

UNIVERSITY OF EDUCATION, WINNEBA

**THE IMPACT OF USING MULTIMEDIA ON STUDENTS' ACADEMIC
PERFORMANCE IN GENETICS IN THE BRONG AHAFO REGION**



AUGUSTINE DAMPAH BAZIRIZII


2018

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**DISSERTATION SUBMITTED TO THE DEPARTMENT OF SCIENCE
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WINNEBA.**

DECEMBER, 2018



DECLARATION

CANDIDATE'S DECLARATION

I, Augustine Dampah Bazirizii declare that this dissertation with the expressions of quotations and references that is contained in published works which to the best of my knowledge have all been identified and duly acknowledged is sincerely my own original work and it has not been either partly or wholly submitted elsewhere for any another degree.

NAME OF STUDENT: Augustine Dampah Bazirizii

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DATE:.....

SUPERVISORS DECLARATION

I hereby declare that the preparation of this dissertation was supervised in accordance with the guidelines set for dissertations laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: Dr. James Azure Awuni

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DATE:.....

ACKNOWLEDGMENT

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DEDICATION

I dedicate this work to my wife Madam Suzy Doe Dampah and my lovely children Fredrick Yuri, Benedict Wullim and Francisca Sugurum for their resilient support. May we continue to live happily May God be with us always.



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ABSTRACT

The study investigated the impact of using multimedia (computer simulation) in improving students' performance in genetics in Senior High School in Brong Ahafo. The main objective of the study was to establish if there is significant difference in academic performance in genetics between students' who were taught with multimedia method and students' who were not taught with multimedia method. The specific objectives were to find out whether there will be significant difference in the academic performance in genetics between the experimental group and the control group, to assess students' views on the use of multimedia method of teaching and whether there is significant difference in the performance of male students' and female students' of the experimental group at post-test measurement. Questionnaires, interviews and students achievement test were administered. Independent t-test was used to test the statistical significance between post-test scores of experimental and control groups at 0.05 level of significance. There was significant difference between the experimental group and the control group at post-test measure of students' performance in genetics. There was significant difference between male and female students' performance at post-test of the experimental group. The findings implied that, the use of multimedia teaching method has significant influence in the performance of genetics of the Senior High School. The following recommendations were made: Biology teachers should be encouraged to employ the use of multimedia method of teaching in the delivery of their lesson so that students can perform better.



CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter contains the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, hypothesis, significance of the study, delimitations and limitations. It also included the organization of the study and operational definitions to the study.

1.1 Background to the Study

The application of science in the various sectors of life such as education, health, industries, agriculture, construction, homes etc., brings about development globally. Countries that have moved from third world in terms of development to first world such as Canada, France, and Japan were able to achieve this height due to the development in their Science and Technology which genetics is inclusive. Science Education has been recognized worldwide as being vital for a nations overall economic development (Ozturk & Ilhan 2001). When used effectively, Science and Technology are able to improve productivity and meet the needs of society. This has been demonstrated in most developed countries and recently in the newly industrializing countries where Science and Technology have been responsible for more than half of the increase in productivity (Anderson, 2006). The 21st century has seen a rapid development in Science and Technology all over the world. Even the third world countries have tried to improve on the development of Science and Technology. Ghana as a country is also not left out in the endeavors as various policies and attempts are made to improve Science and Technology. The youth of Ghana are fast catching up with technology as they are previewed to new information as well as products of

technology. In the executive summary of the president committee on review of Education Reform in Ghana October 2012, it reads "the key to the future socio-economic development of Ghana lies in the development of large number of scientists, engineers, technologist, technicians, and craftsmen to bring about technological innovations and to achieve this, Science and Science Education must be given the number one priority".

Genetics is the study of heredity. (W.H.O, 2004). The study of heredity and how qualities and characters are passed from generation to another by means of genes.

Genetics has been hated by students for several generations now and proves to be particularly hard (Tsui & Treagust, 2010).

According to Wilson (1999) some of the few students who attempt to venture into the study of science psychologically fall out when they meet challenges which they perceive to be difficult to solve.

Genetics require certain level of numeracy and also a rather more analytical approach than most of the other biology aspects (Knipples, 2000). And as such, it poses a lot of challenges to learners who attempt to study it. Students are mostly confused because practical work in genetics require a great deal of time, sometimes weeks, months or even years to obtain a solution but with the time constraints in the school time table it become very stressful for students. This may require a more scientific or computerize approach that may simulate the scenario to bring out a solution in a shorter possible time.

Students also have difficulty comprehending abstract concepts where they are not able to put them into practical activities. The concept of genetics is such that many a time,

teachers teach it in abstract which makes it difficult for learners with weak academic abilities to over stretch their imaginations and may not understand any information that the teacher provides. This may lead to some students resorting to rote learning and others may just be discouraged and give up.

The traditional method of teaching has become the most used approach in the presentation of facts and delivery of knowledge hence there is the need for an alternative way to present lesson in Genetics that will offer students multiple ways of getting information and performing activities in a genetics lesson in shorter duration in the classroom to improve the learning of genetics.

It is prudent for a teacher to devise methodologies that will enable him to interact with students to arouse and maintain their interest and involve the students in the process of learning genetics. There are several methods of teaching but it is left to the teacher to combine the appropriate method and curriculum to achieve the set objectives.

The 2004 Educational Reform Program of Ghana advocates for the use of conventional approach to science teaching (Ministry of Education, 2004) the conventional approach includes the use of science kits, pictures, videos, slide presentations, music, teacher demonstrations and other activities. To achieve this, most Senior High Schools in the country were provided with well stocked laboratories with science equipment including projectors, CDs and other science resources (Serwaa, 2007).

The involvement of technology in the classroom subjects the students to new learning environment in terms of the learning process away from the traditional chalk board approach. The use of technology motivates and builds up the student's inquisitive

instincts since it fits perfectly into the world of the student which is more of the use of technology and its.

Multimedia classroom provides the student with chances for interacting with different media that provides solid background information in the task and content of the subject. Multimedia learning deals with effective and efficient ways of promoting learning. Students learn more and are better able to apply what they have learned with words and pictures than words alone (Mayer, 2010).

Multimedia instructional materials are being used with increasing frequency in several fields of science due to the reality that technology has caught up with us and as such the students are much attracted with learning technologically (Al & Amaal, 2016).

The use of multimedia in teaching genetics is considered in this case as it offers various information and presentation formats simultaneously (Joshi, 2012). Many reasons can be advanced for the difficulty in improving student's performances and interest in genetics of which teaching methods play a key role. It is in this regard that this study examines the option of using multimedia in the teaching of genetics in the Senior High School using Kintampo Senior High School form 3 science class.

1.2 Statement of Problem

Final year science students in Kintampo Senior High School perform badly in answering questions in genetics for a long time now. Their inability to answer genetic questions correctly put some fear and lack of confidence in the students when it comes to writing their final year examination that is the West African Secondary School Certificate Examination (WASSCE) and it results in their poor performance in biology as a subject.

The researcher observed during the study that most students at the SHS cannot answer questions on genetics correctly. Most of their answers reveal specific misconception which needed correction. Genetics contains abstract concepts which make it increasingly difficult for students to grasp.

The researcher's experience as a teacher at all levels of Senior High School indicates that students perform poorly in test items based on genetics.

This has led to poor performance of students in biology at the Senior High School level as indicated by the Chief Examiner Report West Africa Examination Council (WAEC, 2015). This assertion by the WAEC Biology Chief Examiner about Biology students' performance is also shared by colleague biology teachers and examiners.

The WAEC Biology Chief Examiner attributes the low performance to students' failure to properly understand the concept of genetics and providing correct answers. These students' failure can be traced to students' inability to grasp properly the fundamental concepts in genetics and teachers' failure to communicate the fundamental concepts via the appropriate methods of teaching biology.

Further discussion and analysis of the problem from fellow biology teachers and Biology examiners revealed that major contributing factor is the use of inappropriate method of teaching biology by teachers and inadequate classroom facilities.

Most Biology teachers have adopted various methods of teaching and learning Biology in the hope of communicating effectively the core ideas and concepts of genetics to students. Common methods of teaching employed over the years are the traditional or lecture method of teaching, inquiry method, collaborative method. These methods even with the addition of charts and improvised teaching and learning materials are unable

to properly explain concepts such as the process of photosynthesis, circulation of blood in mammals, Protein Synthesis, digestion in mammals, transpiration in plants, fertilization process in plants, DNA replication, and genetics.

To overcome some of the difficulties teachers and students face under these methods as suggested by Davis (1993) and Mckeanchie (1994), is to use audio-visual and models to enhance presentation, captivating and sustaining students' interest. Also, adopt reasonable and adjustable pace that balances content coverage and students understanding

1.3 Rationale of the Study

Research into students understanding in science related topics indicates that ineffective methods of teaching promotes misconception in students, this may lead to poor performance as well as loss of interest in science (Knight,2002)

Genetics is not left out in this regard and has from generations bullied students who attempt to study it.

1.4 Purpose of the Study

The purpose of this study was to find out how multimedia can be used to improve student's performance in genetics.

1.5 Objectives of the Study

The specific objectives include;

- i. To examine the effect of multimedia on student's performance in genetics when they were taught with multimedia.
- ii. To identify students' view on the use of multimedia in the teaching and learning of genetics.

- iii. To find out about students' interest in the learning of genetics with multimedia.

1.6 Research Questions

What is the impact of using multimedia (computer simulation) as a teaching strategy on students' academic performance in genetics? This main question is sub-divided into the following four

1. Is there any difference between the mean scores of experimental group and the control group in the pre-test measurement of students' performance in genetics?
2. Is there any difference between the mean scores of experimental group and the control group in the post-test measurement of students' performance in genetics?
3. Is there any difference between the mean scores of male students and female students of the experimental group in the post-test measurement of students' performance in genetics?
4. What are the views of students about the use of multimedia method of teaching?

1.6.1 Research Hypothesis

The following null hypotheses were set to help answer these research questions.

1. There is no statistically any significant difference between the experimental group and the control group in the pre-test measurement of students' performance in genetics.
2. There is no statistically any significant difference between the mean scores of experimental group and the control group in the post-test measurement of students' performance in genetics. There is no statistically any significant difference between the mean scores of male students' and female students' in

the experimental group in the post-test measurement of students' performance in genetics?

1.7 Significance of the Study

- i. The information obtained from this study throws more light on how to use multimedia and the various media for effective teaching and learning.
- ii. This study would offer help to teachers on how to use multimedia in the Senior High Schools to engage, motivate and involve their students in the teaching and learning of genetics.
- iii. The study would provide information to the Education Ministry, Government and other stake holders on the interventions they can offer to schools in order to promote the use of multimedia in the teaching and learning process in the Senior High Schools in Ghana
- iv. Students who may also access the findings of this study would be guided on how to use multimedia effectively in learning genetics for better understanding.

1.8 Delimitations of the Study

This study could have covered a wider area of the country (Ghana) but it was conducted in Kintampo Municipality in the Brong Ahafo Region only due to constraints of time and resources. The researcher therefore sampled Kintampo Senior High School which do elective biology subject in Kintampo Municipal in order to get the true result of the research work.

1.9 Limitations of the Study

- i. Since the study was an action research, the study was done only in Kintampo Senior High School hence the results cannot be generalized for the Municipality.
- ii. The sample size of the study was small therefore the results cannot be used for the whole region.

1.10 Organization of the Chapters of the Study

This study is presented in five chapters. The first chapter deals with the background to the study, limitations of the study, and organization of the chapters of the study.

The second chapter constitutes the review of the relevant literature on the study, theoretical background on the use of multimedia, purpose of science education, students interest in Genetics, new educational concept and approaches to biology education, the use of modern technology in the teaching of science in Ghana , multimedia and education, meaning of multimedia, brief history of usage of multimedia in teaching, types of multimedia, characteristics of multimedia, educational benefits of multimedia, multimedia learning and procedure, the role of the teacher in designing audio-visuals and challenges in teaching with multimedia.

The third chapter of this report deals with the methodology which is made up of the research design, population, sampling, sampling technique used, and data collection procedure for analyzing the data. Chapter four deals with the results and discussion, the last chapter (chapter five) deals with the summary of main findings, conclusion, recommendation and suggestions for further work that could be done on this study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter is a review of the literature that is considered in undertaken this study. This chapter deals with the relevant information on issues such as, purpose of science education, students interest in Genetics, new educational concept and approaches to biology education, the use of modern technology in the teaching of science in Ghana, theoretical background on the use of multimedia , multimedia and education, meaning of multimedia, brief history of usage of multimedia in teaching, types of multimedia, components of multimedia, characteristics of multimedia, educational benefits of multimedia, multimedia learning and procedure, the role of the teacher in designing audio-visuals and challenges in teaching with multimedia.

2.1 The Purpose of Science Education

Science is defined as the use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process (National Academy of Sciences, 2008).

Since science became one of the core subjects of the National Curriculum, the nature of science education changed and 'there has been a general acceptance that learning science involves more than simply knowing some facts and ideas about the natural world (Millar & Osborne, 1998).

In this century, much is demanded from scientist in solving issues ranging from climate, food security, health and many more. Hence it of essence that science as a subject be given the needed push to make sure that most of human needs are solved.

An adequate understanding of the nature of science and scientific inquiry is the main instructional purpose of science education (Lederman, 2003).

The American Association for the Advancement of Science (AAAS,1989) has it that the understanding to developing scientific literacy and also for meaningful and productive careers in science and asserts that is more and more jobs today require people who have the ability to learn, reason, think, make decisions and solve problems as well as engage in scientific discourse.

This assertion indicates that the goals for science education mentioned in the report of the National Science Education Standard (National Research Council, 1996) stating that the knowledge of science concept and principles would help students to be able to experience the richness and excitement of knowing about and understanding the natural world. Also, it would help students to be able to use appropriate scientific processes and principles in making decisions personally, engage intelligently in public discourse and debate about matters of scientific and technological concern and increase their economic productivity through the use of the knowledge, understanding and skills of scientifically literate person in the careers. Lederman (2003) also points out that science is part of the quest for understanding and wisdom reflects human wonder about the world. Shamos (1995) claims that the knowledge of science is important in making crucial decisions on everyday issues and problems and in the production of informed citizens who are capable of taking personal actions to find solutions to any identified issues and problems. Craven and Penick (2001), therefore understanding the nature of science and scientific inquiries to foster learners' ability to develop scientific literacy is a purpose and goal for science education.

2.2.1 Students Interest in Genetics

Many scholars have pointed to the importance of relevance to curriculum development (Edelson & Joseph 2004). However, when aiming at creating relevant learning materials, developers frequently rely on adult notion of what should be relevant and interesting to students (Wesbrook, De Jong & Pilot, 2006; Chamany, Allen & Tanner, 2008).

In this regard, it will be crucial for researchers and developers of biology education, to involve and identify biology, students' interest in genetics when forming biology curriculum. When allowed to pursue their own interest, students participate more, stay involved for longer period and exhibit creative practices in doing science (Seiler, 2006). Interest has also been found to influence future educational training (Krapp, 2000).

Organizations such as National Research Council (1996), the American Association for Advancement of Science (1993) recommends this idea and has proposed that science curriculum should provide a common basis of knowledge while addressing the particular needs and interest of students. Jenkin (1999) suggested that constructing science curriculum that will enable young people to engage in science related issues that are likely to be of interest and concern to them. Listening to students is still overlooked in the approach to improving academic success (Conboy & Fonseca 2009).

Biology is the most popular science subject among students and adults (Dawson, 2000) and especially among females (Murray & Reiss, 2003). With the increasing importance of genetics in daily life, there is a need to pay greater attention to the subject of Genetics in the schools' science curriculum. Genetics instruction at secondary school also

provides a considerable opportunity to discuss current ethical and social issues. According to Lewis et al (4-6) individuals in secondary level schooling should be able to understand what they hear and read about genetics and they should be able to give an informal response to personal and social issues with science content.

More than thirty years ago, Johnstone and Mahmoud (1991) examined the topics of high perceived difficulty in school biology syllabus and they revealed that genetics is one of the most difficult biology topics for secondary school science students. Genetics is thought of as a subject or topic in biology that is difficult to learn and understand especially for novices (Johnson & Mahamud, 1991).

According to Taber, and Winkerbottom (2006), expectations and uncertainties created by advancement in the field of genetics both excite and concern people. This is partially because genetics research proceeds rapidly, genetics phenomena are complex, and the amount of information related to advances in genetics is continuously increasing. In recent decades there has been a wide range of scientific and technological advances in this field such as the human genome project, cloning, genetically modified foods, gene therapy and treatment of disease including a wide variety of cancers, heart disease and diabetes.

News about research and development in the field of genetics is difficult for people to understand. An increasing number of articles in newspapers, journals and books indicate that there is growing consensus among science educators that students need a better understanding of basic genetics concepts (Alhunoglu, Bahattin & Serker, 2015; Saka, Carrah & Akdeniz, 2006; Kilic, 2014).

Much science education literature of the past two decades has dealt with learning and teaching genetics. Findings showed a poor understanding of the process by which genetics information is transferred. The lack of basic knowledge about the structure involved (gene, chromosome, cell), and they appear to be widespread uncertainty and confusion among student of various levels and among the population in general (Marbach-ad & Stavy, 2000; Wood-Robertson, 2000; Wood-Robertson 1994, Kindfield, 1991).

Knippels, (2000). Had interviewed biology teachers and ten meaningful problem categories were extracted? Some of the main problems in learning and teaching genetics are; the abstract nature of genetics, alienation from real biological phenomena due to lack of connection and meiosis in particular. Students undertaking genetics study unlike other topics do not have access to hands-on teaching and learning materials during genetics classes. In some areas in genetics where practical are easily done, it takes a long period before results are obtained and this retard the interest of students. (Haambokoma, 2007).

Another problem considered in genetics that make it difficult is the complexity of genetics. The structure of genetics knowledge is complex that is, inheritance has to do with all levels of biological organization and an adequate understanding of genetics require a student to have a vast knowledge in cell theory before the student can be conversant in dealing with matters of genetics (Baha, Johnstone & Hansel 1999).

The main reason for learning difficulties were the nature of the topic Cimer, (2012).

As part the complexity of genetics, students who perform poorly in mathematics often do so when solving genetics questions since genetics also involve calculations and sometime equations. (Haambokoma, 2007).

The study of genetics has always been considered as difficult. This results in poor motivation or sometimes making the student to give up on the study of genetics. Students have a negative feeling about genetics especially inheritance. Haambokoma, (2007).

Genetics deals with a lot of terminologies and as such, there are several similar but difficult terminologies in genetics and as such, for a student to be well acquainted in genetics, the student must be conversant with these similar but varied terms which usually make it difficult for students to grasp the knowledge of genetics.

Since genetics is not taught at the basic level, students come into the Senior High School with little or no knowledge in genetics and as such, the relevant previous knowledge is lacking (Knipples, 2005).

In other to reach students accusation of meaningfully understanding of genetics suggestions have been advanced for dealing with problems of preconception, terminological language and basic mathematical requirement (Longden,1982; Wood Robinson 1994; Lewis et al, 2000).

Moreover, significant changes should be made in both curriculums planning and sequencing of teaching when genetics is taught at the school Knipples, (2000).

2.1.2 New Educational Concept and Approaches to the Teaching of Genetics

The scope of biology expands to varieties of domains such as Agriculture, Biotechnology, Health and Industries. Biology education of the Senior High School therefore must provide the foundation for students to pursue the various higher expertise in the various fields of biology in order to satisfy the many needs of biological enterprises.

The objectives and goals of biological studies is enormous and must reflect its social functions which is to produce and reproduce knowledge, apply the knowledge to impact on the society (Engel & Fischer 2015).

In order to address these numerous challenges of biological education such as inadequate funds for practicals, lack of science equipment and many more, to satisfy society for this century and beyond, it requires several considerations including addressing the ethical dimension of biological sciences, new scientific knowledge as well as findings of research on education processes and learning theory.

Little is known about the instructional strategies that were used in 1916, it can be assume that teaching was primarily by lecturing, the traditionally accepted mode of instruction in the universities since their origin (Brockliss, 1996). Many US Biology classes were described as "lecture with conventional laboratory" (Hollisten, 1939) and genetics courses were described in catalogs as "surveys with general treatment of facts and theories" (University of Wisconsin 1915, University of Maire 1915).

The subject matter and our ways of thinking about the teaching of genetics have broadened tremendously since 1916. Then a young, emerging field, genetics is now the foundation for understanding biological information -flow, exchange of storage are of

the fine core concept areas that all undergraduate's biology students should master according to the vision and change report (American Association for the Advancement of Science, 2011).

Genetics has also become highly relevant to students' lives with new stories nearly every day about its impacts on health and society (Redfield, 2012). A growing awareness of problems with traditional instruction. Giodan (1998) explains that learning is better achieved through the power of construction.

Concepts has evolved from the old passive process where by teachers communicated their knowledge to students considered as empty containers to the behaviorist constructivist approach by which the teacher helps the learner to construct knowledge. That is, the moving from the simple to the complex and from the specific to the general.

The development of a more active approach whereby the reconstruction of knowledge follows a necessary phase of deconstruction that is, a process by which the knowledge is generated by the learners themselves.

Findings of a study by de Capparisi, Burman and Magee (2001) suggests that lecture method leads to the ability to recall but demonstration and discussion produces higher level comprehension.

Further research on hands-on method of teaching has shown that hands-on learning produces favorable student performance outcomes and also foster greater participation, self-confidence and leadership abilities (Perkins & Saris 2001, Yoder & Hochevar, 2005).

2.2 A Theoretical Background on the use of Multimedia

The role of interactive multimedia and its effectiveness have been the subject of many studies. User interactivity is a major feature of a well design multimedia course ware. The researchers have shown that an interactive learners' environment can generate effective instruction and learning systems. (Happer & Hedberg, 1997; Sims 1998; Shinde, 2003).

In different research by Mayer, results indicate that using multi-modal instruction is more effective than using any single mode (Norhayati & Siew; 2004; Mayer, 1997)

In several reviews by various researchers on the effectiveness of multimedia use learning suggest that the people who use computer -based instruction perform better in terms of test scores as compared to those who received instruction through traditional classroom lectures (Wakil, Mahamud, Didar & Sarde 2017; Perkins & Saris 2001; Shinde 2003).

Similar research papers showed that children who use the computer and internet at home for learning can have better chances of understanding basic learning skills. Children these days have computer technology in all facets of gadgets, TV remotes, digital games, (etc.). These offer a lot of different ways of playing from what had been impossible in a non-digital world. (Zevenbergen, 2007).

In trying to keep up with such children, educators must up their knowledge and skills and include the use of technology in their instructions. Stich (2003) study shows that the use of animation in teaching cell biology and other fields of biology is beneficial. It was found that scrabble interactive animation with keys and rollover help to enhance the learning in effective way. Animated illustrations accompanied with audio, video,

and kinetic are much better to the cell biology learners than static illustrations (Stith, 2004).

These multimedia packages are usually used for subjects like science, math etc. It was concluded that interactive multimedia is much better than traditional educational methods which depends on classroom and teachers using chalk and talk (Kamat & Shinde, 2009). Well design interactive multimedia system can attract the learners to possess more information. Active engagement is important factor towards improving learning process.

Said attempts to lay down a foundation of a design model of interactive multimedia system which offers active engagement (Said, 2007). Using multimedia to teach genetics in Senior High School Science class will help the student to improve in their learning of genetics.

2.3 The Use of Modern Technology in the Teaching of Science in Ghana

As a developing nation which is poised to achieving greater pedestal in terms of socio-economic development of its people, Ghana as a country has taken steps in using technology as a tool to improve on several fields of the country's economy such as health, agriculture, education, (etc).

In 1995, Ghana became one of the first countries in the sub-Saharan Africa to have access to the internet (Sulberger cited in Intiful, 2003). Although, the country still struggles with funds to promote infrastructural development and providing educational needs such as classroom, laboratories and teaching and learning materials. Government still considers multimedia technology as the key to educational development. Education empowers the citizenry to enable them develop expertise that can be used in

the various fields of the economy for development and technology advancement is critical aspect that the government of Ghana looks at.

As a result, Ghana has put in several programmes to develop ICT infrastructure in schools and college's so as to put Ghana in the main stream of ICT. One of such programmes is the development of a national fiber optic network by the Volta River Authority, (VRA) (Intiful, Okyere, & Osae, 2003).

Other programmes such as the one lap top per child policy which was initiated in 2008. This programme was to provide laptops to students to enable them improve upon their learning especially in ICT. The government of Ghana in many agreements and memoranda tasked Internet providers (network services) to expand their scope in other to reach many remote areas of the country in other to provide internet services not only to schools but to the citizenry to ease and provide access to information. Although government makes these strides, ICT development is still in its infancy in Ghana. The cost of supcription to data, infrastructure is coupled with poor quality of services by internet service providers. (Sulberger, 2001).

For technology to grow in our schools and communities, these barriers must be dealt with. Information on classroom characteristics in the TIMSS 2003 indicates that in Ghana, though the national curriculum has a policy statement on the use of computer in teaching, a large number of students in schools who participated in TIMSS had no access to computers (Anamoah-Mensah, 2004) also most rural schools are not connected to the national electricity grid. Many schools in the country still has problems with infrastructure and this translate into the minimal level of digital literacy, low level of computer literacy (Anderson 2004).

As young scientist sought to develop rapidly in their quest for knowledge, government and other stake holders in science education should roll-out policies that will improve the use of technology in the teaching and learning of science.

2.4 Multimedia and Education

Educational technology has come a long way from the language laboratories of 1950s and 1960s, which served as a convenient scape goat in explaining why even with large infusion of equipment, desired results were not achieved (Otto, 1989, p.14).

Multimedia seems to be the adequate and necessary method of teaching in this era of internet, wireless, online and offline connectivity environment where students can be motivated having those tools. It is essential that students are provided with these technological tools to occupy them than the students using it for just entertainment only. This will allow them to use it positively to impact on science (genetics) education. The availability of these tools has been the norm of the day and students use several of these tools in their day to day activities. It is prudent that educators channel these students' energy in the usage of these tools from just entertainment to letting the students use it to improve their learning. As the world's activities are more or less directed and lead by the use of technology, more inventions, innovations and evolutions of information technology fields are brought to bear, opening new channels and opportunities for teaching and educational methods. Some of these innovations can be used to improve the abilities of teachers in presenting information in an interactive and media enhanced format relative to traditional methods but in an improved manner. This may offer students channels and methods of learning that will be familiar easy and challenging to make them understand and deal with.

Education in these days' encounter challenges in all aspects of social economic and cultural life. These challenges need to be solved and in solving them, the use of modern teaching technologies to face some of the main problems which education and its productivity encounters by increasing the learning level which may be achieve through providing equivalent opportunities for all people whenever and wherever they are, while considered the individual differences between learners (Wilkinson, 1986; Abd El-Halim Said, 1997).

Research indicate that multimedia is one of the best educational technique because it addresses more than one sense simultaneously, that is, as it addresses the sense of sight, it is also at the same time addressing the sense of hearing. Multimedia programs provide different stimuli in their presentations which include a number of elements (Aloraini, 2005 p.55-75).

Today in the mist of social and technological explosion in various fields of knowledge as well as in the techniques by which knowledge is communicated, the teacher can no longer be the sole and mere information giving instrument in the classroom. In addition, due to the increasing numbers of student population it has become difficult for a teacher to reach out to each and every individual student with the giving methods we follow in the classroom. With the advent of rapid development in electronic media, a broad range of media is available for different educational processes.

2.4.1 Meaning of multimedia

Multimedia refers to computer mediated information that is presented concurrently in more than one medium. It consists of some but not necessarily all of the following elements; text, still graphic images, motion graphic, animation, hypermedia,

photographs, video, audio (sound, music, narration). Multimedia can support multiple representations of the same piece of information in a variety of formats. This has several implications for learning (Ke, 2008).

Multimedia is characterized by the presence of text, pictures, sound, animation and video. Some or all of which are organized into some coherent programme, (Phillips, 1997).

Multimedia means "many media". The term multimedia instruction system refers to the usage of appropriate and carefully selected varieties of learning experience which are presented to the learner through selected teaching strategies which reinforces and strengthen one another so that the learner will achieve predetermined and desired behavioral objectives. (Dipika Shah, 1988).

Multimedia can also be defined as the seamless digital integration of text, graphics, animations, audio, still images and motion videos in a way that provides users with high level of control and interaction.

The word multimedia was originally used to indicate a technology dealing with more than one mode of media, such as text, sounds, images etc. At the same time, computers came to play the roles of various media; newspapers, magazines, photographs, films, radios, TV and even telephones. That is, the computer itself has become more than one medium, (Kubo, 1996; p.204-205).

2.4.2 Brief History of Multimedia usage in Teaching

Teaching methods have changed drastically throughout history. Until the beginning of the 20th century, the American students were taught solely through lectures and

textbooks. The first of its kind was opened in St. Louis in USA in 1905, and offered students educational stereographs, slides and films was introduced into the classroom with a motion picture projector. With the emergence of radio broadcasting and recording in the 1920's and 1930's, the new approach to academia was called the "audiovisual instruction movement" which included educational videos with sound (Reiser, 2001). In the 1950's instructional television began to play a large role in classroom education through the creation of public broadcasting stations. In the 1970's computer-assisted instruction was being developed for use in the classroom so education began focusing on "educational technology". By the early 1980's, computers were being used for educational purposes in the majority of American schools (Reiser, 2001). The further development of computers and the internet in the 1990's has introduced a virtually endless capacity for the acquisition of information and presentation of material and has proven to be one of the most influential tools for educational. Online resources have provided easier access for students to obtain material that had previously been difficult and time-consuming to obtain. Power points, and textbook CD-ROMs, are continually being developed in hopes of creating more effective and interesting ways to convey information and enable students to better understand classroom material. These new forms of material presentation are known today collectively as multimedia and have truly shaped the modern educational system (Valleman, 1996).

2.4.3 Types of multimedia

Multimedia may be broadly divided into linear and non-linear categories. Linear multimedia; active content progresses often without any navigational control for the viewer such as in cinema presentation. Non-linear multimedia uses interactivity to

control progress as with video games or self-paced computer training. Hypermedia is an example of non-linear multimedia content.

Multimedia presentation can be live or recorded. A recorded presentation may allow interactivity through navigation system. A live multimedia presentation may allow interaction via an interaction with multimedia.

2.4.4 Components of Multimedia

Multimedia applications can include many types of media. The primary characteristic of multimedia system is the use of more than one kind media to deliver content and functionality. Web and desktop computing programs can both involve multimedia components as well as different media items. A multimedia application will normally involve programming code that enhances user interaction. Multimedia items generally fall into one of five main categories and use varied techniques for digital formatting.

Text

It may be easy content type to forget when considering multimedia systems, but text content is by far the most common media type in computing applications. Most multimedia system use a combination of text and other media to deliver functionality. Text in multimedia system can express specific information contained in other media items. This is a common practice in applications with accessibility requirements. For example, when web pages include image elements, they can also include a short amount of text for the users' browser to include as an alternative in case the digital image is not available.

Images

Digital image files appear in many multimedia applications. Digital photographs can display application content or can alternatively form part of a user interface. Interactive elements such as buttons often use custom images created by the designers and developers involved in an application.

Digital image files use a variety of formats and file extensions. Among the most common are JPEGs and PNGs. Both of these often appear on websites, as the formats allow developers to minimize on file size while maximizing on picture quality. Graphic design software programs such as Photoshop and Paint.NET allow developers to create complex visual effects with digital images.

Audio

Audio files and streams play a major role in some multimedia systems. Audio files appear as part of application content and also to aid interaction. When they appear within Web application and sites, audio files sometimes need to be deployed using plug-in media players. Audio formats include MP3, WMA, Wave, MIDI and RealAudio. When developers include audio within Website, they will generally use a compressed format to minimize on downloading times. Web services can also stream audio, so that users can begin playback before the entire file is downloaded.

Video

Digital video appears on many multimedia applications, particularly on the Web. as with audio, Website can stream digital video to increase the speed and availability of playback. Common digital video formats include Flash, PEG, AVI, WMV and QuickTime. Most digital video requires use of browser plug-ins to play Web pages but in many cases user's browser will already have required resource installed.

Animation

Animated components are common within both Web and desktop multimedia applications. Animations can also include interactive effects, allowing users to engage with the animation action using their mouse and keyboard. The most common tool for creating animation on Web is Adobe Flash, which also facilitates desktop applications. Using Flash, developers can author FLV files, exporting them as SWF movies for deployment to users. Flash also uses ActionScript code to achieve animated and interactive effects.

2.4.5 Characteristics of Multimedia

1. Multimedia storage and retrieval system contain more information than any human training agent can possibly embrace and have many terminals through which student have access to the information.
2. Multimedia system must be controlled by computer. Multimedia devices are electronic and are connected to computer system that provides the stimulations.
3. The information of multimedia system is presented digitally but not manually as in traditional presentation. Multimedia contrast with media that uses only rudimentary printed or hand produced material.
4. The interface to final presentation of media is usually interactive.

Multimedia can be recorded, played, displayed and interacted with or accessed by information content processing devices and as such allows the learner to have several opportunities of either answering questioning, editing, downloading etc. more ideas in its presentation.

2.5 Educational Benefits of Multimedia

The use of multimedia tools in education has enormous benefits both to the learner and the instructor (teacher). Many researches have been conducted and has come out with these as some of the many benefits.

1. Multimedia provides deeper understanding

According to research, a benefit of multimedia learning is that, it takes advantage of the brains ability to make connections between verbal and visual representations of content leading to a deeper understanding which in turn supports the transfer of learning to other situations

2. Improved problem solving

A large percentage of the human brain dedicates itself to visual processing. That is using images, video, and animations alongside text stimulates the brain. Student attention and retention increases. Under these circumstances, in a multimedia learning environment student can identify and solve problems more easily as compared to the scenario where teaching is made possible by text books.

3. Increased positive emotions

According to psychologist Barbara Fredrickson, experiencing positive emotions makes people see more possibilities in their lives. Using multimedia during instructions impact student's mood during the learning process. With a positive attitude, students learn better and tend to be more proactive. it raises the student interest level in the learning process as they interact with several varieties of media.

4. Access to a vast variety of information

With the influx of computers, tablets, smart phones and the internet, students are today better equipped than ever to search and find the information they need.

A study revealed that 95% of students who have access to internet, use it to search for information online, shearing the information and participating in class discussions is done in a more confident way when access to information is as easy as in today.

Multimedia can stimulate more than one sense at a time, and in doing so, may be more attentive getting and attention holding.

5. It increases memorability

Since students perform the activities they can memorize which and whatever information they put into a particular aspect of their learning.

2.5.1 Benefits of multimedia from educator's perspective

1. It provides student with opportunities to represent and express their prior knowledge.
2. It allows students to function as designers using tools for analyzing the worlds, accessing and interpreting information, organizing their personal knowledge and presenting what they know to others.
3. Multimedia application engages students and provide valuable learning opportunities
4. It empowers student to create and design rather than absorbing representations created by others.
5. It encourages deep reflective thinking and creates personally meaningful learning opportunities.

2.5.2 Benefits of Multimedia from the Student Perspective

1. It gives students the opportunity to produce document of their own which provides several educational advantages.
2. Students who experience the technical steps needed to produce effective multimedia document become better consumers of multimedia documents produced by others.
3. Students learn the material included in their presentation at much greater depth than in traditional writing projects.
4. Students work with the same information in four perspectives. That is;
 - a) As researcher, they must locate and select the information needed to understand the chosen topic
 - b) As authors, they must consider their intended audience and decide what amount of information needed to give their readers an understanding of the topic.
 - c) As designers, they must select the appropriate media to share the concept selected
 - d) As writers, they must find a way to fit information to the container including the manner of linking the information for others to retrieve (Smith 1993).

2.6 Multimedia Learning Procedure

A cognitive theory of multimedia learning has been presented by researchers which are based on three assumptions suggested by cognitive science research about the nature of human learning.

The dual channel assumption, the limited capacity assumption, and the active learning assumption.

1. The dual channel assumption is that humans possess separate information processing systems for visual and verbal representations. For example, animations are processed in the visual/pictorial channel and spoken words example narrations are processed in the auditory/verbal channel
2. The limited capacity assumption is that the amount of processing that can take place within each information processing channel is extremely limited.in addition the learner may convert some of the spoken words into verbal representation for further processing in the verbal channel whereas some of the animations can be converted into visual representations for further processing in the visual channel. The learner must select relevant aspects of the incoming images for further processing. The second set of processing is to build a coherent mental representation of the verbal material (from a pictorial model) and a coherent mental representation of the verbal material (from a verbal model). These processes are called organization.
3. A third process is to build connections between the verbal and pictorial models and with knowledge.

These processes are called integrating. The process of selecting, organization and integrating generally do not occur in some rigid linear order, but rather in an interactive fashion. Once a learning outcome has been constructed, it is stored in long term memory for further use.

According to the cognitive theory of multimedia learning, meaningful learning depends on all three of these processes occurring in the visual and the verbal representation. According to this theory, learners can engage in active learning even when the presentation media do not allow hands-on activity (Simhachalam Thaarana, 3rd Annual International Conference, Eltal Tirupti Chapter 2016).

2.7 The role of the Teacher in Designing a Multimedia Lesson

According to encyclopedia Britannica (1984:298) "design is from the Latin word "designara" which means to "mark out". It is the process of developing plans and schemes of action whether in mind or set forth as a drawing model."

Herold and Pomeroy (1992:17) opine that design as a visual thinking of a higher order than verbal thinking. The word design has many depths of meaning and that only philosophical method will strip off all the meaning to provide a coherent and comprehensive view.

Nkuuhe (1995) suggest that before one can produce any instructional materials including printed media, one should plan carefully. Take into consideration the objectives one intends to achieve, the target audience, whether the medias are the most appropriate media. He states further that, whether printed media will be used alone or it should be used in combination with other media. Planning in the production of printed media will have to be more elaborate than that of display media such as the multimedia, there are three stages in this planning: pre-design, design and post-design.

In pre-design, the Teacher plans and assembles all the needed materials and equipment that will be needed to execute a multimedia lesson. The teacher needs to make sure the equipment is tested and are in good condition.

In design, this is the time the Teacher arranges the equipment and position them according to how they will be used in the lesson. Conscious effort must be made to making sure all students in the class will benefit from the position the equipment hence the font size and media size or volume must equally be checked. The class seating arrangement, positioning of special learning is catered for.

Post -design concludes the designing stage. The Teacher ensures a proper check and recheck is done on the set up.

Kemp and Dayton (1985) propose that one has to make a checklist for this preliminary planning before instructional material is produced. Similarly, the researcher agrees that preliminary sketches should be made when designing any instructional media or teaching learning materials. These designs will help the artist to choose the best design that will serve as a guide to complete the finish artifacts.

Garcia-Barbosa and Mascazine (2002) asserts that "The use of media is determined by an instructor's objectives. Researchers have found that the use of media can motivate students to learn. "Therefore, it is important that a teacher makes a conscious effort in organizing all the needed materials that will be needed in executing a multimedia lesson.

2.8 Difficulty in Teaching with Multimedia

1. Most schools in Ghana do not have equipment, tools such as computers, smart boards, projectors, TVs, etc. That can be used in multimedia teaching.
2. Some teachers are not computer literates to be able to put their material and design their lessons with multimedia software.
3. Due to constraint of time, teachers find it difficult to prepare their lesson notes as well as design their multimedia lesson. They find it cumbersome putting their ideas and notes into multimedia designs and at the same time writing hard copy lesson notes in their lesson note books.

4. Some students have no access to computer, smart phones internet etc. Outside the classroom hence it is difficult for multimedia assignment to be giving to students.
5. Some school authorities find it expensive to acquire some of these multimedia apparatuses.

Other research has confirmed that while teachers are motivated to integrate appropriate use of multimedia into their classroom practice, their understanding of how to enhance learning is still developing and pedagogy for effective use has not yet been clearly established (Hannesty, Deaney & Ruthven, 2003).

However, the use of multimedia as a new education tool, according to Falk and Carlson (1992), has had minimal impact on education because they have not been widely used in schools at any level. Reasons for this are many, including a lack of funds for equipment and applications and a lack of knowledge by most teachers. In addition, many teachers do not regard themselves fully-equipped comfortable and sufficient in using ICT in educational settings and they feel more confident with their traditional style (Cavas, Karaoglah & Kisla, 2008). They argue that if multimedia is to meet its potential as an educational technology, teachers must be given in-service- training on how to effectively use it as a teaching and learning tool (Falk & Carlson, 1992). The use of ICT is on the rise and it is being developed and used for education in school and out of school situations (Wakil, Muhamud, Dider & Sarde 2017).

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter describes the research design used for this study. It also describes the other issues such as the study area, research population, sampling procedures, instrumentation, instrument and analysis.

3.1 The Study Area

Kintampo North Municipality is the study area. This Municipality is located in the northern part of the Brong Ahafo Region in Ghana. The study area shares boundaries with five districts in Ghana namely: Central Gonja District to the North, Bole District to the West, East Gonja District to the Northeast (all in the Northern Region) as well as Kintampo South District to the South and Pru District to the Southeast (Both in the Brong Ahafo Region). The Municipality is strategically located in the middle belt of Ghana and serves as a transit point between the northern and the southern sectors of the country.

This Municipality is located on the Trans ECOWAS route and as such, its population is made up of diverse ethnicity and booming businesses. Some of the ethnic groups found in this Municipality include; Bono, Mo, Dagaba, Konkomba, Wangara, Dagomba (etc)

There are two government assisted Senior High Schools in this Municipality. These are Kintampo Senior High School in Kintampo and Dega Senior High School in New Longoro.



Figure 1: Map of Kintampo North District and sister Districts.

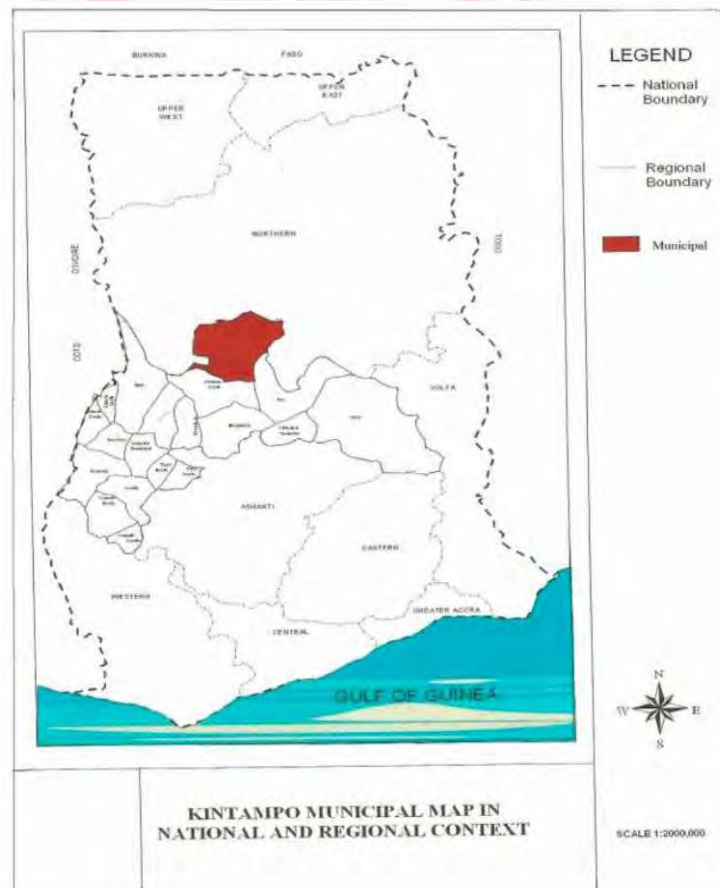


Figure2: Ghana map showing Kintampo North Municipal

3.3 Research Design

Action research was used in this study. Sagor (2000) states that, action research focuses on the development, implementation and testing of programme, product or procedure. Action research has grown in popularity throughout the past two decades (Fleming, 2000). Action research has become a more efficient and accepted tool for teachers to assess their strategies and reflect positively upon their effectiveness. The researcher considered this study as an intervention and also an immediate result was needed hence action research was chosen.

3.4 Research Population

A research population is a large well-defined collection of individuals or objects with similar characteristics (Castillo, 2009). In this study, Form Three Science class was used.

3.4.1 Target Population of the Study

A target population refers to the entire group of individuals or objects to which a researcher is interested in generalizing the conclusions (Castillo, 2009). The target populations usually have varied characteristics (Gill, Johnson, & Clark, 2010). The target population for this study was the government assisted Senior High Schools in the Brong Ahafo Region.

3.4.2 Accessible Population of the Study

The accessible population is the population in research to which the researcher can apply the conclusions. This population is a subset of the target population and it is from this accessible population that a researcher draws his sample (Gill, Johnson, & Clark, 2010).

The accessible population for this study was Kintampo Senior High School in the Kintampo Municipality of Brong Ahafo Region of Ghana. This school offers several courses including Science and has a total population of about 2000 students.

3.4.3 Sampling Procedure

The researcher used the probability sampling method (convenience sampling) for this study. Non-probability sampling is the use of a subject of the population to represent the whole population (Castillo, 2009). Convenience sampling is a type of non-probability sampling method that involves the sample being drawn from that part of the population that is close to handle. (Gill, Johnson, & Clark, 2010).

This method was chosen because; the researcher considered the availability of the students, convenient accessibility and proximity of the students to the researcher. The researcher is a teacher in Kintampo Senior High School hence this choice would allow the researcher ample time and convenience as well as easy access to the students for this study.

3.4.4 Sample size of this Study

This study used the final year (Form Three) Science students of Kintampo Senior High School in Kintampo Municipality of the Brong Ahafo Region. In all, sixty final year students were considered.

3.5 Sampling

A sample is a finite part of a statistical population whose attributes are studied to obtain information about a larger population (Castillo, 2009). The researcher chose Science students of Form Three at Kintampo Senior High School after consulting the students individually based on the availability, ease and accessibility of the students. Other students from the Science Class voluntarily opted to participate in the study. Students who could not be in school during the programmed time were not picked.

The researcher used the survey design that employed quasi experimental method for the selection of the treatment group and the control group. One of the two science classes was chosen as an experimental/treatment group also known as the intervention group and the other as the control group also known as the non- intervention group. The two class captains were asked to ballot (pick from a bowl a folded piece of paper containing an alphabet) and the one who chose the T (treatment) had his class chosen as the treatment group and the one who chose C (control) had his class chosen as the control group.

This study sampled sixty final year Science students made up of 17 females and 43 males from two final year Science classes with their ages ranging from sixteen to twenty years.

3.6 Research Instrument

A research instrument is a device used to collect data to answer the research questions. In this study, three instruments were used to collect data. The instruments were interview schedule, questionnaire and achievement test.

3.6.1 Structure of Interview Schedule

Structured interview was used in this study. This method was chosen to ensure that the questions were answered within the same context to minimize the impact of context effect when the answer given to a question can depend on the preceding question. (Edwards & Holland, 2013). The questions used in the interview schedule were open ended questions that allowed interviewee to express their perceptions and preference for the intervention. The interview schedule had six questions which the students were to answer all. Simple English language was used for the students to easily understand and respond.

Twenty students from the intervention class were interviewed to obtain their opinion and experience about genetics and the intervention. The students were interviewed after they had taken the post-test and have known their performance in genetics after the intervention. Appendix D is a sample of the interview schedule. The oral interview was used to determine students' perception and preference for the teaching of genetics using multimedia teaching and learning method.

3.6.2 Test Items (Pre -test and Post- test)

The two tests were used in the collection of quantitative data. These tests were administered to two groups. The experimental group and the control group. The experimental group was taught topics in genetics using the multimedia teaching method

whiles the non-intervention group was taught genetics using the traditional teaching method.

The pre-test was used to assess the participants' knowledge on genetics after the revision exercise in the pre-intervention stage. The post-test was used to assess students' performance in genetics after they have been taught genetics using the multimedia teaching method in the case of the experimental group. It was also used to assess the performance of students after they have been taught genetics without using multimedia teaching and learning method in the case of the control group. Both tests were constructed with reference to the objectives in the syllabus of SHS 3 of Biology.

Each of the tests composed of 20 multiple choice questions from which a student was to select and shade the correct answer as shown in Appendix A and Appendix B. The pre-test was conducted to ascertain student knowledge in genetics before the intervention. The results of pre-test showed that there was no significant difference between the two groups.

The post-test was used to determine student's performance in genetics after the intervention and to determine whether there is improvement in student performance after the intervention or not.

3.6.3 Structure of Questionnaire

The questionnaire was made of two parts. Part one was the bio -data of the student and Part two was made of eight close ended items which the student had five options of which the student was to choose one by ticking the suitable option. The responses for which the student was to choose from included; strongly agree, agree, not certain, disagree and strongly disagree as shown in Appendix C.

The questionnaire was used to assess students' interest in genetics, student's perception of the multimedia teaching and learning method and student's preference to the intervention.

3.7 Validity of the Instrument

Validity describes whether the means of measurement are accurate and are actually measuring what they intend to measure (Golafshani, 2003). The primary objective of a research is to provide valid information that could be used in describing, predicting and explaining phenomena. Moreover, research data is considered valid if they provide a measure of what is intended to be measured (Cohen, Manion & Morrison, 2000).

To ensure the validity of the interview schedule, questionnaire and achievement test, three experienced Biology tutors of Kintampo Senior High School examined the test material. This was based on the cognitive level of the participants and the instructional objectives as stipulated in the SHS 3 Biology syllabus of Ministry of Education (2010) of Ghana. They also examined the interview schedule as well as the questionnaire to ensure that the errors were eliminated. Then the instruments were vetted by my supervisor and his suggestions were used to improve the instruments.

3.8 Reliability

Reliability is the extent to which items in an instrument generate consistent responses on several trials with different respondents in the same setting, circumstances or condition (Miles & Huberman, 1994). Jope (2000) defines reliability as the extent to which results are consistent over time and if the result of the study can be produced under similar methodology, then the research instrument is considered reliable. To ensure reliability, a pilot test was conducted.

3.9 Pilot Test of test Document and Questionnaire

The researcher carried out a pilot test where questionnaire and test document were pre-tested in Form Two Science class of Kintampo Senior High School in the Kintampo North Municipal of the Brong Ahafo Region. This class was selected for the pilot test because this class shares similar conditions just like the actual class in terms of the learning environment. The students used in the pilot test do not form part of the sample for the study. The data from this pilot test was statistically analyzed to determine the reliability of the test instrument using Spearman-Brown prophecy formula since all the items on both pre-test and post-test were dichotomously scored to show either the student failed or passed. The analysis resulted in reliability co-efficient of 0.58 and 0.63 for the pre-test and the post -test respectively.

Similarly, the data from pilot test of the questionnaire were statistically analyzed by using Internal Consistence Analysis (ICA). The ICA calculation of the Cronbach's alpha coefficient result was 0.81 for the data of the questionnaire. The pilot test enabled the researcher to restructure the test document and the questionnaire to enhance right responses from participants.

3.10 Treatment of the Groups

The participants (control and experimental) were taken through genetics topics for three (3) weeks using the traditional method of teaching (lecture method). They were assessed by using the pre-test. The experimental group was taken through teaching and learning genetics using multimedia method. At the same time, the control group was also taken through the same topics but by using the lecture method. At the end of the three weeks, both groups were assessed with the post test.

3.11 Data Collection Procedure

An introductory letter was obtained from the Head of Science Education Department of the University of Education Winneba. This letter was used to seek permission from the Headmaster of Kintampo SHS to administer the instrument. The pre-test was administered in the first week to the participating classes.

Students in the experimental group were given questionnaire in the last week of the intervention to find out about their views on the use of multimedia teaching and learning method in the teaching and learning of genetics. The Biology periods were used for this purpose. Students were asked to respond to the questionnaire after which the questionnaire was collected at the end of the lesson to ensure that the researcher had 100% collection of questionnaires.

Twenty students from the experimental group were interviewed to determine their perceptions and views of multimedia teaching and learning method. The students who took part in the interviews were assured of their confidentiality. This was done by given them codes. The consent of the students was duly sought for before the interviews. The venue for the interview was chosen by the students in order to make them comfortable.

3.12 Data Analysis using SPSS and Excel

In analyzing data in this study, both quantitative and qualitative methods were used in the data analysis. Data from the interview sessions were collected and analyzed qualitatively whiles data from the questionnaire and the test were analyzed quantitatively.

The researcher used descriptive and inferential statistics in analyzing the quantitative data. The researcher determined the frequencies and percentages of the responses obtained from the questionnaire. The researcher used the independent t-test. The pre-test and post-test results were statistically analyzed using means, standard deviations. The t-test was used to determine whether there were any significant differences in the performance of the students in the two groups before and after the intervention. A qualitative analysis was done on the data gathered through the interviews. The recorded sessions were transcribed, analyzed and summarized. The researcher used the constant comparative method of analysis to determine the uniqueness of each recorded interview.



CHAPTER FOUR

RESULTS

4.0 Overview

This chapter deals with presentation of the data collected and analysis of the results. The data collected in this study was analyzed using percentages, mean, standard deviation and t-tests.

4.1 Analysis of Bio –data

Table 1, indicates the number of male and female students who participated in the study. The numbers of male students were 43 and that of female student was 17 with respective percentages of 71.7 and 28.3

Table 1 indicates the distribution of sex of participants.

Table 1: Distribution of Sex of participants

Sex	Frequency	Percent	Cumulative Percent
Male	43	71.7	71.7
Female	17	28.3	28.3
Total	60	100	100.0

Table 2, show the ages of students in both the treatment class and the control class. Student ages ranged from 16 to 21 years. Majority of the students 43 (71.7%) were of age group of 18-19 years and followed by age group 20-21 years and 13(21.7%) students. Only 4(6.6%) of the students were of age 16-17 years.

In Table 2, the age-range of participants is indicated.

Table 2: Distribution of age of students of the study

Age range (in years)	Frequency	Percent	Cumulative percent
16-17	4	6.6	6.7
18-19	43	71.7	71.7
20-21	13	21.7	21.7
Total	60	100.0	100.0

4.2 Analysis of Research Questions

Research Question 1: Is there any difference between the test scores of the experimental group and control group in the pre-test measurement of students' performance in genetics?

In order to answer this question, data was collected and a null hypothesis was calculated at $p < 0.05$.

Null Hypothesis 1: There is no statistically significant difference between the test scores of experimental group and the control group in the pre-test measurement of students' performance in genetics.

Table 3 indicates the performance of both experimental and control group at the pretest on genetics. In Table 3, the p-value of 0.15 is greater than 0.05. This indicates that there is no significant difference in the performance between the mean scores of the experimental group the control group. This means that they were at the same level. Hence, the intervention was introduced for the experimental group.

Table 3: Results of the pre-test for experimental and control groups

Group	Number	Mean	SD	t-test	p-value
Experimental	30	9.13	1.61	2.00	0.15
Control	30	8.5	1.76		

Student Performance at Post-Test

A 20-test question item on genetics was administered to the experimental and control classes after the intervention (multimedia method of teaching) was used to teach the experimental class. The control class was taught by using the traditional method of teaching. This test was used as Post-test. The marks that students obtained in this test was collated and discussed in the Tables 4, 5 and 6 below.

Research Question 2. Is there any statistically significant difference between the test scores of the experimental group and control group in the post-test measurement of students' performance in genetics?

To answer this research question, the following null hypothesis set at $p < 0.05$ was calculated.

Null Hypothesis 2: There is no statistically significant difference between the mean scores of experimental group and control group in the post-test measurement of students' performance in genetics.

The mean scores of student during the pot-test measurement are shown under Table 4. Table 4, the means of 15.6 and 10.6 for the experimental group and control group respectively give an indication of differences in the students' performance and this is confirmed by a p-value of 0.025 which is less than 0.05. This indicates that, there is significant difference in the mean score of the performance of the experimental group and the control group in the post-test measurement of students' performance in

genetics. Hence multimedia has helped in the improvement of performance of the experimental group in genetics

Table 4: Results of the post-test for experimental and control groups

Group	Number	Mean	SD	Df	t- test	p- value
Experimental	30	15.5	2.7	58	2.0	0.025
Control	30	10.6	1.9			

Research Question 3: Is there any statistically significant difference between mean scores of male and female students" of the experimental group in the post- test measurement of students' performance in genetics?

The study probed further to find out if there was any statistically significant difference in performance between gender with respect to the experimental group.

Null Hypothesis 3: There is no statistically any significant difference between the mean scores of male and female students' in the experimental group in the post-test measurement of students' performance in genetics.

Table 5 indicates male and female performance at post-test measurement of the experimental group. Table 5 shows a p-value of 0.38 which is greater than 0.05.

This indicates that there is no significant difference in the performance of male students and female students of the experimental group at post-test measurement of students' performance in genetics.

Table 5: Results of paired t-test of male and female students' performance of experimental group at post- test measurement

Sex	Number	Mean	SD	Df	t-test	p-value
Male	22	15.9	2.5	29	2.22	0.38
Female	8	14.8	3.2			

Research Question 4. What are the views of students about the use of multimedia method of instruction?

This question was introduced to find out the views of students about the use of multimedia method of teaching. Series of statements were put to the students to find out their views in the form of a questionnaire.

In order to clearly explain the views of students regarding the use of multimedia, percentages of strongly agree and agree were added together and strongly disagree and disagree also added together. Not certain was left to stand alone. See Table 6.

Table 6: Number of students and percentages of students' responses to items of the questionnaire

Statement	Strongly agree	Agree	Not certain	Disagree	Strongly disagree
1. Multimedia explains genetics better	6(20%)	22(73.3%)	1(3.3%)	1(3.3%)	0(0%)
2. Multimedia makes me interested in learning genetics	11(36.7%)	19(63.3%)	0(0%)	0(0%)	0(0%)
3. Multimedia have helped me to understand genetics better	19(63.3%)	9(30%)	1(3.3%)	1(3.3%)	0(0%)
4. Multimedia takes too much time to explain a single concept of genetics	0(0%)	2(6.7%)	1(3.3%)	10(33.3%)	17(56.7%)
5. Multimedia makes lessons very boring	0(0%)	0(0%)	1(3.3%)	2(6.7%)	27(90%)
6. It is difficult to use multimedia in learning	0(0%)	2(6.7%)	2(6.7%)	10(33.3%)	16(53.3%)
7. Multimedia method should be used always in teaching genetics	13(43.3%)	17(56.7%)	0(0%)	0(0%)	0(0%)

Statement 1: multimedia explains genetics better

Table 6 shows the response of students to item 1 of the questionnaire (multimedia explains genetics better); 95.3% of the 30 students who responded to this item agreed that multimedia explains genetics better and 1(3.3%) student was not certain while 1(3.3%) student disagreed that multimedia explains genetics better. The choices of students on multimedia indicates that multimedia makes students understand genetics better. Since a total of 93.3% of them agreed that multimedia explains genetics better.

Statement 2: multimedia makes me interested in learning genetics.

This item was used to determine whether multimedia teaching method is able to create student's interest in class and is able to sustain the interest. Out of the 30 students who responded to this item, 100% agreed to this statement. This percentage reveals that multimedia method of teaching boosts students' interest in the learning of genetics.

Statement 3: multimedia has helped me to understand genetic better

This item was also introduced to determine whether students understand genetics lesson when they are taught with the multimedia teaching method. Results in Table 6, indicate that 93.3% of the participants agreed to the statement that multimedia has helped them to understand genetics better. Most students were in agreement that multimedia helped them in understanding genetics better than chalk and talk. The information collected on this item makes it clear that multimedia method of teaching helps students to understand genetics well.

Statement 4: multimedia takes too much time to explain a single concept of genetics

This item was used to find out students' views on utilization of contact hours in a multimedia teaching method lesson. As illustrated in Table 6, about 90% disagreed to the statement. This response from the intervention group indicates that multimedia method of teaching makes good use of students' contact hours.

Statement 5: Multimedia makes lesson very boring

This item was introduced to determine students' view on their involvement or participation in multimedia lesson to know whether students are bored or not in multimedia lesson. Multimedia teaching is said to be an activity-based lesson and if

students are not actively involved, they will be bored in the course of the lesson hence this item sought to find out.

Table 6 displays results of the responses of students to the statement that multimedia makes lesson boring. No student (0 %) agreed to this statement. Approximately 3% of them were not certain. (96.7%) disagreed to this statement. The responses of students to this item show that multimedia lessons really involve student's participation.

Statement 6: It is difficult to use multimedia in learning

This item seeks to find out whether students are able to use multimedia on their own in learning genetics. Results in Table 6 show students responses to this item. Out of the 30 students who responded to this item, (6.7%) agreed to the statement, another (6.7%) were not certain .86.6% of the intervention group disagreed to the statement. This data indicates that, the students are able to learn on their own using the multimedia.

Statement 7: Multimedia method should be used always in teaching genetics

This item was introduced to ascertain student views on how often multimedia method should be used in teaching genetics. Table 6, displays the responses of students to the last item in the questionnaire. Out of 30 students in the treatment class 100% agreed and no student (0%) disagreed to the statement that multimedia method should be always used in teaching genetics. It can be concluded that multimedia should be used for genetics lesson as majority of the students agreed that multimedia method should always be used.

Interview question 1: Do you enjoy multimedia lessons?

This question was used to find out from the students whether they enjoy multimedia lessons or not. The response to this question from the 20 students who were interviewed

indicated that 18(90%) of the students enjoyed multimedia lessons while 2(10%) of the students did not enjoy the use of this method shown in Table 7.

Table 7: Percentages of number of students who enjoy multimedia lessons

Item	Frequency	percentage
Number of students who enjoy multimedia lessons	18	90
Number of students who don't enjoy multimedia lessons	2	10
Total	20	100

Some of the comments that participants made were: "am able to complete my experiment in a short time unlike if I did it without using computer simulation"; "I was able to share and discuss my findings with my friends even when I was alone in my house but in traditional method, I can only discuss with my friends in school when we are together"; "with the use of the video to show Mendel's experiment, it was more informative than when I only hear of it without seeing how it is done".

Interview question 3: In your opinion, how different is multimedia method of teaching from the other methods of teaching?

All the 20 students who took part in the interview answered that multimedia method of teaching is different from the other methods as indicated in Table 8. This reveals that, students appreciate the multimedia strategy.

Table 8: Percentages of students who said multimedia method is different

Item	Frequency	Percentage
multimedia method of teaching is different from the other methods	20	100
Total	20	100

Interview question 3: will you recommend the use of multimedia teaching method in the teaching of genetics out of the 20 students who responded to this item, 17 (85%) answered yes and 3 (15%) did not respond either yes or no. This is illustrated in Table 9. Table 9 shows that majority 17(85%) of the students liked the multimedia strategy and recommended that it should be used in the teaching of genetics.

Table 9: Percentages of students who responded to question 3 of the interview

Item	Frequency	Percentages
Yes	17	85
No response	3	15
Total	20	100

4.5 Discussions of Results

Cognitive load theory suggest that learners can absorb and retain information effective only if it is provided in such a way that it does not overload their mental capacity (Ayres., & Pass, 2012). The abilities of the students are enhanced when they apply several of their senses concurrently which will lead to easy understanding of concepts such as genetics.

This study revealed that the students' views about the use of multimedia teaching method is positive as students showed their interest in learning genetics by using this method. This was shown by students' responses to item 1 of the interview as all of the interviewees answered positive to the fact that multimedia teaching method is good. Item 1 of the interview demanded student's response on whether they enjoy the use of multimedia in teaching and learning. Ninety percent of them said they enjoy the use of multimedia teaching. Therefore, a conclusion can be made that students accept and enjoy the use of multimedia in the teaching and learning genetics.

Item 2 of the interview asked students "how different" is multimedia teaching from the other methods and students answered that multimedia was different from the other methods in terms of presentation of lesson, interaction with equipment and friends and convenience of using multimedia.

Item 3 of the interview asked students as to whether they will recommend multimedia method of teaching to be used in teaching genetics. Students response to this question was positive as all of them responded that it should be used in teaching and learning genetics.

From the findings of this study, it shows that, the multimedia approach that was used for the experimental group helped to improve their performance in the genetics greatly. This particular outcome in this study is in line with the findings of Voogel- Walcutt, Gebrin and Nicholas (2010) who demonstrated that animations and mechanical systems lead to more and efficient knowledge acquisition. This assertion conforms with Zevenbergen (2007) that, the effectiveness of multimedia use in learning improves the performance of people who use computer -based instruction in terms of test scores as compared to those who receive instruction through traditional classroom lectures.

According to Onyegebu (2006), when students feel a sense of reality in what they learn, it is much easier for them to understand the concepts being taught. Students pointed out during the study that the use of multimedia method of teaching makes them relaxed, save time and enhances their understanding of genetics. With this method, the students are able to conceive the conceptual meaning into the concept hence they are able to understand and this lead to their improvement in the post -test.

During the study, I observed from the students that in most of the cases in the use of the traditional method, the students learn by rote learning, that is, the students just memorize the concept but not understand the concept. A general observation I made during this study to which some of the teachers of science subjects attested to is that the students are oriented towards the short goal of getting good grades in the West Africa School Certificate Examination (WASCE) but they are not oriented to learn science as a lifelong subject. Because of this, teachers do not necessarily prepare and present their science lessons in a way to complete their syllabus.

With the provision of computers to Senior High Schools by the government of Ghana, it will be easier for science teachers to make use of the facility and use the technology efficiently to enhance their teaching methods.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS, RECOMMENDATIONS AND AREAS FOR FURTHER STUDIES

5.0 Overview

This chapter contains the summary of the findings, conclusion and recommendations as well as suggested areas for further studies.

5.1 Summary of Findings

The purpose of the study was to find out if there was any difference in the application of the chalk and talk method in teaching genetics and that of using multimedia method of teaching genetics. Test items of 20 multiple questions were administered at pretest for both control and experimental groups and post-test to find out the performance of students on the two methods of teaching being applied.

Intervention activities were then carried out where the participants were taught for two weeks. The control group was taught using chalk and talk method of teaching and multimedia method of teaching was used with the experimental group.

Sixty (60) students from two science classes of Kintampo Senior High School in the Kintampo North Municipality in the Brong Ahafo Region of Ghana was the sample used for this study. Results from pre-intervention test and post intervention test were collected, marked, recorded, analyzed and discussed.

The statistical analysis of the results of the pre-test of the experimental and the control groups shows that there was no statistically significant difference in the performance between the two groups at the pre-test. This reveals that the experimental and control were comparable on their understanding of the genetics but the statistical analysis of

the post-test of the control and experimental groups showed that there was statistically significant difference in the performance between the experimental group and the control group.

The experimental group performed far better than the control group in the post-test with a p-value of 0.025 which indicated that there was a statistically significant difference in the performance of students in the control group and the experimental group. The significant improvement in the performance of students in the experimental group over the control group after the intervention means students who were taught using multimedia teaching method could interpret and comprehend more of genetics in the study than those who were taught by the traditional method of teaching.

The effectiveness of using multimedia method was also confirmed from the students' perception about the approach of teaching during interview. They indicated that the intervention improved their abilities to understand the concept. Considering the results, it means that students have positive attitudes towards the use of multimedia teaching method to teach genetics.

5.2 Conclusion

The use of multimedia method in teaching produced a significant improvement in students' understanding of genetics as compared to the commonly used instructional technique, the traditional instructional approach. Students' abilities to interpret and comprehend the concept were maximized when they were taught using multimedia method.

Results from this study also indicated that majority of the students enjoyed the interactive lessons with multimedia method and thus, they were motivated more to

participate actively in the lessons; therefore they preferred multimedia instructional method to traditional strategy of instruction.

Finally, it was concluded that multimedia method of teaching was effective in teaching genetics as the experimental group performed much better than their counterparts of the control group.

5.3 Recommendations

From the study, the following guidelines are recommended to schools and teachers who would like to use multimedia method of teaching in the teaching and learning of genetics.

1. Biology teachers should be encouraged to employ the use of multimedia method of teaching in the delivery of their lesson so that students can perform better.
2. Biology teachers should ensure that their student play a significant role in doing their own learning through the use of multimedia instruction.
3. Biology teachers are encouraged to get personal training on the use of multimedia method of teaching that could enhance their teaching.

5.4 Areas for Further Research

The following recommendations are made for further research with respect to the use of multimedia in teaching:

- The attitudes of SHS science teachers towards the use of multimedia method of teaching in delivering their lesson.
- A study should be carried out to determine the knowledge and perceptions of science teachers on the use of multimedia in teaching.

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APPENDIX A

PRETEST QUESTIONS

Dear student,

This study is for academic purpose. You will be contributing to the success of an academic work. Please read carefully the questions that are stated and answer them honestly.

General instructions

From the options lettered A-D, choose the correct answer by shading

1. The alleles which control blood groups are represented by the symbols A, B and O. Which of the following pairs of genotypes is heterozygous?

A. $I^A I^A$

B. $I^B I^B$

C. $I^O I^O$

D. $I^A I^O$

2. The number of chromosomes in human sex gamete is

A. 23

B. 32

C. 46

D. 52

3. Which of the following statement is not true of a dominant gene? It expresses itself

A. In the phenotype

B. even in the presence of a recessive gene

C. in the phenotype in only a homozygous form

D. even in a heterozygous form

4. If a genetic disorder is inherited by a male only from his mother the disorder is

- A. autosomal recessive
- B. automasal dominant
- C. Y-linked
- D. X-linked

5. Which of the following phenotypic traits is controlled by more than two alleles?

- A. Blood group
- B. Albinism
- C. Baldness
- D. Gigantism

6. A backcross between a heterozygous hybrid with a recessive homozygous parent is likely to produce offspring in the ratio

- A. 1:2:1
- B. 3:0
- C. 3:1
- D. 1:1

7. Which of the following conditions is prevalent among black race?

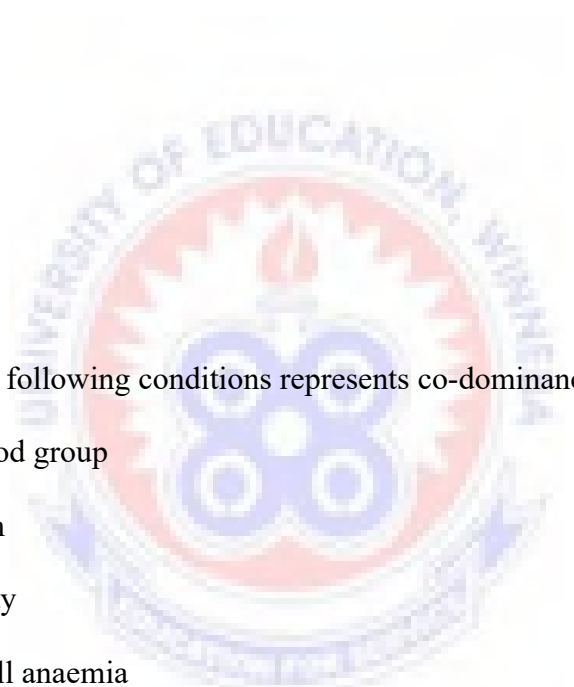
- A. Colour blindness
- B. Hepatitis
- C. sickle cell anaemia
- D. AIDS

8. An individual who is heterozygous for a particular character has its expressed trait controlled by

- A. An allele
- B. polygenes

- C. dominant gene
- D. chromosome
9. Which of the following is the definition of heredity? It is the
- A. non-resemblance of closely related organism
- B. total absence of parental traits in offspring
- C. absence of variation in organisms
- D. transfer of characteristics from parents to offspring
10. The pair of genes expressed in a heterozygous individual is described as
- A. Alleles
- B. chromatid
- C. dominant gene
- D. Centrosome
11. Which of the following statements is not true about chromosome?
- A. body cells have diploid numbers of chromosome
- B. Homologous chromosomes do not occur in pairs naturally
- C. the sex cells have diploid number of chromosomes
- D. chromosomes have many transverse bands
12. Which of the following inherited conditions usually shows incomplete dominance?
- A. sickle cell anaemia
- B. Haemophilia
- C. tongue rolling ability
- D. baldness
13. The observable characteristics of an individual usually resulting from the interaction between the gene composition and the environment is referred to as

- A. allele
 - B. Genotype
 - C. phenotype
 - D. chromosome
14. A character which fails to express itself in the first filial generation but emerges in the second is
- A. Heterozygote
 - B. Homozygote
 - C. Dominant
 - D. Recessive
15. Which of the following represent Mendel's second law of inheritance? The factors for two pairs of contrasting characters are
- A. Dependent on each other
 - B. On homologous chromosome
 - C. Allelomorphic
 - D. Inherited independently of each other
16. An individual that has identical alleles for a trait is
- A. A carrier
 - B. Hybrid
 - C. Heterozygotes
 - D. True breeding
17. In genetics a test cross is performed to determine
- A. Crossing
 - B. Genetic linkage
 - C. Genotypic composition
 - D. Phenotypic composition

18. In dihybrid inheritance, Mendel considered
- A. A pair of contrasting characters
 - B. Two pairs of contrasting characters
 - C. Three pairs of contrasting characters
 - D. Four pairs of contrasting characters
19. How many phenotypes can be found in offspring of a cross between an individual heterozygote for a trait and an individual homozygous recessive for a trait
- A. 3
 - B. 4
 - C. 1
 - D. 4
20. Which of the following conditions represents co-dominance
- A. ABO blood group
 - B. Dwarfism
 - C. Polyploidy
 - D. Sickle cell anaemia
- 
- The logo of the University of Education, Winneba, is a circular emblem. It features a central sunburst or starburst design in white and yellow, set against a red background. Below the sunburst are four blue circles arranged in a square pattern. The entire emblem is encircled by a red border containing the text 'UNIVERSITY OF EDUCATION, WINNEBA' in white capital letters. At the bottom of the emblem, there is a blue banner with white text, likely a motto or founding year, though it is not clearly legible.

APPENDIX B

POST -TEST QUESTIONS

Dear student,

This study is for academic purpose. You will be contributing to the success of an academic work. Please read carefully the questions that are stated and answer them honestly.

General instructions

From the options lettered A-D, choose the correct answer by shading

1. Crossing over occurs
 - a. In late interphase
 - b. In early to mid-prophase
 - c. In mid to mid prophase
 - d. When chiasma appears
2. All of the following are different parts of a eukaryotic chromosome except
 - a. Chromatid
 - b. Centrosome
 - c. Kinetochore
 - d. Telomere
3. A cross between two heterozygotes for one trait yields a phenotypic ratio 2:1. What is the best explanation
 - a. The dominant trait is lethal in its homozygous form
 - b. The trait forms sterile progeny

c. Either the dominant or the recessive allele on its homozygous form is lethal d.

The recessive allele for the trait is lethal in its homozygous form

4. Which of the following is not a feature of continuous traits?

- a. Environment influence phenotype
- b. Effects of environment can vary with genotype
- c. Mendel's laws do not apply to these traits
- d. Two or more genes are often involved

5. A woman with blood type A blood would like to know what the possible blood types of her offspring would be if she mated a type AB male.

- a. A
- b. A, AB, or B
- c. A or AB
- d. O

6. Chromosome measurements are usually taken during

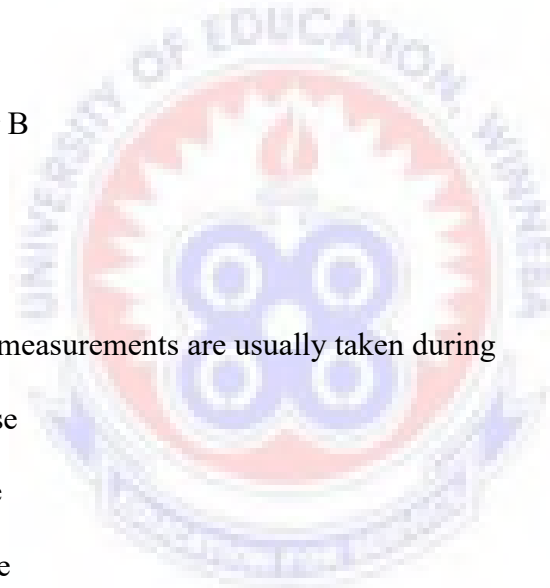
- a) Interphase
- b) Prophase
- c) Anaphase
- d) None of these

7. What are the repeating units of nucleic acids

- a) Phosphate molecules
- b) Nucleotides
- c) Bases
- d) Sugar molecules

8. All of the cells in an individual are genetically identical

- a) True



b) Falls

9. Which of the following is needed for DNA transcription

a) Ribosomes

b) Nucleotides

c) DNA

d) Enzymes

10. A heritable feature is a and may have two or more variants called.....

a) Traits/characteristics

b) Character/traits

c) Character/factors

d) Traits /factors

11. In humans, what is the best explanation for being XX and phenotypically a male?

a) One of the X is incomplete resembling a chromosome

b) A small piece of the Y is inserted on the X chromosome

c) Both the X" s have mutation deleting the female forming genes

d) There is a fragment of the Y chromosome inserted on an autosomal chromosome

12 Hemophilia is a sex link recessive trait in humans. If a father and son are both hemophilia but the mother is normal, her genotype must be

a) X h X h

b) XH X h

c) X HX H

d) X h Y

13. If two white sheep produce a black offspring, the parents genotype for the colour must be

- a) Heterozygous
- b) Homozygous white
- c) Homozygous black
- d) Not enough information was given

14. In the F₁ generation of a monohybrid cross, the phenotypic ratio would be

- a) 3:1
- b) 1:2:1
- c) 2:1:1
- d) 1:1:2

15. An example of allele is

- a) AB and Tt
- b) TT and Tt
- c) T and t
- d) X and Y

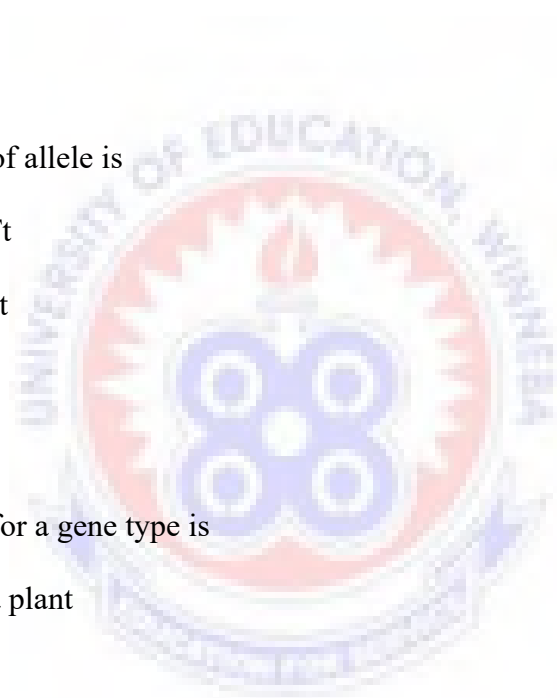
16. An example for a gene type is

- a) A tall pea plant
- b) R and r
- c) TtHH
- d) Hemophiliac

17. Normal human egg have

- a) 22 autosomes and an X chromosome
- b) 22 autosome and a Y chromosome
- c) 23 autosomes
- d) 46 chromosomes

18. Carriers of the colour blindness trait include



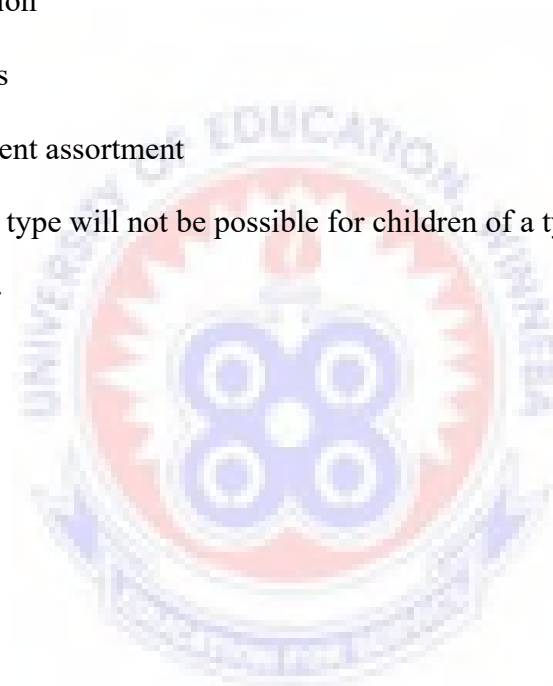
- a) Men who are heterozygous for the trait
- b) Men who are homozygous for the trait
- c) Women who are heterozygous for the trait
- d) Women who are homozygous for the trait

19. Which of the following factors could lead to variation in the offspring of a sexually reproducing organism

- a) Crossing over
- b) Fertilization
- c) Mutations
- d) Independent assortment

20. Which blood type will not be possible for children of a type AB mother and a type A father

- a) O
- b) A
- c) B
- d) AB



APPENDIX C

QUESTIONNAIRE ON STUDENTS VIEWS ON MULTIMEDIA

METHOD OF TEACHING GENETICS

Dear student,

This study is for academic purpose. You will be contributing to the success of this study if you provide responses to the items honestly. Your response will be kept confidential. Please carefully read each item and indicate the opinion that suits your view on each issue raised.

General instruction

Tick the appropriate column

Part One; Bio Data

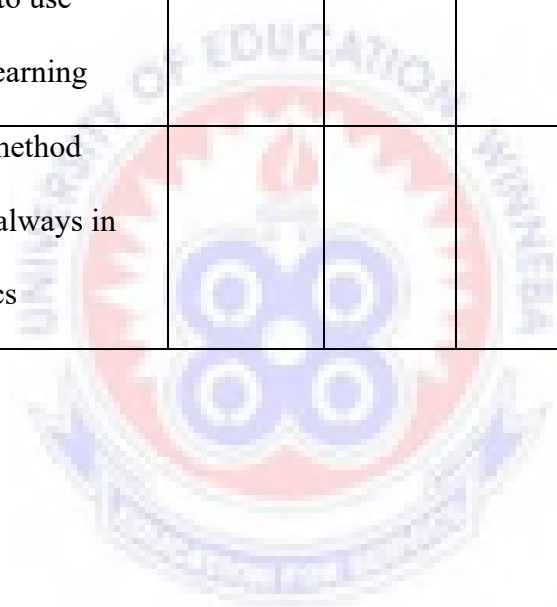
Gender of student: male female

Age of student:

14 years- 15 years 16 years - 17 years 18 years- 19 years 20 +years

Statement	Strongly agree	Agree	Not certain	Disagree	Strongly disagree
1. I am interested in genetics					
2. multimedia explains genetics better					
3. Multimedia makes me interested in learning genetics					

4. Multimedia have helped me to understand genetics better					
5. Multimedia takes too much time to explain a single concept of genetics					
6. Multimedia makes lessons very boring					
7. It is difficult to use multimedia in learning					
8. Multimedia method should be used always in teaching genetics					



APPENDIX D

INTERVIEW SCHEDULE ON THE USE OF MULTIMEDIA

METHOD OF TEACHING GENETICS

Dear student,

This study is for academic purpose. You will be contributing to the success of this study if you provide responses to the items honestly. Your response will be kept confidential.

Please your responses are confidential and will not be used against you in any way.

1. Do you enjoy multimedia lessons?
2. In your opinion, how different is multimedia method of teaching from the other methods of teaching?
3. What are the problems you have realized in using the multimedia method of teaching in genetics?
4. Will you recommend the use of multimedia method of teaching in teaching genetics?
5. Give your reasons for your answer in 4

Thank you for your time