

UNIVERSITY OF EDUCATION, WINNEBA

**The role of activity method in teaching and learning of classification of
Organisms**



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**THE ROLE OF ACTIVITY METHOD IN TEACHING AND LEARNING OF
CLASSIFICATION OF ORGANISMS**



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**A thesis in the Department of Science Education,
Faculty of Science Education, submitted to the School of
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of the requirements for the award of the degree of
Master of Philosophy
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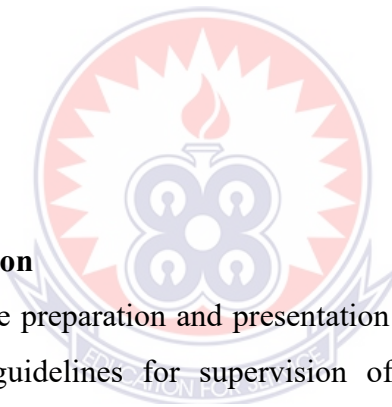
DECLARATION

Student's Declaration

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

Signature:

Date:



Supervisor's Declaration

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

Supervisor's Name: Prof. Ruby Hanson

Signature:

Date:

DEDICATION

I dedicate this work to the Baalongbuoro's family.



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My heartfelt thanks go to my supervisor, Prof. Ruby Hanson, Chemistry Education Department, University of Education, Winneba, for her guidance, patience, encouragement, constructive criticism, suggestions and also spending time and energy in reading through the script during the period of this work. I am equally grateful to my wife, Magdalene Kangyi and children Venedict, Venetia and Valentine Junior, whom I denied comfort and attention when, I had to tread on this short and ambitious academic journey that has taken me far. I acknowledge the support from my parents for their prayers and moral support.

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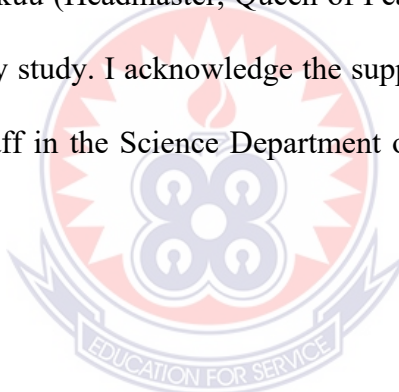


TABLE OF CONTENTS

Content	Page
DECLARATION	iii
DEDICATION	iv
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xi
ABSTRACT	xii
 CHAPTER ONE: INTRODUCTION	 1
1.0 Overview	1
1.1 Background to the Study	1
1.2 Statement of the Problem	4
1.3 Purpose of the Study	7
1.4 Objectives	7
1.5 Research Questions	8
1.6 Significance of the Study	8
1.7 Limitations	9
1.8 Delimitation of the Study	9
1.9 Summary	9
1.10 Organisation of the Study	9
 CHAPTER TWO: LITERATURE REVIEW	 11
2.0 Overview	11
2.1 Theoretical Framework (Constructivist theory)/Conceptual Framework	11

2.2 Aims of Teaching and Learning of Biology	15
2.3 Science Practical Skills	15
2.3.1 Observation	19
2.3.2 Drawing	20
2.3.3 Interpretation	21
2.3.4 Classification	21
2.4 Relevance of Instructional Materials in Biology	22
2.5 Strategies for Activity-Based Learning in Biology	24
2.6 Types of Activity-Based Learning	37
2.6.1 Experimentation	38
2.6.2 Investigations	39
2.6.3 Field Trip	39
2.7 Role of Teacher in Activity-Based Learning	43
2.8 Role of Student in Activity-Based Method	45
2.9 Advantages of Activity-Based Learning	46
2.10 Challenges in Organising Activity-based Lessons	47
2.11 Attitude of Students towards Activity-Based Learning Strategies	55
2.12 Attitude of Teachers towards Integration of Activity-Based Methods	56
2.13 Perceptions of Teachers and Students on the Importance of Performing	58
2.14 Effects of Activity-based Lessons in the Performance of Students in Science	59
2.15 Effect of Motivation on Students Conceptual Understanding	61
2.16 Summary	64
CHAPTER THREE: METHODOLOGY	65
3.1 Overview	65
3.2 Research Design	65

3.3 Sample and Sampling Technique	65
3.4 Research Instruments	66
3.4.1 Questionnaire	66
3.4.2 Test	67
3.4.3 Interview	68
3.5 Pre-intervention Activities	69
3.6 Intervention	69
3.6.1 Intervention Design for the Study	70
3.6.2 Implementation of the Intervention Activities	70
3.7 Post-Intervention Activities	72
3.8 Pilot Test and Reliability of the Questionnaire	73
3.9 Validity of the Questionnaire	73
3.10 Validity and Reliability of the Interview Instrument	74
3.11 Data Collection Procedure	74
3.12 Method of Data Analysis	76
3.13 Ethical Consideration	76
3.14 Summary	77
CHAPTER FOUR: RESULTS AND DISCUSSION	78
4.0 Overview	78
4.1 Analysis of Students' Questionnaire	78
4.2 Results from Test Items of Students	94
4.3 Interview	95
4.3.1 Are you a professional teacher?	96
4.3.2 What is your highest level of education?	96
4.3.3 For how long have you been teaching biology in this school?	96

4.3.4 Which method(s) do you normally employ in your teaching?	97
4.3.5 What are some of the problems you are facing as a biology teacher?	98
4.3.6 How many practical activities do you normally have in a week?	99
4.3.7 Do you travel to designated ‘resource centres’ to do practical activities?	99
4.3.8 Are your students interested in studying biology?	100
4.3.9 What measures are you putting in place to improve the performance of students in biology?	101
4.4 Summary	101
 CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH	 103
5.0 Overview	103
5.1 Summary of Findings	103
5.2 Conclusions	105
5.3 Recommendations	105
5.4 Suggestions for Further Research	106
REFERENCES	107
APPENDICES	128
APPENDIX A: Students Questionnaire	128
APPENDIX B: Interview Guide	132
APPENDIX C: Students’ Achievement Test on Classification (Post-Test)	137
APPENDIX D: Samples Of Students Papers on Pre-Test and Post-Test	142
APPENDIX E: Marking Schemes of Students Pre-Test and Post-Test	162
APPENDIX F: Introductory Letter	169



LIST OF TABLES

Table	Page
1: Practical skills students demonstrate in classification of organisms	79
2: Methods teachers employ in teaching classification of organisms	86
3: Students' perceptions of the activity-based method	92
4: Results of students' pretest and post-test	94



LIST OF FIGURES

Figure	Page
1: A pie chart showing students' ability to demonstrate their scientific	81
2: A pie chart showing improvement in students' practical skills during	83
3: A pie chart showing students' interest and cooperation during project	90



ABSTRACT

The research aimed to determine the effectiveness of the activity method in enhancing students' understanding of classification concepts, as well as to explore their perceptions of this teaching approach. The study was conducted at Queen of Peace senior High School in Nadowli. A case study action research design was employed involving a sample of 46 students. The primary data collection instruments were questionnaires, a student achievement test, and interviews. The statistical Package for Social Sciences (SPSS) was used to analyse the questionnaires. The study established that the acquisition of practical skills by students is facilitated by engaging students in hands-on activities and project work. The study further established that the activity method of teaching is more appropriate for the conceptual understanding of classification of organisms and biology at large. The activity method of teaching was found to be an efficient way to teach and understand science, particularly biology, and should be used by biology teachers as it makes all students participate actively during teaching and learning. Although both teachers and students have positive attitudes towards the activity method of teaching, it does not mean that this necessarily translates into action in the studied area. It is recommended that further studies be carried out to find out the challenges that teachers face in teaching the concept classification of organisms in biology.



CHAPTER ONE

INTRODUCTION

1.0 Overview

The chapter provides background material for this study. It also identifies the main goal of the research and the importance of the findings for improving biology instruction and student understanding. This chapter covers the goals and research questions that form the basis of the study, along with its restrictions and boundaries.

The chapter is structured under the following headings: Background to the study, statement of the problem, purpose of the study, research objectives, research questions, significance of the study, delimitations, and limitations.

1.1 Background to the Study

The study of biology, in general, involves the use of practical activities. Biological concepts can best be understood by involving students in activity-oriented lessons. Biology as a science subject is a practical-oriented subject that focuses on knowledge application rather than mere knowledge acquisition (Biology syllabus, 2010). Given this, more emphasis must be placed on the use of practical skills in explaining biological concepts and theories.

The biology syllabus for the Senior High School (SHS) had been designed to help students acquire profile dimensions that can help them fend for themselves in and after school. The three profile dimensions that have been specified for teaching, learning, and testing in biology are Knowledge and Comprehension-30%, Application of Knowledge-40%, and Practical and Experimental Skills-30% (Biology syllabus, 2010). The application of knowledge and practical and experimental skills of students are evaluated in paper three of the West African Senior Secondary Certificate

Examination (WASSCE). In this paper, students' practical and experimental skills and application of knowledge are tested on the topic "Classification of organisms." Students are assessed on their scientific skills of equipment handling, planning and designing of an experiment, observation, manipulation, classification, drawing, measuring, interpretation, recording, reporting, and conduct in the laboratory/field.

The present mode of teaching biology in Senior High Schools in Ghana emphasises only knowledge and comprehension and neglects the application of knowledge and practical and experimental skills which are key to the conceptual understanding of the topic classification of organisms and biology at large (Perry, 2015).

Ghana has made it a priority to enhance the education/learning of science at all levels of education over the years. Successive governments of Ghana in collaboration with the Ghana Education Service (GES) over the years have played significant roles in reforming the curriculum to meet the current needs of the people and the world at large. The building of Science Resource Centres (SRC) and Science Technology Engineering and Mathematics (STEM) schools across the country are some of the measures to promote effective and efficient teaching and learning of practical and experimental skills in science.

Students' performance in biology on the WASSCE has been declining over time, even with all the efforts made by successive administrations to enhance scientific instruction in senior high schools. According to a study conducted in the United States of America by Ruffato (2012), students were more engaged and performed well on short-term knowledge assessments when they learned biological processes through hands-on methods as opposed to traditional methods like lectures and following drawings on the board. However, teachers' attitudes toward hands-on activity-based

learning and practical work are pitiful. They find activity-based learning and practical work to be a waste of time and this might make them not able to cover enough topics (Kibirige & Teffo, 2014). This situation has made students resort to rote learning and memorisation and could not demonstrate the needed practical and experimental skills when it comes to answering questions on classification of organisms in biology. Students learn best when they are exposed to activities involving hands-on and practical work. They are always curious and participate actively in class when they are made to explore and find solutions to a given problem and this approach must be adapted by all teachers. Rutto and Kaptinge'i (2014) found that pupils in Kenya are less exposed to classroom activities during scientific sessions which makes students unable to understand science concepts and apply them in their daily life activities.

Countless teachers in Ghana have never done much more than a simple repeat of theory work, which is required for examinations (Perry, 2015). As a result, the way some science teachers teach science lessons encourages memorization rather than sound investigative learning. Teachers fail to provide students with opportunities to plan inquiries and conduct their experiments. Students are denied the opportunity to manipulate materials and apparatus, build their knowledge of phenomena, and relate scientific concepts to real-life situations.

Nothing about the circumstances at Queen of Peace Senior High School is unique. WAEC demands that teachers adapt their curricula. Given this, educators are forced to use lectures or content-knowledge approaches to cover as much material as possible, paying little to no attention to the needs, interests, or individual peculiarities of their students. For a few years now, this has caused a drop in the academic achievement of biology students.

Activity-based learning includes reading, writing, discussion, practical exercises, problem-solving, analysis, synthesis, and assessment (Hansraj, 2017). The implementation of the activity-based method in the classroom might encourage pupils to shift from passive to active learners, which is a desirable improvement. Offering students adequate chances to succeed could improve cognition, emotion, and psychomotor domains in turn. Learners can experiment and explore while they are learning through activity-based learning. Education is improved and made more powerful by sensory experience and action (Shahram, 2018).

Activity-based learning has grown in popularity in science-related subjects, albeit with mixed results. However, there is not much research on its application in categorisation education just yet. As a result, the purpose of this study was to determine how activity-based learning functions in the biology classroom at Queen of Peace Senior High School in Nadowli, in Ghana's Upper West, when teaching the idea of organism classification.

1.2 Statement of the Problem

At the pre-tertiary school levels, the Ghana Education Service (GES) curriculum highlights classification as a critical competency area and stresses the value of practical skills and scientific literacy. A fundamental idea in biology, the classification of organisms is essential to students' understanding of ecological interactions, biodiversity, and evolutionary biology (Campbell et al., 2018). Thus, learning to classify information aids students in organizing complicated biological data and improves their capacity for scientific thought (Millar & Osborne, 1998). Bruner (1960) highlighted that students learn best when actively creating their own understanding, which raises the possibility that abstract and application-based subjects

like classification of organisms may not be well taught using conventional lecture-based approaches. It appears that students' inability to understand this fundamental idea reflects shortcomings in observation, critical thinking, and scientific communication in addition to content-related problems. Due to a lack of experiential learning opportunities and ineffective teaching methods, many students in Ghanaian schools, including Queen of Peace Senior High School, have difficulty with scientific reasoning (Amoah & Okyere, 2016).

Although Ghanaian academic research has given science education a lot of attention, there is still a big lack of studies that particularly address students' understanding of biological classification. Without separating classification as a separate conceptual and skill-based area, the majority of previous studies have tended to look at general science performance or obstacles in science education in a broad sense (Amoah & Okyere, 2016; Anamuah-Mensah et al., 2004). Biological classification, which is central to organizing knowledge about living organisms, often receives limited attention in educational research despite its importance in building scientific thinking and observation skills (Millar & Osborne, 1998). Studies like those by Nyarko and Quansah (2014) do not explore how particular topics like classification of organisms are taught, understood, or misunderstood; instead, they concentrate on characteristics like teaching strategies and resource availability that affect science accomplishment. It is challenging to provide focused interventions to address the conceptual and practical difficulties students have when learning classification of organisms because of this neglect. Therefore, to guide curriculum creation and instructional improvement in the Ghanaian setting, research that focuses on this specific area of biology is desperately needed.

Adu-Gyamfi et al. (2017) found that while students could recall definitions and examples related to classification of organisms, they frequently struggled with applying classification keys or grouping unfamiliar organisms—suggesting a disconnect between theory and practice. While most studies emphasize biological classification as a crucial component in understanding biodiversity and ecological relationships (Campbell et al., 2018), there is a noticeable gap in the literature regarding its practical application in classroom settings. According to Mensah (2015), science education in Ghana frequently places more emphasis on subject coverage than experiential learning, which lowers student engagement and conceptual understanding. Furthermore, Dogbe and Ofosu (2020) contend that many schools employ few inquiry-based learning techniques and practical teaching aids, mostly as a result of huge class numbers, a lack of resources, or a lack of teacher preparation.

Even though student-centered approaches like inquiry-based learning, experiential learning, and constructivist teaching models are widely supported, there is still a big gap between what is taught in many science classrooms and what is actually taught, especially in developing nations like Ghana. Through investigation, experimentation, and teamwork, students must actively create their own scientific understanding, according to theoretical frameworks and curriculum norms (Bruner, 1960; Taber, 2010). However, because of time constraints, lack of teaching resources, and huge class sizes, many teachers really resort to lecture-based education (Adu-Gyamfi & Asante, 2021). Osei-Anto (2018) claims that rote learning and note-taking dominate the majority of scientific classes in junior and senior high schools in Ghana, leaving little opportunity for practical exercises or group-based research. The development of fundamental scientific skills like observation, critical thinking, and problem-solving is hampered by this pedagogical distance, especially when it comes to complicated

subjects like classification of organisms that call for active material manipulation and real-world examples. Furthermore, Tamakloe et al. (2020) contend that while educators acknowledge the benefits of activity-based learning, many do not have the necessary training or assistance to successfully apply them, particularly in classrooms with limited resources or high student enrolment. To improve the caliber and applicability of science instruction in these settings, it is imperative to close this gap.

Students at Queen of Peace Senior High School exhibit limited ability to demonstrate basic scientific skills in classification of organisms during practical sessions. Form Two Science Students (2C) of the school struggle to exhibit the fundamental scientific skills needed for the biological classification of organisms. This has been the driving force for this research. Therefore, it is imperative that this study looks into the underlying causes why Form Two students struggle with organism classification, find instructional technique gaps, and provide practical ways to enhance teaching and learning results. The findings of this study will be useful to educators, curriculum designers, and legislators looking to improve science instruction in Ghana and elsewhere.

1.3 Purpose of the Study

The purpose of this research was to find out the role of activity-based method in teaching and learning of classification of organisms at Queen of Peace Senior High School in Nadowli.

1.4 Objectives

The objectives considered for the study were to:

1. assess the initial practical skills that Form 2 students demonstrate in classification of organism during biology lessons.

2. find out the teaching methods that teachers employ in teaching the concept of classification of organisms in biology.
3. assess students' perceptions about the activity-based method.
4. assess the impact of activity-based methods on students' performance.

1.5 Research Questions

The following research questions guided the study:

1. What practical skills do Form 2 students demonstrate in classification of organisms during biology lessons?
2. What methods do teachers use in teaching the concept of classification of organisms in biology?
3. What are the perceptions students hold about activity-based methods?
4. What is the impact of activity-based method on students' performance?

1.6 Significance of the Study

The study explores a strategy for teaching biology at Queen of Peace Senior High School in the Nadowli-Kaleo District of the Upper West Region. The outcome of this study will benefit teachers of Queen of Peace senior High School and researchers. It will educate biology instructors of Queen of Peace Senior High School about the benefits of activity-based learning, and allow them to shift their teaching tactics away from traditional teacher-student interaction and toward activity-based learning that encourages active student participation. The findings will be used as a guide for interested researchers and academics. The outcome of this research will be useful to biology teachers in Queen of Peace senior High School and the Ministry of Education as a guide in policy formulation and implementation.

1.7 Limitations

The research was conducted at Queen of Peace Senior High School, Nadowli in the Upper West Region of Ghana. Therefore, the results of this study can only be generalised to schools with similar characteristics.

Some respondents (students and teachers) may be dishonest in their responses.

Not every respondent who receives a questionnaire is likely to answer and return it.

1.8 Delimitation of the Study

The study limited to only biology teachers and second-year elective biology students of Queen of Peace Senior High School in the Nadowli/Kaleo district of the Upper West region of Ghana.

1.9 Summary

This chapter introduced the orientation of the study on the teaching of biology and classification of organisms in senior secondary schools. The research problem, research questions, significance of the study, limitations, and delimitations of the study were all tackled.

1.10 Organisation of the Study

The study consisted of five chapters. Chapter one focused on the background to the study, the statement of the problem, the purpose of the study, the research objectives and questions, the significance of the study, limitation and delimitation of the study, and organisation of the study. Chapter two dealt with the review of literature which comprised the theoretical bases of the study as well as some empirical studies. Chapter three discussed the methodology employed in the study. This included the methods used in the collection of data to answer the research questions. This involved the research design, population, sample size, sampling techniques, research

instruments, and analysis. Chapter four presented the findings and discussions; the data collected from the field were analysed and answers were provided for the research questions posed at the beginning of the study. Then, Chapter five dealt with the summary of the major findings, conclusions, and recommendations of the study.



CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter reviewed literature that is related to the topic under study. It presents the constructivist theory that backs the study, the aim of teaching biology in second-cycle institutions, and the practical skills that students acquire when they are involved in the activity method of teaching. The chapter also assessed the methods that biology teachers use in teaching classification and biology. The perceptions students have on using the activity method to teach classification of organisms in biology and how it affects their performance were also reviewed. Other areas that were reviewed include the challenges that biology teachers face in integrating activity-based methods in teaching classification of organisms and the availability of resource materials.

2.1 Theoretical Framework (Constructivist theory)/Conceptual Framework

A theoretical framework serves as a research's "blueprint" or direction (Grant & Osanloo, 2014). It is a framework built on an established theory in an area of research that is relevant to and/or represents the study's hypothesis. It is a blueprint that the researcher frequently "borrows" to construct his or her own home or research project. The theoretical framework directs the researcher to ensure that the final scholarly contribution is made without deviating from the parameters of the approved theories. Thus, the specific theory or ideas about a specific aspect of human activity that can be helpful to the study of occurrences are what Brondizio et al. (2014) define as the theoretical framework. The theoretical framework consists of a theory's concepts, constructs, tenants, and principles (Grant & Osanloo, 2014).

This study is grounded in Vygotsky's social constructivist learning theory. According to the social constructivist learning theory, people build their knowledge through their interactions with others and the learning environments (Vygosty, 1978). According to Kolb (2014), learning through conversation gives people the chance to communicate, think back on prior information and experiences, and contrast the past and present. Teachers must therefore establish a collaborative learning environment where students have the resources and chance to build new understandings by fusing experiences from many sources for students to construct knowledge efficiently. By applying their information to the context of fixing real-world problems, learners can explore their knowledge and continuously improve it.

The social constructivist theory holds that instructors should adjust to acting more like facilitators than like teachers. A facilitator aids the learner in reaching his or her knowledge of the material, as opposed to a teacher who presents a didactic lecture that covers the subject. Although it is encouraged to let the learner take charge of the task and solution process, it is not true that any activity or any solution is sufficient. Supporting the learner in developing good thinking skills is a crucial objective.

In this study, it is hoped that including activity-based learning in teaching the classification of organisms would inspire, engage, and maintain students' interest in their education, supporting constructivist learning theory.

The diagram below represents the constructivist theoretical framework that is used to explain how students will be able to develop basic scientific skills to enable them to understand the concept classification of organisms when they are engaged in activity-based method of teaching.

Theoretical Framework

Constructivist Theory



Activity-Based & Learner-Centred Approach



Engagement in Learning Activities



Group Work

Hands-on Exploration



Scientific Skills Developed

(Observation, Questioning, Classifying, manipulating,

Recording, Measuring, Interpreting, Drawing Conclusions)



Knowledge Construction



Understanding of Classification of Organisms

This diagram shows how Constructivist Theory supports a learner-centred and activity-based approach, where students engage through group work and hands-on tasks. These experiences help them develop key scientific skills, leading to the construction of knowledge and a solid understanding of classification of organisms.

Conceptual Framework

Activity Method (**Independent Variable**)



Learning Activities

(Group Work, Hands-on Tasks)



Scientific Skills Development



Student Engagement

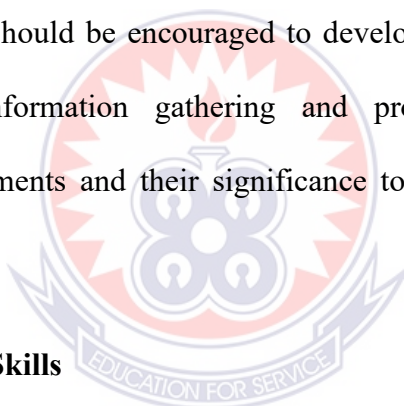


Understanding of Classification of Organisms (**Dependent Variable**)

This conceptual framework explains how the activity method (independent variable) and classification of organisms (dependent variable) help students to understand the concept classification of organisms using the activity-based method as the instructional method. The activity-based method includes engaging, practical strategies to enable students understand the concept of classification of organisms in biology. When students are engaged in hands-on activities, it leads to meaningful learning. As they participate in hands-on and practical activities, they develop key scientific skills which enhance engagement. This process results in a better understanding of how organisms are classified.

2.2 Aims of Teaching and Learning of Biology

One of the main goals of education is to prepare pupils to live as responsible, democratic citizens in their community. Science teachers have to help their pupils fulfil their social obligations and uphold democracy in addition to teaching science facts, principles, and procedures. They should be aware of how many people, cultures, and societies have influenced science and technology development. They must be inspired to value and take part in the ethical application of science and technology for the good of society, to envision the future of our country, and to mature into sensitive and responsible citizens. To preserve a thriving and sustainable society, it is crucial to foster in students critical thinking about the connections between science, technology, and society. Students should be encouraged to develop a scientific perspective on a variety of topics, information gathering and processing, and scientific and technological advancements and their significance to daily life and potential long-term effects on society.



2.3 Science Practical Skills

Students may struggle to acquire the necessary skills to operate scientific apparatus and equipment in the laboratory due to the dearth of practical science work. It is well acknowledged in the literature (Fadzil & Saat, 2013; Ferris & Aziz, 2005; Grant, 2011; Hamza, 2013; Tesfamariam et al., 2015) that students struggle with the use and management of scientific gear. Studies conducted by Delargey (2001) have demonstrated the importance of school-based scientific laboratory activities in preparing students for postsecondary study. It is believed that a student's advancement from one level of practical skill learning to the next is dependent upon how well they performed in the previous level. Delargey (2001) also revealed that students who carried out laboratory manipulations did better on tests of their practical

abilities than those who were exposed to non-laboratory methods like a demonstration. This is consistent with a small-scale study that found university students lack the confidence to do practical tasks as well as the necessary practical abilities (Grant, 2011). Grant also discovered that the primary cause of students' lack of practical skills at the university level was their inadequate exposure to practical work during their education. Thus, to emphasize the development of practical skills in first-year practical courses, higher education institutions must modify their laboratory-based teaching approach.

In a similar vein, Ferris and Aziz (2005) discovered that college students who scored well on exams did not always demonstrate proficiency in laboratory abilities. According to Hamza (2013), science experiences may be beneficially used in many contexts and students must engage in practical activities to learn in the future. Wickman and Ostman (2002) provided more evidence to support the concept that science is learned by university students by applying their prior scientific experiences sequentially.

According to Tesfamariam et al (2015), the barriers to conducting laboratory work were mainly due to budget constraints, large class sizes, time constraints, and inadequate teacher preparations. Thus, practical activities are frequently omitted from classroom instruction in most developing countries. The aforementioned studies (Fadzil & Saat, 2013; Ferris & Aziz, 2005; Grant, 2011; Hamza, 2013; Tesfamariam, et al., 2015; Wickman & Ostman, 2002) clearly illustrate that insufficient opportunities to perform experiments at the school level might affect students transition to higher learning institution as they may encounter many difficulties in the future because of the lack of skills and experience.

The acquisition of manipulative skills is one of practical work's most important objectives (Fadzil & Saat, 2020). These include abilities like utilising a microscope, determining the temperature of boiling water with a thermometer, or using a Bunsen burner.

The usage and handling of chemical substances and scientific equipment during laboratory research are emphasised by manipulative skills in science. Students are also taught the right way to use, clean, and store scientific equipment properly. When students struggle to master science manipulative skills, it may be difficult for them to make critical observations and collect pertinent data (Fadzil & Saat, 2020). This can have a serious impact on student's ability to learn other desirable skills in the laboratory.

The development of science process skills, which include aptitudes like observing, classifying, measuring, and manipulating numbers, as well as inferring, forecasting, and communicating, will also be more likely to be the emphasis for kids who are skilled in science manipulative skills. They will also have a better chance of controlling variables, formulating hypotheses, and experimenting. As a result, these scientific abilities must be taught to children in stages, and in this case, instructors are the primary instrument responsible for creating, instilling, and passing on to their pupils the skills of science learning and manipulatives.

Knowing what is being assessed is crucial for the teaching and learning of manipulative skills to be successful. Unfortunately, experimental work has been neglected in most schools due to a lack of valid assessment (Abrahams & Sharpe, 2013). Since studying science is inextricably related to data gathered and examined in laboratory settings, students' practical skills in scientific laboratories must be

evaluated. Finding evidence to comprehend students' acquisition and performance of manipulative skills is the process of assessment. Direct evaluation of students' practical skills is rare in most science classrooms. As a result, teachers are less likely to invest time and energy in helping students develop their practical abilities (Fadzil & Saat, 2020).

The situation according to Fadzil and Saat is the same in most countries as teachers teach to cover the syllabus. This affects students' acquisition of scientific and experimental skills as most of them cannot demonstrate these skills in class and on their final examinations. I believe that if teachers engage students in activities, they will be able to demonstrate the necessary scientific skills that will facilitate their understanding of scientific concepts in biology.

These are process skills that are representative of the behaviour of scientists and have broad applicability in many scientific domains (Idiege et al., 2017; Jack, 2018). Science practical skills, according to Karamustefaoglu (2011) are cognitive and psychomotor abilities that are applied to problem-solving. Scientists employ these abilities to identify problems, collect data, formulate hypotheses, analyse data, interpret data, and communicate their results. These abilities fall into two categories: integrated and fundamental (Karamustefaoglu, 2011). Identification, observation, measurement, sketching, categorization, communication, inference, and prediction are examples of practical science abilities. Furthermore, Karamustafaoglu (2011) noted that integrated skills include data collection and transfer, data table and graph construction, variable relationship description, material and equipment manipulation, data recording, experiment conclusion drawing, and generalization.

Practical knowledge in science lays the groundwork for simple scientific learning. They allow students to take on and complete increasingly challenging assignments in science experiments (Rauf, et al., 2013). According to Draghicescu (2014), developing scientific literacy must enable people to comprehend the advances, constraints, and dangers associated with scientific ideas as well as the social uses of technology.

This study has taken into account the following skills: categorization, interpretation, sketching, and observation. These are the most important abilities of the West African Senior Secondary Certificate Examination (WASSCE).

2.3.1 Observation

Observation is the first step in almost all scientific endeavours. This includes gathering data, arranging observations, recognising parallels and contrasts, and employing the senses where appropriate and safe. Helping students contribute more effectively to the country's industrial, technological, and economic development is one of education's main national objectives. One of the essential science process skills, according to Alkaslassy and O'Day (2002), is observation. This claim is supported by the fact that we learn about the world around us by observing objects and occurrences with all five of our senses. Observation demands the use of all five senses and goes beyond simple question-asking. One of the basic science process skills is observation. Observing is not simply a question of looking, but it involves the use of all the senses, that is, sight, sound, touch, smell, and even taste. One has to look at a specimen very carefully to be able to draw it accurately, and the labeling of a drawing forces one to think about the component structures and their positions. Observation alone is not necessarily an accurate and reliable activity for gathering

data. Observers often “miss seemingly obvious things” and “invent quite false observations.” Nevertheless, the skill is valuable and crucial to both the process of conducting scientific inquiry and the process of teaching and studying the ways of science. Observational skills expected in science are reading the instrument correctly, noticing colour change, noticing relevant details in a given specimen, locating desired parts in the specimen accurately, and taking observations carefully in a systematic manner.

2.3.2 Drawing

Science requires careful observation and description. One excellent way to describe an object is to draw it. The goal of the observer is normally to move beyond simple mental images of what he/she believes a particular plant or animal looks like, and instead concentrate on the unique identity of that specimen (Dempsey, 2001). Drawing skills subsumes other skills like observation; the learner is expected to make accurate well labelled biological diagrams. The role of drawing skills in the teaching and learning of biology has often been underestimated. He noted that drawing in science had the following functions: Ensure that the student looks at and examines the details of the specimen with proper attention. This ensures meaningful learning which will be translated into good performance in biology.

To provide avenues for learning through visual and kinaesthetic experience in addition to the auditory experience of listening to the teacher. This breaks monotony during the learning process, resulting in increased attention span, to provide a record of the work done by the student. It also provides the student with material useful for revision. In addition to the above, it acts as a medium for analysis and synthesis that is to be a stimulus to think. The use of visual representations to learn can be traced to

Louis Agassiz. In his approach, students were to study nature by carefully observing, drawing, and making inferences.

2.3.3 Interpretation

Interpreting is a very important skill for data from an investigation. The learners should be able to relate the data from an investigation to the content and give clear explanations. Interpreting and inferring are critical determinants of science activities. Information gathered from scientific investigation usually is not readily useful and meaningful; data have to be analysed and interpreted.

As students perform these practices, they begin to inculcate these practices into their lifestyle and they become a part of them. They can relate these skills in solving tasks as well as use these skills in answering questions of the West African Senior Secondary Certificate Examination (WASSCE). The teacher should expose learners to situations where their ideas are matched against biological concepts, which are backed up by evidence through experimentation. This may lead the learners to better understand concepts and hence perform better in practical examinations (Nghipandulwa, 2011).

2.3.4 Classification

The ability to classify in science is very important. Classification aims at simplifying and ordering the components into coherent units called taxa that have widely accepted names and whose members share important properties. Classification can integrate diverse, character-based data in a phylogenetic frame logical property of taxa. With the several importance of classification, the researcher summarises it as it makes identification easier for studies.

2.4 Relevance of Instructional Materials in Biology

The use of teaching and learning resources by teachers for the benefit of their pupils differs greatly from simply giving them resource materials to work with by themselves. In their study on the use of lab resources, Chenwe and Chilee (2014) found that the majority of the easily accessible and less expensive materials, such as textbooks, chalkboards, and chats, were used to a great extent while some expensive biology lab resources, such as computers, overhead projectors, and video-taped instructions, were used to a low extent.

As long as science is a process as well as a product, the laboratory is the focal point of scientific research. The extent of optimal laboratory practices that will guarantee the learners' development of science process skills and competency in science ideas depends critically on the availability of laboratory equipment, facilities, and materials. In his study on the impact of learner and teacher materials on school performance in South Africa, Manqele (2012) showed that prioritised Learner and Teacher Materials (TMs) are critical to modernizing, appropriating, and improving a school's performance and quality of education. Manqele emphasized in the study that without relevant LTMs, schools cannot hope to embrace performance/outcomes-oriented education successfully. Students at those institutions thus keep getting a poor education.

The findings of Nweki and Onyegyegbu (2015) regarding the resources available and students' performance in Nigeria found a notable difference in the achievement scores of students taught using various instructional materials and those who were not.

In their study, Sofeme and Andy (2012) claim that the availability of trained science teachers has a substantial impact on secondary school students' academic progress in

science disciplines. The outcomes also showed that there was a difference between schools with proper laboratory equipment and those without it in terms of academic achievement. According to Mudulia (2012), there is a correlation between the availability of resources and students' success in science. High-performing schools receive more exposure to consumables like chemicals and lab equipment than poor-performing ones. According to Kibirige and Hodi (2013), students who use laboratory investigation have a better comprehension of the physical sciences.

When discussing the value of teaching resources in Kenya, Kibirige and Hodi (2013), emphasise the value of laboratories in giving students the chance to engage with science by using scientific research techniques. Engaging students in inquiry processes, so they can develop research abilities, is one such option. As a result, students' academic performance in science and other subjects using science will progressively improve. According to Owolabi and Oginni (2012), experimenting is a crucial scientific activity as it provides an opportunity to demonstrate the psychomotor talents of both teachers and learners, as well as to apply the theoretical knowledge that is taught in the classroom. This demonstrates that the utilization of laboratory instruments and protocols by students is crucial to achieving learning objectives and has a noteworthy effect on their scientific academic performance.

I strongly agree with the opinions of the above scholars. For students to acquire and demonstrate the needed scientific process skills, the availability of resource materials is key. Students would not be able to demonstrate experimental and practical skills if a school lacked a science laboratory and equipment. Any activity that is carried on either in the science laboratory or outside the classroom demands the use of resource

materials. In teaching the classification of organisms in biology, resource materials are of paramount importance to enable students to understand the concept.

2.5 Strategies for Activity-Based Learning in Biology

Quin (2012) defines activity-based learning as a teaching strategy that actively engages students in the process of learning. This includes cooperative learning, collaborative learning, problem-based learning, and inquiry-based learning. There are many interesting things to do there. The student will actively engage with the material rather than passively absorbing it. Participating in activity-based learning gives students the chance to learn through real-world experiences and applications. Students gain more information when teachers use activities-based teaching methodologies (Shah & Rahat, 2014). An essential tactic that helps students approach challenges in new ways, find the best answers more easily, and boost their self-esteem is activity-based learning. Since they thought that pupils should be active learners rather than merely passive recipients of knowledge, constructivist psychologists Piaget, Dewey, and Vygotsky endorsed this method of instruction. This implies that to engage pupils, professors should employ hands-on instruction as opposed to the traditional lecture format.

A group of educational strategies employed in the classroom are referred to as "activity-based learning." Active learning exercises are largely used in the classroom to control it. The premise behind the activity-based learning paradigm is that kids retain more information when they are actively involved in the learning process as opposed to being passive consumers of it.

Activity-based learning connects students' cognitive abilities with the material by utilizing synthesis, analysis, and critical thinking. Building relationships and using

activity-based learning strategies help students move beyond simple memory and knowledge to the highest levels of Bloom's taxonomy—active thinking, which includes creation, analysis, assessment, and application (Edwards, 2015). Quin (2012) continues by saying that multi-interpreted activity-based projects that are connected to real-world events can serve as a means of boosting students' motivation. How to certify motivated, competitive students so they are prepared for the workforce is one of the major issues that educators face globally. Teachers must therefore determine the most effective techniques to include pupils in the learning process. This can help teachers highlight their students' comprehension of the material being covered in addition to encouraging critical thinking and problem-solving abilities (Younis, 2018). Policymakers consider ways to motivate pupils to go beyond passively absorbing information and instead develop creative solutions to the problems they encounter (English & Kitsantas, 2013). In a classroom, there are two ways for students to learn: actively and passively. As passive information consumers, individuals acquire knowledge without actively engaging in the process of learning.

However, pupils who actively participate in the learning process do so rather than merely listening. Students who don't participate consistently in-class activities are more likely to miss class and may also not contribute. A range of activities, including group discussions, debates, experiments, open-ended questions, personal inquiries, critical thinking, presentations, and role-playing, can effectively involve students. Instructors can use a variety of strategies in the classroom to make sure that students get the precise skills and knowledge required to get ready for the real world. Activity-based learning is the most effective of these strategies. Making students active participants in the classroom is one of the best teaching and learning tactics.

The benefits of activity-based learning for law students in higher education courses were examined by Pierse and Sutton (2012). The writers wanted to include exercises and teaching tools that would not only improve the student experience but also foster higher rates of retention while keeping adult evening learners awake and interested. The learning tools that were created and put into use to improve the modules taught in a legal practice course were activity-oriented in nature. The incorporation of activities offers students a wide range of benefits from all levels of the Learning Pyramid, the authors found, after analysing the aforementioned information.

The many activity-based learning approaches were investigated by Rathee and Sharma (2013), who also provided descriptions of certain cutting-edge activity-based learning strategies. The creative techniques included card games, crossword puzzles, and creativity sessions. The authors concluded that students were viewed as passive participants in traditional teaching approaches. They discovered that management institutes produced students who lacked the practical skills needed in the business sector and simply had academic knowledge, which caused gaps. Innovative and engaging strategies must be used in the classroom if classroom instruction is to be effective in the current environment. The instructors must have adequate training for them to effectively use activity-based learning in the classroom.

To determine whether the approach could foster a more favourable attitude in students about writing essays in French, Bolaji (2014) investigated the impact of lecture and activity-based methods on the attitude of Junior Secondary School pupils. The study employed a quasi-experimental research methodology and concentrated on how students felt about writing French essays. The study's findings ultimately showed that the activity-based approach of instruction had a stronger positive impact on students'

attitudes than the lecture method. Additionally, it was shown that the activity-based form of instruction is both very enjoyable and beneficial from a pedagogical standpoint because it significantly improves students' attitudes toward writing French essays.

Thangam (2015) examined and assessed the level of service provided by the Activity-Based Learning (ABL) educational system in public schools. The ABL system has improved student performance in several areas, including student speed of learning and capability; student intelligence in academics; student-teacher relationships; student eagerness, interest, and engagement in subjects; student group activity; and student self-confidence, self-learning, discipline, creativity, and participation. Service excellence and teacher satisfaction both rose. Overall, it can be said that the ABL system used in elementary school is successful and has a positive influence on both students and instructors.

Haq et al. (2016) have done a study in the setting of Bangladesh in which they evaluated the impact of activity-based teaching on students' speaking skills in a classroom of primary level. Before the study, they talked about their observations regarding the school's usage of the lecture style. They said that during teacher lectures, the students were not paying attention. As part of their study project, they later collected the opinions of the students, who expressed dissatisfaction with the lack of instructional value in the lecture material. The second explanation provided by the students was that they were uninterested in the course material (Eskola et al., 2018). Fallon and Pendergast (2013) examined 82 students' conduct for their senior project and thesis. Two questions were posed to the students: the first concerned their collaboration in a group setting within a project-based learning environment, and the

second concerned their level of project involvement. They found that students who used activity-based learning methodologies understood the subjects and goals of their research more thoroughly. They achieved this by giving the kids exposure to extremely helpful activities like mind mapping, seminars, lectures, and presentations. Students were able to transform research into something practical from the bottom up and learned new techniques for presenting their findings. The emphasis on the fundamental language skills—speaking and listening in the target language—rather than reading and writing, has led to another shift in the way language is often taught. Ude and Ebuoh (2019) argued that when students are taught science (biology) using activities and experiments, their level of understanding is improved.

According to Ufonabasi,,and Nsimeneabasi (2017), successful biology learning is activity-oriented, which necessitates teaching utilising activities. According to Shana and Abulibdeh (2020), activities and student's academic progress are correlated. Biology is a difficult topic that requires a lot of practical applications and experimentation. Students are motivated to learn through activities in biology (Fadzil & Saat, 2020). According to Daba et al. (2016), teaching science devoid of activities reduces students' interest in science subjects, which decreases student involvement and lowers science enrolments.

Motlhabane and Dichaba (2013) opined that activities in science play a great role in learning since students learn better by doing. Activities make students actively involved in learning science when they are engaged in several activities. It releases boredom in them and motivates them to achieve results.

The study of biology is preselected as a core component of science education. The subject is renowned for providing a platform for students to experience a well-

rounded education and to develop the scientific knowledge, comprehension, and attitudes necessary for both their own personal growth and for making contributions to a technologically and scientifically advanced society. For tertiary courses that centre on biology, like medicine and health sciences, biology in this sense adequately prepares students (Aloovi, 2016). For students to learn well, they may need to understand how to use their hands and observe science (Mwangu & Sibanda, 2017). Per Ufonabasi and Nsimeneabasi (2017), when students discover a solution to a given problem by themselves, it encourages them to learn on their own and boosts their self-esteem. According to Ufonabasi and Nsimeneabasi (2017), effective activities help students improve their individual, cognitive, and learning capacities. To be able to acquire essential, useable skills in science topics, learners must receive satisfactory education through a variety of activities. The activity method of teaching can be acknowledged as a great method for teachers to help students develop a genuine understanding, according to Mwangu and Sibanda's (2017) postulation. These authors compare teaching biology theory, which is based on principles, facts, and subject matter, to teaching learners biology. They emphasised that activities should involve students in manipulating things physically while adhering to rules designed to make this easier for them

Killen (2013) asserts that for instruction to take place in the classroom, the teacher must serve as a facilitator of the learning process as students work in groups to solve problems and apply what they have learned to real-world situations. The variety of knowledge, ideas, and skills that students can learn with their teachers but are not yet able to learn on their own should be the main emphasis of teaching.

According to Al Maghraby and Alshami (2013), to accommodate the varied learning styles of students, science teachers must employ flexible, innovative, and learner-centered teaching approaches. Teachers should use instructional strategies that give students the chance to share information and get enough practice with what they can expect in examinations. This could be accomplished by offering students more issues to solve and opportunities to apply what they have learned in the laboratory to real-world settings.

I believe that effective teaching and learning techniques in science, like group work, laboratory investigations, and problem-based education, allow students to engage and aid one another in achieving improved subject comprehension and practical abilities. Different teaching strategies are likely to meet the students' individual learning preferences.

Shadreck and Isaac (2012) suggest that one-way educators might encourage the teaching of activity-oriented lessons in their classroom is by utilising the constructive learner method while including practical exercises in their courses. Thus, it is assumed that using a variety of teaching methods when imparting activity-based knowledge has more benefits than doing so. These benefits include increasing students' attention and interest as well as enabling teachers to adapt to a variety of difficulties that may arise during the teaching and learning process.

According to Kandjeo-Marenga (2011), when students work in groups to solve problems, they support one another by offering advice, explaining things, asking questions of others, indicating to others what the next step should be, and exchanging opinions. Through interactions with peers, group experiments can also give students the chance to reorganise their thought processes (Muijs & Reynolds, 2011). Teachers

of biology and physical science can assist students in conducting processes, handling supplies and equipment, and using practical skills by doing group experiments.

In activity-driven or activity-based learning, Ranganath (2012) suggested that active engagement with a learning object allows for the development of learners' mental models. Through activity-based learning, students are encouraged to develop mental models that support 'higher-order' performance, including applied problem-solving and the transfer of knowledge and skills. The key model of learning objects with activity-based learning is the topic of this study. Since activity-based learning is praised as one of the best teachings and learning methods, particularly in biology, this study concentrated on it.

Piaget (2013) argues that when people act with their current knowledge, they create more powerful and intricate representations of the world. If Piaget is correct, then understanding the sciences as a whole requires practical labour. Since the main goal of practical work is to promote students' learning and provide a link between the world of ideas and the world of real things and verifiable facts, I wholeheartedly support Piaget.

When teaching using a hands-on method, students are encouraged to learn by doing. Students engage more actively in the learning process when they have the opportunity to interact with the objects they are studying, which may include plants, insects, animals, microscopes, and scientific instruments like calculators and rulers. In actuality, it is a science teaching approach that involves student participation throughout the class.

I share the same view with the above scholars because, when children are engaged in hands-on learning strategy, it enables them to gain experience and improves their

capacity to think critically. Therefore, the activity method of teaching is effective for children as they easily recall what they learned through activities that involve a hands-on approach.

It has been proposed by Piaget (2013) that the hands-on approach, which allows students to manipulate objects that may help make abstract knowledge more tangible and intelligible, enhances their academic performance and helps them better understand scientific concepts. By using a hands-on approach, students may take part in real-world instances and witness the effects of changing numerous aspects. Since biology requires more seeing, touching, and manipulating than hearing, this learner-centred method also encourages the "do it yourself" philosophy in science.

In my own opinion, the retention rate of students rises gradually as learning becomes more participatory and activity-oriented. It makes students develop a love for the subject and the instructor at large. When this is done, they can relate what they learned to real-life situations hence improving upon their scientific skills.

According to Adegoke (2013), several researchers, including Aliu (2011), Olorunyomi (2013), and Olorundare (2014), have looked into the reasons why students perform poorly on Secondary School Certificate Examination (SSCE) physical chemistry concepts, and the most common cause is the use of ineffective teaching strategies by secondary school chemistry teachers, such as demonstration, discussion, and lecture methods. The situation is similar in biology because most teachers do not involve students in activities during teaching and learning and as such students are not able to demonstrate experimental and practical skills when answering questions in biology.

Similarly, to this, Olorunyomi (2013) pointed out that teaching Secondary School Certificate Examination (SSCE) physical chemistry concepts like stoichiometry through demonstration is common. The researcher continued by saying that the demonstration approach is teacher-centred because it does not involve students sufficiently. Functional education stresses internalising concrete skills that can be employed in any context rather than merely regurgitating facts and theories. Concrete learning activities are implied to be those that involve using tools to perform tasks. These activities include weighing, measuring, demonstrating, conducting testing or experiments, and engaging in any other activities that might improve students' understanding of concepts like stoichiometry, which is typically taught in senior secondary schools.

In his study, Alasi (2018) examined the effects of an activity-based learning technique on second graders' test results. After doing the tasks, it was claimed that students could understand the relationships between the models or data more clearly. Students were able to explain the relationships that arose from the problems or scenarios offered in the activities with accuracy and speed by applying the exercises to real-world situations.

Isha and Abugado (2011) also looked at the effects of several models of activity-based learning content on grade 3 students' success rates. The control and experimental groups each received a post-test with 40 multiple-choice questions. They stated that because of the classroom activities, experimental group pupils outperformed those in the control group on post-tests. According to Douglas and Joke (2016), hands-on learning techniques could be essential for instructors to improve their ability to integrate technology into their class plans.

Celik (2018) conducted a study whose goals were to determine students' attitudes toward learning activities and to compare the effects of activity-based learning against traditional learning approaches on sixth-grade mathematics achievement. He discovered that the academic performance of the experimental and control groups had both improved. The pretest-post-test study methodology was used to quantify the increase in students' performance for both groups before and after the activity-based learning technique was introduced. To provide more insight into how students view learning activities, an attitude measure toward mathematics activities was also used for the control and experiment groups.

A group of 78 sixth-graders who participated in the study were divided into the experimental group and the control group at random. Members of the experiment group learned through activities, as opposed to the control group, which got standard instruction. The pretest and post-test results that were finished by both groups revealed an increase in the control and experimental groups' mean scores. While the mean post-test scores in the control group barely moved from 4.48 to 5.79, they increased from 4.46 to 7.44 in the experiment group. This indicates that the academic performance of the students in the experiment group was superior to that of the students in the control group. He attributed the pupils' enthusiasm and active participation as the source of their motivation. So, activity-based teaching could positively affect student achievement and student attitude toward science whether it was a hands-on activity or an online activity.

An activity-based lesson is any in which students observe or work with real-world materials and objects, deduce information from intricate systems, test theories, analyse and assess variable data, participate in discussions, watch demonstrations,

perform simulations, and complete exercises (Millar, 2012). To see and comprehend the natural world, students engage with materials or secondary sources of information during scientific practicals, according to Lunette's definition (Lunette 2016). A scientific-practical is an exam or class in which students construct items or conduct experiments, according to The Macmillan Dictionary (2018). The phrase describes what is related to "doing" in practice or activity. The "doing" is contingent upon gaining the necessary abilities. The scientific syllabus outlines how the concepts of "practical" and "skills" work together to facilitate effective science learning. Furthermore, any scientific teaching and learning activity that has students working one-on-one or in small groups while handling and examining actual materials and objects as opposed to virtual ones is considered a science practical. The scientific training that results in science learning activities is called science practical.

While there are student-centred approaches to education, laboratory work remains the cornerstone of scientific education (Singer, 2015; Woolnough, 2013). The primary goal of practical work in science education, according to Dikmenli (2009), is to give students conceptual and theoretical knowledge to help them master particular ideas and scientific procedures to grasp the nature of science. In other words, when students are forced to participate in meaningful tasks, practical labour piques their interest in the science they are studying; information gained via experience and practical work also helps to strengthen long-term memory, something that theory alone is unable to achieve. This makes it clear that students learn better in scientific classes when they are allowed to participate in tasks such as operating machinery, categorizing, designing, experimenting, formulating hypotheses to conclude, and validating findings. Furthermore, hands-on biology activities provide kids the chance to truly grasp science and experience learning about it.

According to Copriady (2015), science practical work is viewed as a chance for hands-on learning that fosters critical thinking about the world we live in. The effectiveness of the practical exercise, the teacher's organizing skills, and the level of practical knowledge all matter (Copriady, 2015). A greater variety of experiences can be beneficial to seasoned scientific educators, who can then incorporate them into their regular work practices (Kosgei, et al., 2013). On the other hand, Eunice and Ondigi (2014) define practical work as logical instruction focused on ideas, knowledge, and a range of skills that students should be able to master on their own with guidance from their teachers. Working practically imparts implicit information, which is only conveyed through nonverbal exchanges during hands-on activities and cannot be taught orally. Theory and practice by themselves are insufficient to provide a complete comprehension of scientific phenomena. This is because the theoretical and empirical concepts are interdependent and irreversible (Jokiranta, 2014). The fact that science is both a process and a product support this. In science, "science" refers to a set of procedures that include measurement, observation, data collection, material manipulation, drawing, communication, recording, interpretation, prediction, and experimentation to arrive at a certain result. When scientists use these procedures to generate theories, regulations, and scientific veracities, science turns into a product (Sadhana, 2017). To improve learning, encourage the development of practical abilities, and promote inquiry and practical experiences in the classroom, teaching practical work involves several dynamic processes and activities.

The scientific method is a methodical, logical, and reasonable approach to gaining information in science. The scientific process involves several phases, including observation, predictions, experiments, hypotheses, and conclusions (Ezeh, 2013).

There are several approaches to approach activity work, including experimentation, research, and fieldwork.

2.6 Types of Activity-Based Learning

According to Millar (2012), practical work is any type of science instruction and activity in which students control and/or observe real objects and materials while working independently or in small groups (e.g., choosing which of a variety of objects is magnetic; performing and observing flame tests). Depending on what students must perform in these practical activities and what professors want to teach them, there are several types of practical work (Millar R. , 2012).

Practical work's primary goal is to assist students in making connections between the domain of ideas and the domain of objects and observables (Millar R. , 2012). According to Millar (2012), because students are concentrating on two different areas, their practical activities may vary. He does concur that the world of ideas is subordinate to the domain of things and observables, though. The study of objects and observables enables students to observe, which necessitates that they retain what they have seen. The realm of ideas requires students to gain knowledge of key scientific concepts, which will improve their comprehension of the material they are studying. According to Millar (2012), learners learn best when exercises demand them to use both their hands and their thoughts, hence it is important to include both domains when evaluating an exercise's effectiveness.

According to Millar (2012), when engaging in these activities, students may need support following proper protocol and coming up with practical solutions for the tasks that would ultimately aid in their learning. According to him, activities that

incorporate scaffolding into their designs are also more likely to be successful than those that do not.

2.6.1 Experimentation

Testing by following protocols to yield verifiable results is known as experimentation. It is the procedure by which a scientific test is conducted to examine developing findings and learn new information. It also includes presenting and analysing. Students have the chance to use experimental approaches to seek knowledge by employing the experimental approach. It has the characteristics of questioning, looking into, and facing the unknown. It also requires thorough observation and analysis of data. An experiment that is carried out well can result in improved knowledge retention, deeper comprehension of the subject matter, and the development of useful skills (Froyd & Simpson, 2008). Instead of presenting principles, facts, and concepts to students in a theoretical or abstract manner, experimental activities in biology might be seen as a strategy to help make the subject matter more tangible or real for them. Science experiments are crucial to students' academic achievement because they are a technique of instruction that involves the real-world application of scientific ideas, theories, and laws. Students who participate in experiments eventually develop the ability to learn new information, as well as concepts, principles, and abilities that help them establish scientific habits and attitudes (Onyegegbu, 2006). Since teachers often relate to the real manipulation of apparatus and equipment, experiments are regarded as the characteristic of practical work training (Tifi, et al., 2006). He asserts that experiments provide students the chance to interact with their professors as well as with one another. He goes on to say that students use the procedures, ideas, and concepts they are learning in class in their experiments. Through experiments, students may actively participate in the

development of their scientific knowledge, abilities, and tool use. As a result, students engage in activities that are task-oriented. Through interactions with peers, experiments can also provide students the chance to reorganize their thought processes (Muijs & Reynolds, 2011).

2.6.2 Investigations

According to Hofstein et al (2007), an investigation is defined as practical work that is done and entails testing a theory or resolving an issue. According to Roberts (2004), investigations are defined as practical undertakings that examine an issue for which there is not a readily remembered answer. Additionally, he clarified that the definition of an investigation is a problem limited to the consideration of correlations between variables; investigations are known to be relatively brief, concentrated jobs that may be finished quickly. Rughill (2011) found that students demonstrated a substantially high grade for this cognitive dimension in his study on the laboratory investigative technique for an effective teaching style for high school science education.

Science practicals education in senior secondary school may provide students with practical concepts, ideas, and tools to help them overcome obstacles both before and after graduation. Instead of focusing on theory and concepts, they have an experimental setup (Opuh, et al., 2018). In his study, Rughill (2011) found that students demonstrated considerably higher marks for this cognitive component in his laboratory investigative technique for an effective teaching style for high school scientific education.

2.6.3 Field Trip

A field trip is a visit to a location outside of the typical classroom that is intended to accomplish some goals that cannot be as effectively attained by other methods. Field

trips offer students the chance to leave the classroom and engage in new activities, and they include aspects that make it easier for pupils to understand abstract concepts (Imed, 2024). Learning is more effective when kids go on field trips since they can learn a lot about the subject. Field trips engage kids by piquing their interests and curiosities and give instructors, parents, and students the chance to collaborate on the curriculum. Since parents must give their permission, a letter sent home with the permission explaining the purpose of the trip is a good way to pique their curiosity and encourage them to ask the students or teachers about the trip (Addo, 2021). Students can also choose the location to be visited, develop questions to ask, develop writing reports, or evaluate the expenses. To protect their children from harm, parents' guide their children. The parents and teachers might develop a much tighter bond thanks to this position. Working in groups will also boost the interaction between students within each group. Through field trips, students get the opportunity to see directly what is going on in our environment. It helps pupils' interest in the subject to grow and be maintained. Jim (2020) says that the interactions' constant nature aids in knowledge retention. A field trip is an out-of-class experience where students can participate in innovative activities, experience unusual circumstances, and learn valuable life lessons. Students can visit various locations on a field trip where they can engage in a variety of activities firsthand and take in fresh views (Kellington, 2011).

A field trip could entail riding the bus to a different town or going to a nearby place. Whatever the case, the major objectives of a field trip are learning, experiencing a new environment, and having the chance to do new activities. Youngsters who acquire thorough education in the classroom grow up to be global citizens. Pupils in schools must have a thorough education in the arts and participate in field excursions,

in addition to mastering arithmetic and English. If indoor and outdoor activities are equally valued, children will be more equipped for life in the real world. Unfortunately, most schools consider field excursions to be a curiosity rather than a need (Shakil et al., 2011).

Students get the opportunity to participate in their academics through field trips. Beyond only reading about it in a textbook, children may take part in the event (Paige, 2022). Students who go on field excursions get access to a range of resources and environments that they would not otherwise have. Students can visit historical sites or even an aquarium featuring an aquatic environment while on field excursions (Wayne, 2022).

Pupils who participate in field trips grow more tolerant and empathetic than those who do not. Students who participate in field trips can think critically and approach a subject from a different perspective (Simm & Marvell, 2015).

Children are known to become bored easily and become sidetracked easily. On school field trips, children experience enjoyment and excitement on a new level. It gives them something to look forward to (Ayushi, 2022). Students experience a different social environment outside of the classroom when they go on a field trip. They get the opportunity to socialize with a possible new group of adults and perhaps meet additional children throughout the field trip (Christian & Tiani, 2022).

According to Singh (2022), kids can benefit from entertaining and instructive field trips. Since field excursions are a helpful teaching strategy that promotes learning outside of the classroom, they ought to be part of the curriculum. It might be difficult to maintain students' interest in the lecture process. A shift in the educational setting

may ignite a student's curiosity. Thus, a field trip is an effective means of improving teaching strategies.

Field trips provide students with a range of experiences that cannot be obtained in a classroom. Furthermore, improving pupils' textbook knowledge does not ensure that they will advance academically as a whole. Thus, a field trip is an excellent way to provide students with real-world experience (Cooke-Nieves, 2022). To help students improve their talents and impart cultural values, teachers take them on field excursions to historical sites, museums, zoos, mountains, etc. Additionally, pupils' social skills are improved when they engage with others from diverse backgrounds. Although field excursions seem like a lot of fun, organizing them may be challenging for teachers.

According to Oxford World School (2020), enhancing experience and contextual learning is the main objective of planning field trips and educational excursions for students. To help pupils expand their horizons and continue their education outside of the classroom, the school also plans pre-planned field trips. Students benefit from field excursions by connecting what they learn in the classroom to real-world experiences. Trips are made especially to teach children about and help them understand the actual world, which is varied.

One popular tactic for exposing students to ideas, events, and concepts that are not possible in a classroom context is field excursions. Field visits may be viewed as brief educational experiences that allow students to observe their subject of choice outside of the classroom setting (Pridane, 2015). According to Nicholas and Kentucky (2022), school vacations that take children on sightseeing excursions to enticing locations are the ones that they like the most.

Field trips are strategies for introducing pupils to concepts, ideas, and events that are not feasible in a classroom setting. Field trips may be thought of as quick learning opportunities that let students develop an interest in the subject matter outside of the classroom (Pridane, 2015). Children like school holidays more when they are taken on sightseeing trips to interesting places, as claimed by Nicholas and Kentucky (2022).

2.7 Role of Teacher in Activity-Based Learning

An essential part of a country's growth is played by teachers. They prepare students to be capable, knowledgeable, skilled, and ready to lead in the development of their nation. As a result, they need to frequent capacity-building training that can help them become abreast with modern trend of teaching. These days, their role in the classroom has changed due to the advancement of active learning strategies. Teachers are thought of being active learning techniques facilitators. Educators possess an extensive array of efficacious pedagogical approaches, such as activity-based approaches. Teachers who are innovative enough and can blend activities with modern technology would be able to capture students' attention during lesson delivery as opined by Prakash (2016). They will also simplify and improve learning. They should consequently provide a stimulating and participatory environment to enhance learning. The traits of the 21st-century teacher in activity-based strategy, according to Rotgans and Schmidt (2011), are to be affable, good communicators, supportive, and pass on their love for their subject. Kudryashova et al. (2016) listed the roles a teacher played in activity-based learning. Some of these roles include:

- Examine pupils past knowledge and involve them in activities that pique their curiosity.
- Activities related to design should link to previous, current, and upcoming educational experiences.

- Assign assignments that encourage investigation to produce fresh concepts.
- Encourage pupils to explore, engage with, and experience the material to gain a deeper understanding.
- Use experiments and extra assignments to push pupils' conceptual understanding and improve their abilities.
- Assess pupils' knowledge and skills to determine their progress.
- Encourage kids to like learning and the subject.
- Provide the learner with preconceived ideas.
- Manage the learning process, ensure that students are learning, and have them reflect on their learning.
- Moderate the methods, aid in the learning process, and motivate pupils to apply their past knowledge and abilities correctly.
- Take the lead in the learning process and give every pupil a safe environment.

According to Prakash (2016), a teacher is a student's buddy and a mentor. Teachers and students interact frequently in the classroom; therefore, they need to be aware of each other's strengths and limitations. The ideal teacher is a counsellor who can identify pupils' issues and learn about their routines. A trained professional teacher should be able to tolerate concerns that pupils may be facing, such as low achievement, financial difficulties, frustration, and family troubles.

Teachers should also know how to engage with students from different backgrounds and areas, as most schools have students from these backgrounds. The teacher needs to find out where the kids are from to consider their circumstances because some of them are from slum areas, others are from metropolitan areas, and some are from rural areas. Teachers' ought to be familiar with the techniques utilised in active learning environments and classrooms. Teachers can inspire students to think critically and

strengthen the bond between them and their pupils by using inquisitive hands-on science activities (Kassir, 2013).

2.8 Role of Student in Activity-Based Method

The most effective strategy for transforming the learner's role from passive to active in the classroom is activity-based learning. Students may work in small groups to accomplish specific objectives in an active learning setting. All students are expected to participate and assist the group by exchanging ideas, resolving issues, relating their work, engaging in argumentation to establish a consensus, and working together to accomplish the key objectives. During active learning, students participate fully in assignments, make contributions, and consider what they have learned. Anything a student does in the classroom aside from paying attention to the teacher and remaining still. This covers anything from listening to take in information to writing assignments that stimulate students' reactions to the readings to more difficult group activities that demand applying what they have learned to actual situations (Hamann et al., 2012). Through activity-based learning, students can develop the following skills:

- Self-reflection
- Self-assessment
- Engagement
- Gaining knowledge by contributing and participating

Through information collecting to support their positions and defend them to others, as well as participation in class debates and group discussions, students engage in activity-based learning. Small group discussions are preferred over large group discussions because studies show that small groups are better for student discussion

when it comes to thought expression, participation, applying issues, understanding issues, and knowledge status (Hamann et al., 2012).

When learning through activities, students are in charge of their education. They need to be familiar with the new active learning techniques so that they don't waste time trying to figure out their duties during the session. Role distribution is one of the values that activity-based learning teaches its students. As such, students must allocate tasks and missions based on the abilities and skills of each individual. When activity-based learning is used in the classroom, students also play a critical role in helping one another understand new concepts, supporting their low-achievers' classmates in grasping the concepts, and motivating them to finish their tasks.

2.9 Advantages of Activity-Based Learning

Understanding pedagogy is crucial when addressing activity-based learning systems. The term "pedagogy" refers to a teaching strategy used by teachers to facilitate learning. The goal of pedagogy is to attain academic brilliance and to elegantly fulfill curriculum objectives. The success of a lesson is determined by the application of complete pedagogy, which is a significant contributor to the delivery of successful instruction. With the aid of audio-visual teaching aids and hands-on activities, instructors can elicit a student's desire to enjoy or despise a subject. Teachers must learn how to affect students' motivation, interest, and comprehension in a given subject area by using facilitation techniques. Activity-based learning systems are based on a variety of instructional strategies that try to turn lectures into a handful of hands-on experiments. The activity-based learning project emphasises the idea that kids learn better when they are active rather than inert. When allowed to do

experiments on their own, pupils become more receptive, and learning becomes enjoyable, lasting, and joyous (Agbenyeku, 2014).

Activity-based learning transforms students from constant passive listeners in class or at work into active participants. This approach will help students understand the context more effectively through activities including games, brainstorming sessions, discussions, group projects, and other activities. Students benefit from problem-solving activities during learning. Additionally, it aids students in comprehending the situation and learning numerous fixes for issues that can arise throughout their assignments or work. The effectiveness of activity-based learning in helping pupils remember information and the applicability of that information in everyday life are just two of its many advantages.

2.10 Challenges in Organising Activity-based Lessons

Teaching biology through activities offers a variety of challenges, according to a study by Mwangi and Sibanda (2017), including lack of facilities and equipment, packed classrooms, lack of time allowed for the classes, and teachers who lack practical expertise. The shortage of laboratory materials and inadequate laboratory space continue to be challenges for biology instruction, according to Dabala et al. (2016).

According to a study done in Ethiopia by Dabala et al. (2016), practical learning activities encourage pupils to understand science. According to Lebata and Mudau's (2014) research in Lesotho, a major issue with biology instruction is that teachers fail to involve students in activities. Ndiokubwayo (2017), on obstacles to science laboratory activities in Rwandan teacher training institutions, found that the majority of schools lacked laboratories and teachers lacked the expertise to carry out the

experiments in the laboratories. Similar gaps in resources and facilities were also shown by Nsengimana (2020). Therefore, it is important to be aware of the difficulties that arise when teaching biology.

According to Aina (2012), if successful science teaching and learning are to occur, the laboratory is a crucial component of the educational institution. A laboratory is a space, a room, a building, or any other designated area that is furnished and reserved for conducting practical or experimental research. "It is an instructional facility used by the teacher to help students learn about science and how scientists investigate the world around them," (Ude & Onah, 2017). It gives students the chance to plan and carry out investigations, use scientific reasoning, operate machinery, create, record, and analyse data, and then present their findings. This suggests that without a fully functional laboratory, scientific instruction and learning cannot be fully completed in a secondary school. Ude and Onah (2017) attributed the dearth of laboratory facilities to pupils' subpar science achievement.

According to Jacobs et al. (2011), science teachers must understand how to enable practical work because knowing the prescribed practicals in the subject's syllabus without understanding how they were carried out is insufficient. This kind of information aids the teacher in planning practical activities for students as well as in preparing and setting up the necessary supplies and tools for students who must conduct experiments. Schools need knowledgeable teachers, who have classroom experience, and have the guts to lead practical (Hill, 2014). Hill (2014) adds that teaching should also be a practical experience that can help students, help them build their knowledge, and help them improve their practical abilities. Teaching should not

only be about enabling learning in which students are expected to gain new knowledge.

Likoko et al. (2013) contend that the lack of fundamental experimental materials in laboratories prevents the teaching of practical work. To teach practical skills, the laboratories' practical materials and equipment are crucial. They contend further that the calibre and quantity of teaching resources can have an impact on student's performance in practical exams.

According to Malathi and Rohini (2018), there is not enough time set aside for practical work, there are not enough resources, and there are too many students in a class, making it difficult for teachers to offer each student their undivided attention at once. According to the authors, teachers are under pressure to adhere to the assessment of theory activities, which reduces instructional time. These are some of the limiting elements to productive practical labour. By far, the most important issues that teachers deal with are the lack of appropriate locations, favourable surroundings, technical support, and laboratory assistants (Malathi & Rohini, 2018).

According to Kapting'ei and Rutto (2014), students should be able to develop a variety of skills, including thinking and procedural skills. Additionally, because they don't understand practical principles, students frequently struggle to develop scientific skills. As a result, they encounter the following difficulties:

- i. Schools don't have enough laboratories.
- ii. Limited area for laboratory work.
- iii. Insufficient laboratory technicians.
- iv. Inadequate apparatus for the laboratory
- v. Time allotted for practical work is limited.

- vi. Few useful handbooks.
- vii. Insufficient money to fix the equipment.
- viii. Learners' inadequate comprehension and mastery of practical topics.

The difficulties encountered when completing Physical Science practical work in Kenyan secondary schools were described by Kaptin'ei and Rutto (2014) as listed above as impeding learning. Globally, schools frequently lack laboratories, for example.

Childs et al. (2016) define a laboratory as a place where scientific problems are addressed through learning efforts. The presence of explosive chemicals in some practical work poses a risk to kids' safety, hence having laboratories off school property is dangerous. According to him, doing such tests in a laboratory lowers their risk (Kasiyo et al., 2017).

Without laboratories, it is difficult for teachers to maintain the safety of the restricted equipment, placing them in danger of destruction. As a result, the number of available pieces of equipment will decrease. According to Kaptin'ei and Rutto (2014), some schools have laboratory space that appears to be highly constrained and unable to accommodate the number of students in a class for the practical sessions, which lowers the productivity of the practical work that students must complete. For students to fit in the laboratory and have enough access to practical tools, teachers occasionally may be required to divide their classes into groups. Working in shifts may take too much time, leaving the practical job undone as required by the syllabus. When the laboratory is well-equipped and contains the materials required for practical work, learners can readily understand scientific concepts through hands-on activities. According to Kaptin'ei and Rutto (2014), more than 70% of the schools they visited

for their study lacked adequate supplies. Nghipandulwa (2012), asserts that the majority of Namibian schools have outdated laboratories. Due to this, there are not many opportunities to complete the practical tasks specified in the syllabus. Additionally, students are denied the opportunity to acquire science ideas as prescribed by the curriculum. In addition to the dearth of adequate equipment, Kaping'ei and Rutto (2014) note that some schools have very old and dysfunctional equipment, and teachers complain that there aren't enough funds to update the outdated items. The lack of qualified laboratory technicians who have the required professionalism and technical know-how is another issue that schools must deal with.

Some schools, according to Kaping'ei and Rutto (2014), do not have any laboratory assistants, which makes it difficult for teachers because they are needed to perform technician-level duties and squander instructional time. Last but not least, their research showed that teachers in some schools said they avoided practical education in favour of theory instruction, which reduced the amount of practical instruction that was covered. Due to teachers setting up the majority of the practical work themselves, Namibian schools hardly ever use lab assistants (Kasiyo et al., 2017). Since they are not qualified enough to undertake practical work using contemporary techniques, teachers lack the expertise to set up practical. The forty minutes allotted for each period are insufficient for a teacher to conduct a practical with a large number of students. Each learner's needs must be met, which is challenging in a situation when resources are scarce and might need to be shared. The potential for each student to investigate, acquire, and comprehend practical information is reduced when resources are shared among learners, according to Kasiyo et al. (2017), because time does not permit it. According to Kasiyo et al. (2017), teachers have also expressed their

dissatisfaction with mandatory management meetings that are scheduled during class time.

According to Kaptan and Timurlenk (2012), it is crucial to offer enough time for preparation before a practical activity so that everything may be set up properly and so that students can get ready. This will guarantee that learners receive accurate feedback and practical work that has a purpose. According to a review of science literature, even though practical exercises involve time, which is frequently scarce, teachers emphasise safety risk assessment and health safety. Similarly, Mwangu and Sibanda (2017) reported that there are not enough science teachers, there are not enough resources, there is not enough funding, and there is not enough time for practical biology instruction in Zimbabwean schools.

Furthermore, according to Mwangu and Sibanda (2017), inadequate teaching aids such as laboratory equipment, chemicals, and local specimens, and a lack of textbooks are factors in students' subpar performance. I strongly support the views of Mwangu and Sibanda (2017) because many schools in my region face similar challenges. It is very difficult to get some chemicals and equipment to carry out experiments in the laboratory. This situation consequently affects students' performance in their final examination.

Scientific instructors have been sending their students into the laboratory for years with the common belief that effective scientific courses provide students with experience in doing, not simply talking about science. Teachers have always faced management issues because laboratory activities take a lot of time from both them and the pupils. Important financial limitations are also at play because of the hefty expenses related to providing the labs and equipment required for practical work. To

ensure that students get the most out of their practical work, teachers are expected to devote a significant amount of their time and energy to their teaching. Due to numerous obstacles, it is often difficult to execute science practical activities effectively in many developing nations, including Ghana (Cossa & Uamusse, 2015). "Some of these constraints include the lack of appropriate settings, the availability of lab supplies and equipment, as well as financial resources, to teach practical; inadequate teacher preparation; poor execution of practical procedures; an excessive amount of activities required by the curriculum; and poor practices teachers display when planning practical work" (Cossa & Uamusse, 2015; Motlhabane, 2013). Furthermore, Mwangi and Sibanda (2017) assert that the teaching of practical lessons has been hampered by the absence of scientific teachers in schools, as well as by a shortage of supplies, money, and time.

There are numerous reasons why students perform poorly in practicals, such as when teachers use inappropriate teaching methods when there are inadequate laboratory facilities when practical activities are poorly organized, when teachers and students are not committed to the activities when there is a partial or complete lack of a laboratory, when there are insufficient qualified science teachers, and when the practical activities are conducted in a laboratory setting. According to studies, when doing practical exercises, teachers primarily employ teacher-centred techniques. Most teaching strategies, including lectures and demonstrations, which are employed in scientific classrooms and laboratories, encourage memorization and deprive students of the chance to work with objects and think back on their actions as they are being taught and learning. One important factor in making information concrete may be the interactions between students during hands-on activities in the lab. According to Mawazo (2010), the majority of students perform badly in science, and one possible

explanation for this low performance is the pedagogy employed when teaching practical work.

Practical work is rarely done in underdeveloped nations, and traditional transmission methods are still widely used (Kandjeo-Marenga, 2011). According to the author, practical work is mostly done through demonstrations. According to Kandjeo-Marenga, these methods can prevent students from gaining the practical skills that the science curriculum emphasizes.

To increase students' academic performance and shift their perspective, science topic classes must include practical activities. However, things are not the same in the majority of Ghanaian schools. To conduct activities in the classroom, teachers are not well-trained in science process skills (Rose et al., 2013). Teachers attempt to avoid the actual work in the lab as a result, and they fail to recognize the significance of laboratory experiments. Little emphasis was placed on the use of science practical work to strengthen students' cognitive skills, according to research conducted by Ghartey et al. (2004) on teachers' views on the use of science practical activities in the teaching of science in Ghanaian Senior High Schools. According to a study by Mwangi and Sibanda (2017), most teachers did not plan their practical work well, and in certain situations, their practical activity's goals were unclear.

According to several academics, the low percentage of students passing scientific-practical exams can be linked to a variety of factors, including unhappiness with the syllabus, teacher credentials, workload, experience, inadequate teaching methods, and ineffective subject matter delivery (Millar, 2012). According to research by Buabeng and Ntow (2010), there were several factors at play when it came to Ghanaian students' subpar biology performance. Among them, the teacher factor was most

important. The majority of students stated that they performed badly in Physical Science at the Senior High School level as a result of receiving inadequate instruction in practical work. The most crucial strategies teachers use to accomplish the goals of a practical lesson are teaching methods of practical work (Buabeng et al., 2014). To accomplish lesson objectives, physical science teachers in senior secondary schools need to employ a variety of teaching strategies. Teachers must use successful teaching strategies if they want students studying physical science to gain practical skills (Buabeng et al., 2014).

One more reason why some professors neglect to plan science activity lessons is the enormous number of students in the science classrooms. A few educators lament that they are unable to assist every student during practical exercises because of the large class sizes. Ramnarin (2014) provided support for this viewpoint when he noted in his research that it was extremely challenging for the instructor to plan and execute lesson plans that included activities because of the large number of students in each class who engaged in science practical activities.

2.11 Attitude of Students towards Activity-Based Learning Strategies

The behaviour a person takes toward other people, objects, situations, or happenings has been defined as their attitude. It is well-known in scientific education that attitudes have a significant impact on students' performance (Yara, 2009). As stated by Chawla et al. (2013), attitude is a perspective. Less-than-ideal attitudes have been shown by students about scientific practicals. According to Edu and Edu (2013), attitudes are comparatively stable orientations that people form toward the different things and problems they experience in life. They explained this by saying that attitudes have an impact on one's ability to perceive and think. They said that the Cognitive Dissonance Theory explained why people are driven to leave difficult

situations, and that they do this by adopting an attitude that is congruent with the unpleasant condition. This lessens the discomfort brought on by the condition. When these practical lessons are scheduled, student participation is often quite low, except when the practical is scheduled right before the final exam (WASCE). Some students wind up in the practical class, pay less attention to the directions, and ultimately fail to accomplish the goal for which the practical is designed. Some students arrive at the lecture without pencils or guidelines, which makes it difficult for them to sketch.

Hinne (2017) found that although students may be enthusiastic about the activities, the practical experience they get from them does not substantially encourage them to pursue careers in biology. Furthermore, the way that hands-on activities are handled has an impact on how students complete them (Hinne, 2017).

2.12 Attitude of Teachers towards Integration of Activity-Based Methods

According to Ogembo et al (2015), the attitude the instructor adopts when presenting a lesson, as well as the teaching methodology used, has a significant influence on the learners' attitude toward the lesson's subject matter. Additionally, the way an attitude is expressed can have a favourable or negative impact on outcomes. According to the present study, a teacher's disposition can significantly affect a student's mental state. According to Abudu and Gbadamosi (2014), a frequent theory regarding teachers' attitudes and student achievement is that students who are taught with the proper approach or attitude have excellent performance scores.

According to Willemse and Deacon (2015), a teacher's bad attitude throughout the teaching and learning process might readily impede the provision of high-quality education. It was anticipated that teachers of science topics would be impacted by the

sharp fall in student interest in the subject. The lack of interest in science-related occupations as a career option is influenced by this declining interest in science.

Willemse and Deacon's (2015) study on teachers' attitudes toward their work suggests that several factors influence a teacher's attitude. Teachers' positive attitudes regarding their profession are often pushed and enhanced by having a strong support network behind them. To help instructors deal with day-to-day issues, the school administration, guardians of students, and the surrounding community are expected to provide a support system. In addition, other viewpoints including a welcoming workplace, considering the surroundings on school property, and promoting appropriate behaviour from students help teachers foster a positive outlook and a passion for their work.

According to Madukwe et al. (2019), attitude is a key factor in behaviour that affects how a teacher interacts with students, which in turn affects a student's academic success. Learners view activity as a crucial part of their science education, according to Hinneh (2017). He continues by saying that his study found that students had a favourable attitude toward lessons that involve activities, which led him to conclude that hands-on activities are considered to be crucial components of science education.

An excellent communication platform is created by a teacher and student who get along well. According to Madukwe et al. (2019), an attitude encompasses elements like sentiments, ideas, and dispositions that have an impact on how a student behaves in a classroom. He continues by saying that children's behaviour affects the goals they set for themselves, which in turn influences how successful they can be.

A teacher's response to a student influences the tone of the classroom. Therefore, if a teacher behaves badly toward students in the classroom, other instructors and students in the school will take note (Madukwe et al., 2019). In a similar vein, teachers' attitudes, methods, and instructional strategies can have an impact on students' attitudes regarding topic knowledge (Madukwe et al., 2019). A favourable attitude about the subject is highly influenced by the teaching methods and the teacher's personality. According to Madukwe et al. (2019), learners perform worse when a teacher lacks interest in and enthusiasm for the subject. They also concur that teachers must build strong relationships with their students and design lessons that demand active participation from students. A productive learning atmosphere is promoted by an engaged and steady teacher, which is highly advised. Lessening student grades is the outcome of teachers' negative attitudes. Because the teacher's attitude prevents it, students are denied the chance to ask questions in class. Teachers should be committed to their work and have a positive outlook since they have a significant impact on how children develop their cognitive, affective, and behavioural traits.

2.13 Perceptions of Teachers and Students on the Importance of Performing Activity-based Lessons

Perception is the capacity of an individual to perceive and comprehend facts that are not readily apparent to others. From a physical, psychological, and physiological standpoint, perception may be described as how we assess or appraise other people. This indicates that people assess those they regularly interact with. According to Eggen and Kauchak (2001), perception has a cognitive component. According to them, perception is the method by which individuals give meaning to their experiences. They clarified that the processing of perception proceeds when individuals attend to specific stimuli in their sensory memory. Perception is important

because it affects what information reaches working memory, claims Davis (2010). Schemas represent prior information that influences perception and future learning.

Teachers' perceptions of practicals are concerning since some believe they are unnecessary and should not be taught because they take up a lot of time. Some educators contend that if the practical work was significant, the curriculum authors would have included a dedicated time for it in the schedule.

Students share this teacher's perspective since it has permeated their education. According to Eggen and Kauchak (2001), a teacher's good attitude is essential for effective instruction. It is the responsibility of teachers to pique pupils' interest in what they are about to learn so that they will put uninteresting objects out of their minds. This suggests that students would likewise have a high view of integrated science if professors had a greater perception of it. This is a result of professors igniting their pupils' intense curiosity about the issue and what the following steps are. The perspective of students is contingent upon their familiarity with and instruction from the teachers who are the subject of the evaluation. As such, their minds are already filled with recollections. Both recent and prior experiences, a person's mood at a given time, the physical state of a sense organ, their level of interest, their level of attention, and the interpretation they make of their perception may all serve to energize perception. The majority of students believe that practicals are solely important for the final test (WASCE).

2.14 Effects of Activity-based Lessons in the Performance of Students in Science

According to Oman and Zakari (2017), students' positive attitudes and motivation for successful scientific learning can be enhanced by practical practice. Thus, students' progress in science is significantly impacted by a favourable attitude toward the

significance of practical work (Hinne, 2017). Students can expand their constructivist learning through interactive experiences offered by practical work (Umar et al., 2005). It also gives students the chance to do science rather than just study it. Students learn positive scientific attitudes- honesty, open-mindedness, tolerance, inventiveness, discipline, and many more as they engage in hands-on learning. They are taught to behave like scientists and put such behaviour into practice. By imitating the activities of scientists, students will enhance their comprehension, sharpen their problem-solving abilities, and gain a grasp of the nature of science.

There are several justifications for assigning practical work in scientific classes in schools, claims Dillon (2008). Keeping students interested in scientific research, transforming ideas into practical applications, encouraging accurate observations and descriptions, and encouraging a logical and rational style of thinking are a few of the motivations. Therefore, via hands-on laboratory activities, students should set up work and observe the concepts in science classes independently. Students often learn more effectively and take an interest in science as a subject when they participate in experiments that provide them with real-world experience (Watts 2013).

Since new information is discovered by actual observations and/or experiments, science is by its very nature provisional, with knowledge being viewed as a partial truth. Improved student outcomes may be attained by teaching common phenomena through experiments and hands-on learning, as well as by actively participating in problem-solving and discovery. One of the main components of scientific education is practical work, which appears to improve students' comprehension of science when they participate in laboratory activities. It also provides an opportunity for the learner

to develop laboratory abilities, such as the ability to use laboratory equipment and inquiry techniques.

To bring theoretical classroom learning experiences to life and pique students' interest in science, practical science activities are crucial. In addition, it gives students the chance to engage with materials and concepts, which encourages the growth of the emotional and psychomotor learning aspects in addition to the cognitive component, ensuring the student's holistic and all-around development Agbowuro (2006). Studies have also indicated that students' communication abilities for solving scientific problems are enhanced by practical work, which in turn increases their motivation for the subject. Furthermore, students' interest in science is stimulated and increased by practical activity, which also promotes science as an interesting topic. The attitudes and mental viewpoints that are essential for scientific investigation are ingrained via practical labour.

2.15 Effect of Motivation on Students Conceptual Understanding

Science study demands a lot of activities due to its nature. Students are always ready to participate in activity-oriented lessons since it is so interesting to them. To help students, grasp science, Gudula (2017) promotes the use of hands-on activities. The results that learners achieve, according to Gudula (2017), are greatly influenced by their motivation. If students are not driven to complete an activity work, they will do it out of necessity, which will result in subpar performance. Since the instructor has a significant impact on a student's motivation, it is crucial for teachers to have a positive attitude and view of activity work to inspire students to complete an activity and ultimately do well. Science has increased humankind's quality of life, their understanding of how the cosmos functions, and how scientific competition develops

(Nacionales et al., 2015). Therefore, it is crucial to understand what inspires people to learn science from many countries. The process of introducing and sustaining goal-directed behaviours is referred to as motivation. Since motivation permeates our lives on many different levels, it drives us as humans every day. According to Nacionales et al. (2015), the amount of interest among students in learning is unclear. The degree of student motivation can provide an answer to this.

According to Nacionales et al. (2015), a learner's academic achievement in the study of science can be predicted by the learning strategies they employ. According to Hornstra et al. (2015), teachers support students by modifying the learning environment for motivational purposes. They go on to say that different teachers may use different motivational strategies.

Cook and Anthony (2016) distinguish between two categories of motivation: An explicit reward for doing something, such as commending someone for their good performance, is referred to as extrinsic motivation. Although its effectiveness has been questioned, it is frequently used in schools since vocal praise and unexpected prizes are thought to have a detrimental effect on other types of motivation. The authors go on to say that extrinsic motivation helps students understand the value of accolades, praise, and attention. Extrinsic motivation does not have the same impact on learning behaviour as intrinsic motivation, according to Tokan and Imakulata (2019).

They refer to the reality that elements like parental support for learning, infrastructure, and social interaction do not inspire students to read books, go to libraries, browse the internet, or attend classes, and as a result, have no bearing on how they behave when learning.

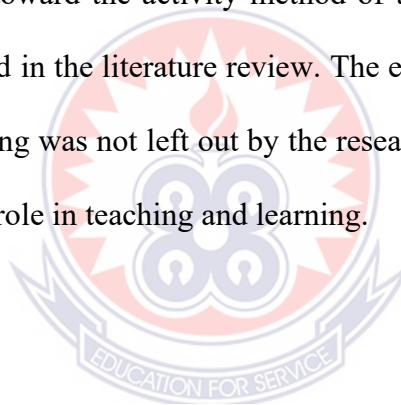
Also, Cook and Anthony indicated that learners have an innate desire to perform a task that they consider will make them happy without receiving a reward from anyone. They described such an innate desire to perform tasks on their own as an intrinsic form of motivation. According to a study by Tokan and Imakulata (2019) on the impact of intrinsic motivation and learning behaviour on student achievement, learners' learning behaviours are influenced by things like interests, ideals, and aptitude, which in turn encourage them to form routines like reading books, using the internet, attending classes, and studying for exams well in advance, all of which help them perform better.

According to Tokan and Imakulata (2019), students form these habits, and their desire to study biology increases. Some students even wish to become biology teachers. The desire, drive, and aptitude that students possess inside themselves serve as the source of intrinsic motivation. This might even manifest as the desire, as Tokan and Imakulata (2019) suggested, to teach biology. These authors similarly defined intrinsic motivation as one's internal encouragement, which is connected to satisfaction. Tokan and Imakulata (2019), in their study on intrinsic motivation, concluded that the learner's behaviour results from a strong intrinsic incentive for learning. Nacionales et al. (2015) state that research has revealed characteristics that have been useful in explaining the motivation for theories of self-concept. According to Nacionales et al. (2015), learning and self-concept are interconnected. The ability of learners to dedicate themselves to their education is strongly influenced by factors including motivation, achievement, attribution, and goal orientation, according to these writers. Programs that are intended to enhance student performance and foster their desire to study have been developed. Attribution modification programs have

been developed to help lower the failure rate for students. The program's feedback enhances motivation, self-efficacy, and skill acquisition (Nationales et al., 2015).

2.16 Summary

The chapter began looking at the theory that backs the study. Methods used in teaching biology and their merits and demerits were reviewed. The role both teacher and students played in activity method of teaching to enhance conceptual understanding and acquisition of practical and experimental skills of students was considered under the literature review. The challenges teachers encounter in integrating the activity method of teaching classification as well as the attitude of teachers and students toward the activity method of teaching was another important issue that was discussed in the literature review. The effect of motivation on student's conceptual understanding was not left out by the researcher because the motivation of students plays a major role in teaching and learning.



CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter covers the research design used in the study. The target population as well as the sampling techniques and sample size that guide the study are all dealt with in this chapter. The chapter also provides an account of the instruments employed in gathering data and the intervention techniques that were used to help solve the problem being studied.

3.2 Research Design

The design is a case study that will adopt a mixed-method approach. Creswell (2018) defined research design as the plan, structure, and strategy of inquiry conceived to obtain answers to research questions and control variance. Research design is a plan that specifies how data relating to a given problem should be collected and analysed. Qualitative and quantitative methods of data analysis were the two main techniques that the researcher employed to analyse data. The data from the test items and questionnaire were analysed quantitatively while the data from the interview was analysed qualitatively. In my own view, a research design is the overall plan or strategy a researcher uses to conduct a study. It is a blueprint that outlines the methods and procedures for collecting, analysing, and interpreting data to answer specific research questions.

3.3 Sample and Sampling Technique

A sample is a group of people who have been chosen through a sampling technique from a wider population. The sample is an accurate representation of the research subjects because it includes people who share the same traits as the target population.

Purposive sampling was the method used for the study's sample selection. To gather information from people who, due to their professional position, area of expertise, or experience, have in-depth knowledge about specific issues, this sampling is used. To choose the cases that should be part of a sample, researchers apply their judgment (Cohen & Morrison, 2018). Three Biology teachers and Form Two Science 2 (2C) students were chosen as the study's research subjects. There were 46 students in Form 2C overall, including 22 girls and 24 boys. The form two class was selected because it was thought that by that time, students would have engaged in some biology activities and, at that age, would provide more reasonable answers to the interview questions, improving the trustworthiness of the data. Since the intervention began during the regular teaching periods, all students were chosen.

3.4 Research Instruments

The main research instruments employed to gather data for the study were questionnaires, achievement tests, and interview schedules.

3.4.1 Questionnaire

A questionnaire is a survey tool consisting of a series of questions and other prompts designed to gather information from a respondent. The questionnaire was important because it aimed to learn students' opinions about their performance in biology and the strategies used during biology lesson delivery. Facts are gathered through questionnaires to categorize individuals and their situations. They are also intended to collect uncomplicated data about people's actions. Surveys examine a population's fundamental beliefs about a certain topic and gauge how satisfied consumers are with a brand-name good or service. They assist in gathering "baseline" data that may be monitored over time to look for changes (Amoah & Eshun, 2015).

A closed question was used. This was to limit the answers given by respondents and to make it easier to code items. The questionnaires used in this study were designed and distributed in a non-personally identifiable manner to ensure full compliance and candid responses. The questionnaire was personally administered by the researcher. This was to ensure that the survey reached the respondents directly. Additionally, each part of the survey that was problematic for the respondent was explained in more detail. Second-year science students were selected as research subjects to answer the questionnaire.

3.4.2 Test

Pre-intervention and post-intervention tests using two test items were conducted. The pre-test questions were different from the post-test questions but the difficulty level was the same. This was done to evaluate how the intervention affected the academic achievement of the students. It was also to ascertain whether students could apply their knowledge on classification of organisms after going through a series of intervention strategies. A criterion-reference test was used. The criterion-referenced test asks students to meet a predetermined benchmark or a set of criteria rather than comparing their scores to those of other students (Cohen & Morrison, 2018). This particular test was chosen to determine the precise content that each student had learned as well as their abilities and limitations.

Following the execution of the intervention activities, the post-intervention test was carried out. This was done to assess the intervention's efficacy on how students understood the topic classification of organisms in biology after going through several activities. It was also to ascertain whether students were able to demonstrate their scientific skills in answering the test items. The test was divided into two parts: the

first part asked for background information about students' personal information, including number (students were assigned identification numbers for the study's purposes rather than names to ensure confidentiality), and age, and the second part was composed of fill in the blank items. This was done to find out how students would demonstrate their skills in answering questions. The passing grade was 50% of the total points for each test. Following the two examinations, the students' grades were recorded.

3.4.3 Interview

An interview is a conversation where questions are asked and answers are given. It is a one-on-one conversation with one person acting in the role of the interviewer and the other in the role of the interviewee. The interviewer asks questions, while the interviewee responds. Interviews can be structured, semi-structured, or unstructured. Interviews also enable a researcher to obtain students' impressions first-hand and enable him to ask probing questions based on their answers to understand them better. Two separate semi-structured interviews were conducted; one with the biology teachers and the other one with the students. The semi-structured interview was used since it is flexible and allows new questions to be brought up during an interview. Thus, it allows one to probe further into the responses given by the respondents. It also allows respondents to freely express their views. The interview formed the secondary source of data to supplement that of the primary source, the questionnaire, and tests.

The biology teachers were interviewed to find out their level of qualification, the methods they employed in teaching biology, the challenges they encountered in integrating activity methods in their lesson's delivery, the student's attitude towards

biology, and how their attitude influenced their performance in the study of biology. The interview was also employed to find out factors that contribute to the problems students face in their learning of biology. Ten (10) students selected at random were interviewed one after the other about their perceptions and attitudes during biology lessons.

3.5 Pre-intervention Activities

These included student class exercises, test responses, as well as informal interviews conducted to determine the causes of the Queen of Peace Senior High School students' inability to demonstrate some scientific skills in answering questions in classification of organisms in biology. An informal conversation with the students was conducted to learn more about their perceptions of and challenges with biology as a subject. This was done to determine the severity of the issue and how best to assist the students in solving it.

A pre-intervention criterion-reference test on the topic classification of living organisms was undertaken. This topic was chosen because it frequently appears in practical problems on the West African Senior Secondary Certificate Examination (WASSCE). Based on the results of the pre-intervention activities, interventions were created and put into action to help Form Two Science 2C students demonstrate and apply scientific skills in classification of organisms in biology through the use of interactive teaching methods.

3.6 Intervention

This discussed the steps taken to address the issues of students' low performance and lack of enthusiasm for learning biology. It discusses the intervention's design, the

tools used, and how it was put into practice to enable students to demonstrate their scientific skills in teaching and learning biology.

3.6.1 Intervention Design for the Study

Results from the pre-intervention activities gave the researcher insight into the sort of intervention strategies that could be adopted to aid Form Two Science Two (2C) students in developing practical and experimental skills needed to understand the topic classification in biology. The interventions used were:

- i. Activity-based methods of teaching,
- ii. the use of a hands-on instructional approach in teaching,
- iii. laboratory practical activities,
- iv. the use of group activities,
- v. project-based learning and,
- vi. organizing recurrent problem-solving exercises and effective assessment of students' work to keep them in tune with their performance.

3.6.2 Implementation of the Intervention Activities

The researcher selected the topic "classification of organisms" to address the issue. The main teaching methods employed throughout the intervention were hands-on instructional methods, which were designed to aid students in understanding the concept, spark an interest in biology, and excel in the topic. The utilisation of teaching resources, group projects or activities, presentations, and practical laboratory activities were all components of the hands-on instructional approach that was used during the intervention. The TLMs employed diagrams, graphic illustrations, models, and tangible materials to effectively and realistically express meaning. The learning tools were able to clarify and better illustrate topics and concepts that the students found

difficult to understand. These were to help them develop a positive attitude toward biology and change their perceptions about the subject.

The biology lessons included group projects or activities. Different learning levels of students were mixed in groups of five or more. Their task was to create an album featuring both plants and animals. They were instructed to write the organism's English name, scientific name, habitat(s), class, two features of the class, and order. As they worked in their various groups, they engaged in activities to learn more about themselves and one another. They were able to discuss ideas and share them. The various groups received guidance and help throughout this procedure. Comments, thoughts, and viewpoints expressed by them were discussed with their colleagues.

Field trips were planned for the students to examine concepts for their comprehension both inside and outside of the Nadowli community and the school. The various species of organisms found in ponds, their adaptive features that allow them to live in water, how they obtain oxygen, the features that allow aquatic plants to live in water, the relationships between aquatic plants and animals, and the differences that can be observed between aquatic and terrestrial organisms were some of the concepts that were explored. The specimens collected were sent to the laboratory for further observations to be made on some features that could not be seen clearly with the naked eye using the compound light microscope. During this exercise, students were able to demonstrate their scientific skills of observing, manipulating, designing, experimenting, and drawing as they were made to draw some of the organisms they collected. The students were instructed to adhere to a specified range of measurement (10cm–12 cm) in drawing the organisms they were instructed to draw. This was done to help students develop their skills of measurement in biology. There were numerous

practical exercises carried out, and students participated actively by contributing and asking questions for clarification. Procedures and instructions on how to complete tasks during practical or field sessions were given to students. Lessons on identifying and using laboratory apparatus were given to the students before the start of the practical exercises.

Assignments to produce brief notes on the subject were provided to the students. Randomly selected members of each group were invited to the chalkboard to present their findings, lead discussions, and help members of the other groups in the class solve problems or understand concepts that they were having trouble understanding. This was done to assist them in finding material on their own and in presenting their notes to the class with assurance.

Each session ended with either class exercises or homework being provided to the students. Additionally, they regularly participated in project work and class assessments within a set time frame. These tasks, quizzes, exercises, and assignments were marked on time and with the necessary notes so that the students could evaluate their development. Students were frequently updated on the marking policies for various tests, exercises, assignments, and projects to help them become more exam-ready.

3.7 Post-Intervention Activities

Students took a post-intervention test, which lasted 40 minutes and was of similar difficulty level as the pre-intervention test after the intervention had been put into place. This was done to compare the students' performance before and after the intervention period to gauge how effective the intervention techniques were.

3.8 Pilot Test and Reliability of the Questionnaire

A pilot test of the questionnaire was conducted in a Form Two Science (2C) class at Lassia Tuolu Senior High School to ascertain its reliability. A sample of 46 students were chosen for the pilot test. This was done to make it easier to spot errors and change the questions. It also assisted in determining the precise language and order of the questions that the study sample had to answer. The questionnaire was reconstructed after the pilot study to get the necessary replies. Clear directions for filling out the questionnaire and a comfortable testing atmosphere helped to increase dependability.

From the data generated from the Statistical Package for Social Sciences (SPSS), the calculated Cronbach's alpha value for reliability was 0.75 which is considered to indicate acceptable or good internal consistency of the items in the scale. This suggests that the items within the scale are reasonably related to each other and are likely measuring the same underlying construct fairly consistently. This means that the scores obtained from the scale are relatively stable and reliable. This is an indication that if I were to administer the same scale to the same group of people under similar conditions, the results are likely to be similar. A Cronbach's alpha value of 0.75 is a positive finding, suggesting that the scale demonstrated acceptable to good internal consistency and provides reasonably reliable measurements in research context and can confidently be used.

3.9 Validity of the Questionnaire

A validation analysis was performed on the questionnaire. Colleagues were given the instrument to read so they could provide feedback, and this was accomplished. My supervisor, who has conducted extensive studies on science education, approved the

questionnaire that was evaluated by coworkers. Colleagues, the supervisor, and others provided suggestions and feedback that were used to enhance the instrument's face and content validity. All respondents answered the same questions on the full questionnaire, which allowed the researcher to cross-check some of the responses.

3.10 Validity and Reliability of the Interview Instrument

The data collection took place in the same place as all the informants were working in the same institution. It was held in a quiet place to safeguard confidentiality. The responses to the questions were written down by the interviewer and later compared. The interviews were documented with the consent of each of the interviewed subjects to preserve the collection of informative data.

Therefore, this research is framed within the proposed ethical considerations: Informed consent, avoiding deceit of study participants, protecting participants' privacy, upholding the accuracy of data and interpretation, and respect for the individual. Furthermore, to protect the participants' privacy, all personally identifiable information that might be used to identify them has been eliminated, guaranteeing their anonymity throughout every interview. Concerning the consent, every single one of them was told about the goal of the study.

The semi-structured interview questions were given to colleagues' teachers to make corrections and inputs. My supervisor who has in-depth knowledge of research approved the questions for the interview.

3.11 Data Collection Procedure

To get approval from the Headmaster of Queen of Peace Senior High School, Nadowli to conduct the study there, an introduction letter was received from the Head

of the Department of Science Education, University of Education, Winneba. Students in the form two General Science Two class were given 46 questionnaires with the help of the biology teacher. To reduce ambiguity in the students' responses, the item instructions were made explicit to them. The instructions were explained to the students to avoid any challenge students might have on any of the questionnaire's items. Students were requested to write their identification numbers instead of their names on the questionnaire since they had been guaranteed that their answers would remain anonymous and secret. The forty (40) minute questionnaire was completed and returned.

To obtain accurate and reliable data from the interview, the researcher contacted the interview subjects, and a voluntary agreement was made to be involved in an interview session by the interview subjects. After an agreement from the respondents, the researcher arranged the date and time for the interview according to respondent availability and then invited them one after the other to get their individual opinions. It was made clear to respondents that their responses would be documented and read to them after the interview session was over to ensure that the information gathered from each of them was truly documented by the researcher.

The interview was conducted face-to-face by using semi-structured guided questions. The researcher started with greetings, and self-introduction from both the interviewer and interviewee, and then the researcher explained the objectives of the interview session, the process of interviewing the respondents, and recording the interview data until the closing of the interview session. The entire interview session took almost 30 minutes. After that, the researcher summarized the interview session and offered questions, suggestions, or thoughts from the interviewees. Finally, the researcher

expressed appreciation and pleasure to the interviewees for their support. The interview was conducted in the English language.

3.12 Method of Data Analysis

While the data from the interview session was analysed qualitatively, the data from the questionnaire and tests were quantitatively analysed. Two (2) stages of analysis were performed on the study's findings.

The test results (pre-intervention test and post-intervention test) and questionnaire results were analysed in the first phase using means, frequencies, and percentages. On the other side, a qualitative analysis was conducted to learn about the biology teachers' opinions and perceptions they have on the role of activity methods in teaching classification of organisms and biology at large. It was also to ascertain the challenges they encounter integrating the activity method of teaching in their lesson's delivery. The data from the interviewees were documented verbatim. Details of the analysis and the study's conclusions are provided in chapter four.

3.13 Ethical Consideration

According to Babbie (1992), participants' psychological well-being and dignity must be preserved while they should be protected from harm. It is important for a researcher to get the consent of the people to be interviewed or to retrieve pieces of information from them. For this reason, personal contacts were made with the respondents for the study. After explaining to them the purpose of the research and its benefits, and assuring them of confidentiality that would be accorded them and the pieces of information that would be gathered from them, they agreed to participate in the research. Throughout the research work, moral and legal issues about the participants were taken care of. I first and foremost, sought permission from the

authorities of the headmaster of Queen of Peace Senior High School, Nadowli before carrying out the research. This was done through a letter and several visits to the institution. Permission was subsequently granted for me to carry out the research. Walliman (2011) asserts that social research and other types of research which examine people and their interactions with each other and the world, need to be especially concerned with issues of ethical behaviour. In line with this, I treated all respondents with due ethical considerations including the way and manner the respondents were chosen, how they were treated, and how the pieces of information they offered were used and treated and secured mainly for academic purposes.

3.14 Summary

This chapter describes the research design and instruments used for the study. The pre-intervention, intervention, intervention design, implementation of intervention activities, and post-intervention activities were all discussed. The validity and reliability of the main research instrument were equally elaborated in this chapter. The procedures followed to collect data for the study and the methods used to analyse the data collected were some of the areas that were considered.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

The research results, analysis, and discussion of the study are presented in this chapter. The analysis is based on the answers to the questionnaire, the achievement tests, and the instructor interview that was conducted.

4.1 Analysis of Students' Questionnaire

Research question 1: What practical skills do students demonstrate in their classification of organisms?

This question sought to find out the practical skills students demonstrate during the teaching and learning of classification of organisms as a topic in biology. It was also to ascertain the challenges and difficulties students encounter in classifying organisms by applying the needed scientific skills. The responses of students about their ability to demonstrate the needed scientific skills. Additionally, this question aims to determine how well students can use critical thinking and scientific inquiry while categorizing living things based on their traits, structures and taxonomy. This study intends to explore the problems and hurdles students may have when completing categorization tasks. Also, to recognizing the practical abilities they exhibit. These difficulties might include a lack of exposure to a variety of specimens, poor use of scientific instruments or resources, misunderstanding of biological terminology and classification. The responses of students about their ability to demonstrate the needed scientific skills in classification are presented in Table 1.

Table 1: Practical skills students demonstrate in classification of organisms

Response	S. D	D	N	A	S. A	M	S. D
Ability to manipulate equipment	1(2.2%)	7(15.2%)	2(4.3%)	28(60.9%)	8(17.4%)	3.76	0.993
Able to demonstrate my scientific skills	2(4.3%)	5(10.9%)	3(6.5%)	26(56.5%)	10(21.7%)	3.80	1.046
I improve my drawing skills during activity lessons	6(13.0%)	11(23.9%)	4(8.7%)	14(30.4%)	11(23.9%)	3.28	1.404
My observation skills improve during activity lessons	5(10.9%)	3(6.5%)	3(6.5%)	15(32.6%)	20(43.5%)	3.28	1.330
My ability to classify organisms improves during fieldwork	5(10.9%)	2(4.3%)	1(2.2%)	16(34.8%)	22(47.8%)	4.04	1.298
My practical skills are improved when the lesson involves practical activities	2(4.3%)	1(2.2%)	0(0.0%)	14(30.4%)	29(63.0%)	4.04	1.299
I am able to set apparatus during a practical demonstration	6(13.0%)	7(15.2%)	4(8.7%)	19(41.3%)	10(21.7%)	3.43	1.344
I improve my communication skills	3(6.5%)	2(4.3%)	1(2.2%)	12(26.1%)	28(60.9%)	4.30	1.152

I can manipulate equipment during practical activities

From Table 1, 28 students representing (60.9%) strongly agreed that they can improve upon their manipulative skills when the lesson involves activities and eight students

representing (17.4%) agreed with the statement. However, seven students representing (15.2%) strongly disagreed, and one student representing (2.2%) disagreed with the statement. This is an indication that students' ability to manipulate scientific equipment is enhanced when they are subjected to student-centred learning. Fadzil and Saat (2020) in their study found that the usage and handling of chemical substances and scientific equipment during laboratory research are emphasised by manipulative skills in science. Students are also taught the right way to use, clean, and store scientific equipment properly.

They also suggested that students with strong science manipulative skills will have a better chance of concentrating on the growth of science process skills, which comprise competencies like observing, classifying, measuring, and using numbers, as well as inferring, predicting, and communicating. They will also have a better chance of controlling variables, formulating hypotheses, and experimenting. As a result, these scientific abilities must be taught to students, in stages, and in this case, instructors are the primary instrument responsible for creating, instilling, and passing on to their students the skills of science learning and manipulatives.

I can demonstrate my scientific skills when lessons are activity-oriented

It is observed in Table 1 that, 26 students representing (56.5%) agreed, 10 students representing (21.7%) strongly agreed, only three students representing (6.5%) of the respondents remained neutral while two students representing (4.3%) and five students representing (10.9%) strongly disagreed and disagreed with the statement respectively. Inferring from the figures above, it is clear that the majority of the students testified that they improve upon their scientific skills when the lesson is activity-oriented. Ufonabasi and Nsimeneabasi (2017), indicated that for students to

be able to acquire essential, useable skills in science topics, they must receive satisfactory education through a variety of activities. Effective activities help students to improve their individual, cognitive, and learning capacities. The outcome of this is presented in Figure 1.

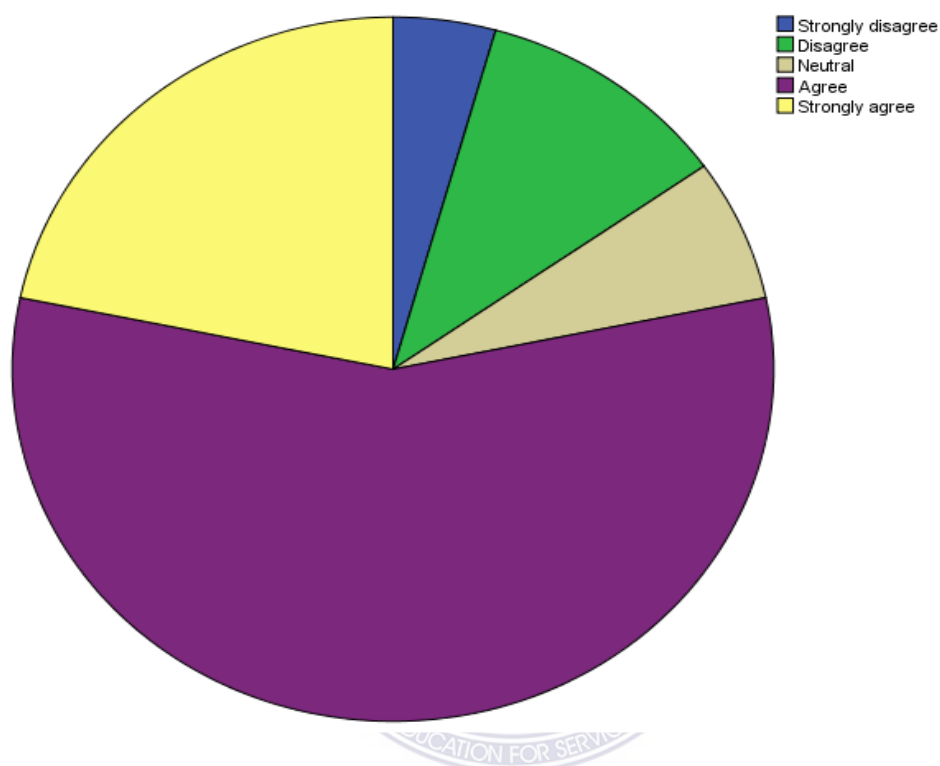


Figure 1: Students' ability to demonstrate their scientific skills

I improve my drawing skills during activity lessons

Table 1 indicated that, six students representing (13.0%) have strongly disagreed, 11 students representing (23.9%) had disagreed, four students representing (8.7%) remained neutral to the statement. Those who had agreed and strongly agreed with the statement were 14 students representing (30.4%) and 11 students representing (23.9%) respectively. Though the majority of the students indicated their drawing skills improve during activity lessons, much needs to be done by biology teachers to aid those who have challenges with their drawing skills.

My practical skills improved when the lessons involved hands-on activities

It had been observed in Table 1 that, 14 students representing (30.4%) had agreed with the statement, 29 students representing (63.0%) had strongly agreed with the statement while two students (4.3%) had strongly disagreed with the statement. Only one student representing (2.2%) of the respondents completely disagreed with the statement. Based on the data above, one can conclude that hands-on activities facilitate students' ability to acquire practical skills. Piaget (2013), in his research, indicated that humans build more complex and potent representations of the world by acting with them in the context of their current knowledge. If Piaget is true, then practical activities are crucial to comprehending the sciences in general. I strongly support Piaget because the primary purpose of practical work is to assist students in learning and relating or making connections between the world of real things and verifiable facts.

Students are encouraged to learn by experience while teaching with a hands-on approach. Students engage more actively in the learning process when they have the opportunity to interact with the objects they are studying. Students participate actively in the class when science is taught using the activity approach. This was demonstrated by the students when they were assigned group project work and group presentations during lesson delivery on classification of organisms at the intervention stage. This is shown in Figure 2.

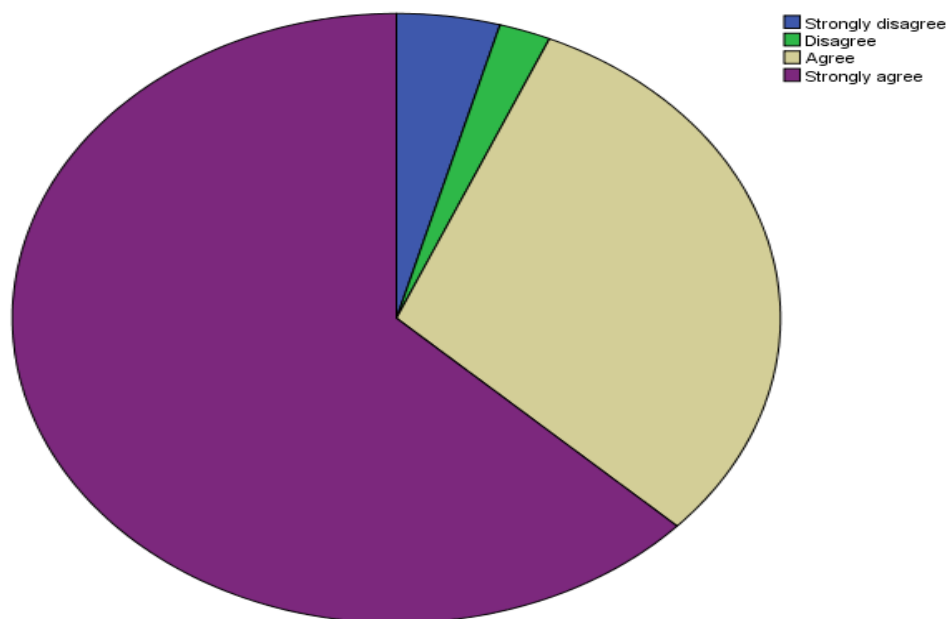


Figure 2: A pie chart showing improvement in students' practical skills during practical activities

I can set up needed apparatus during a practical demonstration

The views of students were solicited on their ability to set up apparatus during practical demonstration lessons and out of the total number of the sample students that took part in answering the questionnaire as shown in Table 1, 19 students representing (41.3%) of them agreed that they were able to set up apparatus during practical demonstration, 10 students representing (21.7%) strongly agreed as well, four students representing (8.7%) remained neutral as they could not confidently attest to the statement. Those who disagreed were six students representing (13.0%), and seven students (15.2%) strongly disagreed. Though a majority of the students were able to set up apparatus for practical demonstration, about twenty (20) of them confirmed their inability to confidently set up apparatus on their own. This means that students need to be exposed to more practical activities to enhance their conceptual understanding and improve their manipulative and experimental skills. The hands-on

method has been suggested by Piaget (2013) as a way to improve students' academic performance and comprehension of scientific concepts by allowing them to manipulate things that could help make abstract knowledge more physical and understandable. Students can participate in real-world examples and see the effects of changing various factors by engaging in a hands-on approach. Since biology requires more seeing, touching, and manipulating than hearing, this learner-centred method also encourages the "do it yourself" philosophy in science as stated by Piaget (2013).

My ability to classify organisms improved during fieldwork

From Table 1, it is observed that 16 students representing (34.8%) and 22 students representing (47.8%) responded positively by agreeing and strongly agreeing with the statement respectively. Five students representing (10.9%) and two students representing (4.3%) responded negatively to the statement by strongly disagreeing and disagreeing with the statement. Only one student representing (2.2%) of the respondents remained neutral to the statement. The majority 16 students representing (34.8%) and 22 students representing (47.8%) of the students agreed that fieldwork activities facilitate their understanding of how to classify organisms based on common features they possess. This means that if biology instructors blend fieldwork, and activity methods of teaching, students will not have much problem in classifying organisms which is a major challenge to most students when it comes to paper three of their final West African Senior Secondary Certificate Examination (WASSCE).

My observation skills improved during activity lessons

The responses in Table 1 indicated that 15 students representing (32.6%) agreed, and 20 students (43.5%) strongly agreed with the statement. Of those who did not support the statement, five students representing (10.9%) and three students representing

(6.5%) of the respondents strongly disagreed and disagreed with the statement respectively. Those who had no idea and remained neutral were three students representing (6.5%). This supports Motlhabane and Dichaba (2013) who opined that activities in science play a great role in learning since students learn better by doing. Activities make students actively involved in learning science when they are engaged in several activities. It reduces boredom in them and motivates them to achieve results.

I improve upon my communication skills when my biology teacher engages us in activities

From Table 1, those who agreed were 12 students representing (26.1%), strongly agreed 28 students representing (60.9%), strongly disagreed three students representing (6.5%), disagreed two students representing (4.3%) and one student representing (2.2%) remained neutral. A good number of students 12 students representing (26.1%) and 28 students representing (60.9%) indicated that their communication skills were improved anytime they were engaged in activities during teaching and learning by their teacher. This means that biology teachers should emphasize teaching methods that would make all students actively involved in class instead of being passive learners and recipients of knowledge. This supports Kolb's (2014) the assertion that learning through conversation gives people the chance to communicate, think back on prior information and experiences, and contrast the past and present. Teachers must therefore establish a collaborative learning environment where students have the resources and chance to build new understandings by fusing experiences from many sources for students to construct knowledge efficiently. By applying their information to the context of fixing real-world problems, learners can explore their knowledge and continuously improve it. Vygotsky (1978) also attested

to this when he added that people build their knowledge through their interactions with others and the learning environments.

Research question 2: What methods do teachers employ in teaching classification of organisms in biology?

The question is aimed at finding out the kind of teaching strategies biology teachers employ in their lesson delivery to teach biology in general and the impact these methods have on the conceptual understanding of students. It was also to come out with the appropriate strategy/strategies for biology teachers in their lesson delivery instead of possibly relying solely on one strategy. The responses from the respondents are indicated in Table 2.

Table 2: Methods teachers employ in teaching classification of organisms

Response	SD	D	N	A	SA	M	S. D
I prefer the lecture method to activity-based lessons	24(52.2%)	13(28.3%)	2(4.3%)	4(8.7%)	3(6.5%)	1.89	1.233
My biology teacher always gives us project work every semester	5(10.9%)	8(17.4%)	1(2.2%)	19(41.3%)	13(28.3%)	3.59	1.359
I understand concepts well during a group presentation	4(8.7%)	13(28.3%)	1(2.2%)	13(28.3%)	15(32.6%)	3.48	1.426
At the time of giving presentations, I do not feel confident	19(41.3%)	10(21.7%)	0(0.0%)	11(23.9%)	6(13.0%)	2.46	1.545
Group projects help me learn to work with others and cooperate	2(4.3%)	0(0.0%)	0(0.0%)	15(32.6%)	29(63.0%)	4.50	0.888
Preparing projects creates a burden for studies	18(39.1%)	12(26.1%)	6(13.0%)	6(13.0%)	4(8.7%)	2.26	1.341
During team projects, I do not get a chance to put my viewpoints	21(47.7%)	18(39.1%)	2(4.3%)	2(4.3%)	3(6.5%)	1.87	1.128

I prefer the lecture method to activity-based lessons

In Table 2 above, 24 students representing (52.2%) of the respondents strongly disagreed, and 13 students representing (28.3%) disagreed respectively that the lecture method of teaching biology should not be encouraged. Only two students representing (4.3%) of the respondents remained neutral to the statement as they could not determine which of the two methods would be appropriate in teaching biology. Those who agreed and strongly agreed that the lecture method was appropriate and should be used during lesson delivery in biology were four students representing (8.7%) and three students representing (6.5%) respectively. Alasi (2018) investigated how an activity-based learning approach affected the test scores of second-graders in his study. It was asserted that when the exercises were completed, it was easy for students to make the relationships between the given data or models. By putting the exercises into reality, the students accurately and swiftly explained the similarities that emerged from the challenges or scenarios presented in the activities. Based on Alasi's deduction and others like Piaget, one can conclude that the activity method would be appropriate in teaching biological concepts like classification of organisms as the students will be actively involved in gathering and putting organisms into groups based on their common features. In doing this, the students' scientific skills of observing, classifying, and manipulating will improve as students learn best when they see, touch, and feel objects.

My biology teacher always gives us project work every semester

It is observed in Table 2 that, five students representing (10.9%) strongly disagreed, and eight students representing (17.4%) disagreed. Only one student representing (2.2%) of the respondents remained neutral and could not attest to that fact. However, 19 students representing (41.3%) and 13 students representing (28.3%) of them

responded positively to the statement by confirming that their biology teachers have been engaging them in project work every semester. The majority of the students confirmed that the biology teachers have been giving students project work to do. Motlhabane and Dichaba (2013) opined that activities in science play a great role in learning since students learn better by doing. Activities make students actively involved in learning science when they are engaged in several activities. It reduces boredom in them and motivates them to achieve results. As students are engaged in project work, it motivates them to search for information to achieve results. This further enables them to develop scientific skills as they interact with organisms and equipment in their quest to come out with meaningful project work.

I understand concepts well during group presentations

From Table 2, four students representing (8.7%) and 13 students representing (28.3%) respondents strongly disagreed and disagreed with the statement by indicating that they do not understand concepts well during group presentations. One student representing (2.2%) remained neutral. Thirteen students, representing (28.3%) and fifteen students representing (32.6%) agreed and strongly agreed that they understand concepts when they are engaged in group presentations. The majority of the students confirmed that group presentations boosted their confidence level and helped them improve their communication skills. Al Maghraby and Alshami (2013) emphasised this point by stating that, to accommodate the varied learning styles of students, science teachers must employ flexible, innovative, and learner-centred teaching approaches. Teachers should use instructional strategies that give students the chance to share information and get enough practice with what they can expect in examinations. This could be accomplished by offering students more issues to solve

and opportunities to apply what they have learned in the laboratory to real-world settings.

I believe that effective teaching and learning techniques in science, like group work, laboratory investigations, and problem-based education, allow students to engage and aid one another in achieving improved subject comprehension and practical abilities. Different teaching strategies are likely to meet the student's individual learning preferences.

At the time of giving presentations, I do not feel confident

In Table 2, nineteen students, representing (41.3%) and ten students representing (21.7%) respondents disagreed that during group presentation they feel bored while eleven students representing (23.9%) and six students (13.0%) of them said they are always bored when the lesson involves group presentation. The majority of the students prefer group presentations while few of them do not like group presentations. This means that biology teachers should engage students in group presentations as it will keep most of the students active during teaching and learning as said by Al Maghraby and Alshami (2013).

Group presentations help me learn with others and cooperate

From Table 4 only two student (4.3%) respondents strongly disagreed with the statement while 15 students representing (32.6%) and 29 students representing (63.0%) of the respondents also agreed and strongly agreed with the statement. This means that when students are exposed to group presentations, it goes a long way to motivate them thereby encouraging them to achieve higher heights. This is shown in Figure 3.

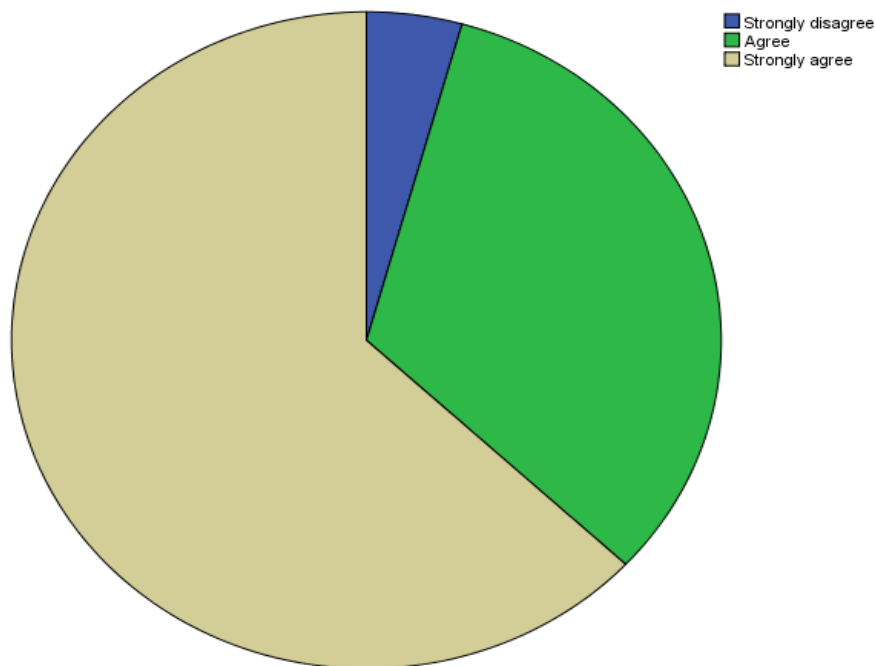


Figure 3: students' interest and cooperation during project work

Preparing projects creates a burden for studies

Data in Table 2 revealed that 18 students representing (39.1%) and 12 students (26.1%) strongly disagreed and disagreed that preparing projects creates a burden for studies. Only six student (13.0%) of them indicated that they had no idea while six students representing (13.0%) and four students representing (8.7%) agreed and strongly agreed with the statement preparing projects creates a burden for studies. The results suggest that. majority of the students agreed that when they are engaged in group projects it helps them to research for more information and does not create any burden on their studies. It is therefore paramount for biology teachers to blend group projects in their lesson delivery as it will help promote collaborative learning amongst students. As students work in groups, they can learn from their peers, tolerate each other's views, and improve their communication skills, observation skills, and discovery skills. This in effect facilitates their conceptual understanding and prevents them from rote learning.

During team projects, I do not get a chance to express my viewpoints

This statement required the respondents to indicate their levels of agreement. In Table 2 it was observed that 21 students representing (45.7%) respondents indicated strongly disagreed, 18 students representing (39.1%) disagreed, two students representing (4.3%) were neutral while two students representing (4.3%) and three students representing (6.5%) respondents agreed and strongly agreed to the statement. This is an indication that if teachers involve students in group presentations, it will help them to improve their confidence level and facilitate their acquisition of scientific skills.

Research question 3: What are students' perceptions of the activity-based method and their performance in classification?

The question is geared towards finding out the perceptions students held about the activity-based method of teaching biology in general. It is also aimed at finding out how this method of teaching affects their conceptual understanding of the topic classification of organisms. The responses of the students are presented in Table 3.

Table 3: Students' perceptions of the activity-based method

Response	S. D	D	N	A	S. A	M	S. D
I feel curious about what I learn when I am involved in activities	4(8.7%)	1(2.2%)	3(6.5%)	19(41.3%)	19(41.3%)	4.04	1.173
I understand concepts well when the lesson is activity-based	2(4.3%)	1(2.2%)	4(8.7%)	19(41.3%)	20(43.5%)	4.17	0.996
Students pay less attention when they are involved in activities while teaching	17(37.0%)	15(32.6%)	1(2.2%)	11(23.9%)	2(4.3%)	2.26	1.307
I feel bored in class whenever my biology teachers involve us in activities	26(56.5%)	13(28.3%)	3(6.5%)	2(4.3%)	2(4.3%)	1.72	1.068
Activity-based lessons waste my time	26(56.5%)	11(23.9%)	1(2.2%)	6(13.0%)	2(4.3%)	1.85	1.229
I enjoy biology lessons that involve activity	0(0.0%)	1(2.2%)	3(6.5%)	17(37.0%)	25(54.3%)	4.43	0.720
I easily recall concepts that are taught using activity-based method	1(2.2%)	0(0.0%)	2(4.3%)	15(32.6%)	28(60.9%)	4.50	0.782

I feel curious about what I learn when I am involved in activities

Table 3 indicates that four students representing (8.7%) of the 46 respondents strongly disagreed, only one student (2.2%) disagreed, three students (6.5%) were neutral whilst 19 students representing (41.3%) of the respondents agreed and strongly agreed with the statement. This means that students are always eager and pay attention to their teachers whenever they are exposed to activities. To enable students, to develop their scientific skills in answering questions in biology and for that matter classification of organisms, biology teachers need to pay much attention to the activity method of teaching because it is more student-centred. According to Prakash's (2016) research, educators who can foster an environment of active learning will be able to support their students and provide knowledge in a variety of ways.

They will also make learning easier and better. As a result, they ought to offer an engaging and interactive setting to improve education.

I understand concepts well when the lesson is activity-based

The statement sought to ascertain the impact the activity-based method of teaching has on students understanding of scientific concepts. In Table 3, two students representing (4.3%) strongly disagreed, one student (2.2%) disagreed, four students representing (8.7%) remained neutral, 19 students representing (41.3%) agreed and 20 students representing (43.5%) strongly agreed with the statement. It implies that the majority of the students understand concepts well when they are engaged in an activity-based method of teaching. This still buttressed the assertion by Prakash (2016).

I feel bored in class whenever my biology teachers involve us in activities.

The statement was to find out how students react when they are involved in activities during biology lessons. It was equally important to find out their attitude toward the activity method of teaching and the perceptions they hold about the activity method of teaching. Table 3 indicated that 26 students representing (56.5%) respondents out of the 46 respondents strongly disagreed, 13 students representing (28.3%) disagreed, and three students representing (6.5%) respondents indicated neutral about the statement. Those who had agreed and strongly agreed with the statement were two students representing (4.3%). Though the number of students who did not like the activity method of teaching was few, it is still paramount on the part of the biology teachers to use innovative methods of teaching that could help the students develop an interest in the activity method of teaching.

I easily recall concepts that are taught using the activity method of teaching

It was observed in Table 3 that one student representing (2.2%) strongly disagreed with the statement while two students representing (4.3%) remained neutral. Of those who struggle to support the statement five students representing (32.6%) agreed and 28 students representing (60.9%) strongly agreed with the statement. The responses show that students' conceptual understanding and their ability to retain knowledge after going through activity-oriented lessons is very encouraging and as such biology teachers should consider the activity methods of teaching as appropriate in handling the topic classification of organisms. This would make the topic easy to understand by students as they can easily recall some of the concepts.

4.2 Results from Test Items of Students

Descriptive statistics were used to examine the test items for the pre-test and post-test. To determine how well students performed after the intervention, the least and maximum scores on the two tests and their means were compared. The outcomes are shown in Table 4.

Table 4: Results of students' pretest and post-test

<i>PRETEST</i>		<i>POST-TEST</i>	
Mean	15.84782609	Mean	22.58695652
Standard Error	0.984403687	Standard Error	1.046192123
Standard Deviation	6.676550644	Standard Deviation	7.095620205
Sample Variance	44.5763285	Sample Variance	50.34782609
Minimum	1	Minimum	7
Maximum	29	Maximum	36.5
Count	46	Count	46

From Table 4, the pre-intervention tests' minimum and maximum scores were one (1) and twenty-nine (29), respectively, and the post-intervention tests' minimum and maximum scores were 7 and 36.5, respectively. This demonstrates the significant improvement in biology performance among Form 2C science students. The achievement of students in learning and understanding classification of organisms has improved. Relating the mean score of the pre-test (15.85) to that of the post-test (22.59), it can be seen that there has been a substantial rise of 6.74 in the mean score.

The results indicated that the performance of Queen of Peace Senior High School Form Two Science (2C) students in classification of organisms has improved, leading to a change in attitudes regarding the study of the concept classification of organisms. Their performance on the post-intervention test reflects this. Even though some students fell short of the cutoff, of 20 marks, there was a significant improvement because the mean score on the post-test (22.59) was higher than the pre-test (15.85), indicating that the students had made progress.

To arouse students' interest and help them form favourable opinions of biology and other relevant science courses, teachers of biology should encourage them to explore their surroundings. To assist in arousing and maintaining the students' attention, teachers should incorporate the use of instructional methods (activity-based) and instructional materials (teaching and learning materials).

4.3 Interview

To obtain in-depth information on the teaching of classification of organisms in biology and biology as a whole at Queen of Peace senior high school, face-to-face follow-up interviews were conducted at the end of the intervention lessons. The biology teachers' views to the interview questions are presented below.

4.3.1 Are you a professional teacher?

The inquiry was to ascertain if the biology teacher had completed formal education and professional training. This query received a favourable response.

Biology teacher 1 said:

Yes, I completed university and I did an education

Biology teacher 2 said:

Yes, I completed college of education and university

Biology teacher 3 said:

Yes, I completed university and did post-graduate diploma in education

4.3.2 What is your highest level of education?

The biology teacher's level of education that qualified him/her to teach biology at the senior high level was to be ascertained by asking this question. This question received the same answer as all of them said:

University level.

4.3.3 For how long have you been teaching biology in this school?

The question sought to find out the experiences the teacher had in teaching biology. The teachers had almost the same number of years of handling biology. This is evident in the following responses. Teacher 1 in answering this question said:

I taught biology for two years.

Teacher 2 in response to this question said that:

This is my third year of teaching biology

Biology teacher 3 also responded that:

I have been teaching biology for four years now.

For teaching to be effective, teacher experience is key. Though most of them have taught more than one year, they still need to gain some experiences that would enable them to tackle challenging topics in biology.

4.3.4 Which method(s) do you normally employ in your teaching?

Different views were expressed by the biology teachers in describing the teaching approaches they employed to teach biology in their various classes. Some of the teachers indicated that they sometimes taught lessons by using only the lecture method, while others indicated that mostly they rely on group presentations, class discussion, and at times hands-on activities. This is evident in the following responses. Teacher 1, when commenting on the teaching methods used by him said:

I used the lecture method, discussion and group presentations, and hands-on activities depending on the topic to be treated. I equally give students notes to copy when the topic is a bit technical for the students to understand.

Teacher 2 gave his view about the teaching methods he used in his lesson's delivery.

He remarked that:

I use the lecture method always because some of the students find it difficult to express themselves in English and when you give them group work you will end up wasting time and will not be able to cover much. I give them notes to copy in class and homework as well.

Teacher 3 in her opinion said:

I used group presentations and discussions in my lesson delivery. I realised that students who are very quiet in class contribute meaningfully when they are engaged in group presentations.

Could you briefly explain why you liked the method(s) employed?

This was done to find out why the respondent favoured particular teaching approaches and strategies. This question received similar responses from biology teacher 1 and teacher 3.

Biology teacher 1 and teacher 3 said:

Group learning enables the learners to learn from one another.

Teaching and learning become more practical when the lesson involves activity methods. Additionally, it aids in students' learning of concepts and abilities. The discussion method enables students to express their views and clarify issues.

Biology teacher 2 said: *The lecture method enables me to cover most topics in the syllabus.*

4.3.5 What are some of the problems you are facing as a biology teacher?

This question sought to find out some of the barriers to teaching and learning biology.

The responses from the biology teachers indicated the following:

Biology teacher 1 said:

- *Too much workload*
- *Large class size in some of the classes.*
- *The school has no laboratory technician to always prepare the laboratory for practical activities.*
- *Inadequate apparatus and reagents in the laboratories.*

Biology teacher 2 remarked:

- *Due to the large class size, it is difficult to carry out practical activities*
- *The apparatus needed to perform some activities is lacking in the laboratory*

Biology teacher 3 said:

- *I teach multiple classes and because of that it is difficult to organise practical lessons*
- *The school does not have a laboratory technician to always prepare the laboratory for practical lessons*

4.3.6 How many practical activities do you normally have in a week?

The biology teachers were asked to state if they taught practical work to their learners.

The excerpts below illustrate the teachers' responses:

Biology teacher 1

It is not every week. I take my students through practicals when the need arises.

Biology teacher 2

I reserved all practical activities for those handling year threes. I do not take students through practical Biology teacher 3 I do not carry out practical activities weekly. I take my students through practical whenever it is necessary.

The responses indicated whenever the lesson involves practical work in the laboratory. This means that biology teachers engage students only when they feel that a particular concept should be taught in the laboratory. Though the teachers have been engaging students in the laboratory, much needs to be done as biology practical is not only carried out in the laboratory. Biology practical can be done in or out of the laboratory.

4.3.7 Do you travel to designated 'resource centres' to do practical activities?

This question sought to determine whether schools without the Science Resource Centre (SRC) and equipment visit schools with the Science Resource Centres and equipment to enable the students to interact with the resource equipment/materials to improve upon their skills, knowledge, and performance. The answer to this question by all the biology teachers was that:

The school does not visit a school that has been designated a "resource centre" to conduct practical activities.

This means that the students are not exposed much to some of the equipment and apparatus in the laboratory and this could affect their experimental skills and practical skills.

4.3.8 Are your students interested in studying biology?

The purpose of this question was to ascertain how students felt about biology. The biology teachers in response to this question indicated that:

Biology teacher 1

Most of them are interested in learning biology except some few Home science students.

Biology teacher 2

Yes, but the problem is from the Home Economics students. Most of them are not serious.

Biology teacher 3

Yes, I only have a problem with some of the home science students because most of them cannot read well.

The biology teachers' responses indicated that students have a favourable outlook on learning biology. Since the students showed a positive attitude toward learning biology, it is incumbent on the part of biology teachers to use innovative methods of teaching that would keep all students actively involved during lesson delivery. When this is done, it would arouse their interest and facilitate their ability to recall concepts learned already.

4.3.9 What measures are you putting in place to improve the performance of students in biology?

The purpose of this inquiry was to examine the steps the instructor was taking to raise the performance of students in biology. The biology teachers that were interviewed gave divergent views to the question asked.

Biology teacher 1 said:

Changing up the teaching strategies to keep students interested in biology
Making learning relevant and applicable by utilising teaching and learning
Resources Organising field trips for students to visit places that will arouse their interest in biology

Biology teacher 2 indicated that:

By organising quiz competitions amongst the students frequently
By sensitising students on the importance of studying biology

Biology teacher 3 remarked:

By engaging students in hands-on activities that will enable them to come out with their results, reminding them of the prospects of studying biology, relating what students learn to their daily life activities

The responses were good from the biology teachers only if they could be implemented. If students can relate what they learned to real-life situations, it would facilitate their conceptual understanding and arouse their interest in learning.

4.4 Summary

The chapter examined the study of the research tool. The results of the students' questionnaires were evaluated using the descriptive statistics component of the Statistical Package for Social Sciences (SPSS) to assess the pre-test and post-test outcomes. To determine the role activity method played in the conceptual

understanding of classification of organisms in biology, the means of the pre-test and post-test were compared. The teachers' interview was analysed qualitatively.



CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.0 Overview

The chapter includes a summary of the study's key conclusions. The chapter also examines advice and proposals made by biologists for additional research, and finally, suggestions for further research.

5.1 Summary of Findings

The study investigated the role of the activity method in teaching classification of organisms in biology at Queen of Peace Senior High School, Nadowli in the Upper West region of Ghana. This became necessary as most students were not able to demonstrate the needed practical and experimental skills in answering questions on classification during teaching and learning. The study was also necessary because students are assessed on the concept classification of organisms in biology in paper three of the West African Senior Secondary Certificate Examination (WASSCE). The research design was a case study with an action research approach. Quantitative and qualitative research assessment methods were used to collect data from Queen of Peace Senior High School students and biology teachers. The questionnaire for students was analysed using a statistical program for quantitative data analysis of the Statistical Package for Social Sciences (SPSS) and the achievement test for students was analysed by using simple descriptive statistics. The interview data for teachers was analysed qualitatively.

The study found that when teaching and learning are combined with activities and when students are allowed to explore and operate apparatus and equipment, it helps

them to demonstrate practical and experimental skills of manipulating, planning, and designing experiments, as well as gain skills in equipment handling, drawing, observing, measuring, classifying, interpreting, recording, and reporting. This was observed when students were engaged in group exercises, projects, and hands-on activities. They learned to support one another, which improved their involvement and performance in classification of organisms and biology at large. With the help of these strategies, the students were able to freely express themselves, discuss ideas, foster a sense of teamwork, and even learn from one another. During lessons, students gained self-assurance and were free to share their thoughts. As a result, they were able to improve their communication skills, analytical skills, inductive skills, and reflective learning abilities.

Also, results revealed that students' participation in class is aroused by engaging them in activities that could allow them to arrive at results on their own. Both the teacher and the students found that activity-based lessons were interesting as all students participated actively. The activity method of teaching was found to be an efficient way to teach and understand science, particularly biology, and should be used by biology teachers as it makes all students participate actively during teaching and learning.

The study further revealed that students develop positive attitudes toward the activity method. This was demonstrated by students when they were engaged in activities both in the laboratory and outside the laboratory. The activity method of teaching facilitated their conceptual understanding of classification of organisms in biology as manifested in their class assignments, quizzes, projects, and the results of the

achievement post-test, and more importantly, the gain of science practical skills and experimental skills.

5.2 Conclusions

The study outcomes elucidate that students demonstrate practical and experimental skills effectively when they are exposed to activities. Students' responses on the questionnaire and interviews with the biology teachers show a positive attitude towards the activity method of teaching. Although both students and teachers have positive attitudes towards the activity method of teaching, it does not mean that this necessarily translates into action in the studied area. Therefore, further studies are required such as the challenges teachers face in teaching the concept classification of organisms to truly determine what teachers do during lesson delivery.

Since the study used a small sample, it is recommended that a study using a larger population should be conducted in Nadowli- Kaleo district secondary schools so that the results could be generalised.

5.3 Recommendations

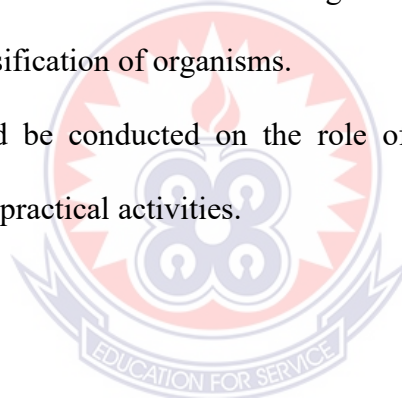
1. Biology teachers of Queen of Peace Senior High should adopt innovative strategies to teach, by engaging students in other hands-on activities, even in the absence of the standard equipment and materials.
2. Teaching methods used in the teaching of biology should be flexible enough to accommodate diversity among the students. Appropriate teaching and learning materials should be used when teaching biology if they can be acquired.
3. Grouping students making use of mixed ability groups should be encouraged to build positive student-student relations in the study area.

4. Giving students group projects every semester is the most effective way of teaching biological concepts, especially the classification of organisms in Queen of Peace Senior High School.
5. Future research conducted should include more schools to provide a full picture of the situation.

5.4 Suggestions for Further Research

The study provides the following recommendations for more research on the role of activity methods in teaching classification of organisms in biology for students' conceptual understanding.

1. A study should be conducted on challenges that teachers face in teaching the concept of classification of organisms.
2. A study should be conducted on the role of laboratory technicians in the organisation of practical activities.



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SECTION B: Practical and experimental skills students demonstrate in classification of organisms

Statement	SD	D	N	A	SA
1. I am able to manipulate equipment well during activity-based lessons					
2. I have been able to demonstrate my scientific skills whenever the lesson involves activities					
3. I improve upon my communication skills during group activity lessons					
4. Learning through activity has improved my drawing skills					
5. My observation skills improves whenever the lesson involves activities					
6. My ability to classify organisms improves whenever we embark on fieldwork					
7. I prefer doing activities in class to discussion					
8. I am able to organise equipment and apparatus well during activity method of teaching					
9. My practical skills are improved when the lesson involves practical activities					
10. I am able to set up apparatus during practical demonstration					

SECTION C: Methods teachers employed in teaching classification of organisms in biology

Statement	SD	D	N	A	SA
11. I prefer the lecture method to activity-based lessons					
12. My biology teacher always gives us project work in every semester					
13. I understand concepts very well whenever my biology teacher engages us on group presentation					
14. At the time of giving presentations, I do not feel confident					
15. During team projects I do not get a chance to put my viewpoint					
16. Group projects help me in learning to work with others and co-operate					
17. Preparing projects creates a burden for studies					

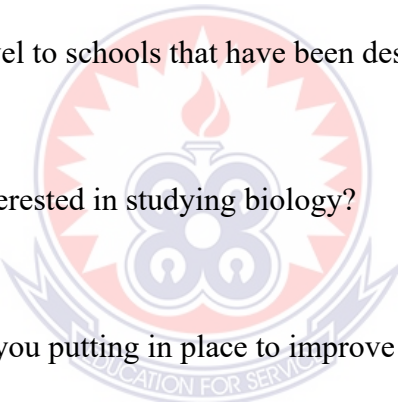
SECTION D: Students' perceptions about the activity-based method and their performance in classification

Statement	SD	D	N	A	SA
18. I feel curious about what I learn when my teacher involves us in activities					
19. I understand concepts well when the lesson is activity-based					
20. Students pay less attention when they are involved in activities during teaching					
21. The use of activity-based learning makes lessons difficult for students.					
22. I feel bored in class whenever my biology teachers involve us in activities					
23. Activity-based lessons waste my time					
24. I enjoy biology lessons that involve activities					
25. I easily recall concepts that are taught using activity-based methods					
26. Students participate actively in class when they are involved in activities					
27. Performing activity in class creates distraction					

APPENDIX B

INTERVIEW GUIDE

Semi-Structured Interview Schedule for Biology Teachers

1. Are you a professional teacher?
 2. What is your highest level of education?
 3. For how long have you been teaching biology in this school?
 4. Which method(s) do you normally employ in your teaching?
 5. May you please explain briefly why you preferred the method(s) used?
 6. What are some of the problems you are facing as a biology teacher?
 7. How many practical activities do you normally have in a week?
 8. Do you normally travel to schools that have been designated 'resource centres' to do practical activities?
 9. Are your students interested in studying biology?
 10. If No why?
 11. What measures are you putting in place to improve the performance of students in biology?
- 
- The logo of the University of Education, Winneba, is a circular emblem. It features a central lamp with a flame, surrounded by a sunburst pattern. The text 'UNIVERSITY OF EDUCATION' is at the top and 'WINNEBA' is at the bottom of the emblem. Below the emblem, the motto 'EDUCATION FOR SERVICE' is written in a banner.

Semi-Structured Interview Scheduled for Students

1. What is your name?
2. How old are you?
3. What is your favourite subject(s) and why?
4. Do you like biology?
5. Do you like the way biology teachers teach biology and why?
6. How many class exercises, class test, and project do you do in a week?
7. Do your biology teachers use activities in teaching?
8. What changes would you like to have in your biology lessons?

APPENDIX C

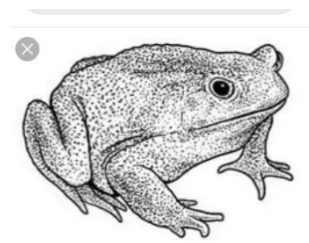
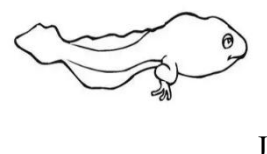
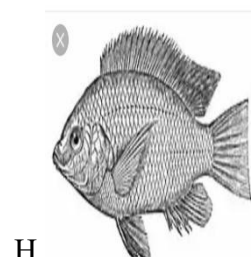
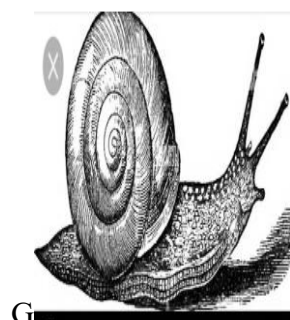
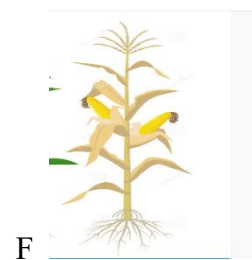
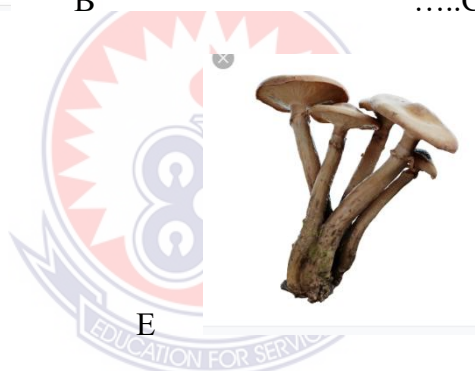
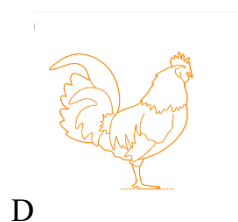
STUDENTS' ACHIEVEMENT TEST ON CLASSIFICATION (PRETEST)

Please read the following sentences and kindly provide the information required.

GENDER: Male [] Female [] {Please Tick $\checkmark$ }

General instruction: Please indicate your response by filling the blank spaces provided where applicable

Study the specimens below carefully and answer the questions that follow.



Q1. a(i) What is the relationship between specimen J and K (2mks)

.....

.....

.....

1a(ii) State **two** ecological importance of specimen H (2mks)

.....

.....

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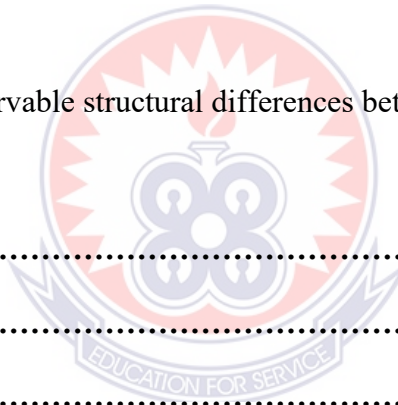
.....

1a(iii) State **three** observable structural differences between specimens H and J (3mks)

.....

.....

.....



Q1. a(iv) State **three** adaptive features of specimen D that enable it to fly. (3mks)

.....

.....

.....

.....

.....

Q1. b(i) What type of metamorphosis does specimen B undergoes? **(1mk)**

.....

.....

Q1. b(ii) Give **two** economic importance of specimen **B**. (2mks)

.....

.....

.....

Q1. c(i) State the respiratory organ of specimen **A** **(1mk)**

.....

Q1. c(ii) Name the special feature(s) that enable specimen **A** to capture its prey
(2mks)

.....

Q1d. State **three** adaptive features that enable specimen **K** to live on land.
(3mks)

.....

.....

.....

.....

.....

Q1e. Name the structure in specimen **K** that secretes poison **(1 mk)**

.....

2 a i. Briefly describe the mode of nutrition in specimen **E**. (2mks)

.....

.....

2 a ii. State **three** biological importance of specimen **E** (3mks)

.....

.....

.....

2 a iii. State **two** features of biological importance of specimen **C** (2mks)

.....

.....

2b i. State **two** observable differences between specimens **C** and **G** (2mks)

.....

.....

.....

2b ii. Give the class and orders of the following (6mks)

Organism	Class	Order
Maggot		
Caterpillar		
Mosquito larva		

2b iii. State the class that specimen **F** belongs to

(1 mk)

.....

2b iv. Give **four** reasons to support your answer in 2b (ii) above (4mks)

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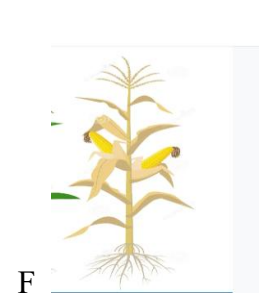
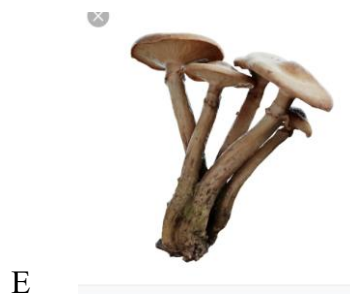
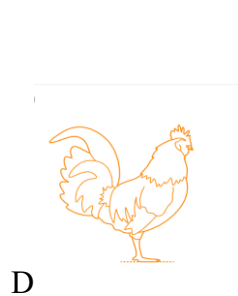
Students' Achievement Test on Classification (Post-Test)

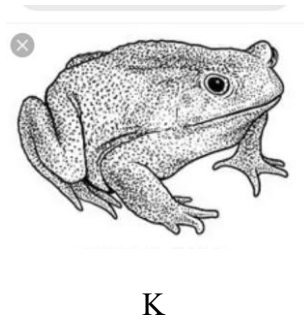
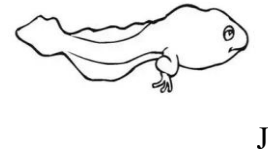
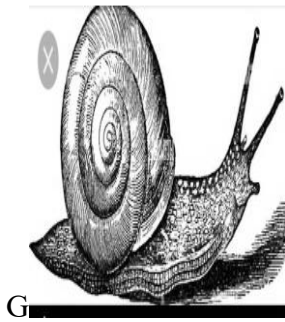
Please read the following sentences and kindly provide the information required.

GENDER: Male [] Female [] {Please Tick $\checkmark$ }

General instruction: Please indicate your response by filling in the blank spaces provided where applicable

Study the specimens below carefully and answer the questions that follow.





Q1. a(i) Identify and write down the names of all the specimens above. (10 mks)

- A
- B.....
- C
- D.....
- E
- F
- G
- H.....
- J
- K.....

1a(ii) State **two** observable structural differences between specimens **A** and **B**.
(2mks)

1a(iii) Name the phylum and class of **each** of specimens **C, D, E, G** and **H**. (5mks)

SPECIMEN	PHYLUM	CLASS
C		
D		
E		
G		
H		

10*1/2= 5 marks

Q1. a(iv) State **two observable** structural features that adapt specimen H to its habitat.

(2mks)

Q1. b(i) State **two** observable structural features of each of specimens **D** and **F**.

(4mks)

D.....

F.....

Q1. b(ii) State the **role** played by **each** of specimens E and F in the ecosystem. (2mks)

E.....

F.....
.....
.....

Q1. c(i) State the locomotory structure of specimen **G (1mk)**

.....

Q1. c(ii) Name the kind of orientation shown by specimen H. **(1mk)**

.....

Q1d. State two types of respiration exhibited by specimen **K**

.....

.....

.....

(2mks)

Q1e. State the respiratory organ of specimen J **(1 mk)**

.....

2 (a) i. Distinguish between **acoelomate** and **coelomate** animals. **(2mks)**

.....

.....

ii. List the classes of division Bryophyta **(2mks)**

.....

.....

2b i. State three differences between a crab and spider **(3mks)**

.....

.....

.....

ii. Give three structural differences between centipede and millipede (3 mks)

.....

.....

.....



APPENDIX D

Samples Of Students Papers on Pre-Test and Post-Test

01/40 35

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STUDENTS' ACHIEVEMENT TEST ON CLASSIFICATION (PRETEST)

Please read the following sentences and kindly provide the information required.

GENDER: Male [] Female [☒] (Please Tick ✓)

General instruction: Please indicate your response by filling the blank spaces provided where applicable

Study the specimens below carefully and answer the questions that follow.

A  B  C 

D  E  F 

G  H  I 

K 

Q1. a(i) What is the relationship between specimen J and K (2mks)

The relationship between J and K, they are all food they live in the same habitat.

1a(ii) State two ecological importance of specimen H (2mks)

1. It serves human needs.

2. It serves as sources of income.

1a(iii) State three observable structural differences between specimen H and J (3mks)

It has gird | J has no gird.
It has large body | J is small in size.

Q1. a(iv) State three adaptive features of specimen D that enable it to fly. (3mks)

.....
.....
.....
.....

Q1. b(i) What type of metamorphosis does specimen B undergoes? (1mk)

Incomplete metamorphosis.

Q1. b(ii) Give two economic importance of specimen B. (2mks)

1. It leave to beautify the environment.
2. It live for scientific experiment purpose.

Q1. c(i) State the respiratory organ of specimen A (1mk)

.....

Q1. c(ii) Name the special feature(s) that enable specimen A to capture its prey (2mks)

.....

Q1d. State three adaptive features that enable specimen K to live on land. (3mks)

- 1) Locomotion from one place to another
- 2) Vision of the environment.
- 3) To Search for food and insects to eat.

Q1e. Name the structure in specimen K that secretes poison (1 mk)

Salivary.

2 a i. Briefly describe the mode of nutrition in specimen E. (2mks)

the mode of E is the nutrition that it gives to build a organisms.

2 a ii. State three biological importance of specimen E. (3mks)

- ① It is serve as body building food for organism.
- ② It shell is use for medication purposes.
- ③ It seed is use for to prepare for or to germinate to bring forth new young plants.

2 a iii. State two features of biological importance of specimen C. (2mks)

- (1) For human amputation.
- (2)

2b i. State two observable differences between specimen C and G. (2mks)

- (1) Two pair of compound eyes. It walks with the stomach of three pair of walking legs. It in a circular form.

2b ii. Give the class and orders of the following (6mks)

Organism	Class	Order
Maggot	Insecta	monocotyledonia
Caterpillar	Insecta	monocotyledonia
Mosquito larva	Insecta	monocotyledonia

2b iii. State the class of specimen F

(1 mk)

Plantae.

0

2b iv. Give four reasons to support your answer in 2b (iii) above

(4mks)

- ① It is a plant to satisfies human needs.
- ② It serves as a sources of income.
- ③ It use for medical purpose.
- ④ It use for production of food.

0

0

00

$$01 + 00 + 00 = 01$$

28/40

2

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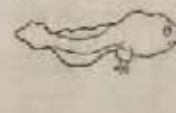
STUDENTS' ACHIEVEMENT TEST ON CLASSIFICATION (PRETEST)

Please read the following sentences and kindly provide the information required.

GENDER: Male ☒ Female ☐ (Please Tick ☒)

General instruction: Please indicate your response by filling the blank spaces provided where applicable

Study the specimens below carefully and answer the questions that follow.



Q1. a(i) What is the relationship between specimen J and K (2mks)

K is the adult form of J. 1

1a(ii) State two ecological importance of specimen H (2mks)

Specimen H serves as food for other organisms.
Specimen H reduces the outbreak of malaria by eating larvae. 2

1a(iii) State three observable structural differences between specimen H and J (3mks)

• Specimen H has fins. Specimen H has no fins.
• Specimen H has no limbs. Specimen H has limbs.
• Specimen H has scales. Specimen H has no scales. 3

Q1. a(iv) State three adaptive features of specimen D that enable it to fly. (3mks)

• Specimen D has hollow bones. 0
• Specimen D has feathers for flight. 0
• Specimen D has streamlined body for easy sliding through the air. 1

Q1. b(i) What type of metamorphosis does specimen B undergoes? (1mk)

B undergoes complete metamorphosis. 1

Q1. b(ii) Give two economic importance of specimen B. (2mks)

• Specimen B aids in pollination. 2
• Specimen B acts as food for other organisms.

Q1. c(i) State the respiratory organ of specimen A (1mk)

Spiracles. 0

Q1. c(ii) Name the special feature(s) that enable specimen A to capture its prey (2mks)

• Specimen A has claws for grasping the prey. 0

10

Q1d. State three adaptive features that enable specimen K to live on land. (3mks)

- * Specimen A has membranous hind limbs for hopping
- * Specimen A has stout fore limbs for absorbing shock when landing after hopping
- * Specimen A has a tympanum for hearing

Q1e. Name the structure in specimen K that secretes poison (1 mk)

The poison gland in the skin

2 a i. Briefly describe the mode of nutrition in specimen E. (2mks)

Specimen E undergoes saprophytic mode of nutrition. Specimen E feeds through living on dead decaying organic matter by absorbing nutrients from the dead substrate.

2 a ii. State three biological importance of specimen E (3mks)

- * Specimen E provides food
- * Specimen E provides oxygen to animals and other organisms
- * Specimen E reduces the amount of carbon dioxide in the atmosphere

2 a iii. State two features of biological importance of specimen C (2mks)

- * Specimen C has claws for grasping prey
- * Specimen C has a pair of antennae for sensitivity

2b i. State two observable differences between specimen C and G (2mks)

- * Specimen C has five pairs of limbs whilst specimen G has none
- * Specimen C has claws whilst specimen G has none

2b ii. Give the class and orders of the following (6mks)

Organism	Class	Order
Maggot	Insecta	Hemiptera
Caterpillar	Insecta	Lepidoptera
Mosquito larva	Insecta	Ardonata

2b iii. State the class of specimen F

(1 mk)

Class Monocotyledonae

2b iv. Give four reasons to support your answer in 2b (ii) above

(4mks)

- * Specimen F has leaf sheath
- * Specimen F has no leaf stalk
- * Specimen F has tubular roots
- * Specimen F has parallel leaf venation

$$10 + 13 + 05 = 28$$

Q1. a(i) What is the relationship between specimen J and K (2mks)

J is the larval stage of K
J develops into K

2

1a(ii) State two ecological importance of specimen H (2mks)

- ① Produce CO_2 for producers to use for photosynthesis
- ② Produces nitrogenous wastes which is converted to be used by producers

1a(iii) State three observable structural differences between specimen H and J (3mks)

- J is having limbs whilst H is not having limbs
- H is having homocercal tail whilst J is not having homocercal tail
- H possesses fins for swimming whilst J is having tail for swimming

Q1. a(iv) State three adaptive features of specimen D that enable it to fly. (3mks)

- Possession of hollow bones
- Possession of wings with feathers
- Possession of streamlined body

0

Q1. b(i) What type of metamorphosis does specimen B undergoes? (1mk)

Complete metamorphosis

1

Q1. b(ii) Give two economic importance of specimen B. (2mks)

- It aids in pollination
- It beautifies the environment

2

Q1. c(i) State the respiratory organ of specimen A (1mk)

Lung book

1

Q1. c(ii) Name the special feature(s) that enable specimen A to capture its prey (2mks)

Possession of webs that is used to capture prey

12

Q1d. State three adaptive features that enable specimen K to live on land. (3mks)

- Presence of limbs for movement.
- Presence of lungs for respiration on land.
- Presence of eyes to see.

Q1e. Name the structure in specimen K that secretes poison (1 mk)

Tympanum.

2 a i. Briefly describe the mode of nutrition in specimen E. (2mks)

E secretes enzymes of the host that is dead plants the enzymes digest the organic matter and it is absorbed by E. The mode of nutrition is referred to as saprophytic.

2 a ii. State three biological importance of specimen E. (3mks)

1. Reduces the amount of CO_2 in the atmosphere.
2. Produces food for consumers.
3. Reduces the amount of nitrogen in the atmosphere.

2 a iii. State two features of biological importance of specimen C (2mks)

- Possession of stalk eyes.
- Possession of two body divisions.

2b i. State two observable differences between specimen C and G (2mks)

- C possesses shells but G does not possess shell.
- C possesses muscular foot for locomotion whilst G possesses walking legs for locomotion.

2b ii. Give the class and orders of the following (6mks)

Organism	Class	Order
Maggot	Insecta ✓	Diptera ✓
Caterpillar	Insecta ✓	Dictyoptera ✓
Mosquito larva	Insecta ✓	Diptera ✓

2b iii. State the class of specimen F

(1 mk)

Class Monocotyledonae

2b iv. Give four reasons to support your answer in 2b (ii) above

(4mks)

- ~~+~~ Specimen F has lead sheath
- ~~x~~ Specimen F has no lead stalk
- ~~+~~ Specimen F has tubular roots
- ~~x~~ Specimen F has parallel leaf venation

$$10 + 13 + 05 = \textcircled{28}$$

13 1/2 / 40

35

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STUDENTS' ACHIEVEMENT TEST ON CLASSIFICATION (POST-TEST)

Please read the following sentences and kindly provide the information required.

GENDER: Male ☐ Female ☒ [Please Tick ✓]

General instruction: Please indicate your response by filling in the blank spaces provided where applicable

Study the specimens below carefully and answer the questions that follow.



Q1. a(i) Identify and write down the names of all the specimens above. (10 mks)

A Spider
B Butterfly
C Crab
D Domestic fowl
E Mushroom
F Tilapia
G Snail
H Tilapia
J pupa toad
K Toad

07

1a(ii) State two observable structural differences between specimens A and B. (2mks)

A has four (4) pairs of legs
A cannot fly
B has antennae
B has wing for flying

2
2

1a(iii) Name the phylum and class of each of specimens C, D, E, G and H. (5mks)

SPECIMEN	PHYLUM	CLASS
C	Arthropoda	Insecta
D	Arthropoda	Basitophyta
E	Alismatophyta	Bryophyta
G	Arthropoda	Insecta
H	Arthropoda	Bryophyta

0 1/2

10 * 1/2 = 5 marks

Q1. a(iv) State two observable structural features that adapt specimen H to its habitat.

① H swim with the gills
② H breathe in air.

(2mks)

0
0

Q1. b(i) State two observable structural features of each of specimens D and F. (4mks)

D. can move about
can eat
F. produce food for organism to eat
germinate from seed and bring forth new plants

0
0
1
0

12 1/2

Q1. b(ii) State the role played by each of specimens E and F in the ecosystem. (2mks)

E. It do no bring fire new once into a sistance.
It die and for all.

F. Is grow to bring fire new young?
once to a sistance.

Q1. c(i) State the locomotory structure of specimen G (1mk)

It move to place to place for vision.

Q1. c(ii) Name the kind of orientation shown by specimen H. (1mk)

Lateral view

Q1d. State two types of respiration exhibited by specimen K.

1. It live in water or dry place.

2. It is a poisonous animal in nature.

(2mks)

Q1e. State the respiratory organ of specimen J (1 mk)

It stay in a porous or stagnant water.

2 (a) i. Distinguish between acoelomate and coelomate animals. (2mks)

A coelomate is a living stematic structure.
While acoelomate is made the animal grown well.

ii. List the classes of division Bryophyta

Mosses

2b i. State three differences between a crab and spider (3mks)

Spider	Crab
1) It has four pair of legs	It has three (3) pair of legs.
2) It has blunt tail	It two big biting legs.
3) It has no eyes	It has pair of compound eye for vision.

ii. Give three structural differences between centipede and millipede (3 mks)

Centipede	Millipede
1) Centipede has counting legs	Millipede has uncounting legs.
2) Centipede has no segment body	Millipede has segment body.
3) Centipede has no line on the body	Millipede has lines on the body

$$12\% + 01 = 13\%$$

36½/40

1

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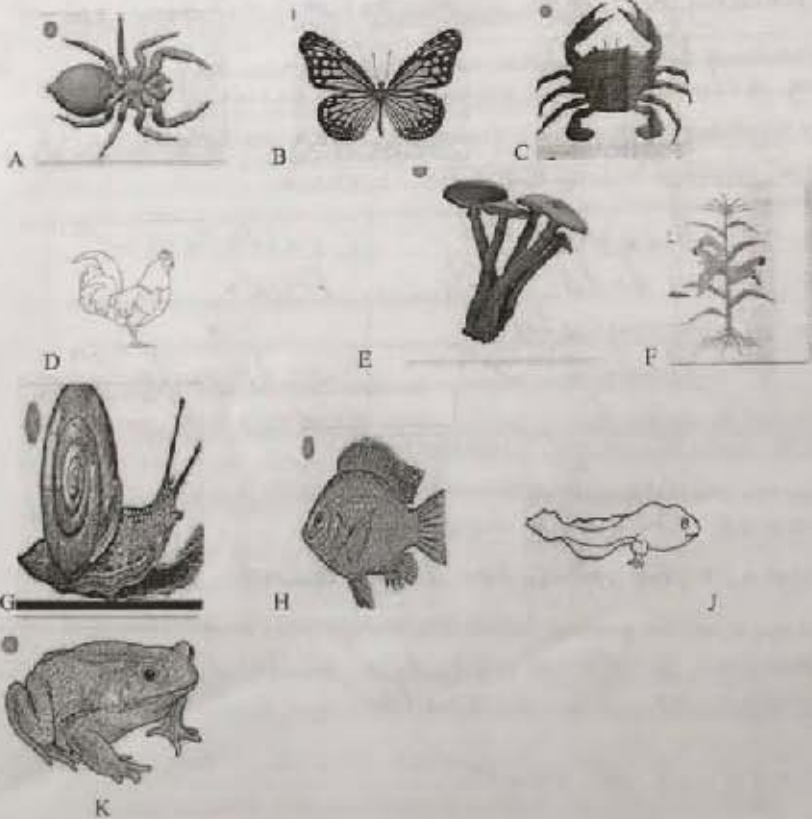
STUDENTS' ACHIEVEMENT TEST ON CLASSIFICATION (POST-TEST)

Please read the following sentences and kindly provide the information required.

GENDER: Male ☒ Female ☐ (Please Tick ✓)

General instruction: Please indicate your response by filling in the blank spaces provided where applicable

Study the specimens below carefully and answer the questions that follow.



Q1. a(i) Identify and write down the names of all the specimens above. (10 mks)

A. Spider ✓ B. Butterfly ✓
 C. Crab ✓ D. Scent ✓
 E. Mushroom ✓ F. maize plant ✓
 G. Snail ✓ H. Tilapia ✓
 J. Tadpole ✓ K. frog ✓

1a(ii) State two observable structural differences between specimens A and B. (2mks)

- B is having wings for flying but A is not having wings.
 - B is having long and narrow abdomen but A is having short and broad abdomen.

1a(iii) Name the phylum and class of each of specimens C, D, E, G and H. (5mks)

SPECIMEN	PHYLUM	CLASS
C	Arthropoda ✓	Crustacea ✓
D	Chordata ✓	Ave. ✓
E	Zygomycete ✓	✓
G	Mollusca ✓	Gastropoda ✓
H	Chordata ✓	Osteichthyes ✓

10*1/2= 5 marks

Q1. a(iv) State two observable structural features that adapt specimen H to its habitat. (2mks)

- presence of eyes for vision
 - presence of fins for movement

Q1. b(i) State two observable structural features of each of specimens D and F. (4mks)

D - i. presence of muscular foot
 ii. presence of a shell

F - i. presence of roots

ii. presence of leaves

Q1. b(ii) State the role played by each of specimens E and F in the ecosystem. (2mks)

E. plays the role as a decomposer.

F. plays the role as a primary producer.

Q1. c(i) State the locomotory structure of specimen G (1mk)

Muscular foot

Q1. c(ii) Name the kind of orientation shown by specimen H. (1mk)

Lateral

Q1d. State two types of respiration exhibited by specimen K.

- Lateral Respiration through the lungs
- Respiration through the skin.

(2mks)

Q1e. State the respiratory organ of specimen J (1 mk)

Gills

2 (a) i. Distinguish between acoelomate and coelomate animals. (2mks)

Acoelomate animals are organisms without body openings like a mouth and anus. Coelomate are those with body openings that is mouth and anus.

ii. List the classes of division Bryophyta

(2mks)

Class Musci

Class Hepaticae

2b i. State three differences between a crab and spider

(3mks)

- Crab has stalked eyes but spider does not have stalked eyes
- Crab has five pair of walking legs but spider has four
- Crab is having thick exoskeleton but spider does not

ii. Give three structural differences between centipede and millipede (3 mks)

- Centipede have one pair of legs on each segment but millipede has two on each segment
- Centipede have a pair of poisonous claws but millipede does not
- Centipede is red in colour but millipede is dark brown in colour

$$21\frac{1}{2} + 15 = 36\frac{1}{2}$$

15

34½/40

2

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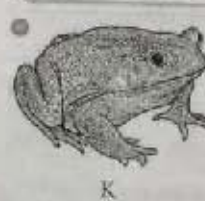
STUDENTS' ACHIEVEMENT TEST ON CLASSIFICATION (POST-TEST)

Please read the following sentences and kindly provide the information required.

GENDER: Male ☒ Female ☐ (Please Tick ✓)

General instruction: Please indicate your response by filling in the blank spaces provided where applicable

Study the specimens below carefully and answer the questions that follow.



Q1. a(i) Identify and write down the names of all the specimens above. (10 mks)

A is a spider ✓

B is a butterfly ✓

C is a crab ✓

D is a hen ✓

E is a mushroom ✓

F is a maize plant ✓

G is a snail ✓

H is a fish ✓

J is a tapeworm ✓

K is a frog ✓

1a(ii) State two observable structural differences between specimens A and B. (2mks)

* B has two pair of wings whilst A has no wings...

* A has four pairs of limbs whilst B has three pairs of limbs ✓

1a(iii) Name the phylum and class of each of specimens C, D, E, G and H. (5mks)

SPECIMEN	PHYLUM	CLASS
C	Arthropoda ✓	Crustacea ✓
D	Chordata ✓	Aves ✓
E	Basidiomycota ✓	Basidiomycota ✓
G	Chordata ✓	Gastropoda ✓
H	Chordata ✓	Osteichthyes ✓

10*1/2= 5 marks

Q1. a(iv) State two observable structural features that adapt specimen H to its habitat. (2mks)

* It has fins which enable it to move in the water ✓

* It has eyes for vision ✓

Q1. b(i) State two observable structural features of each of specimens D and F. (4mks)

D. It has feathers ✓

It has a pair of walking limbs ✓

F. It has fibrous roots ✓

It leaves have an alternate arrangement on the plant. ✓

2 1/2

Q1. b(ii) State the role played by each of specimens E and F in the ecosystem. (2mks)

E... is a decomposer and so breaks down dead decaying organic matter especially dead plants

F... is a plant and so uses the sunlight with other simple substances to synthesize food and also produce oxygen into the atmosphere.

2

Q1. c(i) State the locomotory structure of specimen G (1mk)

The body.

0

Q1. c(ii) Name the kind of orientation shown by specimen H. (1mk)

H shows lateral orientation

1

Q1d. State two types of respiration exhibited by specimen K.

* Cutaneous respiration
* Buccal respiration

2

(2mks)

Q1e. State the respiratory organ of specimen J (1 mk)

Gills

1

2 (a) i. Distinguish between acelomate and coelomate animals. (2mks)

A coelomate animal does not have a body cavity (rt)
Acoelomate animal has a body cavity

2

ii. List the classes of division Bryophyta

(2mks)

Class hepaticae
Class musci

0
1

2b i. State three differences between a crab and spider

(3mks)

* A crab has five pairs of limbs while spider has four pairs
* A spider has an elongated abdomen whereas a crab has none
* A crab has claws whereas a spider does not have claws

ii. Give three structural differences between centipede and millipede (3 mks)

* A millipede has larger number of legs than the centipede.
* A centipede has two pairs of antennae while millipede has one
* A centipede is smaller in size as compared to the millipede

0

1

0

$$21K + 13 = 34\frac{1}{2}$$

13

APPENDIX E

Marking Schemes of Students Pre-Test and Post-Test

Marking Scheme for Pre-Test

1 ai The relationship between specimen J and K is that

- Specimen J is the larva stage of specimen K or J develops into K

2 marks

aii. Two ecological importance of specimen H are

- specimen H supports carnivorous animals in the ecosystem
- it helps the circulation of nutrient metabolites of which mainly production depends

Any 2*1= 2 marks

aiii. Three observable differences between specimens H and J

specimen H

- Has scales

- Has fins

- Has no limbs

specimen J

Has no scales

Has no fins

Possessed limbs

Any 3*1 = 3 marks

aiv. Three adaptive features of specimen D that enable it to fly are

- Possess powerful muscles for flight
- The sternum is extended to form a keel, which provides anchorage for flight muscles
- Possesses hollow bones which makes it light during flight

3*1 = 3 marks

1bi. The type of metamorphosis specimen B undergoes is complete

1 mark

1bii. Two economic importance of specimen B are

- It helps in pollination
- Used in decoration

2*1 = 2 marks

1ci. The respiratory organ of specimen A is the lungs book

1 mark

1cii. The special feature(s) that enable specimen A to capture its prey are

- Pedipalps
- Front legs

2*1 = 2 marks

1d. Three adaptive features that enable specimen K to live on land are

- The hindlimbs are longer and more muscular for its hopping movement
- The forelimbs are short and stout for absorbing the shock of landing after hopping
- It is able to camouflage

3*1 = 3 marks

1e. The structure in specimen K that secretes poison is the poisonous gland

1 mark

2ai. The mode of nutrition in specimen E

- The saprophytic mode of nutrition is used by specimen E
- Dead and decaying plant or animal tissue is a source of nutrition for the specimen.

2*1 = 2 marks

2aii. Two features of the biological importance of specimen E are

- It acts as an antibacterial
- Immune system enhancer
- Cholesterol-lowering agent
- Used as a food supplement

3*1 = 3 marks

2a.ii. Two features of biological importance of specimen C are

- Possesses powerful chelipads (pincers) for feeding and defense
- Chitinous exoskeleton for protection and to prevent desiccation

2*1 = 2 marks

2bi. Two observable differences between specimens C and G

Specimen C

- Legs for walking
- Shell for protection

Specimen D

- Muscular foot for locomotion
- Carapace for protection

2*1 = 2 marks

2bii.

Organism	Class	Order
Maggot	Insecta	Diptera
Caterpillar	Insecta	Lepidoptera
Mosquito larva	Insecta	Diptera

6*1 = 6 marks

2biii. The class of specimen F is Monocotyledoneae

1 mark

2biv. The reasons for the answer in 2bii are

- Leaves are parallel venated
- Has fibrous root
- The embryo has one seed leaf
- Flower parts are in threes or multiples of threes

4*1 = 4 marks

Marking Scheme for Post-Test

1a i

A Spider

B Butterfly

C Crab

D Domestic fowl

E Mushroom

F Maize plant

G Snail

H Tilapia

J Tadpole

K Toad

10*1= 10 marks

1a ii. Structural differences between specimens A and B

Specimen A

Specimen B

Has no wings

Has wings

Has no antenna

Has a pair of antennae

Has four pairs of legs

Has three pairs of legs

Any 2*1 = 2 marks

1a iii



SPECIMEN	PHYLUM	CLASS
C	Arthropoda	Crustacea
D	Chordata	Aves
E	Basidiomycota	Basidiomycetes
G	Mollusca	Gastropoda
H	Chordata	Osteichthyes

10*1/2= 5 marks

1a iv Observable features of specimen H

- Presence of lateral line to detect vibrations in water
- Presence of nostril for smelling food
- Presence of scales against mechanical injury

Any 2* 1 = 2 marks

1bi Two observable structural features of specimen D

- Beak for pecking
- Body covered with feathers which act as insulators against temperature fluctuation
- Possess hindlimbs for walking

Any 2*1 = 2 marks

Two observable features of specimen F

- Possession of roots for anchorage
- Possession of leaves
- Possession of male inflorescent

Any 2*1 = 2 marks

1b ii Role played by specimen E in the ecosystem

- Serves as a producer in the food chain
- Recycle dead plant materials(saprophytic)

Any 1*1 = 1 mark

Role played by specimen F in the ecosystem

- Serves as producer in the ecosystem
- Serves as food for other organisms

Any 1*1 = 1 mark

1ci. The locomotory structure of specimen G is foot (muscular) **1*1 = 1 mark**

1cii. The orientation shown by specimen H is lateral view

1*1 = 1 mark

1d Types of respiration exhibited by specimen K

- Skin (cutaneous)
- Buccal (mouth)
- Lung (pulmonary)

Any 2*1 = 2 marks

1e Respiratory organ of specimen J is Gills

1*1 = 1 mark

2ai Acoelomate is an organism that lacks coelom or formal body cavity while coelomate are organisms with true body cavity

1eii Classes of division Bryophyta

- Hepaticae
- Musci

2*1 = 2 marks

2bi Differences between a crab and a spider

Crab

Spider

Has five pairs of walking legs

Has four pairs of walking legs

Crab belongs to class Crustacea

Spider belongs to class

Arachnida

Body covered with carapace

Body is not covered with

carapace

Has mandibles

Has chelicerae

Any 3*1 =3 marks

2bii Structural differences between centipede and millipede

Centipede

Millipede

- Has a pair of poison jaw

No poison jaw

- Few body segments
- A pair of leg per tergite
- Flattened body

Numerous body segments

Two pairs of legs per tergite

Cylindrical body

Any 3*1 = 3 marks



APPENDIX F

Introductory Letter

 **UNIVERSITY OF EDUCATION, WINNEBA**
FACULTY OF SCIENCE EDUCATION
DEPARTMENT OF INTEGRATED SCIENCE EDUCATION
P. O. Box 25 Winneba, Ghana is@uew.edu.gh
☎ +233 (020) 204 1077

Our ref. No.: ISED/PG. I/Vol. I/22
Your ref. No.: Date: 16th June, 2022

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

LETTER OF INTRODUCTION
MR VALENTINE BAALONGBUORO

We write to introduce, Mr Baalongbuoro is a postgraduate student of the Department of Integrated Science Education, University of Education, Winneba, who is conducting a research titled:

Using activity -based learning strategies to enhance the understanding of classification of organisms in form two science class at Queen of Peace Senior High School, Nadowli

We would be very grateful if you could give him the assistance required.

Thank you.

Yours faithfully,


ALEXANDRA N. DOWUONA
CHIEF ADMIN. ASSISTANT
For : HEAD OF DEPARTMENT

 www.uew.edu.gh