; auditory, where

students learn best through listening and finally kinaesthetic learning, where students learn best through experience or hands on activities.

Educators argue the importance of incorporating learning preferences allows learners to receive a more personalised learning experience which ultimately results in an overall improvement in the progression and attainment that is made (Honey & Mumford, 2006). It is important to note though that these concepts are still met with opposition and some leaders in education today disagree with the idea of labelling a child with a specific learning style, as this could, in turn, narrow their abilities. Instead, they feel it is better to approach this with a view of incorporating a variety of different activities but not labelling a learner directly (Hastings, 2012).

Additionally, by being aware of different types of learning styles, teachers are able to plan lessons that take all of these in to account, but it is important to remember that students learn in more than one way, and therefore teachers should always provide them with a variety of different activities to allow them to access learning (Cherry, n.d). It is also important to remember that learning styles are still very much supported by a large number of teachers, businesses and even parents. Parents may favour this concept of learning styles as it appears to customise learning for each and every learner present, allowing them to access the curriculum in a way that is suitable for them (Hastings, 2012). Furthermore, if a child fails to achieve their predicted potential, parents may feel that the child‘s learning needs have not been met, therefore, placing blame on the school rather than the child.

2.3.4 Gardner’s Multiple Intelligence.

Gardner (1996, 1999) as cited in (Tachie Young, 2009; Maftoon, 2012) emphasises that human beings view the world in seven ways, which he refers to as the seven human intelligences. Students possess different kinds of minds and therefore learn,

remember, perform and understand in different ways. Individuals can view the world through language, musical thinking, spatial representations, logical-Mathematical analysis, bodily movement, understanding others or one‘s self and naturalistic thinking (Maftoon, 2012). According to Armstrong (2000), the multiple intelligence theory is a cognitive model that seeks to describe how individuals use their intelligence to solve problems. Gardner‘s technique is directed to how the human mind performs on the content of the world. By contrast, the other learning style models are mainly process - oriented, for example, in a sensory-channel model (visual-auditory-kinaesthetic), it is possible to be deaf and be quite musical or blind and yet have spatial intelligence as multiple intelligence is not bound to the senses (Armstrong, 2000).

The multiple intelligences theory represents a definition of human nature, from a cognitive perspective: that is, how the learner perceives and is aware of things. This provides absolutely pivotal and inescapable indications as to the learners preferred learning styles, as well as their behavioural and working styles, and their natural strengths. The types of intelligence that a person possesses indicate not only a person‘s capabilities, but also the manner or method in which they prefer to learn and develop their strengths and also their weaknesses.

There are there examples here:

- A person who is strong musically and weak numerically will be more likely to develop numerical and logical skills through music, and not by being bombarded by numbers alone

- A person, who is weak spatially and strong numerically, will be more likely to develop spatial ability if it is explained and developed by using numbers and logic and not by asking them to pack a suitcase in front of audience.
- A person who is weak bodily, physically and strong numerically might best be encouraged to increase their physical activity by encouraging them to learn about the mathematical and scientific relationships between exercise, diet and health, rather than forcing them to box or play football.

People possess a set of intelligences - not just one type and level of intelligence. Intelligence is a mixture of several abilities that are all of great value in life. The fact is that people are all intelligent in different ways (Blunkett, 2004)

According to Denig (2004), Howard Gardner developed the theory of multiple intelligences in opposition to the idea that a single construct could accurately determine a person‘s intelligence. The typical test of a person‘s intelligence quotient (IQ) was limited in that it only measured the mathematical and linguistic domains. In addition, the analytic style of the IQ test served to discriminate against examinees with a global approach to learning. The theory advanced by Gardner was founded upon the idea that individuals, in fact, display a wide variety of culturally valuable intelligences that could not be measured or indicated by the standard IQ test but could be utilized to develop essential products and solutions (Gardner, 1999). As such, Gardner argued that there are at least eight intelligences including linguistic, logical mathematical, spatial, kinaesthetic, musical, interpersonal, intrapersonal, and naturalistic; a ninth, existential intelligence should also be potentially included. A variety, if not all, of these intelligences characterize most people, but at varying levels of development and exhibited strength (Jacobs-Connell, 2000).

The theory of multiple intelligences has received some criticism for its lack of experimental research. There has been no attempt by Gardner to hide this fact, and despite the negative aspect of having little to no research base, the multiple intelligences theory has much popular support. Dunn et al. (2001) assert that a significant factor in this method‘s appeal is that, instead of demanding mastery of academic content, it encourages the development of each student‘s inherent potential. In this flexible learning environment, comprehension is the ideal pathway to knowledge and thinking is revered above memorization. Practical application of this theory includes recognizing the importance of each type of intelligence and subsequently changing instructional practices and teaching methodology to employ students‘ interests and abilities in an effort to maximize learning (Denig, 2004).

2.3.5 Bernice McCarthy’s 4MAT

This system provides four learning styles (Huitt, 2009). These styles are based on the work of John Dewey, Carl Jung, and David Kolb (St. Germain, 2002). The system‘s four quadrants represent the variety of ways a student can approach a learning situation, process information and transform learned information. The 4MAT system permits students to fall on a range of Active Experimentation to Reflective Observation. These include innovative learning styles, analytic learning styles, common sense learning styles and dynamic learning styles preferences.

Innovative learning styles preferents are principally individuals who are interested in personal learning. They are also referred to as Concrete-Random or "Imaginative Learner" and demand to know "Why" they should be involved in any activity (Huitt, 2009). They need to have reasons for learning and to have reasons that connect new information with personal experience and establish that information‘s usefulness in daily life (Tachie Young, 2009). Some of the instructional strategies effective with

this learner type are cooperative learning, brainstorming, and integration of content areas (e.g., science with social studies, writing with the arts, etc.). They are primarily brainstormers with the need to become personally involved in the class. They perceive information in a concrete manner and reflectively process it. This temperament is similar to the Sensing/Perceiving (SP) temperament in the Myers-Briggs Type Indicator (MBTI).

Analytic learning styles preferents are learners who are primarily interested in acquiring facts in order to deepen their understanding of concepts and processes. They are capable of learning effectively from lecture, and enjoy independent research, analysis of data, and hearing what the experts have to say- *field - independent* (Adeyanju, 2000). They are analytical, receiving information abstractly and reflectively processing it. The Abstract-Sequential learner wants to know "What" to learn and is similar to the Intuitive/Thinking (NT) temperament (Huitt, 2009). Thus, they are typically interested in the question –what?" They are also interested in details that lead to greater conceptual understanding.

Common sense learning styles preferents are also learners who are primarily interested in how things work; they want to get involved and try things for themselves. They are also called Concrete- Sequential learners who want to know –How" to apply the learning and are similar to the SJ (Sensing/Judging) temperament (Huitt, 2009). Concrete, experiential learning activities work for them best. They prefer using manipulative, hands – on task and kinaesthetic experience method of learning. They process information actively after they receive it in an abstract way. A primary question of this type of learner is "how?" They are _doers' who are interested in procedures. A strong preference is demonstrated to try things out for themselves which leads to conceptual understanding (Tachie Young, 2009)

Lastly, dynamic learning styles preferents are associated primarily, with students who are interested with self - directed discovery. They are Abstract-Random learners who ask "If" this is correct, how I can modify it to make it work for me. They rely greatly on their own intuition, and seek to teach both themselves and others. Any type of independent study is effective for these learners. They also enjoy simulations, role play, and games (*field - independent*). They are considered risk - takers as they perceive information concretely and actively process it. An essential question that they prefer to address is ~~–if~~?" They are interested in self - discovery and have the desire to learn by try and error method (Tachie Young, 2009). Huitt (2009) explains that, the personalities of these learners are similar to the Intuitive/Feeling (NF) temperament. According to Huitt (2002), in the language of the ancient Greeks, these are the *Sanguine, Choleric, Melancholy,* and *Phlegmatic* temperaments, respectively. The DISC personality system has a similar categorization. Each learning style is associated with both left- and right-brain learners. Left-brain learners are logical, rational, sequential, serial, verbal learners (*Analytical learners*). Right-brain learners are intuitive, emotional, holistic, parallel, and tactile learners (*Global learners*).

2.3.6 Gregoric Style Delineator

Gregoric Style Delineator identifies four learning styles, namely *concrete sequential, abstract sequential, concrete random, and abstract random.* People perceive and process information in various ways according to their perceptual and sensory strengths. This combination of perceiving and processing information forms one's unique learning styles.

Gregoric (1979a), as cited in McCarthy (2010), addresses two sets of qualities which form distinctive learning patterns and styles: Concrete/ Abstract, and Sequential/ Random. These are separated into four learning styles: Concrete Sequential (CS),

Abstract Sequential (AS), Concrete Random (CR), and Abstract Random (AR). Individuals demonstrate use of all four learning styles, but 95 percent express preference in one or two (Tachie Young, 2009).

Concrete Sequential (CS) style preferents want direct, hands-on experience. They exhibit extraordinary development of their five senses. They like touchable, concrete materials, and orderly presentations. They are also adverse to change and not oppose to tradition. Additionally, they are habitual, punctual and desire perfection. They normally would not wear ostentatious colours or mismatched outfits. Finally, they are organised, and give practical gifts (kinaesthetic)

Abstract Sequential (AS) style preferents have excellent abilities in written, verbal and image symbols. They like to read, listen and use their visual skills. They are extremely verbal and will never have a short conversation. They also prefer a step–by–step presentation that is rational and substantive or they consider meetings a waste of time. They are –fence straddles" and highly sceptical.

Concrete Random (CR) style preferents, on the other hand, like to experiment using the trial and - error - method. They tend to jump to conclusions and prefer to work independently or in small groups. They are gamblers and risk takers. CR's may arrive late to meetings and leave early if they feel the meeting is boring or going nowhere. They always want to play the leadership role and not follower; loving to take charge and be in charge. They refuse to accept the words –don't" or –can't". They also thrive in a competitive atmosphere. CR's are not overly concerned with making impressions or going out to win over people and are often the prime movers of change.

The Abstract Random (AR) style preferents have the capacity to sense moods and they use intuition to their advantage. They prefer to learn in an understanding environment, such as group discussions and activities. To them lecture hours are

viewed as time to socialise. They also prefer not to be restricted by unnecessary rules and guidelines. This is because AR‘s continuously discharge energy, they may appear ―hyper" when indeed they are not. Furthermore, they use hands and body movements when communicating and dislike routine activities as well as cold, unemotional people.

In studying the influence of learning styles on academic performance of biology students in Wesley Grammar School- Dansoman, the Researcher observed that the students possessed different styles. Some of these styles include auditory, visual, kinaesthetic, individual, group or cooperative, oral expressive, written expressive, analytical or sequential and global (Wilson, 2011).

2.4. Teaching methods used

Instructional strategies are teaching methods and practices utilized to conduct a learning activity (Wilson, 2011). The syllabus for teaching biology in the senior secondary schools in Ghana states that teaching should be learner-centred (Biology Syllabus, 2010). Instead of this, the teacher-centred approach is the most widely used teaching method among many Ghanaian teachers (Tachie Young, 2009). In this case, the teachers transmit information to students who assimilate that information and learn thereby (Goby & Lewis, 2000). This method could include such strategies as a teacher presenting a lecture, students copying the teacher‘s notes, and the teacher performing an experiment or demonstration for the students to observe. Teacher-centred method might also take the form of teacher presentation of information followed by questioning and drill and practice such as completion of worksheets, in other words, the teacher acting as a figure that holds authority and is responsible for dispensing information (Barber, 2007).

2.5 Influence of Learning Styles on Education

The field of learning styles research has implications for both teachers and students and is capable of influencing a variety of perceptions and outcomes. Many claim this influence is positive, bringing about increased understanding and improved performance (Cano-Garcia & Hughes, 2000; Evans & Waring, 2006; Hall & Moseley, 2005; Honigsfeld, & Schiering, 2004; Minotti, 2005; Noble, 2004; Rosenfeld & Rosenfeld, 2008). However, some questions remain about the most effective ways to obtain the greatest benefits from the current knowledge in the field. Understanding one‘s learning style can be beneficial for more than just attending training and classes. According to Graham, Garton and Gowdy (2001) one‘s learning style affects the way he/she solves problems, makes decisions, develops and changes one‘s attitude and behaviour. It also largely determines the career in which one will find the most comfortable fit. Furthermore, learning style will also affect how students act in a group, participate in classroom activities, and relate to others (Graham et al., 2001).

2.5.1 Teachers

Education professionals have demonstrated an increasing interest in learning styles and related assessment instruments, instructional models and pedagogical techniques (Hall & Moseley, 2005; Pashler et al., 2009). This interest is stimulated by a desire to personalize and improve student learning and is supported by a wide variety of models displayed and promoted in professional magazines (Hall & Moseley, 2005). Some assert that teachers who have a greater understanding of learning styles can increase their effectiveness in both instruction and assessment (Hall & Moseley, 2005; Honigsfeld & Schiering, 2004; Sternberg, 2008).

2.5.2 Instruction

Although some argue the ―manner of instruction can be more important than the types of learning activities selected" (Morrison, Sweeney, & Hoffman, 2006), it is essential that teachers develop a large repertoire of instructional strategies for use in different settings with diverse students (Hall & Moseley, 2005; Honigsfeld & Schiering, 2004). Moral conviction for equal opportunity and fair treatment of every individual demand that educators meet the learning needs of all students. Thus, teachers must become proficient in differentiating instruction to accommodate those needs, make learning more meaningful, and enhance student success (Honigsfeld & Schiering, 2004; Noble, 2004).

An understanding of learning styles can increase teachers' confidence and ability to incorporate varied instructional practices in a way that provides for differing levels of ability and unique student learning preferences while maintaining an appropriate level of academic rigor (Noble, 2004). Further, research indicates that incorporating learning styles based instructional strategies assists teachers in creating a comfortable learning environment, demonstrating true concern for their students, and promoting a love of learning (Honigsfeld & Schiering, 2004).

Additionally, many educators acknowledge the existence of learning styles, but not all are capable or willing to implement the learning style concepts in daily practice (Minotti, 2005; Noble, 2004).Thus, one can observe a broad range of instructional approaches in classrooms around the country. A review of some common designs is important and helpful in understanding current practice. These include teacher - centered instruction, instructional model approaches, constructivism, and experiential instruction.

Teacher-centered instruction: Teacher - centered instruction is a model in which teachers transmit information to students who assimilate that information and learn thereby (Goby & Lewis, 2000). This type of instructional approach caters for and revolves around the teacher and the information the students are required to learn and for which they will be responsible.

Teacher-centered instruction is also known as didactic instruction. This style can include such strategies as a teacher presenting a lecture, students copying the teacher‘s notes, and the teacher performing an experiment or demonstration for the students to observe. Didactic instruction may also take the form of teacher presentation of information followed by questioning and drill and practice such as completion of worksheets. The factory model of instruction and the behavioural approach are also both teacher-centered approaches to instruction, (Zeng, 2013). The classic didactic instructional approach is the lecture, with teachers acting as a figure that holds authority and is responsible for dispensing information (Barber, 2007).

Instructional model approaches: As a response to the need for instruction other than teacher-centered approaches, several instructional model approaches have been developed. These approaches are a teacher‘s means of applying an understanding of various learning styles in the development of philosophically sound instructional practices (Roberts, 2006). Each instructional model approach has a basis in one or more learning style theories and has characteristic activities or methods of progressing throughout the learning process. In addition, they maintain a design intended to consider and address variations in student learning needs (Roberts, 2006). Whole language is an instructional model that, according to Roberts (2006), does not require that students‘ learning styles be identified, but is designed to provide numerous instructional options which teachers may implement in an effort to enable all children

to be successful. Likewise, foxfire activities focus on relating learning activities to real-life experiences and follow a design intended to meet a variety of student needs (Roberts, 2006).

One multifaceted instructional method is the 4MAT system which, according to (Roberts, 2006), utilizes a series of eight steps, each of which is designed to accommodate a specific learning style, thereby maximizing the abilities of all students at some point throughout the process. Another instructional method that deliberately addresses personal differences in students‘ learning styles includes describing, interacting, controlling, selecting, instructing, and evaluating. The first letter of each of these components forms the acronym that names this method, the DICSIE model (Roberts, 2006).

Constructivism: According to Alesandrini and Larson (2002), constructivism is a learner-centered approach founded upon the belief that learners derive knowledge through exploration and discovery and that they are continuously constructing and reconstructing meaning with each new experience they encounter. In an attempt to move away from an approach centered on the teacher, who continuously dispenses information or one singularly focused on a particular strategy for presenting instruction, there has recently been significant development of an interest in the constructivist approach to education. The foundational principal of constructivism is that learners construct knowledge through their experiences as well as reflections on and responses to those experiences (Goby & Lewis, 2000). The shared inquiry of a community and authentic activities are vital to the constructivist approach to learning. Constructivism not only stresses diversity in experiences, but also in resultant products that are characteristically unique to each student or group of learners (Alesandrini & Larson, 2002).

Experiential instruction: The goal of experiential instruction is to engage students mentally and emotionally in real-life experiences that will enable them to relate personally to the information presented (Young, 2002). Reflection allows and encourages students to develop theoretical understanding from concrete experiences by providing a framework to guide them through the learning process and drives the transformation from passive learning to active doing (Goby & Lewis, 2000). Although Dewey was one of the originators of the model that ultimately can be traced back to the ideas of Confucius, Kolb has been one of the most significant contributors to the field of experiential learning through his development of the experiential learning model that (Barber, 2007). Young (2002) asserts that Kolb's experiential learning cycle requires significant planning and intentional application in order to concentrate on curricular goals directly through engaging and motivating encounters with the concepts addressed in the lessons.

However, teachers who effectively implement the experiential approach do not focus on the hands-on nature of constructivist experientialism to the exclusion of serious mental involvement. Indeed, students must also interact mentally through reflection and conceptualization of their experiences (Kolb & Kolb, 2009). The implementation of this involves active experimentation and concrete experiences in the hands-on stage and reflective observation and abstract conceptualization in the minds-on stage (Young, 2002). This circular flow of instructional experiences is termed teaching around the cycle and is central to the effective use of Kolb's model to enhance learning among students with any of the four learning styles identified in the model (Felder, 2000). The first stage of the cycle involves presenting new topics in a way that will motivate students to engage in the topic and seek more information. The focus of the second stage is to provide students with the necessary essentials for

understanding the principles and methodology of the topic. The fourth and fifth stages involve supplying a variety of opportunities for students to experience and gain proficiency in following appropriate strategies for implementation and then reinforcing and extending the topic through additional applications (Felder & Brent, 2005; Kolb & Kolb, 2009).

2.6 The intervention strategies

In this study, developing strategies to help the students achieve high academic successes, the Researcher categorised the learning styles into global and analytical or sequential. Lessons were then organised to suit the characteristics and preferences of these learners.

2.6.1. Analytical learning style: characteristics and preference

Several educational theorists have proposed models for categorising learning styles, but it was Gregoric and Butler (2006) who popularised the concept of analytical learning. Gregoric's model focuses on a learner's preferred method of perceiving incoming information. Sequential or analytical learners prefer to receive information which are directly visible, perceive in ordered, organised and linear, as opposed to random-order thinkers who prefer information that provides a global perspective that they can later break into parts or chunks. Analytical learners are therefore more often considered logical thinkers due to their preference for sequential order. This learning style is also called ―field independent" or ―descriptive cognitive style". Students in analytic mode associate stimuli on the basis of their overt physical attributes like part or whole. Loo (2004) also looked at Analytic styles as the tendency to associate objects or events on the basis of common characteristics; for example, a chair and a table are similar because they both have four legs.

Analytical learners are best able to understand new information if it is presented in a linear, step-by-step way. They are more likely to benefit from detailed, clear instructions that offer them a method for carrying out a task to completion. Analytic learners are also more likely to create sequential methods of organising tasks or information for themselves. For instance, they might request for a checklist of after-school chores and activities to help them stay focused. Analytic learners are typically self-motivated, logical, and focused. They pay close attention to details and specifics and often values facts over intuition and feelings. Analytic learners also have a sense of fairness when solving problems. Students that are analytic prefer to working in quiet, clean environments for studying. They prefer to finish one thing at a time and may prefer direct answers. They are also more likely than other types of learners to defend their arguments or positions with appeals to logic or common sense.

The appropriate teaching methods that could best be used in teaching analytical learners might include the use of academic games/computer simulation, field trip/role play/problem solving, brainstorming, case study, colloquia/using a resource person, debate, demonstration, discovery/inquiry, on-line instruction and learning, presentations and lecture, projects and recitation. These instructional methods among others would be discussed in the subsequent chapter.

2.6.2. Global learning style; characteristics and preference

Felder and Brent (2004; 2005) acknowledge that, students with global learning style learn by discussion and cooperate in group efforts. They do several things at once and may skip steps/details. Global learners see the big picture before seeing in part (global) and the relationship between ideas. They like to read between the lines to see many options when working. They work hard to please and try to avoid conflict. Students with global learning style are able to work from general to specific, they like

to receive information from many sources when learning new concepts (abstract random); they like to be physically involved (active) and relate learning to emotions (affective). They learn by looking at the world around them (field-sensitive) and see concepts before individual facts (concept-oriented). They tend to avoid individual competition and paraphrase in explaining a perspective. Global learners prefer to learn concepts in a random manna and put things together in novel way.

In order to help students with global learning style to achieve good academic performance, the appropriate teaching methods that could best be used in teaching them as suggested by Gregoric and Butler (2006), should commence by telling the main idea and goal of the lesson. This can be achieved by stating attainable objectives which are read out to the class at the onset of the lesson. Furthermore, the use of humour, board illustrations, Power Point presentations, demonstrations, stories or personal anecdotes that relate to the topic, Showing of lots of visual images, diagrams, chart, pictures and graphs and organising experiments or practical session are other methods that the teachers could adopt in their lessons.

In summing up, the learning styles discussed refers to a combination of characteristics that apply to all students. Each student possesses some of the learning styles. Ideally, one would have a balance of all the learning styles, however, most students gravitate toward one or two of the learning style preferences (Grasha, 2002). Learning styles preferences are likely to change as one encounters new life and educational experiences. No matter what approach is used to record for the learning styles of a group of students, one thing is certain, there will be at least as many learning styles in the classroom as there are students. Hence, it is important to find teaching techniques that encourage students of all learning styles to learn. To disclose these natural tendencies and styles, it is important to use a comprehensive model of learning styles

that identifies each individual‘s strength and preferences across the full spectrum of physiological, sociological, psychological, emotional, and environmental elements (Tachie Young, 2009).

2.7 The influence of global and analytical learning styles on students' performance

According to Wilson (2011), understanding the key differences in student learning styles leads to better learning support. Several assessment tests allow individuals to determine their own learning styles and help parents and teachers find ways to encourage learning. Teachers can develop lesson plans that accommodate both styles, such as incorporating narratives and group work into lesson plans to accommodate global learners. At home, parents can better support their children's learning needs, by providing a brightly-lit, quiet area for an analytical learner or playing music in the background for a global learner.

The learning-style of students changes as students move from elementary school into adolescence and young adulthood. Others find that learning styles are also different by achievement level, gender, and age (Dunn & Griggs, 2005). Thus, general changes in learning style can be expected as students develop. Ricketts, Rohs, and Nichols (2005) described the need for instructors to determine learning styles of their students and utilize this information as a teaching tool. Learning styles and preferences have been of interest to educators for decades. The more teachers know about learning styles of those they teach, the better able they are to design curriculum and deliver instruction (Tachie Young, 2009).

Graham, Garton, and Gowdy (2001) reported that learning style has been found to be an important variable in students‘ academic achievement, how students learn and teachers teach, and student-teacher interaction. Rudd, Baker, and Hoover (2001),

however, acknowledged that there are ~~n~~many differences among students which can be easily observed and identified such as race, gender, age and academic ability". Rudd et al. (2001) also suggested that individual learning styles are not as easily identified as these simple observations, and that instructors tend to teach the way they were taught and typically have a limited understanding of the different learning styles of their students.

Investigating field - dependent (global) versus field - independent (analytical) learning style and how they affected sixth-grade readers, it was found that, of the good readers, half were analytic and half were global. Of the poor readers, 85% were global. Therefore it was concluded that good readers were field - independent (analytic) because they could see each letter, sound it out individually, and piece it together with others to form words. Campbell (1990) has found that there is no relationship between learning style matching and examination scores. However, Van Vuren (2003) found that students whose preferred learning style matched the teacher's preferred teaching style received higher examination scores than those whose style did not match. Research findings support the view that when a student learning style preferences match their teacher's teaching styles, student motivation and achievement usually improve (Miller 2001; Stitt-Gohdes, 2003).

Matching student's learning styles with appropriate instructional strategies improve their ability to concentrate to learn and, if mismatching occurs, students feel anxious and even physically ill when trying to learn. Most teachers are best at teaching students who match their own learning styles of thinking and learning (Sternberg, 2008). According to Sternberg, students tend to receive higher grades when their styles are the same as those of their teachers. This implies that teachers must learn to be flexible and exhibit different styles in their classroom.

The most critical point that teachers needed to know is how to teach both analytically and globally. Analytics learn best when information is presented in a step-by-step sequence, whereas globals needed to understand the whole concept first; they then focused on the details. To engage the global learner, the teacher should introduce a new lesson with a humorous story and use diagrams, illustrations, and pictures to represent key ideas. It is important to note that many global learners prefer to work with peers rather than alone or with a teacher, and they often like to structure their own tasks. Global learners appear to concentrate best with sound, soft or low lighting, an informal seating arrangement, and some form of intake. Also, they take frequent breaks while studying and often work on several tasks simultaneously. Analytics, on the other hand, prefer to work on one assignment at a time before proceeding to the next. They prefer a quiet, well illuminated environment and formal seating. Most analytics do not require intake to concentrate (Dunn and Griggs, 2000).

2.8 Conceptual framework

Conceptual framework is a written or visual presentation that explains either graphically, or in narrative form, the main things to be studied – the key factors, concepts or variables - and the assumed relationship among them (Smyth, 2004). The conceptual framework for this study has been depicted in Figure 1.

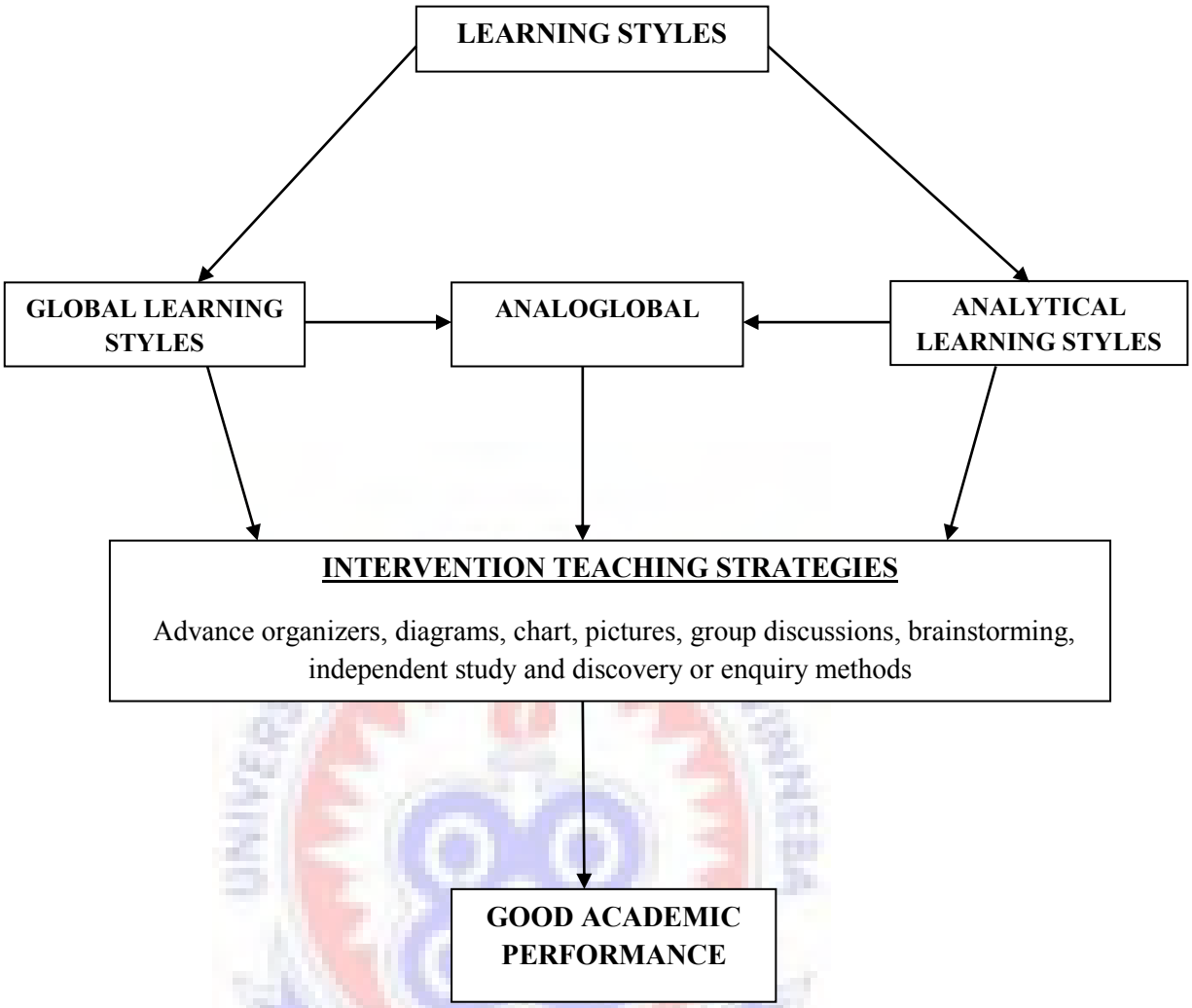

Figure 1: Conceptual Framework of the Study

From the above diagram, it is evident that learners come to class with different forms of learning styles. These learning styles include the two extremes; Global and analytical learning styles (Dunn & Dunn, 2000). Again in the classroom, there would be students who might have the characteristics of both learning style groups. This group is what the Researcher referred to as Analoglobal. Guild (2001) emphasised that educators are familiar with the diversity of the learners who populate their classrooms, they maintain limited understanding of the differences among individual learners and are likely to seek one paramount approach as the answer to all teaching and learning. Both global and analytical learners have specific characteristics and preferences which enable them perceive information differently. However, guiding students to adopt the right learning styles have the potential to make learning of confusing and complex or difficult concepts more interactive, authentic, and meaningful. Thus learning styles seem to give students experiences that facilitate conceptual development leading to increased understanding of difficult concepts in biology.

For this study, the Researcher used appropriate intervention teaching strategies which accommodated all three groups. Strategies such as advance organizers (humour and storytelling), diagrams, chart, pictures, graphs and group discussions among others during lesson delivery were comfortable for learners with global learning styles. The Researcher also used academic games, computer simulation programmes, brainstorming, colloquia, independent study and discovery or enquiry methods of teaching, which were comfortable for learners that are analytical. The Analoglobal group were comfortable with any of the teaching strategies. Graham et al. (2001) proposed that, due to the diverse learning styles found in students entering institutions

of higher education, it is crucial for instructors to identify learning style differences and incorporate teaching strategies that address the learning needs of all students.

Therefore, these intervention strategies for the learners must not be used in isolation; this is because all three groups of learners might be present in the same class at the same time. Butler (2006) suggested both coping strategies for the learner and bridging (teaching) strategies for the instructor related to how best to help students learn. Hence, using appropriate intervention strategies that best suit students with global, analoglogal and or analytical learning styles would lead to good academic achievement, especially in biology

2.9 Conclusion

Helping students become lifelong learners should be the ultimate goal of education, and understanding students‘ various learning styles could help educators achieve that goal. Hanafin, Shevlin, and Flynn (2002) encouraged educators to embrace the diversity of their students and develop a classroom environment and a variety of instructional strategies that commemorate and support this diversity. Felder (2000) has asserted that teachers must teach to students with all types of learning styles and noted that an instructional model is only effective to the extent that it is able to assist educators in meeting the needs of all students. Indeed, educators must make a commitment to understanding learning styles, recognising the unique qualities of each student, and doing everything within their power to provide the tools and opportunities necessary for every student to achieve success, especially in biology

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter covered the methodology that was employed in the study. This includes the research design which is the plan that specified how data related to the study were collected and analysed. Also, discussions were made on the population used for the study, which include both the target and accessible populations. In addition, discussions were made on the sample and sampling procedures, the research instruments used in the data collection process. Finally, the method used in scoring data, validation of instruments, reliability of research instruments, method of data collection as well as the method of data analysis are discussed.

3.1 Research Design

Research design, according to Amedahe (2002) is a plan or blue-print that specifies how data relating to a given problem should be collected and analysed. Designing a study helps the researcher to plan and implement the study in a way that will help the researcher to obtain intended results, thus increasing the chances of obtaining information that could be associated with the real situation. Research designs are of different types and these include action research design and survey research design.

3.1.1Survey research design

Survey research design involves procedures in quantitative research in which the researcher administer a survey to a sample or to the entire population of people to describe the attitudes, opinions, behaviour, or characteristics of the population (Creswell, 2012). In surveys, standard set of questions are used to get a broad overview of a group‘s opinions, attitudes, self - reported behaviour and demographic

and background information (Barnes & Onley, 2008). According to Babbie (2007), there are two basic types of surveys: Cross-sectional surveys and Longitudinal surveys. Cross-sectional surveys gather information on a particular population at a distinct time. Longitudinal surveys, on the other hand, collect information over a period of time.

3.1.2 Action Research design

According to Parsons and Brown (2002), action research is a form of investigation designed for use by teachers to attempt to solve problems and improve professional practices in their own classroom. It also involves systematic observation and data collection which can then be used by the practitioner - researcher in reflection, decision - making and the development of more effective classroom strategies. Action research is known by many other names, including participatory research, collaborative enquiry, contextual action research, and action learning. Furthermore, Miller (2007) has stated that action research is a natural part of teaching. Teachers are continually observing students, collecting data and changing practices to improve student‘s learning and the classroom school environment. Miller (2007) further explains that action research provides a framework that guides the energies of teachers toward a better understanding of why, when, and how students become better learners. Put simply, action research is learning by doing (Miller, 2007). Action research, therefore, aims to contribute both to the practical concerns of people in an immediate problematic situation and to further the goals of social science simultaneously.

In this study the Researcher chose action research as the design for the research. The Researcher chose action research, because it is usually participatory. This implies a partnership between the Researcher and the students. By this choice of design, the Researcher was able to use the responses made by the students during the interaction period of the study. Action research can therefore be seen as turning unpromising beginnings into effective endings. Action research is also a stronger option for offering a range of choices as well as having direct and obvious relevance to the study.

3.2 Population

According to (Mogu, 2002), a population is a group of individuals, persons, objects, or items from which samples are taken for measurement. Creswell (2012) also describes population as a group of individuals or objects who have the same characteristics. For instance, a group of teachers form a population of teachers. More so a research population is a large well-defined collection of individuals having similar features (Castillo, 2009). Castillo differentiates between the types of population, the eligibility criteria, the target population and accessible population.

In this study, the population was the students of Wesley Grammar School. Wesley Grammar School is in the Greater Accra Region of Ghana, which is located along the southern coast of Ghana. The school had a student population of 1,651 of which 812 were boarders and 839 were day students.

3.2.1 Target population

According to Creswell (2012), a target population is a group of individuals with some common defining characteristics that the researcher can identify and study. Also target population is the total group to which a researcher would like to generalised the

results of a study (Ary, Jacob & Razzavieh, 2002). Creswell added that within this target population, the researcher then select a sample for the study.

For this study the target population was all Home Economics students of Wesley Grammar School, Dansoman – Accra. This was because they all offered biology as one of their elective subjects. The school had two streams of Home Economics classes for each form, thus making a total of twelve classes.

3.2.3 Accessible population

According to Fraenkel and Wallen (2001), accessible population is the group to which the researcher is able to simplify his/ her findings. Moreover, accessible population is the group of subjects that are within the reach of the Researcher and from which the sample will be obtained (Ary et al., 2002; Castillo, 2009). Cohen, Manion and Morrison (2008), also observed that the researcher needs to ensure that access is not only permitted but also practicable. Additionally, Cohen et al. (2008) noted that access to sensitive areas might not only be difficult but also problematic both illegally and administratively.

In this study the accessible population, was all first year Home Economics students only of Wesley Grammar School, Dansoman – Accra. This was because the accessible population was in the same form and comprised of newly enrolled students of the Home Economics classes. Additionally, Wesley Grammar School was chosen for the study because the Researcher had been teaching in the school for six years prior to the study and was familiar with the academic environment in the school.

Furthermore, proximity and time were factors considered for the choice. The resources available for the research were not sufficient enough for the Researcher to

conduct the research with the entire target group. The Researcher also considered the level of the students. They were all in SHS 1 and were supposed to have passed their Basic Education Certificate Examination (BECE) in science. The Researcher would also have enough instructional contact hours with the students in order to gather enough data for the research.

3.3 Sample

According to Creswell (2008), a sample is a true representation of the population from which it was selected or a subgroup of the target population that the researcher plans to study for generalising about the target group. In addition, it can be defined as a set of respondents (people) selected from a larger population for the purpose of a survey (Mogu, 2002). There are three primary kinds of samples: the convenience, the judgement sample, and the random sample. These three differ from each other in the manner in which the populations are chosen (Mogu, 2002).

Cohen et al. (2008) ascertain that a convenience sample is a type of non-probability sample used in qualitative research. Cohen et al. (2008) further explained that a non-probability sample is a deliberately selected sample to represent the wider population; it seeks only to represent a particular group, a particular named section of a wider population, such as a class of students or a group of students who are taking a particular examination. A convenience sample could be used when the more suitable elementary units are chosen from a population for observation (Mogu, 2002). A judgement sample is obtained according to the discretion of a researcher who is familiar with the relevant characteristics of the population. Moreover, a random sample is the one that allows a known probability that each elementary unit will be chosen. For this reason, it is sometimes referred to as a probability sample (Mogu, 2002; Cohen et al., 2008).

In this study, the Researcher chose the convenience sample, since the respondents for the study were suitable and within the reach of the Researcher. Convenience sampling also saves time, money and efforts (Patton, 2002).The sample selected for this study was made up of 50 students of one intact class. The 50 students consist of 48 female and only two male students. The number of female students was far greater than that of the male because Home Economics is said to be female-biased.

3.3.1 Sampling Procedures

Sampling is the act, process, or technique of selecting a suitable sample, or a representative part of a population for the purpose of determining parameters or characteristics of the whole population (Mugo, 2002). Sampling techniques, on the other hand, are the strategies applied by researcher during the sampling procedure (Castillo, 2009). A purposeful sampling, also commonly called a judgmental sample, is one that is selected based on the knowledge of a population, information-rich cases for in-depth study and the purpose of the study.

In this study the purposeful sampling was useful to the Researcher because it helped to reach the target and the set objectives. The students were selected because of some characteristic such as the class of the students and their interest level (Crossman, 2013). Purposeful sampling is also very useful for the situations where the Researcher needed to reach the targeted sample quickly and where sampling for proportionality is not the main concern. Makhado (2002) agrees with the use of purposeful sampling technique by stressing on the fact that it is important to select information - rich cases as this would help the researcher to address the purpose of the research. Purposeful sampling is of high-quality during the action research because a limited or small

group is required to undertake the study to find solution to a problem before implementing it on a larger scale.

McMillan and Schumacher (2001) further recommend purposeful sampling, because the sample that is chosen is likely to be knowledgeable and informative about the phenomenon the researcher is investigating. Purposeful sampling may involve studying the entire population of some limited group. It was against this background that the Researcher in this study chose purposeful sampling to select the sample.

3.4 Research Instruments

A research instrument is a testing device for measuring a given phenomenon, such as a paper and pencil test, a questionnaire, an interview, a research tool, or a set of guidelines for observation (Mosby, 2009). According to Annum (2015), research instruments are the fact finding strategies and the tools for data collection. They include questionnaire, interview, observation and reading action research.

The Researcher used four research instruments in the data collection process for this study to obtain the scores necessary to perform the indicated statistical analyses. The processes were lesson plans, learning packages, observational check-list (OCL) and learning style inventory instrument. These were used during the pre-treatment or pre-intervention phase and the intervention phase of the study. The learning style inventory instrument (LSI) was used during the pre-treatment phase to elicit information about the students learning style they possess at the time of entry. On the other hand, the lesson plan, learning packages and the observational check-list (OCL) were all used during the intervention or treatment phase of the study.

3.5 Lesson plan

According to El-Tigi (2000), a lesson plan is writing and noting the method of delivery, and the specific goals and time-lines associated to the delivery of lesson content. Fink (2007) acknowledges that whenever teachers plan or design their courses, they are in essence making a series of decisions aimed at creating a design, which in this case consists of a plan of activities for what the teacher and students will do in a course. It helps the teacher to know what to do in a class (prepared by them) with quite specific activities (Fink, 2007).

The lesson plans (Appendix A) used in this study were to guide the running of the learning package in the classroom. It was used to elicit students‘ relevant previous knowledge (RPK) in some concepts in biology designated by the syllabus at their level. These topics included concepts in biological drawing, life processes of some insects and other organisms. This was done before proceeding to the next activity in the lesson. The lesson plan was used to provide activities to be performed by the students and the Researcher. It contained the implementation of the intervention packages on the aforementioned concepts. It also contained provision and information for the Researcher to monitor and intervene. For instance, during practical lessons where students were put into groups, the Researcher only served as a facilitator monitoring the students as they performed the activities. The Researcher only came in when necessary to clarify issues.

The Researcher used the planed lessons to evaluate the students‘ understanding of the topics as well as to monitor students‘ execution skills. In addition, the lessons were used to evaluate students‘ understanding and performance in each of the lesson. For the duration of this process, the Researcher took into consideration the following: conceptual understanding of scientific concepts, deeping of factual knowledge,

efficiency at exhibiting practical skills and the type of learning styles they were exhibiting. In conceptual understanding of scientific concepts, the Researcher monitored and noted students‘ responses in each lesson. This was done using the questioning and answering strategy for soliciting information from them.

To access deepening of factual knowledge, written answers or feedbacks of the students were monitored in the second half of the term due to the late arrival of the first year students. This was done to ascertain if there were improvements of their understanding with the use of the instructional methods. Writing is practically an effective way of engaging students in critical thinking and understanding. This therefore improves understanding and expressing deeper levels of thinking of students. Moreover, exhibiting practical skills of students was achieved mainly through practical lessons, such as experiments and demonstrations. There, the students displayed manipulative skills, communication skills, inquiring skills as well as team work. Finally, in addition to these aforementioned, observations, written notes, instructional packages and pictures/models/charts were also used to enhance information that was obtained from the instrument.

3.4.1.Observational check-list (OCL)

Creswell (2002) has recommended the use of observational protocol as a method for recording notes. This is to enable the researcher to know exactly what goes on in the classrooms. In this study the Researcher adopted lesson observation protocol (Appendix B) developed by Local Systematic Change International (Chappuis & Stiggins, 2005) to collect qualitative data from the respondents. The essence of the lesson observations was to enable the Researcher gain more insight into the problems identified through classroom interactions. Furthermore, lesson observation was used to clarify some of the responses given to some of the questions answered during the

interaction period. It was a check-list and contained 15 items. The lesson observation protocol required background information on the students, time and date of observation as well as the name of the class. It also required information on the classroom context (physical environment). Again, it required information on students' role during the teaching and learning process and the attitude of the students. It ended with the Researcher's comment on the observations made.

There were a few changes made on the lesson observation protocol. For instance, in the original version of the instrument there was pre-lesson observation interview protocol, the researcher and the teachers also planned and taught lessons together after observing the teachers' lessons. In this study, the Researcher did not interview the teachers or students before observing them during the lessons and did not also plan lessons with any of the teachers in the school. The Researcher also prepared a list of all the students in the class and used the list during the instructional period. As the students gave responses to the Researches' questions, the Researcher marked /ticked and scored as —A (analytical), —G" (global) and —B" for both (analytical and global).

3.4.2Learning package

Two learning packages prepared on worksheets were developed by the Researcher which were used in the treatment phase of the study. The learning packages contained information materials that are captured in the syllabus for SHS 1 and the teacher's scheme of work. The packages were:

a. Self-instructional Learning Package (SLP)

b. Group-instructional Learning Package (GLP)

Self – instructional Learning Package (SLP) is a model text- assisted programme instructions designed to cover topics of the biology syllabus. The SLP was prepared on this structure; Name, class, topic, duration, instructional objectives, instructional text or concepts and self-assessment. The SLP was compared with the standard of Akinbobola (2009) and Yusuf and Afolabi (2010). A sample of the SLP is found in Appendix C.

There were lessons on biological drawings, life processes of insects (butterfly and grasshopper) and the mode of life of some organisms (*Tilapia* and *Bufo regularis*) which covered six weeks period. The lesson had a component of self-assessment attached to them. The language used in the SLP was very easy for the students to read and understand it. The SLP was made for each student on each of the lesson and the student used the worksheet with little or no Researcher‘s intervention.

The Group-instructional Learning Package (GLP) was mostly used when the teaching – learning materials were inadequate for the lesson. The students were put into 10 different groups comprising of five members each. The GLP has similar features to the SLP; e.g., group, class, topic, time, instructional objectives, concept, prerequisite skills, materials, instructional procedural and self and group assessments. GLP was compared with the standard of Ifamuyiwa and Akinsola (2008) and Shafqat (2008). A sample of the GLP is found in Appendix D.

In GLP, group task worksheets were prepared. Each student received the response part in all the groups after each lesson in order to solve the relevant exercises individually first before group discussions and presentations. These were in line with the instructions in the learning package. This was to ensure that students exhibit team

learning and also cater for those with global learning styles. The students were also made to present their findings on each package in the classroom.

3.4.4 Learning style inventory instrument (LSI)

According to Dunn and Burke (2006), learning styles inventory is the method of understanding how one learns and processes information. The learning style instrument (LSI) is a self-diagnostic instrument consisting of 41 items as compared to the original which contained only 21 items (Appendix E). The items are mainly made of the characteristics of the learning styles under study and on how students process information.

Learning style inventory instrument (LSI) is a simple programme adapted for students to work on using computers. There are two columns; the first column was made up of short sentences which are based on the characteristics of analytical and global learning styles. The second column consisted of small boxes for which the students would click. Each of the items had a brief introductory statement which participants were expected to read and then click in the small square box beside each statement that best suited the students' description and typical academic habit. The LSI contained 43 items and were scored as follows;

> *All odd numbers clicked or responded to were for Global learning style.*
>
> *All even numbers clicked or responded to were for Analytical learning style.*
>
> *Equal odd and even numbers clicked were for Analoglobal learning style.*

3.5 Validation of Instruments

Validity of a research instrument is concerned with how well it measures the concept(s) it is intended to measure (Alhassan, 2006). To ensure that participants' scores from the quizzes, individual and group assignments made sense, were meaningful and enabled good conclusions to be drawn from the sample studied to the research population, the designed instruments were presented to one senior biology lecturer in the Department of Biology Education of the University of Education, Winneba and two SHS elective biology teachers with considerable teaching experience in the Accra Metropolis for their comments and suggestions in order to correct possible errors that are associated with items on the packages. The content validity of the instruments were further enhanced through assessment by the Researcher's supervisors in the Department of Science Education, who are experienced, competent and familiar with the research area.

3.6 Reliability of instrument

Reliability according to William (2006) refers to consistency or _dependability' of the measurement or the extent to which an instrument measures the same way each time it is used under the same condition with the same subjects. In order to ensure that the research instruments produced scores that are stable and consistent and their test items are devoid of any ambiguities (Creswell, 2008) as much as possible, the LSI and the learning packages (SLP and GLP) were pilot tested using twenty (20) SHS 1 Elective Biology students in Ebenezer Senior High School, Dansoman, in the Greater Region of Ghana. Data from the pilot test were statistically analyzed to determine the reliability of the test instruments using the Superman Brown prophecy formula since all items on both LSI and learning packages were dichotomously scored. The analysis yielded reliability coefficients of .56 and .61 for the LSI and learning packages

respectively. According to Ary, Asghar and Lucy (2002), if the measurement results are able to be used for making a decision about a group or for a research purposes, or if an erroneous initial decision can be easily corrected, then scores with modest reliability coefficients in the range of.50 to.60 may be acceptable. The above reliability coefficients for the LSI and learning packages therefore, signify that both test instruments are considerably reliable.

3.7 Data Collection Procedure

The data collection procedure was divided into three phases: pre-treatment phase, treatment phase and post-treatment phase. The Researcher administered the learning style inventory (LSI) personally to the biology students. The students interacted with the LSI during the instructional period with little or no interference from the Researcher. The test, quizzes, class exercises and assignments which were given to students were collected and analysed regularly to identify potential difficulties. The results assembled were used as data for the study. This is illustrated diagrammatically below

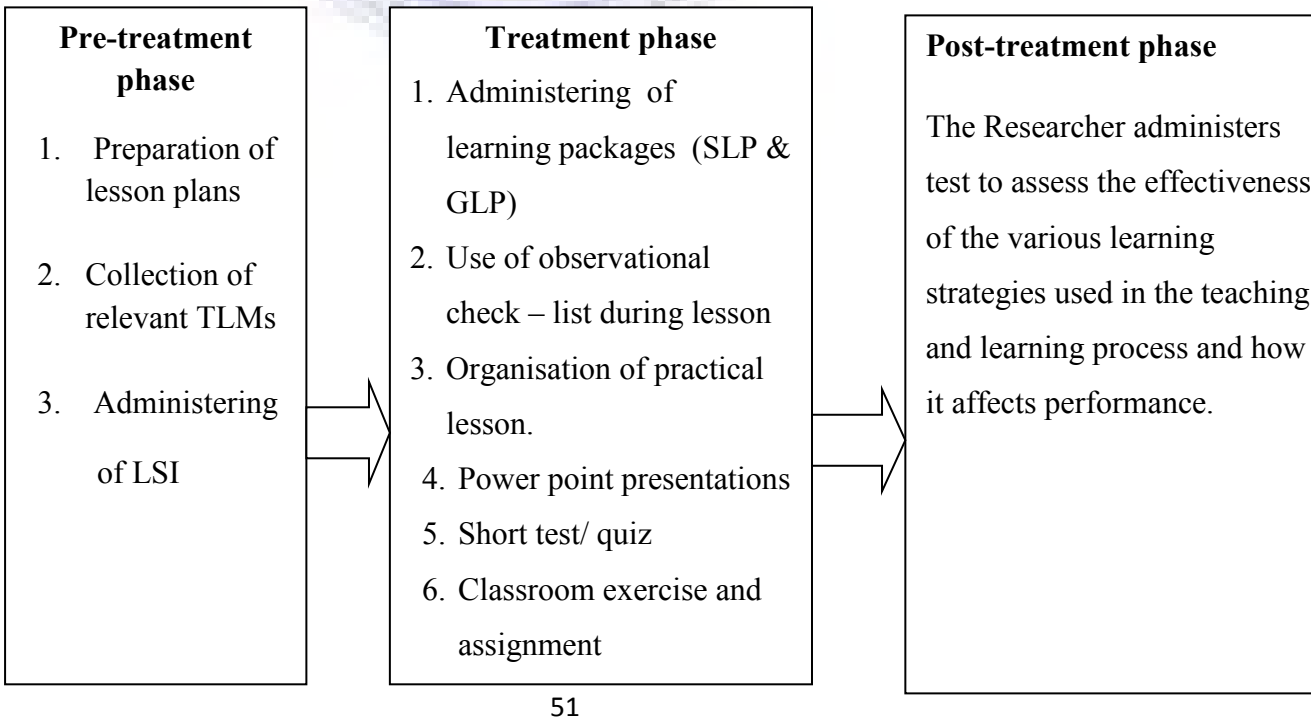

Figure 2: The Process of Data Collection

3.7.1 Pre-Treatment Phase

In the pre-treatment phase the Researcher prepared the lesson plans from the term's scheme of work. In the process, the Researcher collected all the relevant teaching and learning materials (TLMs) needed for the lessons. These included charts, pictures, and real specimens, such as grasshoppers, butterflies, *Tilapia* and toads for preservation. The SLP and GLP worksheets to be used in the various lessons were also prepared beforehand. Colleague teachers were brief on the study to solicit for their maximum support during the study. Finally the LSI was administered to the participants. Two computers were made available to the participants with the programme on them to manipulate. This period lasted for only two weeks of the study

3.7.2 Treatment Phase (Intervention strategies)

The Researcher fully implemented the learning packages (SLP and GLP) where applicable. The following equipments/materials were used by the Researcher to carry out practical lessons for the participants; projector, laptop computer, knives, beakers, charts, work/manual cards, etc. There was also group project works which were accompanied by oral presentations from the various groups. The classroom settings and environments were prepared in such a way that they catered for the various learning style groups in the class. For example, providing a traditional classroom setting where each student sat behind a table in rows facing the board with a well-lit environment goes for the analytical group. Each learner worked on the SLP at his/ her own pace without any pressure from either the Researcher or peers. The feedback on each SLP consisted of simple questions with answers and some explanations based on the lessons.

The treatment phase of the study lasted for six weeks in the second term of the 2013/2014 academic year in the Ghanaian SHS calendar. The learning packages were presented in lessons used in the classroom. Series of classroom interactions were made: these included organising short quizzes and giving class assignments (both individual and group). The Researcher taught the class having in mind the various characteristics for global and analytical learning styles. This was to enhance the performance of SHS1 students in elective biology.

3.7.3 Post-treatment Phase

The post-treatment phase of the study was undertaken in the last week of data collection period in the class. After the administration of the intervention strategies in the class, another set of exercise, a quiz and an assignment were administered to all participants in the class. This was done to assess the effectiveness of the various learning strategies adopted in the teaching and learning process on the performance of SHS 1 participants in biology.

3.8 Data analysis

Ader and Mellenbergh (2008) defined data analysis as the process of inspecting, cleaning, transforming, and modelling data with the role of highlighting useful intonation, suggesting conclusion and supporting decision-making. In this study, the Researcher employed qualitative and quantitative data analyses methods to examine the effect of the differences among the three groups of learning styles and on their academic performance in biology of some selected students of Wesley Grammar School. The study employed the two-factor factorial methodology which was:

1. Type of Learning Style and
2. Gender

The first factor had three levels, they were

i. Analytical

ii. Global

iii. Analoglobal (Both)

The second factor had two levels, that is

i. Male

ii. Female

3.8.1 Qualitative Data Analysis

Qualitative analysis was performed on the data gathered through the learning style inventory and the lesson observations. The responses made on the learning style inventory were counted and analyzed. However, data collected through observation schedule was analyzed using frequency counts and percentages. The results were then compared to find out whether what the students ticked during the answering of the learning style inventory instrument was actually what they practiced during instruction.

3.8.2 Quantitative Data Analysis

Quantitative data analysis methods were used to analyse the total scores obtained from SLP and GLP. The data collected were analyzed using the SPSS version 16.0 for windows. The descriptive function of the SPSS was used to compute the mean and the

standard deviation of the responses provided by the students. The package further helped to determine the impact of learning styles on performance. ANOVA and multiple comparism tests were used to determine the relationship between learning style and performance

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

In this chapter, presentations and analysis of the data pertaining to the research questions are made as well as findings for the study discussed. The analysis was to determine the learning style preferences of Home Economics students offering biology in the SHS and assess the influence on their learning performances. The research questions offered the framework for presenting the findings. Data were acquired from the responses to standardized self-instructional learning package (SLP) and group-instructional learning package (GLP), observational lessons and learning style inventory administered to them. Descriptive statistics was used in the analysis of the data collected. To determine the dominant learning style preferences of students, descriptive statistics were used to substantiate findings. To determine the relationship between the learning styles of students and their academic performance in biology, multiple comparism tests and two – way Analysis of Variance (ANOVA) was used. Furthermore, the results of each research question were theoretically discussed and a full report given on each lesson carried out with the students. The first part presents the analysis of the data, while the discussion of the findings of the study is dealt with in the second part.

4.1 Background information of the respondents

The part A of the observational checklist and learning style inventory required that respondents indicated their background information. These were collected and analysed and the analysed responses are presented in terms of frequencies and percentages in Table 1.

Table 1: Relevant Background Information on Gender and the types of Learning Styles

Variable	Category	No. Of student	Percentage
Gender	*Male*	2	4
	Female	48	96
Total		**50**	**100**
Learning styles	Global	28	56
	Analytical	7	14
	Analoglobal	15	30
Total		**50**	**100**

4.1.1 Learning styles

In Table 1, the students indicated mixed learning styles namely global, analytical, and Analoglobal which was a hybrid of the two extreme learning styles. Out of the 50 participants involved in the study, 56% (28) of them were globals, only 14% (7) students were analytical and 30% (15) of them being Analoglobal who were identified to have exhibited the characteristics of both learning style groups.

Students who showed Analytical learning style were best able to understand new information when presented to them in a linear, step-by-step manner. They preferred detailed, clear instructions that offered them methods for carrying out their tasks to completion. Analytic learners were also able to create sequential methods of organising their tasks or information for themselves. This means that they were able

to do discovery learning and searched for information for themselves. Furthermore, they were self-motivated, logical, and remained focused during the period of study. Students that were analytic preferred working in quiet, clean environments for studying and also preferred to finish one task at a time.

The group that exhibited characteristics of global learning, on the other hand, learnt by discussion and cooperated in group efforts. They did several things at once and skipped steps or details in most of their presentations. Global learners see the big picture before seeing in part *(global)* and the relationship between ideas. They also liked to read between the lines to see many options when working and worked hard to please and try to avoid conflict. The hybrid group exhibited a mixture of both analytical and global learning styles. Table 1.0 presented above shows the learning styles of students in form one Home Economics class.

4.1.2 Gender

From Table 1, the total participants involved in this research were 50 biology students. They were made up of two males (4%) and 48 females (96%). This gives a distribution of the population under consideration in terms of their gender. The percentage of female was more than the male due to the fact that Home Economic class was used and this was dominated by the female students. A clear picture of the distribution of gender is displayed in Figure 1 below.

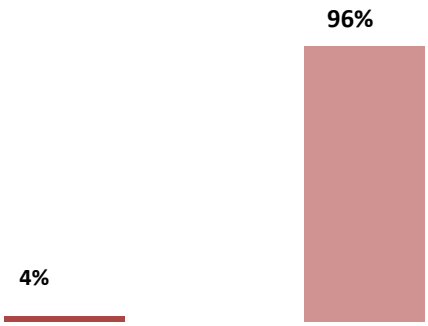

Fig.3: Gender Distribution of Student Respondents in the Study

4.2 Report on lesson 1

Topic: Biological Drawing

Instructional objectives: By the end of the lesson the students should be able to:

1. Draw with confidence in biology
2. Identify and explain the orientations of an organism.
3. Identify and use the rules for biological drawing and labelling.
4. Draw and label a longitudinal section of a hibiscus flower.

Activities

A. Materials: Fruits (orange, mango, pear, apple), hibiscus flowers, knives, cotton wool, A4 sheets, HB pencil, eraser, blade, Petri dish, ruler, chart, work sheets of self-instructional learning package (SLP).
B. Classroom organisation: Formal sitting (each student sits at his/ her own place in class), each student with a set of materials.
C. Relevant Previous Knowledge (RPK): Students were able to identify most of the materials as they have been using them every day.

D. Presentation: In this special presentation, the lesson was introduced with a short video on biological drawing (retrieved from YouTube) which lasted for four minutes. In the video were scenes which described the various orientations exhibited by an organism. These were anterior (Head view), posterior (Tail view), dorsal (Back view), ventral (Belly view) and lateral (Side view). Again, the video showed how to draw an insect observing all the biological rules. The students were then asked to identify and mention the materials given to them. The Researcher went on to explain the concept of sectioning, orientation and the rules to observe in doing biological drawings. According to Asabere and Haruna (2007), sectioning is a cut made vertically or longitudinally through a whole or part of an organ of an organism. The types of sectioning were longitudinal, transverse and vertical sections. The Researcher led the students to perform the transverse and one sectioning on the fruits. A chart/ pictures were used to show the parts of the sections they had done. This is shown below in figures 4,5 and 6

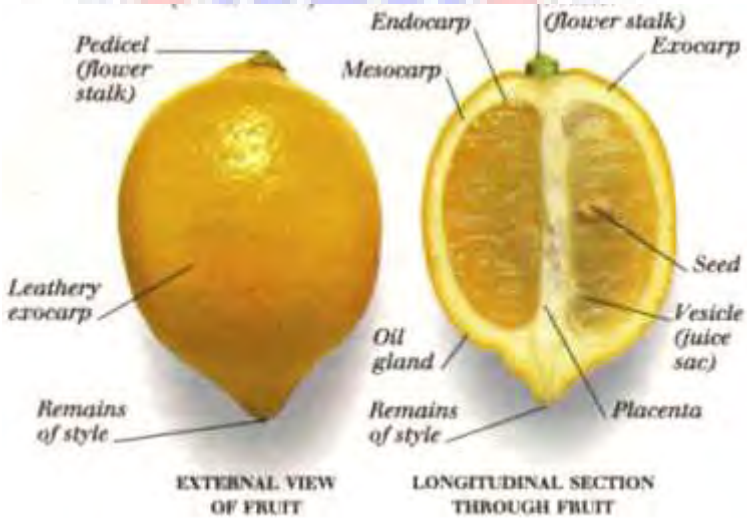

Figure 4: A labelled drawing of the Longitudinal Section of a lemon (Ekko, 2006)

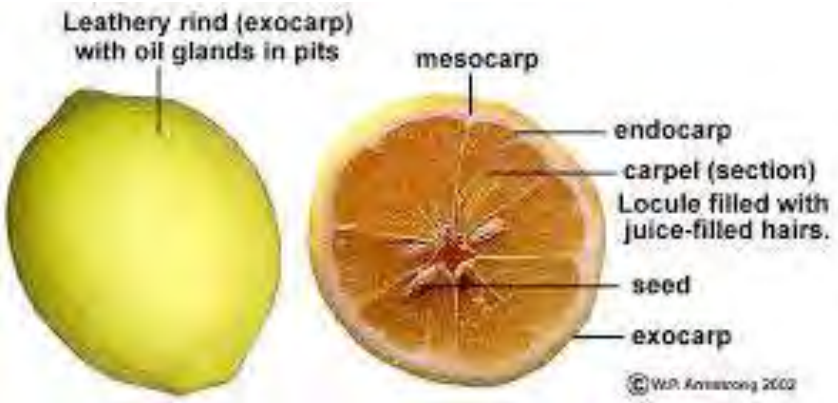

Figure 5: A labelled drawing of the Transverse Section of a lemon (Ekko, 2006)

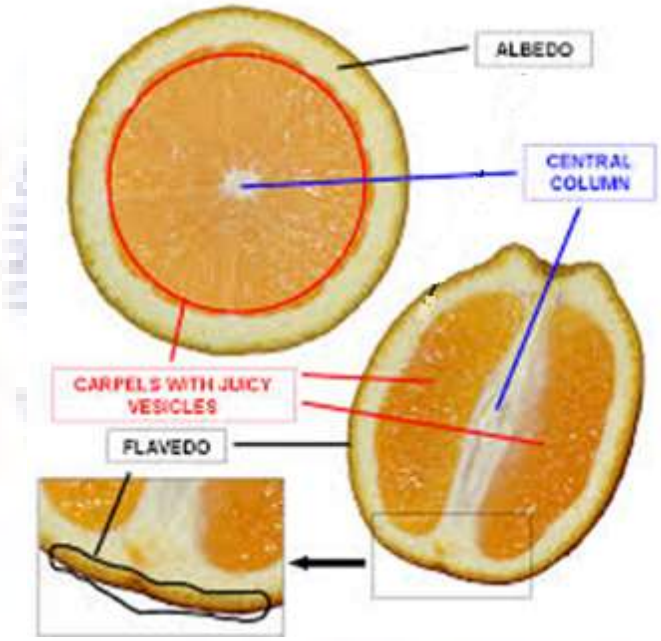

Figure 6: A Picture of Longitudinal and Transverse Sections of an Orange (Ekko, 2006)

The Researcher then distributed the worksheets for self-instructional learning package (SLP) to the students to perform the next activity on the hibiscus flower individually. Classroom interaction, according to Freiberg (2011), is a practice that enhances the development of the two very important language skills which are speaking and listening among the learners. This device helps the learners to be competent enough to

think critically and share their views among their peers. This was not left out during the presentation of the lesson although the Researcher‘s role was passive yet it was very crucial. By creating a learning atmosphere inside the classroom and through the session the Researcher extracted responses from the learners and motivated them to come out with new ideas related to the topic. The Researcher used discussion and brainstorming methods to interact with the learners collectively. As the learners performed the task in the SLP, the Researcher moved round to supervise the work and also had one-on-one interaction with them. Lessons where students have multiple opportunities to communicate with the teacher are essential for the effective construction of student knowledge.

At the closure of the lesson the Researcher went over the key points again and then exhibited a picture of a half flower to them. This was done to facilitate better understanding. Below is the longitudinal section of a hibiscus flower used.

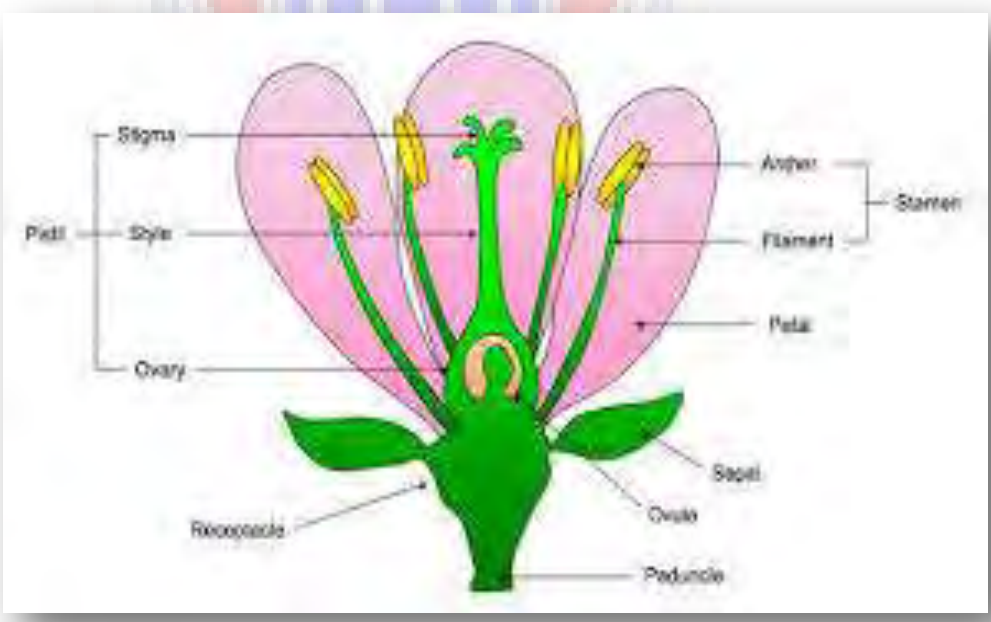

Figure 7: A Labelled Diagram of a Longitudinal Section of a Hibiscus Flower

Remarks: Evaluation was made on the lesson‘s objectives at the end of the lesson. Upon collecting and marking the students‘ exercises, the Researcher appreciated that the students‘ level of confidence in biological drawing had improved as compared to their previous drawings. They also exhibited the rules for biological drawing, such as using ruler to rule out the guide lines, labelling horizontally written and smooth out lines. Additionally, the students were able to explain the types of orientation and performed a longitudinal section on the hibiscus flower. Furthermore, in the cause of the lesson, the Researcher, with the help of a colleague teacher, observed the students. The information collected was analysed and the responses were presented in terms of frequencies and percentages in Table 2

Table 2: Distribution of Learning Styles and their Percentage

Learning Styles	Frequency	Percentage
Global	30	60
Analoglobal	15	30
Analytical	5	10
Total	50	100

In Table 2, it was observed that majority of the students exhibited the Global learning style. They form 60% of the student population.

Finally, as the students worked on their task, the Researcher observed that the analytical students were found distancing themselves from their peers even though they were in groups. The use of multimedia (video, chart, hibiscus flower) and multimodal approaches (eg., discussions, making presentations, brainstorming) in the

classroom accommodated for the different learning styles used by the different learners in the class.

4.3 Report on lesson 2

Topic: Life Processes of Grasshopper (*Valanga nigriconis*)

Instructional objectives: By the end of the lesson the students should be able to:

1. Give the taxonomic order of grasshopper from the Kingdom to the Order.
2. State three characteristics possessed by grasshopper which enable it to be in the order mentioned in (1) above.
3. Describe the external features of grasshopper.
4. Draw and label one hind limb of grasshopper.

Activities

A. Materials: Petri dish, preserved grasshoppers, forceps, gloves, projector, laptop computer, hand lenses.

B. Classroom organisation: group/ cluster arrangement. The students sat according to their respective groups with five members in each.

C. Relevant Previous Knowledge (RPK): Students had seen and played with the specimen.

D. Presentation: The lesson was introduced with a short exercise by asking the students to observe the specimen with a hand lens write what they saw which lasted for five minutes. The Researcher continued the lesson helping them state the taxonomic order as well as the habitat. The classification was:

Kingdom - Animalia, Phylum - Arthropoda, Class - Insecta and Order - Orthoptera. The Researcher led the students to brainstorm the characteristics and the external features of the specimen. The Researcher then distributed the worksheets for GLP to the students to perform the next activities on the grasshopper. The activities included writing the function for each feature identified and drawing of the hind limb. At the closure of the lesson the Researcher went over the key points again and then projected a picture of a grasshopper for them to see. This was done to facilitate better understanding. Below is a labelled diagram of a grasshopper (Figure 8).

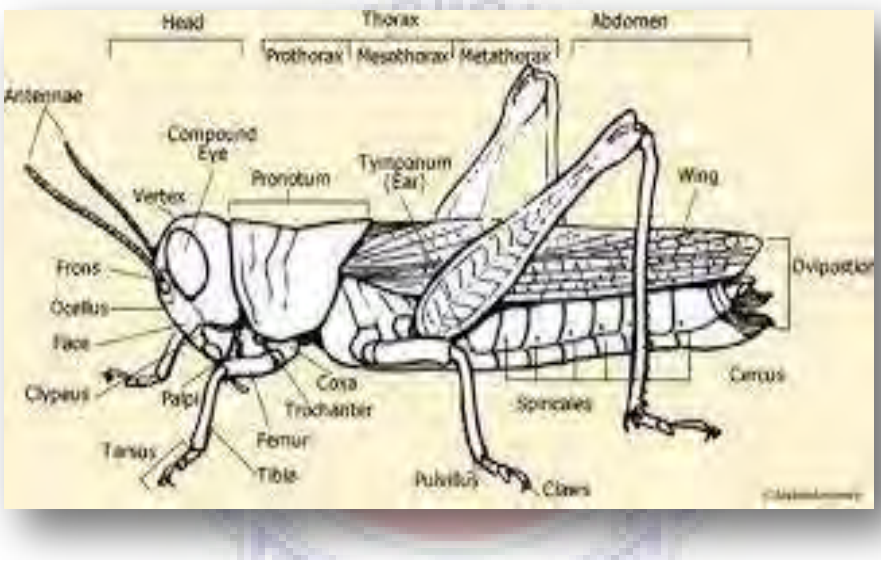

Figure 8. A labelled drawing showing the external features of grasshopper adopted from animal corner

Remarks: The performances of the students were encouraging. During the group activity, they were able to come out with some characteristics which classify grasshopper in the order Orthoptera. They were able to state that grasshoppers possessed:

- Two pairs of wings; leathery forewing for protection and membranous hind wings for flight.
- Metathoracic legs which are enlarged for jumping and hopping.

- A biting and chewing mouth parts.

The students were also able to coordinate properly the external structures and functions. The drawing skills of the students were slightly improved even though some could still not draw with confidence. Their manipulative skills and observation skills were also slightly improved. The use of the group-instructional learning package (GLP) in the group activity fostered good communication and team work among the students in the classroom. Students who were global actively participated in the lesson while the analytical passively participated. The Researcher therefore interacted with the analytical students encouraging them to get involved.

Report on lesson 3

Topic: Life Processes of Butterfly

Instructional objectives: By the end of the lesson the students should be able to:

1. Give the taxonomic order of butterfly from the Kingdom to the Order.
2. State three characteristics possessed by butterfly which enable it to be in the order mentioned in (1) above.
3. Describe the external features of butterfly.
4. Draw and label fully the dorsal view of butterfly.

Activities

A. Materials: Petri dish, preserved butterfly, forceps, gloves, projector, laptop computer, hand lenses.

B. Classroom organisation: group/ cluster arrangement. The students sat according to their respective groups.

C. Relevant Previous Knowledge (RPK): Students had seen and played with the specimen.

D. Presentation: The lesson was introduced with a short exercise by asking the students to observe the specimen with the hand lens and write what they saw which lasted for five minutes. The Researcher continued the lesson by helping them to state the taxonomic order as well as the habitat of the specimen. The classification was:

Kingdom - Animalia, Phylum - Arthropoda, Class - Insecta and Order - Lepidoptera. The Researcher led the students to identify the characteristics and the external features of the specimen.

The Researcher then distributed the worksheets for GLP to the students to perform the next activities on the butterfly. The activities included; writing the function for each feature identified and stating the adaptative features of butterfly to its habitat. At the close of the lesson the Researcher went over the key point again and then projected a picture of a butterfly for them to see. This was done to facilitate better understanding. Figure 9 is the image of the butterfly projected and figure 10 shows the diagram of the life cycle of the butterfly.

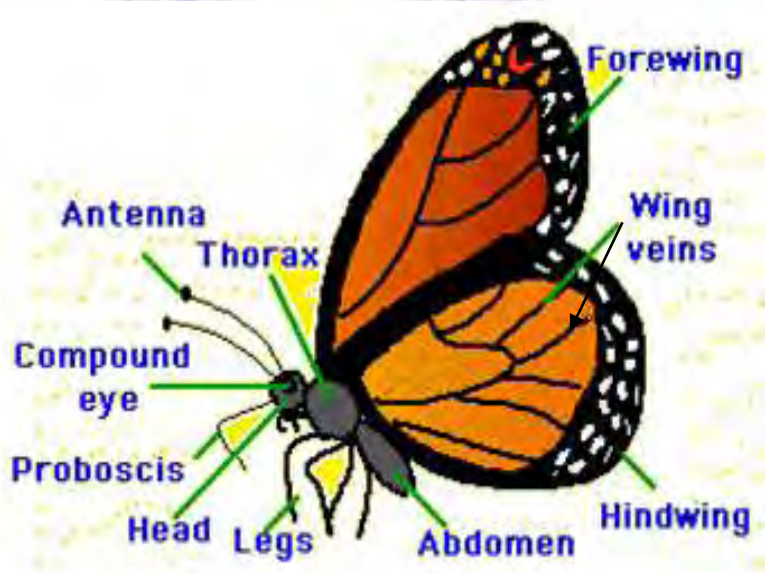

Figure 9: A labelled drawing showing the external features of butterfly (Opler, n. d)

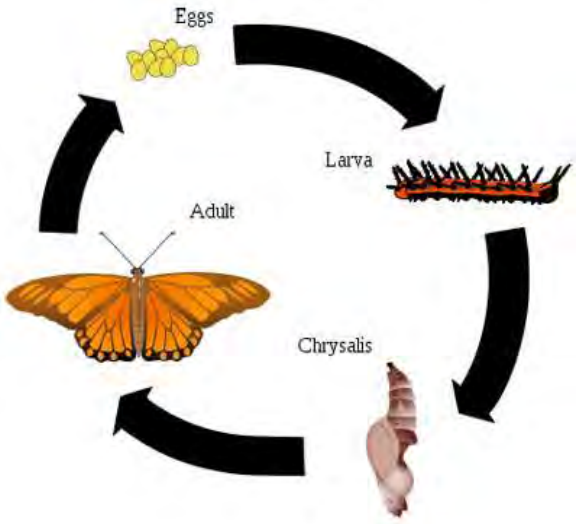

Figure 10: A labelled diagram showing the life cycle of a butterfly adopted from Opler.

Remarks: The performances of the students were very encouraging. During the group activity, they were able to come out with some characteristics which places butterfly in the order Lepidoptera. They were able to state that butterfly possesses:

- two pairs of wings of similar nature which are membranous for flight.
- the body and wings are covered with powdery scales for protection.
- a mouth parts modified into proboscis for sucking nectar.

The students were also able to relate properly the external structures to functions. The drawing skills of the students were this time highly improved and about 90% of them could now draw with confidence. Their manipulative skills and observation skills were also highly improved. Good communication and team work among the students in the classroom was promoted.

4.4 Report on lesson 4:

Topic: Mode of life of *Tilapia* (Bony Fish)

Instructional objectives: By the end of the lesson the students should be able to:

1. Mention the shape of the specimen.
2. State three characteristics possessed by *Tilapia* which enables it to be adaptive to its habitat.
3. Describe reproduction *Tilapia*.
4. Draw and label fully *Tilapia*.

Activities

A. Materials: Petri dish, freshly killed *Tilapia*, forceps, gloves, projector, laptop computer, hand lenses, knife, instructional packages

B. Classroom organisation: Formal sitting (each student sits at his/ her own place in class), each student with a set of materials for analytical students and grouping for global and Analoglobal students. There were four members in each group on the criteria of mixed ability, where students of different academic abilities studied together in the same class (retrieved from; www.123HelpMe.com/view, 2015). An effective educator will be mindful of differing learning styles and sensitive to differing personal dynamics, but they should not be separated based on ability.

C. Relevant Previous Knowledge (RPK): Students had seen or eating fish as a source of protein.

D. Presentation: The lesson was introduced with a short narrative to get the students' attention for the lesson. The Researcher asked the students questions about *Tilapia* to build their interest in the lesson. For instance, what is the shape of *Tilapia*? Give your answer with reason (s). The answer was streamline shape and the reason was for easy movement in water.

Students in the learning style groups were engaged on the learning package. The Researcher distributed the worksheets for SLP for students who were analytic and GLP for students who were global as well as other materials that could enhanced their understanding. The activities performed included the following;

- Use of hand lens to observe the fins critically.
- Counting of the fins.
- Identification of paired and unpaired fins.

The globals who working in groups was observed to analysed and developed their own strategies for their work. In this way, each member of the group studied and understood their part of the task. Team work was exhibited in this manner. They assigned group leaders and secretaries who took notes and wrote down agreed solutions to their task. The group leader made sure that there was peace and sanity in the group. The analytical learners, on the other hand, were observed to be following the instructions on the worksheet sequentially. They read each instruction with meaning and preformed the task accordingly. After a period of 50 minutes, the Researcher asked one student from each side to present a brief presentation of their findings. At the closure of the lesson the Researcher also highlighted the key points again and then projected the pictures and video for them to see. This was done to make understanding easy and better.

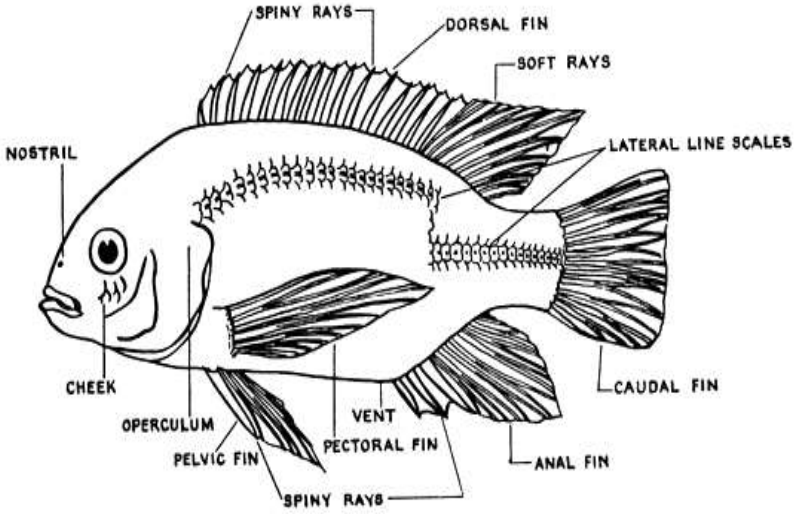

Figure 11. The Lateral View of a Labelled Bony Fish

(McGinnis, 2006)

Remarks: Students with SLP could not practice effective communication with their peers in the lesson. In their presentation they were unable to provide correct answers to some of the questions. Students with GLP, on the other hand, made their presentation with some responses being too general. The GLP group showed team work which promoted communication among them. As both groups performed the task on their worksheets, they acquired the skills of manipulation and writing as in recording observations made with the hand lens and drawing. The skills of measurement were also acquired as in calculating the magnification. As the lesson progressed, the Researcher observed a number of students who exhibited Global learning styles (31) were still more than that of the Analoglobal (15) and Analytical (4). However, the Analytical group were able to do and give better outcomes than their counterparts. During the questioning time, both groups asked numerous questions showing their curiosity to know more about the specimen under study.

4.5 Report on lesson 5:

Topic: Mode of Life of the Common African Toad (*Bufo regularis*)

Instructional objectives: By the end of the lesson, the students should be able to:

1. State two reasons why *Bufo regularis* is classified as an Amhpibian.
2. Describe how toad feeds and performs movement.
3. Explain why the toad croaks when it is in water.

Activities

A. Materials: Petri dish, preserved butterfly, forceps, gloves, projector, laptop computer, hand lenses.
B. Classroom organisation: group/ cluster arrangement. The students sat according to their respective groups due to the limited toads available.
C. Relevant Previous Knowledge (RPK): Students had seen and played with the specimen in their locality.
D. Presentation: The students were taken out on a short expedition to the school's agric farm to have a firsthand experience of the specimen in its natural habitat. This took only 15 minutes, as the farm was close to the biology lab. The students returned to the classroom to continue with the lesson. The Researcher asked the students to observe the specimen with the hand lens and write what they observed which lasted for another five minutes. The Researcher led the students to identify and discuss the characteristics and the external features of the specimen.

The Researcher then distributed the worksheets for GLP to the students to perform the next activities on the specimen. At the closure of the lesson the Researcher went over the core points again and then projected some life processes such as feeding, movement and reproduction for the students to facilitate better understanding. Below are some pictures exhibiting some of the life processes:

Figure 12. A toad about to catch an insect (McGinnis, 2006)

Figure 13. Tongue flicked out to lick the insect (McGinnis, 2006

Figure 14. Toad performing crawling/ walking movement (McGinnis, 2006)

Figure 15. Toads swimming in a pond (McGinnis, 2006)

Figure 16. Toads mating (McGinnis, 2006)

Figure 17. Toad eggs lay in string of jelly (McGinnis, 2006

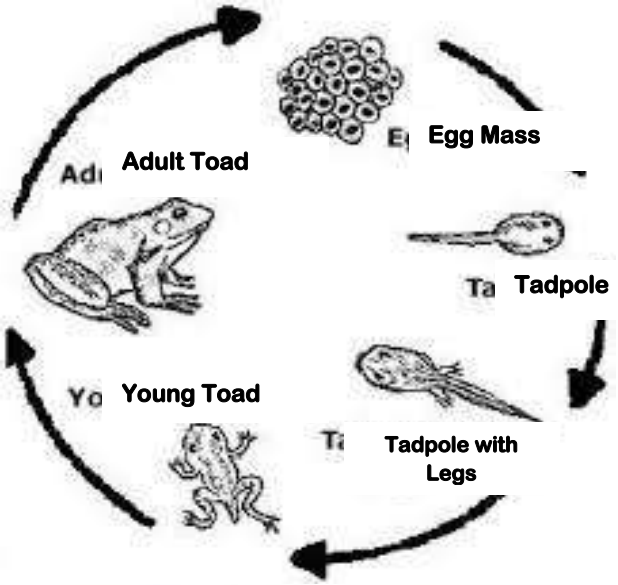

Figure 18. Stages involved in the development of a toad; from egg to adult (McGinnis, 2006)

Remarks: There was much improvement in this lesson compared to the previous lessons. During this lesson the Analytical, Global and Analoglobal learning styles groups exhibited full grasp of the new changes of the instructional methods. Also in this lesson, the students sought little or no clarification from the Researcher. They focused and concentrated on the package and other available learning materials that they could fine information on, to facilitate their understanding. The students in the groups worked with confidence. In the use of GLP, the students practiced communication with each other and made unique contributions to the lesson. Their observational skills were also improved as they were able to state observable features of the specimen with their functions.

4.7 Quantitative Analysis with respect to research question two

RQ 2: What is the relationship between the learning styles of students and their academic performance?

The research question sought to investigate the relationship between the learning styles of students and their academic performance. Descriptive statistics such as, means, standard deviations and ANOVA were computed and used to determine the relationship between performance and learning styles.The study used performance difference as the dependent variable and learning styles as the independent variable. A formulated model for this study is given as:

$$performace = Intercept + Lstyle$$

This model when estimated was found to be robust and significant with an F-statistic of 3.676 and a p-value of 0.033. A coefficient of variation (R^2) of 0.135 can be observed for this model, indicating that about 13.5% of the variations in students' performance were explained by learning styles. Table 3 shows the results of the two-way analysis of variance conducted.

Table 3.0: Determination of relationship between Performance and Learning Styles

Variable	**Mean square**	**coefficient of vari.**	**F value**	***p* - value**
Learning styles	13.3676	0.135	3.676	0.033

a = not significant at 0.05; p > 0.05. * = significant at 0.05; p < 0.05

Furthermore a post hoc test showed that there is a significant different between the global learning style and the analytical learning style. A mean difference of 2.1429 and a p-value of 0.028 can be observed for this pair. Table 4 display a multiple comparison result for various pairs of learning style.

Table 4 Multiple Comparisons

Dependent Variable: diff

	(I) Learning Style	(J) Learning Style	Mean Diff (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Global	Analytical	2.1429*	.80610	.028	.1920	4.0937
		Anaglo	.7429	.61037	.449	-.7343	2.2200
	Analytical	Global	-2.1429*	.80610	.028	-4.0937	-.1920
		Anaglo	-1.4000	.87318	.254	-3.5132	.7132
	Anaglo	Global	-.7429	.61037	.449	-2.2200	.7343
		Analytical	1.4000	.87318	.254	-.7132	3.5132
LSD	Global	Analytical	2.1429*	.80610	.011	.5212	3.7645
		Anaglo	.7429	.61037	.230	-.4851	1.9708
	Analytical	Global	-2.1429*	.80610	.011	-3.7645	-.5212
		Anaglo	-1.4000	.87318	.116	-3.1566	.3566
	Anaglo	Global	-.7429	.61037	.230	-1.9708	.4851
		Analytical	1.4000	.87318	.116	-.3566	3.1566

Based on observed means.

The error term is Mean Square (Error) = 3.639.

*. The mean difference is significant at the .05 level.

4.8 Quantitative Analysis with respect to research question three

RQ: What is the effect of the intervention teaching strategies on student's academic performance.

This research question sought to determine the effects of the intervention teaching strategies on student's academic performance. To estimate the effect of the intervention, a paired sample t-test was conducted on the performance of students prior to the administering of the intervention and after the intervention was administered. Immediate descriptive statistics of the students' performances can be seen from table 5. The average performance after the intervention was administered was recorded to be 7.92, when scored over 10. The performance was much better compared to when they were not introduced to the intervention

Table 5: Results of Paired Samples t-test: Performance before and performance after the intervention teaching strategies were administered

	N	Mean Score	S. D	Std. Error Mean
Performance After	50	7.9200	1.04667	0.14802
Performance Before	50	2.3000	1.55511	0.21993

*p>0.05

The result of the paired sample t-test showed that there is a significant difference between the before and after performances of the students. This gives an indication of some level of effectiveness of the intervention administered. The t-statistic for this test was 19.780 with a corresponding p-value of 0.000. Table 6, shows the result of the paired t-test conducted.

Table: 6 Paired Samples Test

	Mean Score	S. D	Std. Error Mean	t	df	sig.
Performance After-Performance Before	5.620	2.009	0.284	19.78	49	0.000

4.9 Impact of learning styles on students' performance

Preliminary results showed that students with the global learning style on the average performed better than the other two groups. On the average they had a score of 6.1429 with a minimum standard deviation of 1.58030. Even though the global learning group was larger than the others, test of constant variance was not violated, a requirement for an inferential statistic. A Leverne's test of equality of error variance for the performance difference has an F – statistic value of 1.134 with 2 and 47 degrees of freedom and p-value of 0.330. Table 7 gives the descriptive statistics for the performance difference. Figure 19 shows a line plot of average performance of students against their learning style.

Table 7 Descriptive statistics for the performance difference between learning styles

Groups Compared	**No.**	**Mean**	***Std* - value**
Global	28	6.1429	1.5803
Analytical	7	4.0000	2.0000
Analoglobal	15	5.4000	2.3845
Total	**50**	**5.6200**	**2.0091**

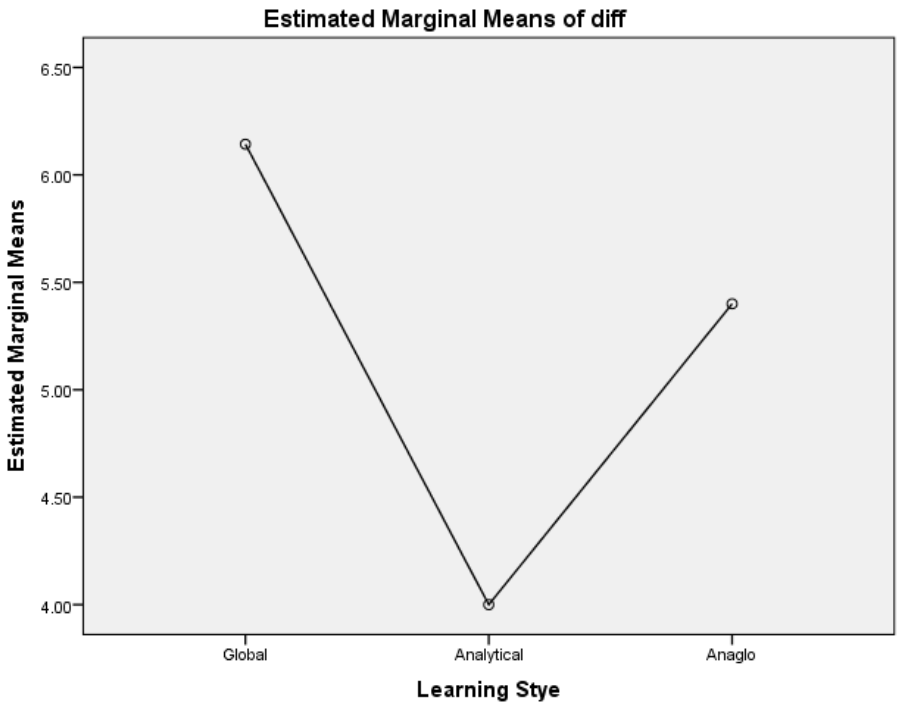

Figure 19 Plot of mean performance and learning styles

Discussion of findings

RESEARCH QUESTION ONE (1)

RQ: What learning styles do students exhibit in learning science (Biology) most?

This research question sought to determine the types of learning styles students used in learning biology most. The items in the observational check-list were used to collect information on the learning styles the students used during the classroom interactions. This was administered during the pre-treatment phase to get a prior knowledge or a fair idea about the students learning styles in the classroom. Pashler et al. (2009) acknowledged the fact that, different people learn information in different ways and also differ in regard to what mode of instruction or study is most effective for them. The sample used was newly enrolled into the school from their previous

level into a new level. It was therefore assumed that they were tuned to a particular way of learning or had their own learning styles. Ricketts, Rohs, and Nichols (2005), express the need for instructors to determine the learning styles of their students and utilized this information as a teaching tool. In the cause of gathering information, students responses, written answers, reasoning ability and explanations were observed monitored and analysed thereafter.

A similar survey conducted in Ghana on how JHS students learn Science, found out that majority (65%) of JHS students have auditory learning style, 25% are kinaesthetic and 10% visual (Tachie Young, 2009). This means that each student enrolled into the Home Economics class had his or her own learning style preference. In addition to that, there were some first year topics in the teaching syllabus that did not call for experiments/practical lesson. These included some aspect cells, diversity of living things, and classification. It would therefore be difficult to assess the type of learning styles the students exhibited during the period.

For that matter, the Researcher in this study used series of practical lessons, multimodal approaches as well as lots of multimedia to solicit information about the learning styles understudy which were used by students. The trend of the observation made in *lesson 1* especially revealed that students showed more Global learning style preference to analytical learning style as seen in Table 2. It was also clear that some students exhibited a combination of both learning styles (Analoglobal).

Observations were made in the classroom right from the first lesson to the fifth lesson. Students‘ individual reasoning abilities and presentations were monitored during these lessons. Dunn and Dunn (2000) have found that students react very differently to instructions which they learn differently. Again in researching into how students learn, it was revealed that every student has a unique profile of skills and strength in

identifying and supporting these strengths which leads to better outcomes (Searson & Dunn, 2001).

4.7.2 RESEARCH QUESTION TWO (2)

RQ 2: What is the relationship between the learning styles of students and their academic performance?

The research question sought to investigate the relationship between the learning styles of students and their academic performance. Brown (2003) stresses that student learning styles and achievement usually improves when the learning and teaching styles match. Hence, students learning in biology may be affected positively or negatively depending on how well the teacher is able to integrate the process of teaching styles that demand for the individual learning styles. Consistent with this, the Researcher observed that students‘ process skills were enhanced after the intervention was implemented. Through the use of quantitative methods and multimedia tools, students‘ performances in biology were found to have increased, with a performance difference of 5.620 as shown in table 5. This findings were similar to that of Dolin (2001), Vaughan and Bruce (2008). These evidences showed that the use of learning packages and other instruments on students have positive effects since students performance improved tremendously as the result of the use of the intervention tools. If instructors recognized students as being different and each student has a preferred learning environment, determination of students‘ LS could offer an insight to instructors to help facilitate a more favourable learning environment for all students and potentially improve academic performance.

4.7 3. RESEARCH QUESTION THREE (3)

RQ: What is the effect of the intervention teaching strategies on student's academic performance?

This research question sought to determine the effects of the intervention teaching strategies on students' academic performance. The intervention strategies the Researcher employed in the study were: humour, storytelling, diagrams, chart, pictures, group discussions, brainstorming, independent study and discovery or enquiry methods. These strategies were fully utilized during the implementation of the research instruments which were lesson plans, learning packages, observational checklist and learning style inventory. The intervention spanned six weeks and lessons were conducted three times a week for eighty (80) minutes per meeting. Students were introduced to the various topics in Biology using materials including self-instructional learning package (SLP) and group instructional learning package (GLP) worksheets, preserved specimens, pictures, charts, models, knives, hand lenses etc. Below are the description of each group reacted with each of the intervention strategies:

Advance organizers: The Researcher used these strategies mostly during the introduction of the lesson. The stories were related to each topic taught. The global students showed interest in the lesson. They were attentive at each storytelling period. They were also able to recall the story when asked. The analytical students, on the other hand, showed little or no interest in the story. They only listened and asked series of questions for clarification. The Analoglobal students showed indifference characteristics.

Pictures, charts, and diagrams: According to Kihlstrom (2013), these are visual learning strategies such as graphic organizers, diagrams, outlines and more which are being used in classrooms for effective learning. They were used to emphasize salient points as well as to clarify confusing concepts in biology. The use of these strategies also helped the students to integrate new knowledge. According to Kihlstrom (2013), students better remember information when it is represented and learned both visually and verbally. Furthermore, they helped students think critically thereby linking verbal and visual information which helped students make connections, understand relationships and recall related details. In this study, these strategies were used during the presentation stage of the lesson. All three groups (Global, Analytical, and Analoglobal students) participated very well in the lesson. This was evident in the way they responded to the evaluation questions which were answered very well by all the three groups. These strategies helped the students to better manage learning objectives and achieve academic success.

Brainstorming: It is a process for generating creative ideas and solutions through intensive and freewheeling group discussion (Plan, 2011). Every participant is encouraged to think aloud and suggest as many ideas as possible, no matter seemingly how outlandish or bizarre. Brainstorming encourages creativity and discourages criticism during the idea finding phase. The evaluation of ideas is separated from the creation (Plan, 2011). In this study, the Researcher used this strategy during the administration of the SLP and GLP. The learners were presented with the problem/ task and they were guided through the discussion. During these periods, the analytical students actively participated in the lesson. They asked most of the ‗how' and thought-provoking questions. They were also observed writing most of the time and responding to most of the questions after critically thinking through. The global

students participated passively when this strategy was used. Although they look part in the lesson, their interest and attention span could not last for long. They could not stand the many questions and were in a hurry to answer the questions. The Analoglobal, on the other hand, again showed indifferent behaviour.

Group discussion: It refers to the method of instruction which give pupils an opportunity to express their views or opinions orally on certain issues (Zvavanhu, 2010). One person speaks at a time, while others are listening. It doesn't always involve the presentation of new information and concepts. It also involves sharing of ideas and experiences, solving problems and promoting tolerance with understanding during the lesson. In this study, it was used during the administration of the GLP mostly. All the three learning style groups were seen actively participating in the discussion. The responses gathered from the evaluation exercises when analysed showed an increase in their performance in biology (Table 5).

Independent/discovery/inquiry: The active participation of the learner in the learning process is called discovery learning (Balim, 2009). In discovery learning, students construct knowledge based on new information and data collected by them in an explorative learning environment. Harley (2004), states that, inquiry learning in science develops the perception skills of students, because it allows them to understand the natural phenomena and the world by using their cognitive and physical skills. It is suggested that this kind of learning shows students the nature of scientific studies and the ways learning is realized. Thus, it develops their discovery skills (National Research Council [NRC], 2004). In this study, independent/discovery/inquiry strategy was mostly used during the implementation of the SLP instrument where the students were given the instructional package for them to learn on their own. They were also given take home assignments to facilitate

independent/ discovery learning. The analytical as well as the Analoglobal students were observed seated quietly working on their task, while the global students, on the other hand, moving from one person to another unable to sit at one place for a long them.

The Researcher demonstrated the concepts using the materials in a range of activities to help the students understand the concepts before proceeding to do their own activities spelt out in the SLP and GLP. The lessons were taken out of the elective biology syllabus authorised by the Ghana Education Service (GES) and other sources of information the Researcher deemed vital to use. The Researcher used different methods, techniques and strategies to ensure that maximum students' participation was achieved. The students were allowed to perform both individual and group work as they manipulated the materials. The Researcher only served as the facilitator, providing help when needed and asking taught-provoking questions to stimulate critical, analytical and complex thinking in order to help them identify their own learning styles.

According to Oliver – Hoyo (2003), in the classroom, one of the most effective methods for improving understanding is using writing. The researcher recognised the great potential of coupling understanding with writing. Since Oliver – Hoyo (2003) acknowledged the benefits of writing to improve critical thinking and possession of some processed skills such as measuring, data recording, data analysing and data interpretation, the responses and written answers of students were part of the techniques or methods used to monitor the understanding of students. These evidences showed that the use of appropriate intervention strategies on students had positive effects since students' performance in biology improved tremendously as a result of the use of the intervention tools.

Furthermore, the activities and resources planned and implemented during each lesson ensured that different learners were engaged at different points in the lesson. The sources and activities worked successfully to ensure all learning styles were catered for. As seen in the detailed evaluation of each lesson, overall student engagement was improved as a result of the lesson plan and the used of learning style instructional packages.

To further answer the third objective, the quantitative results shows that the intervention teaching strategies had a significant impact on the academic performance on the study group. This was evident in the paired t-test conducted. As students' performance improved after the intervention was administered. A significant mean difference of 5.620 was observed. Besides that, the average performance after the intervention was implemented gave a mean score of 7.920 with a relative small standard deviation and standard error, 1.04 and 0.148 respectively. This statistics entirely shows that students' performance improved after the intervention was given. This findings reaffirm the previous studies of (Fayombo, 2015) conducted in psychology showed that both learning styles and learning strategies jointly contributed 20% (Rsq=0.200) to the variance in the academic achievement and this was found to be significant ($F(2,168) = 21.04$, $p < .01$). A probable reason for this finding could be attributed to the fact that in this study, the student learning styles match their active learning strategies which were well packaged to enhance their academic achievement in this psychology course. This result amplified the earlier report that agreement between teaching strategies and learning styles has a positive impact on the academic achievement of the students (Damrongpanit & Reungtragul, 2013; Tulbure, 2012).

4.6. Conclusion

From the evaluations of the marked exercises, assignments and projects that were undertaken, it was evident that using the SLP and GLP had helped improve students' engagement in the classroom. Also the use of instructional learning style packages had improved the way in which lessons had been delivered and helped learners to retained information better. A set of successful resources and pedagogy had been created and used to ensure that effective learning had taken place. Having used a variety of different tools available to ensure that all learning styles were included, it ensured that all learners had the opportunity to learn. As this class was predominantly female and of a mixed ability, it was important to make sure that the learners could access the unit in a way that was suitable for them. The analysis made quantitatively indicated that, when the right teaching strategies were used to meet the learning styles of the individual student would lead to academic achievement.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Over view

The purpose of this final chapter is to give a summary of the research study. It also contains the main findings of the research, the implications of the study to education and the conclusion derived from the qualitative and quantitative analyses of the study. It also highlights the recommendations of the study. This was done though the use of Action Research design which provided descriptive information on learning styles of students and their academic performance in Biology (Science).

5.1 Summary of work

The purpose of this study was to find out the relationship between the learning styles of Biology students and their influence on students‘ academic performance at Wesley Grammar SHS level in Ghana. This study utilized an Action Research design to collect data related to one Home Economics one students‘ learning styles and academic performance. Fifty students of Wesley Grammar intact class of SHS 1 were used as sample in this study which consisted of forty-eight females and two males. Four main instruments were used in this research, these were lesson plans, learning packages, observational check-list, and learning style inventory. All the instruments were used on the students.

Lessons, responses, written answers and observation were used to collect qualitative data from the students which were used to solicit more information from students. However, total scores obtained from quizzes, SLP and GLP were used to collect quantitative data from the students. The quantitative data collected were computed into means, standard deviations and percentages which were used in the analysis. Descriptive analysis was also employed for the statistics.

5.2 Main Findings

1. The study showed that students in one Home Economics one had diversity of learning styles. Sixty percent of them being Global, only ten percent being Analytical and thirty percent possessing both characteristics of groups (Analoglobal) as indicated in table 1. The analytical students possessed personality qualities such as being more articulate, obsessive and compulsive, always insisting on the best and showing perfectionist tendency. These abilities where exhibited during the intervention periods of this study where they felt comfortable working alone rather than in groups.
2. The findings also indicated that there was significant difference between students learning styles and their academic performance as shown in Table 6 and 7.
3. The findings also indicated that when the right intervention strategies were used during the teaching and learning process, yielded positive results by improving upon students‘ academic performance in Biology as shown in table

5.3 Extensions of discussion of findings

The empirical evidence found in this study was consistent with much prior research (Alaka, 2011; Bishka, 2010; Hall & Moseley, 2005; Pashler et al., 2009) learning styles still appeal for educators (Bishka, 2010; Martin, 2010; Scott, 2010). A potential benefit of incorporating learning styles research in the classroom is helping teachers and students alike to develop a greater awareness and understanding of the unique characteristics of each individual represented in any given classroom (Alaka, 2011; Charlesworth, 2008; Koçakoğlu, 2010; Lauria, 2010). Learning style assessments can help identify personal preferences as well as potential strengths and weaknesses in how learners deal with content and approach learning tasks (Hawk & Shah, 2007).

However, students may be inaccurate in their responses to assessment items (Bishka, 2010), and teachers must be careful to avoid labelling students based on assessment results, as this would be counterproductive to a theory designed to encourage and support diversity (Scott, 2010). Instead, teachers should utilize assessment findings to assist them in broadening their methods to incorporate the variety of styles expressed by the students under their charge (Cox, 2008; Hawk & Shah, 2007; Koçakoğlu, 2010). Even if teachers or schools choose not to administer assessments, teachers can still use an understanding of learning style characteristics to inform their instruction.

Although research studies have been unable to consistently provide evidence that matching styles is beneficial to students‘ academic achievement, there are indications that this may be the case (Hsieh, Jang, Hwang, & Chen, 2011; Lauria, 2010). Furthermore, the literature also supports the idea that teaching to a variety of learning styles may be even more beneficial than tailoring instruction to exactly match student preferences (Alaka, 2011; Martin, 2010). However, the overwhelming learning style theories plethora of physiological preferences, psychological tendencies, and personality traits can leave teachers puzzled (Alaka, 2011). Components from the various learning style theories, makes it a worthwhile tool to help teachers develop an awareness of learning styles concepts and assessment information. Teachers can then use such information to monitor their instruction and ensure they are utilizing a variety of strategies and selecting those most appropriately suited to particular lesson content (Koçakoğlu, 2010).

Ultimately, it is essential to return the focus to teaching students and helping them become successful learners. Teachers must be empowered to refine the art of instruction, trusted to develop and utilize their skill and intuition, and encouraged to implement strategies that meet the needs of the children (Martin, 2010). It is also

essential to return the spotlight to the students rather than content standards and proficiency scores. Obviously, it is necessary to maintain measures of accountability and uphold high standards, but the education system must not do this at the expense of teaching for student learning. An awareness of learning style preferences and the ability and willingness to differentiate instruction by incorporating a variety of teaching style approaches suited to such references can help teachers make great strides in reaching and meeting the educational needs of all their students (Cox, 2008; Hawk & Shah, 2007; Hsieh et al., 2011; Lauria, 2010).

5.4. Conclusion

Learning style as described by (Dunn et al., 2001) as the way in which each person begins to concentrate on, process, internalize, and remember new and difficult academic content. The study showed that students in 1 Home Economic1 had diversity of learning styles. According to Adeyanju, (2000) a child‘s learning preference depends on his/her rearing practices. For instance, if a mother encourages her child to be independent and edges her child to explore his/her environment, he or she will turn to be analytical. However, if the child is protective and the child is often hampered in exploration of the environment, he/she will turn to be global. A related study conducted on similar work revealed that Analytical learners were better in Science subjects than the global learners (Adeyanju, 2000; Lehman, 2007; Johnson & Johnson. 2006).

Additionally, the findings also indicated that, the intervention strategies yielded positive results by improving students‘ academic performance in Biology. Brown (2003) stressed that students‘ learning styles and achievement usually improve when the learning and teaching styles match. The use of multimodal instructional

approaches integrates different pedagogy instructions (Vaughan & Bruce, 2008) as means of improving outcomes in the classroom is widely acknowledged in journals and other educational research work (Dolin, 2001). Also, the Chinese proverb, ―Tell me and I'll forget; show me and I may remember; involve me and I'll understand" seems appropriate.

Hence, students of biology especially may be affected positively or negatively depending on how well the teacher is able to integrate the process of teaching styles that demand for the students' learning styles. Indeed, learning style of students may not be a panacea for non-performance, but whatever small the variance may be in students' achievement, counts (Tachie Young, 2009). Therefore, it is hoped that knowledge and findings on learning styles in this thesis would go a long way in modifying the teacher's attitude, classification of students, in guidance and counselling and in adopting a teaching methodology that would help individual students' with respect to differentiation in the learning styles of Global and Analytical learners.

5.5. Recommendations

In the course of my literature study, I came across many discouraging ways but obviously doubtfully of the effectiveness of learning styles. I would have taken such literature line- hook and sunk if I was not privileged to have undergone this research work. On this note, I can authentically vouch that how students learn depends a lot on their learning styles. I therefore recommend that all teachers should be exposed to basic knowledge on the benefit of learning styles to help students at any level improve upon their performance. Also, since the research considered the two extremes of learning styles (*Global learning style and Analytical learning style*), here are some

recommendations of how best to accommodate these learners in the classroom to maximize effective learning.

5.5.1 Implementations for classroom instruction

If instructors and students are aware that learning styles exist and that all students do not learn in the same way, they may be able to facilitate the learning process through modifications in teaching, studying, and coping strategies.

For the Analytical learners the instructor should:

- Provide usual classroom setting.
- Show and organize the sequences of information, in a step-by-step manner.
- Begin their lessons with small or less difficult concepts before leading to larger or difficult concept of understanding.
- Provide activity that follows sequence, process, list, timeline, and charts. Example: bring back pieces or parts of body altogether and explain their functions.
- Encourage discovery learning by giving research assignments.

For Global learner the instructor should:

- Provide flexible learning environment.
- Explain concept first then the details.
- Give them chances to do some group work.
- Give them multiple tasks at once.
- Plays background music, if possible.

- Gives open ended questions.

- Relates concepts to life information.

5.5.2 Recommendations for teachers

1. Teachers in the institution should identify dominate learning styles of their students and use it as a tool for instructional purposes.
2. Teachers in the institution should not grow weary at explaining points thoroughly and giving clear instructions during the teaching learning process.
3. Teachers should also vary instructional methods to suit the different needs of individual learning styles because individuals are different in all respect including their learning styles.
4. Teachers should encourage students to undertake independent research work by using the library frequently.
5. Teachers should assist students who are analytical to socialise through group work.
6. Teachers can develop lesson plans that accommodate both styles, such as incorporating narratives and group work into lesson plans to accommodate global learners.
7. Funds and other resources should be made readily available to Science educators in order to make the teaching and learning more activity oriented.

5.6 Suggestions for Further Research

1. It is suggested that the study be conducted in other parts of the country with students from other disciplines. This will provide a better picture on the type of learning styles students use for learning science at the SHS level.

2. Additionally, it is suggested that the study be conducted in other SHS in the municipality to determine the learning styles of students and its influence on their academic performance.

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APPENDIX A

LESSON PLAN FOR COMMON AFRICAN TOAD

DAY AND DURATION	TOPIC/ SUBTOPIC ASPECT	OBJECTIVE (S) R.P.K	CORE POINTS	TEACHING/ LEARNING MATERIALS AND TEACHER/LEARNER ACTIVITIES	EVALUATION EXERCISE	REMARKS
Monday 9:^{50} – 11:^{20} am Tuesday 11:^{50} am – 1:^{20} pm Thursday 10:^{30} – 11:^{50} am	Topic Toad/Frog Sub-Topic Structure and Function Life processes	By the end of the lesson the students will be able to: Mention six external features of load or frog and their function. State three adaptations of toad/frog to its habitat. Describe the life processes of toad/frog. (Locomotion and Nutrition)	External features: The body of the toad is divided into the head and trunk without neck On the head are: A pair of bulging eyes - a pair of nostril - mouth - tympanum On the trunk are: - two (2) pairs of limbs	Preserved toad, chart, laptop, projector and chalk board illustrations ACTIVITY - Examine and discuss the external features of toad/frog - Draw and label the toad to show external features - Discuss some of the life processes of toad -Show a short video on the life processes of toad	1. Mention six external features of toad/frog and their functions 2.Draw and label the toad to show external features	

			Adaptations: - Most and vascularised skin for breathing - Short stout forelimbs for absorbing shocks when landing. Etc Life processes of toad/frog			

APPENDIX B

OBSERVATIONAL CHECK-LIST

Date…….. Name of School……

Time of Observation……..... Start……..… End……

Class……. Teachers‘ Gender……

Number of Students……... # of Boys…… # of Girls……

CRITERIA	DEGREE OF ACHIEVEMENT					
	Global		Analytical		Analoglobal	
A. Classroom physical Environment/ Atmosphere	Yes	No	Yes	No	Yes	No
1. Classroom brightly lit						
2. Playing music in the background						
3. Adequate Teaching Learning Materials(TLMs) present in the classroom for teaching and learning						
4. Classroom temperature is warm						
5.Desks orderly arranged to promote individual learning						
B. Students role during teaching and learning						
1. Listen attentively in class						
2. Ask questions in class for clarification						
3.Prefer teacher tells a story that gets to the point easily						

4. Wants an example that is related to them about the concept by asking the "why" and "how" questions						
C. Learning Attitude						
1.Like to work independently						
2. Prefer working in groups/enjoy work with others						
3. Concentrate easily without getting disturbed						
4. Do several things at the same time						
5. Prefer discussion, role play and experimentation during teaching and learning process						
6. Prefer brainstorming computer stimulation and discovery during teaching and learning process						

Comments……

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APPENDIX C

Framework of Self and Group Instructional Learning Package

Self-instructional Learning Package

School: Wesley Grammar School

Class: One

Duration: 80 minutes

Topic: Biological Drawing

Objective: By the end of the lesson you should be able to ;

1. Mention the types of orientations used to view specimen.
2. Explain the orientations you have identified.
3. Know the rules for biological drawing and labelling.
4. Draw and label a longitudinal section of a hibiscus flower.

Relevant Previous Knowledge: Make a list of all the materials line up on your desk.

Introduction: Watch a short video on biological drawing and pay attention to every step that you observe.

Text on Topic

A. Body orientation shows how a body is positioned with respect to the viewer. There are four types of orientations namely;

a. Anterior - view from the head end of an animal.

b. Posterior - view from the tail/hind end of an animal.

c. Dorsal - view from the back or upper part of an animal.

d. Ventral - view from the belly or underside of an animal.

e. Lateral - view from the side of an animal.

B. Body symmetry is the exact likeness in size and shape between two sides of a specimen or an organism when cut along one or more planes. There are two main types, namely

a. Bilateral -------- If a body can be cut vertically through only one plane or direction to produce two equal halves which are exact mirror images such that the left side is the same as the right side.

b. Radial ---------- If the body is cut vertically through two or more plane to produce mirror images of each other.

C. Sectioning is an imaginary flat planes passing through the body of an organism or organ. There are three types; namely

   a. Longitudinal sectioning - A cut made through the vertical axis of the organ of an organism.

   b. Transverse sectioning - A cut made at right angle to the vertical axis or horizontally through an organ.

   c. Vertical sectioning - A cut made vertically through the organ not necessarily along the vertical axis. This is used when the organ or

   organism is irregular in shape and its dimension.

D. Rules guiding biological drawing

   a. Heading of biological drawing must be straight forward and concise.

   b. Outline of biological drawing must be smooth and not woolly or dotted.

c. Guide lines of biological drawing must be ruled out with ruler/straight edge. It must touch the exact part you want to label.

d. Labels of biological drawing must be neat and horizontally written.

e. Writing the magnification of biological drawing;

Formula: Size/length/linear dimension of drawing

Size/ length/linear dimension of object/specimen

It should be written at the right corner of the drawing. E.g. **X3, X5,** etc.

NOTE: Magnification has NO unit

Self assessment questions ***(about five objective test questions)***

1. What is the name of the symmetry of an animal if it can be divided along more than on plane?
2. State the types of orientation and briefly explain each type.
3. Make a longitudinal section of a Hibiscus flower and draw.
4. Calculate the magnification of your drawing.

Evaluation: Assessment on the SLP

Examining, making and drawing of half-flower of hibiscus

1. Observe and Measure the length of **the two flowers** (from the tip of the stigma to the base of the pedicel)
2. Remove the sepals one after the other

a. How many of them can you count?

b. Were they free/fused

c. Is the ovary superior **(on top)** or inferior - ***Width***

d. Make a transverse section through the ovary an draw.

e. Make a longitudinal section via the 2nd flower

f. Draw and label the section you have made

Remarks:

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APPENDIX D

Group-instructional Learning Package

School : Wesley Grammar School

Class: 1 Home Economics 1

Duration: 80 minuets

Topic: The structure and mode of life of Tilapia

Objective: by the end of the lesson you should be able to;

a. Mention the shape of the specimen.
b. State three characteristics possessed by *Tilapia* which enables it to adapt to its habitat.
c. Describe reproduction *Tilapia*.
d. Draw and label fully *Tilapia*.

RPK: Students eat Banku and Tilapia at home

General Description: Group activity was used. Students work in groups of five. This provided the opportunities for students to work in pairs and small groups and use multiple modes of communication (e.g., discussions, making presentations, and brainstorming) were used. It also encouraged the student to work together as a class to contribute to a comprehensive answer to an open-ended problem. More so, grouping encourages in-depth conversations among students and students; and between students and instructor. Lastly, the student practice communication with pressure.

Concepts: Classification, structure and functions, reproduction and adaptations.

a. Classification : Kingdom – *Animalia*, Phylum – *Chordata,* Class – *Osteichthyes* (bony fish)

b. Habitat: fresh bodies (eg. Lake, rivers and brackish water in lagoon).

They are poikilothermic (cold blooded) i.e. They are unable to maintain a constant body temperature.

c. Structure and function: The body narrows or tapers at both the anterior and posterior ends i.e. the head and the tail. It has no neck therefore the head is wedged into the trunk directly. This is described as **streamlined body shape.** The trunk is covered with backwardly overlapping **scales** that point towards the tail. The surface of the body is **slimy substance**. The streamline shape, the arrangement of the overlapping scales towards the tail makes it easy for swimming. The **mouth** is terminal and wide with many triangular teeth used for gaseous exchange and feeding. It has two large **eyes** behind nostrils without eyelids used for vision. It has a pair of **nostrils** located above the mouth for smelling. The presence of a bony gill cover (**operculum**) protects the gills. It has a pair of **lateral lines** on each side between the head and tail which are sensitive to vibration and used to escape predators. The presence of **fins** (paired and unpaired) used for movement and defence.

d. Reproduction: in most bony fish, the females lay eggs and males shed sperms into the water. The sperms swim to fertilize the eggs (external fertilization). The fertilized eggs are usually abandoned by parents and most are eaten up by predators. Some also exhibits parental care.

In breeding seasons male and female dig a shallow pit in the bad of the water. Female lay egg and male sheds sperms over them. The male then carries the fertilized eggs in its mouth for about two weeks until they are hatched. After hatching the young fish swim around the mouth of the parent but quickly retrieve into parents‘ mouth in case of a danger. Most of the young fish survive due to this parental care. The young fish becomes independent when sufficiently grown.

e. Adaptations of Fish to its Environment

- Streamlined body shape for easy movement
- Backwardly pointing overlapping scales
- Highly vascularised gills for gaseous exchange
- Lateral line for detection of stimuli
- Strong body muscles and powerful muscular tail for movement in water
- Presence of fins for locomotion or movement
- Ability to camouflage its predators eg. Using the silvery ventral surface and darker dorsal surface
- Gill slits allow water to flow backwardly to propel the fish forward
- Large eyes to see preys, predators, mating partner

E. Prerequisite skills/ Materials: Petri dish, freshly killed *Tilapia*, forceps, gloves, projector, lab top computer, hand lenses, knife, instructional package

F. Procedure/Methodology

1. What is the shape of the Tilapia

2. Observe the fins critically

a. Are there many fins

b. How many of them are paired and how many are unpaired

c. Name the different types

d. Which is the longest of the fins?

3. Note the two types of fin rags in these fins

a. Note that Tilapia has two lateral lines of unequal length

b. Have you notices that the scales are easily removable and they point in the backward directions?

c. Remove one of the lateral lines scales and examine it with the hand lens

d. Can you see a hole through it?

e. What is significance of this hole

f. Draw and label the dorsal view of the specimen

Group / individual assessment respond to worksheet questions

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Evaluation / Group presentations:

Remarks:

Names of group members:

APPENDIX E

LEARNING STYLE INVENTORY INSTRUMENT (LSI)

Instructions

Complete the questionnaire below by clicking in the square.

Check all statements that you think are true about yourself as a learner.

If you think the statement is NOT true about you, leave it blank.

Once you have checked all the statements which are true about yourself, click on the **GLOBAL** or **ANALYTICAL** button below

Name: Your Name

Questions

1. ☐ I make most decisions based on my feelings, rather than look at all the facts and figures.
2. ☐ I don't use many gestures when I explain something to someone.
3. ☐ I enjoy doing more than one thing at a time.
4. ☐ I can work well even when it is noisy.
5. ☐ I take frequent breaks when I study.
6. ☐ I enjoy learning from posters, photographs, looking at models, etc.

7. ☐ I prefer to sit at a desk when I study.

8. ☐ I study best when it is quiet.

9. ☐ I prefer studying in a very well-lit area.

10. ☐ I prefer studying in a shaded area.

11. ☐ When I am given an assignment, I like the teacher to give clear, detailed instructions.

12. ☐ I don't like to eat or drink while I study.

13. ☐ I usually finish my homework on time.

14. ☐ I enjoy studying while sitting in a soft chair or couch.

15. ☐ I find it difficult having to sit in one place for a long time.

16. ☐ When I study I get distracted easily by noise in the background.

17. ☐ I like to work alone.

18. ☐ I prefer to work in a small group or with a partner.

19. ☐ I prefer to study with background music.

20. ☐ I feel more comfortable in cool weather than I do in warm weather.

21. ☐ I like my teacher to check my school work.

22. ☐ I prefer warm temperatures to cool temperatures.

23. ☐ I can sit in one place for a long time.

24. ☐ I am easily motivated to do my school work.

25. ☐ I concentrate best when working at a table or desk.

26. ☐ I often nibble while I study.

27. ☐ I don't like bright light when I study.

28. ☐ I like to do well at school.

29. ☐ I often forget to finish my homework.

30. ☐ I like studying with others.

31. ☐ I think it's important to have new information introduced with humour or a good, interesting story.

32. ☐ When I am working on a task, I like to finish it.

33. ☐ I prefer sitting or lying on cushions or on the floor when I study to sitting at a desk.

34. ☐ I prefer to do one task at a time.

35. ☐ I don't enjoy working in groups.

36. ☐ I don't really care about getting certificates, stickers or stamps as rewards for my work.

37. ☐ I like to make my parents happy by getting good marks.

38. ☐ I don't enjoy working in groups.

39. ☐ I don't enjoy getting a lot of instructions.

40. ☐ I prefer to have instructions written down so I can check on them again later.

41. ☐ When I explain something, I gesture quite a lot.

42. ☐ I tend to use logic and look at facts and figures to help me make my decisions rather than my emotions or 'gut feeling'.

43. ☐ It is often difficult for me to get interested in my school work.

Comment

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