UNIVERSITY OF EDUCATION, WINNEBA

Multimedia usage in teaching the human digestive system and its effects on students' academic performance

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MULTIMEDIA USAGE FOR INSTRUCTION AND ACADEMIC PERFORMANCE OF STUDENTS ON A SELECTED TOPIC IN INTEGRATED SCIENCE

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**A thesis in the Department of Science Education,
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DECLARATION

Student's Declaration

I, Mawutor Doku , declare that this thesis, except for quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE:……..…

DATE:…….

Supervisor's Declaration

I, hereby declares that the preparation and presentation of this work were supervised following the guidelines for supervision of the thesis as laid down by the University of Education, Winneba.

NAME : DR. JAMES AWUNI AZURE

SIGNATURE:……..…

DATE:…….

DEDICATION

This thesis work is dedicated to God Almighty, my creator, my source of inspiration for wisdom, knowledge and understanding for on His wings only have I soared. He has been my source of strength throughout this program. I also dedicate this work to my Parent, Mr. Seth Kwesi Doku and Mrs. Sophia Mensah Doku for their constant encouragement during the challenges of graduate school life. I am truly thankful for having them in my life. Again, to my husband and adorable children who have been affected in every way possible by this quest. My love for them all is unconditional and therefore cannot be quantified. God bless you.

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ABSTRACT

This study investigates multimedia usage for instruction and academic performance of students on a selected topic on integrated science of Junior High School students in learning Digestion in Humans at Oshiyie M/A. Recognizing the challenges students face with traditional teaching approaches, the research employs a descriptive quasi-experimental design involving two intact classes, each comprising fifty Form 2 students. One group, designated as the experimental group, was taught using multimedia resources, while the control group received instruction through conventional lecture methods over three weeks. Pre-tests and post-tests were administered to evaluate student performance, supplemented by questionnaires to assess the perceived effectiveness of multimedia instruction. The results showed that the experimental group achieved significantly higher post-test scores compared to the control group ($p < 0.05$). Additionally, students taught with multimedia demonstrated greater engagement and interest in learning Digestion in Humans, reflected in their higher mean scores relative to those taught via traditional methods ($p < 0.05$). Based on these findings, it is recommended that educators incorporate multimedia teaching strategies to foster effective, participatory, and active learning experiences among students.

CHAPTER ONE
INTRODUCTION

1.0 Overview

The background of the study, the problem statement, the study's purpose, and the research questions are covered in this chapter. Additionally, it includes the study's hypotheses, significance, limitations, and delimitations. The chapter concludes with an overview of how the study report is organized.

1.1 Background to the Study

It has been shown that most developed nations rely substantially on the study of science and technology (Anaeto et al ,2016), Cooper,1972), Ahmed, & Stein ,2004). Several countries are viewed as role models for how to make the transition from underdeveloped to first- or developed-world status through the study of science and technology. Such nations include South Korea, North Korea, Japan, China, and Singapore, to mention but few. This success has been attributed to the development of their scientific base and making sure that, the information is applied to the technology sectors (Ndesaulwa, & Kikula, 2016; Anaeto et al., 2016).

Science and technological advancements have helped every element of life, including health, sports, education, agriculture, transportation, housing, offices, and a variety of other fields. Additionally, Ghana has made significant technological advancements in recent years (Nishimura, et al , 2019). Several African governments have made it a priority to improve their nations via the use of science and technology (Chakravorti, & Chaturvedi, 2019). To help in the advancement of science and technology in Ghana, the government established the Ministry of Environment, Science, Technology and Innovation (MESTI). Additionally, new second-cycle institutions in the fields of Science, Technology, Engineering, and Mathematics have been established across the nation to aid in this effort. For instance, the Ministry of Education reports that ten

STEM (Science, Technology, Engineering, and Mathematics) schools are under construction to encourage the study of science throughout the country (Mensah, A., & Suleman,B.(2022). The executive summary of the President's Committee on Review of Educational Reforms in Ghana, October 2002, specifically states that the education reforms introduced in October 2002 supports this perspective. Future socioeconomic development in Ghana will depend on the training of a sizeable number of scientists, engineers, technologists, technicians, and artisans to produce technical improvements. Therefore, it is up to us to make science and science education the top priority in order to accomplish this initiative. (Educational Review Committee, 2002).

A body of knowledge gained via experimentation and observation is referred to as science (Otto and Towle, 1985). Experiments and observations can be used to learn more about science. This can be executed perfectly if appropriate multimedia is used in the teaching and learning of science. When science is not taught practically or through activities that allow students to investigate based on their ideas, it becomes a challenging subject. Teachers of science in the country's numerous schools frequently rely too heavily on the lecture method of instruction, which makes the subject matter content-centred rather than activity-centred (Osei, 1998). This might be partly due to lack of resources to purchase teaching and learning materials like televisions, laptops with internet connection, and more advanced equipment like smart boards and visualizers, as well as inadequate modern science laboratories in schools. Based on how science is taught in schools, students have unique and challenging perception of science that permeates all educational levels.

Students at all academic levels would want to avoid science whenever possible because of this unfavourable perception of it. This is demonstrated by the fact that there are minimal number of students studying General Science in Senior High Schools than

there are for other disciplines like Business, Home Economics and General Arts. Some students who seek to study the sciences experience psychological breakdown when they encounter hurdles that they view as being tough to overcome (Wilson, 1999). Only when the proper methodologies, appropriate and relevant teaching and learning materials, and correct approaches are used in the teaching and learning process at any academic level, students or learners can understand science more effectively (Munna, & Kalam, 2021).

The use of Information Communication Technology (ICT) as a means of reaching out to the poor in Ghana has been captured in the country's development agenda like the Ghana Poverty Reduction Strategy Paper (GPRS I & II) and the Education Strategic Plan 2003-2015 (Mangesi, 2007). Upon the basis of the importance of ICT in the nations socio-economic agenda, the Government of Ghana with the help of the Government of India have established the Kofi Annan Centre of Excellence in Information Technology to help in accomplishing this agenda (Owusu, 2009). The teaching and learning of ICT has therefore been formally enshrined in the educational system. The new Education Reform has emphasized the teaching and learning of ICT. These developments underscore the importance the country attaches to the development of ICT.

Multimedia has been successfully applied in many courses in order to provide a wide variety of learning styles or modalities. Learning styles are defined as characteristic cognitive, affective, and physiological behaviours that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment. Learners are more comfortable learning in an environment which reflects their predominant learning styles (Sankey, 2006). Learners have a preferred learning modality, namely, visual, aural, read/write or kinaesthetic, while many learners are

multimodal (use a combination of these modalities). Multimedia can be used to develop a more inclusive curriculum that appeals to visual, aural and kinaesthetic learners and overcome differences in students' performance that may result from different learning styles. Presenting material in a variety of modes has been used to encourage students to develop a more versatile approach to learning (Morrison et al., 2003).

Moving from book to the computer is the opportunity for greater interactivity and novel ways to think about a learning activity. Technology provides more ways to represent concepts through different media formats. Such advances in technology ask for pedagogical enquiries to confirm the usefulness of such new activities in facilitating learning. Learners who have access to multiple representations enhance their comprehension, learning, memory, communication and inference (Rogers & Scaife, 1996). Kozma (1991) argues that learners will benefit more if the instructional methods provide, perform or model cognitive operations that are important to the task and the situation. Learners will also benefit more if they can perform or provide for themselves the operations provided by these representational media (Kozma, 1991). Providing the learner with a sound structure and content is more important than providing them with interactivity and animation afforded by new media. Comprehension and learning require a sound content and structure of instructional material and not new media or types of representation. The combination of text and image is effective when the information provided is complementary and adapted to each presentation. Making connections from multiple representations depend not only on the presentation mode and the construction of the interrelations between the multimodal items but also on the characteristics of the task (Dubois & Vial, 2000).

Currently, multimedia technology utilizes communication media such as videos, computers and still images in the modern world to achieve its purpose of enhancing

teaching and learning. Cockerill et al. (2015) duly acknowledge the importance of multimedia in learning when they state that it promotes a large variety of teaching styles as well as learning preferences. The usefulness of video technology, particularly in laboratory science, cannot be underestimated as it facilitates the visualization of procedures and allows for more profound understanding than when the same information conveyed through only text. The thrilling effects of multimedia continue to provide every reason for researchers to persistently explore deeper into its application in education and even beyond.

Science looks at various concepts on certain natural phenomena that cannot be seen or felt. These ideas present many difficulties to students, especially novices who must acquire the basics. Reproduction in Humans, Respiration, Digestion in humans, and photosynthesis and others are a few examples. Academically challenged students find it impossible to understand anything at all when such abstract concepts are taught to them. If these topics are taught using experiments, these learners or students can benefit. Using alternatives to the traditional lecture presentation will increase the effectiveness of the educational process (Puspitarini, & Hanif, 2019).

Due to the simultaneous availability of several information presentation methods, multimedia plays a significant role in education (Joshi, 2012). The Government, the Ministry of Education, and Ghana Education Service (GES), all of which are active in the field of education, are accountable for enhancing the teaching and learning of Integrated Science in schools. The burden also lies on the subject teachers to also device means of enhancing the understanding and the performance of their students as they interact with the students more often. This is what motivated me to embark on the research.

1.2 Statement of the Problem

Most of the students in the JHS 2 class A & B at Oshiyie M/A Basic school faced difficulty in grasping concepts in Digestion in Humans. This was discovered by the researcher based on her previous experiences with the class. Tests and group presentations that were given to the students when they were in Form one(1), on Digestion in Humans indicated low performance in the concept.. Also, poor student performance in integrated Science has been attributed to a variety of factors, including teachers' use of ineffective teaching methods (Ahmed & Abimbola, 2011; Kareem, 2003; Umar, 2011). Studies have also shown that, the traditional teaching approaches do not promote perceptual acquisition and long-term memory of specific abstract ideas (Ahmed, 2008; Ahmed & Abimbola, 2011; Kareem, 2003; Umar, 2011). Thus, the problem needs to be solved to prevent mass failure of the students in their Basic Education Certificate Examination (BECE). An option to solve this problem is to use a technology-based instructional approach that promotes meaningful learning. Adegoke (2011) and Kuti (2006) both stated that employing multimedia presentations can help solve the drawbacks of conventional teaching techniques and improve oral and visual formats with graphics, simulations, text, and narrations. This supports the claim that using multimedia in teaching and learning often results in learners remembering the content better than when using a traditional teaching and learning approach. Therefore, the researcher intends to determine “Multimedia usage in teaching the human digestive system and its effects on students’ academic performance ‘’

1.3 Purpose of the Study

This study aims to determine Multimedia usage in teaching the human digestive system and its effects on students’ academic performance ‘

1.4 Objectives of the Research

The study's objectives are to;

1. Determine the effects of the use of multimedia approach on academic performance of JHS 2 students in learning of Digestion in Humans.
2. Find out student's view on the use of multimedia in the teaching and learning of digestion in humans.
3. Find out about students' interest in learning digestion with multimedia approach.

1.5 Research Questions

The results of the study address the following research questions.

1. What is the effect of the use of multimedia approach of teaching Digestion in Humans on the academic performance of JHS 2 students?
2. How does multimedia impact student's engagement in learning Digestion in Humans?
3. Will the use of multimedia help students to develop interest in integrated Science as compared to the traditional lecture method of teaching?

1.6 Research Hypotheses

The research addressed the following research hypothesis;

HO1 - There is no statistically significant difference between control and experimental groups in pre-text measurement of student's performance in digestion in humans.

HO2. - There is no statistically significant difference between the control group and the experimental in post -test measurement of student's performance in digestion in humans.

HO3. - There is no significant difference in the mean performance scores between male and female students' who are taught digestion in humans using multimedia approach.

1.7 Significance of the Study

The researcher is confident that, the results of this study will significantly improve students' comprehension and academic performance in Digestion in Humans. It will also allow students to develop an interest in the learning of the subject. They can do some researches on their own using the internet and information on television and other media outlets. Moreover, the findings will help teachers of Oshiyie M/A Basic to employ modern technologies in teaching integrated Science. This could improve the teaching of integrated science and overcome the difficulties integrated science teachers encounter when teaching certain concepts.

1.8 Limitations of the Study

Best and Kahn (1996) described limitations as events beyond the researcher's control that will limit the study's findings as well as its application. This research has its own limitations. During the research some students were reluctant to take part in answering questions on the digestion in humans as the topic alone scares them.

Most students at the time the test was conducted were absents in the previous days when the topic was taught which affected their performance in the test. The time allocated for the completion of each test (30minutes) did not allow some students to complete the test. This also affected their performance. Some students absenting themselves from school during the day of sampling also affected the sample size of the study.

1.9 Delimitations

The research, the effects of the use of multimedia on the academic performance of students in the learning of Digestion in Humans was delimited to Oshiyie M/A Basic. A Junior High School in Accra in the Greater Accra Region of Ghana. It was also delimited to the concept of Digestion in Humans in Junior High School, Year 2 integrated science syllabus of Ghana.

1.10 Organization of the Research

The study is divided into five chapters. The first chapter is the Introduction. It talks about the background to the study, the problem statement, the objective of the study, the research questions, and the scope of the study and the significance of the study. Chapter Two is the Literature Review. This chapter describes what other writers have said concerning the use of multimedia in teaching and learning. The next chapter is the Methodology of the research. It contains details of how the research work will be carried out. It specifies the research design, the source of data, the unit of analysis, the population and the sampling frame. It also contains information on the sampling size and technique, data collection instruments and data analysis. Chapter Four presents the results and discussion of the research work. Chapter Five draws on the summaries, conclusions and recommendations of the study.

1.11 Operational Definition of Terms

Science: It is the body of knowledge about nature that represents the collective efforts, findings, insight, and wisdom of people.

Multimedia: It refers to the use of power points and videos in the teaching and learning process

Concept: An abstract idea or mental symbol that is typically connected to an equivalent representation in a language or symbols can be described as a concept in general

1.12 Operational definition of abbreviations

WAEC: West African Examination Council

JHS: Junior High School

GES: Ghana Education Service

MESTI: Ministry of Environment, Science, Technology and Innovation

BECE: Basic Education Certificate Examination

CAI: Computer-Assisted Instructions

CHAPTER TWO
LITERATURE REVIEW

2.0 Overview

The chapter presents sections on conceptual framework, theoretical review, and how the theory t underpins this study. This chapter also reviewed and discussed issues in the literature relating to important aspects of the study chapter such as the Concept of Biology, Methods of teaching Biology, the Concept of Multimedia, Multimedia method of teaching and learning versus

Traditional method of teaching and learning, The effects of multimedia as a tool in teaching Digestion in Biology, and Multimedia as a tool for teaching Digestion in humans and their impacts on students' interest and involvement.

2.1 Theoretical Foundation

In this study, the researcher used the Cognitive Theory and Cognitive – Constructive Theory of multimedia learning as its theoretical foundation.

2.1.1 Cognitive Theory of Multimedia Learning

The Dual-Channel Assumption, the Limited Capacity Assumption, and the Active Processing

Assumption are the three underlying presuppositions of the Cognitive Theory of Multimedia Learning (CTML) (Mayer & Moreno, 1998; Mayer, 2003). Based on Baddeley's (1983) theory of working memory, the dual-channel hypothesis states that working memory has both auditory and visual channels. Second, each working memory subsystem has a finite capacity, according to the limited capacity assumption, which is based on the cognitive load theory (Sweller, 1988, 1994).

The active processing hypothesis, which is the third supposition, contends that humans only meaningfully generate knowledge when they pay attention to the pertinent information, arrange it into a coherent mental structure and incorporate it with their

existing knowledge (Mayer, 1996). According to CTML, when pupils have to process both on-screen text and on-screen images at once, the visual information processing channel may become overwhelmed. The cognitive load on the visual channel is lessened when words are provided as narration since they can be processed in the verbal channel (Mayer, 2005).

2.1.2 Cognitive-Constructivist Theory of Multimedia Learning

The concepts of learning that underlie the Constructivist Theory of Education were solely derived from many subfields of cognitive science. The premise behind the constructivist teaching method effectively utilizes students' prior knowledge and cognitive frameworks built on those experiences (Bull, 2012). This means that when creating interactive digital learning materials, the images, animations, photographs, and graphics should be relevant to the students' past knowledge rather than presenting them with something unfamiliar. This suggests that the learner's experiences should be considered while developing multimedia teaching and learning materials.

2.3. Conceptual Framework

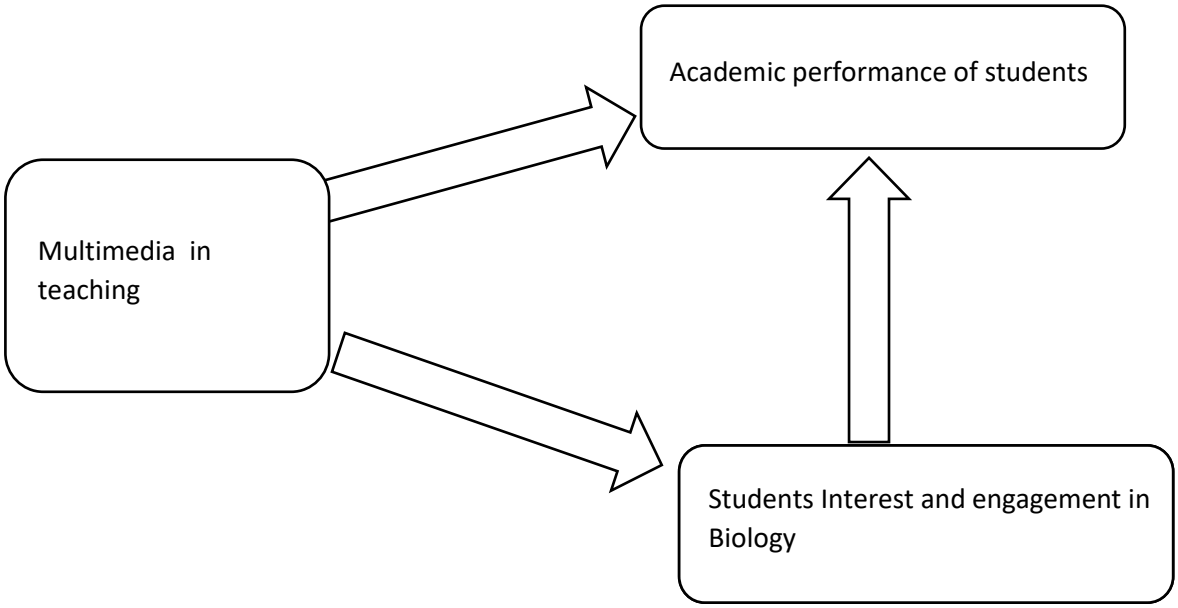


Figure 1: Conceptual Framework of the Study

The use of multimedia to teach Digestion in humans will have a positive effect on the academic performance of students (Fig: 1) and help students to develop interest in the study of Biology. Also, when students develop interest in the study of Biology, it will in turn boost their academic performances (Fig: 1).

2.2 What is Biology?

Biology is the scientific study of living organisms and their interactions with each other and their environment. It is a natural science that focuses on the study of living things, including their shapes, structures, physiology, and heredity. It is a foundational science subject that provides the groundwork for comprehending the intricate workings of an organism's various body parts. According to Taiwo and Emeke (2014), the study of Biology exposes students to the world of self-knowledge as well as the nearby and faraway environment. This might be the reason

Ghana's Junior High Schools (JHS) curriculum has as a subject to be learnt. Accurate laboratory and field skills in Biology is a meaningful and applicable understanding of Biology: and the capacity to apply scientific information to daily life are among the

aims of Biology instruction in Ghana's Senior High Schools. Several studies (WAEC, 2011; Taiwo & Emeke, 2014) reveal the persistently subpar performance of students at the external examinations, notwithstanding the significance of Biology instruction in Senior High Schools for the development of people. Other research has also supported this poor performance in students in the Senior High school (Yususf & Afolabi, 2010; Ahmed, 2008).

Numerous variables have been suggested as the cause of students' poor achievements in Biology. These factors range from school-related issues (Ibe, et al ., 2016), kinds of textbooks (Dev, M. (2016), teaching approaches (Owusu, et al., 2010), to teacher quality (Akinsolu, 2010; Anita, 2013). However, reports have indicated that the primary reason for students' subpar performance in sciences in Senior Secondary Schools is the predominant teaching methodology used in class (Ukoh & Adewale, 2014). The teaching of Biology should be carefully planned to foster meaningful learning that might raise students' performance in order to successfully accomplish the admirable goals of teaching and learning Biology in Senior Secondary School.

Biology instruction that promotes comprehension and meaningful learning may require the use of the right techniques. The teaching of Biology could be improved by taking into account UNESCO's (2012) recommendation to diversify the subjects and teaching methods, encourage experimentation and creativity, and disseminate and share information. Instead of utilizing the outdated traditional way of lecturing in teaching Biology, it is possible to use the diversification of contents and methods, innovations, and technology through the integration of technology.

2.3 Methods of Teaching Biology

All students should have access to a range of chances to learn about themselves and their surroundings. Some of these techniques can be utilized to teach biology and, as a

result, aid students to better understand who they are and the world they live in. The discovery method, action method, lecture, discussion, and question-and-answer sessions are some of the approaches that have been utilized for teaching biology over the years (Tanner & Allen 2017). Currently, there are also more cutting-edge techniques available for teaching biology. These techniques include multimedia approaches which are practical to maintain students' interest, and enable them to access knowledge no matter where they are. It is possible to teach using these techniques.

With the aid of multimedia, educational materials can be distributed to students after school with the hope that they will return to class the following day with more in-depth questions for the teacher to answer. The information is given through a number of films, podcasts to listen to, problem-solving activities, and many other means. Students can be assigned by using videos and the students their responses taken later. Once more, students can utilize the internet to learn new things and discover answers to their questions.

Information is made available to everyone through the use of multimedia in education, including learners who may have some sort of impairment, such as those who are visually or audibly challenged. According to Talabi (2003), a high-quality education is one of the most urgent demands in every nation right now. Effective communication is essential for effective education. On the other hand, effective communication requires sufficient and high-quality teaching resources and tools. Learning must be accelerated so students retain information more quickly and apply in real-life situations. When the right teaching method is used, all of these can be accomplished.

2.4 Concepts in Biology

In general, a concept can be described as an abstract thought or mental symbol that is typically connected to matching representation in a language or symbols, according to

Woolfolk, Davis and Anderman (2013). Such biological concepts include those related to Digestion, protein synthesis, mammalian digestion, etc. Concepts, according to Woolfolk et al. (2013), aid students in grouping voluminous knowledge into manageable chunks. He also stressed on how concepts drive one's thinking and memory processes. It has been claimed that difficulty in understanding of science, especially Biology topics, are the result of improper teaching techniques (Erinosho, 2008). Teachers need to understand how students learn and how to support them to learn.

The extent of the pertinent cognitive structure of learners determines the degree of meaningful learning. It is advised that Biology teachers use teaching charts with illustrations and photos. The use of charts with illustrations can attract students' attention, teach a new concept, clarify steps in processes and shape students' perspectives. According to Farrant (1998), unless students are engaged in activities involving objects and materials, it is challenging for students to understand the majority of science concepts through simple explanations. This indicates that appropriate teaching and learning materials or equipment are necessary for effective and successful teaching and learning to occur. Biology instruction and learning are made challenging by the lack of or the inadequate resources in the Ghanaian educational setting. Now; it is the teacher's responsibility to do everything in their power to provide students with the necessary instructional resources and tools to aid in their understanding of biological principles.

2.5 The concept of Multimedia

The meaning of the term "multimedia," which is made up of the terms "multi" (which denotes incorporating multiple expressions and ways) and "media" (which suggests technical terms like computer, dialogue, and digital), has evolved over time. Multimedia is a term that refers to a platform that combines analogue information in a

variety of forms, including texts, graphics, and audio-visual elements into a single digitized data and relays them via multiple media. Users can employ simple and quick information communication networks. On a budget-friendly desktop computer, multimedia is the fascinating fusion of computer hardware and software that enables the integration of video, animation, audio, graphics, and test resources to create compelling presentations (Fenrich, 2005).

The evolution of science education and learning has entered a new age because to the availability of multimedia technology. According to Syazwan, et al. (2011), "multimedia courseware is one of the solutions in dealing with students' differences in learning styles and knowledge background since it integrates media elements that can engage human information retrieval method which is visual, auditory, reading, and kinaesthetic. Multimedia is considered to be an impressive learning medium because it can activate our perception such as the sight, hearing, and tactile. Multimedia is thus defined as a method of information transmission that incorporates a variety of communication modalities. Texts, videos, audios, still photos, sound, animations, paintings and interactive information are all examples of multimedia. Any combination of the aforementioned is what the computer delivers.

The fascinating mix of computer hardware and software that enable the integration of text resources, audios, animations, graphics, and videos to make successful presentations on a budget-friendly desktop computer is referred to as multimedia by Malik and Agarwal (2012). Neo (2007) supports this assertion by stating that multimedia consists of texts, images, sound, animations, and videos, some or all of which are arranged into a logical program. It is clear from the definitions that multimedia entails the exchange of information through a variety of avenues. These components, such as sounds, animations, texts, audios, images, graphics, and videos,

could all be mixed and used in Biology lessons. Technology integration has emerged as a practical and affordable solution as a result of the technology's quick expansion and wide range of applications. It is therefore becoming more and more obvious that conventional textbooks will be abandoned and that the adoption of the e-book will have that effect (Gertner, 2011).

2.6 Multimedia learning and teaching: concepts and resources

Multimedia or digital learning resources assist learners to get on well with mental representations with the use of different media elements, which support information processing. Information, which is made up of content and sometimes learning activities, are presented with the use of the combination of text, image, video and audio by digital learning resources. It has been demonstrated, by research on using multimedia for learning, that there are more positive results observed in learners who combine picture and words than those who use words only (Chen & Liu, 2008; Mayer, 2008). As stated in Eady and Lockyer (2013), different pedagogy methods were implemented by the use of digital resources. Their paper presented how the authors were able to introduce topics to students, demonstrate to them, stimulate a group, make different text types available and engage students in an interactive manner.

Generally speaking, multimedia technology for educational purposes can be categorized according to whether they are used for teaching or for learning. Some of the different multimedia or digital learning resources are listed in Eady and Lockyer (2013). Furthermore, according to Guan et al. (2018), several studies have established the importance of multimedia technologies to education and the widespread adoption of multimedia tools. Multimedia generally involves the use of technology and the widespread adoption of multimedia applications in education is as a result of its many

benefits (Almara'beh et al., 2015). Some of the benefits of the multimedia application tools for teaching and learning are summarized as follows:

1. Ability to turn abstract concepts into concrete contents
2. Ability to presents large volumes of information within a limited time with less effort
3. Ability to stimulates students' interest in learning
4. Provides teacher with the ability to know students position in learning.

Multimedia designed for learning refers to the process of building mental representation from words and pictures in different contexts. They are designed to assist learning with tools which can be used in presentations, class room or laboratory learning, simulations, e-learning, computer games, and virtual reality, thereby allowing learners to process information both in verbal and pictorial forms (Alemdag & Cagiltay, 2018). Multimedia designed for learning requires understanding of some theories such as cognitive theory of multimedia learning, which postulates three assumptions that describe how people learn from instructional multimedia materials. These assumptions can be phrased as dual-channel, limited capacity, and active processing (Alemdag & Cagiltay, 2018). Dual-channel assumes that learners have many channels to separate visual and auditory information. The restricted/limited capacity assumes that there is a limit to the load of data that can be processed in each channel. Understanding these will allow teachers not overwhelming learners with much information. On the other hand, learners will be aware of their information processing limitations or capabilities. Active processing proposes that when it comes to information selection, organization, and integration, human beings are active agents and are capable of managing the forms of information they are interacting with.

The appropriate use of ICT in teaching transforms the learning environment from teacher-centred to learner-centred (Coleman et al., 2016) just as it is transforming all aspects of human life (Guan et al., 2018). Coleman et al. (2016) emphasised that the shifting from teaching to learning creates a student-centred learning where teachers are there as facilitators and not sages on the stages, thus changing the role of the teacher from knowledge transmitter to that of a facilitator, knowledge navigator and a co-learner. Keengwe et al., (2008a) concluded that the application of multi-media technologies ensures a very productive, interesting, motivating, interactive and quality delivery of classroom instruction while addressing diverse learners' needs.

2.7 Multimedia tools in teaching and learning

The review revealed that multimedia tools have been developed to enhance teaching and learning for various fields of study. The review also shows that multimedia tools are delivered using different technologies and multimedia components, and can be broadly categorized as web-based or standalone.

From the review, it was found that standalone multimedia tools were more than twice (64%) the number of tools that were web-based (36%). Standalone tools are a category of teaching and learning aids which are not delivered or used over the internet, but authored to be installed, copied, loaded and used on teachers or students' personal computers (PCs) or workstations. Standalone tools are especially useful for teaching and practicing new concepts such as 3D technology for modelling and printing (Huang et al., 2017) or understanding augmented reality (AR) software (Blevins, 2018). Microsoft Powerpoint is a presentation tool used in some of the reviewed articles and is usually done with standalone systems.

Standalone tools were favoured over web-based tools probably because the internet is not a requirement which makes the tool possible to deploy in all settings. This means

that teachers and students in suburban and rural areas that are digitally excluded, can benefit from such a multimedia tool. This system is considered most useful because a majority of the populace in most developing countries are socially and educationally excluded due to a lack of the necessary resources for teaching and learning. The need to sustainably run an online learning environment may be difficult, and therefore, the standalone, provides a better fit for such settings. However, the problem with a standalone application or system is the platform dependency. For instance, a Windows based application can only run on a windows platform. Also, there will be slow convergence time when there is modification in the curricular or modules, since, each system will run offline and has to be updated manually or completely replaced from each location where the tool is deployed.

The other category, web-based multimedia tools, are authored using web authoring tools and delivered online for teaching and learning purposes. About one-third of the tools identified from the review were web-based although they were used largely in university teaching and learning.

Examples of these tools are: online teaching and learning resource platform ,graphic web-based application (Bánsági & Rodgers, 2018), multimedia tool for teaching optimization (Jian-hua & Hong, 2012), and educational videos on YouTube (Shoufan, 2019).

One of the benefits of the web-based multimedia solution is that it is online and centralized over the internet. Part of its advantages is easy update and deployment in contrast to the standalone multimedia system. The major requirements on the teachers and learners' side are that a web browser is installed and that they have an internet connection. Also, the multimedia web application is platform independent; it does not require any special operating system to operate. The same multimedia application can

be accessed through a web browser regardless of the learners' operations system. However, when many people access the resource at the same time, this could lead to congestion, packet loss and retransmission. This scenario happens often when large classes take online examinations at the same time. Also, the data requirements for graphics or applications developed with the combination of video, audio and text may differs with system developed with only pictures and text. Hence, the web-based system can only be sustainably run with stable high speed internet access.

A major weakness of web-based multimedia tools is the challenge posed for low internet penetration communities and the cost of bandwidth for low-income groups. As access to the internet becomes more easily accessible, it is expected that the advantages of deploying a web based multimedia solution will far outweigh the disadvantages and more of such tools would be web-based.

2.8 Student Engagement and Motivation towards Multimedia Instruction

Research indicates that multimedia instruction significantly enhances student engagement and motivation across various educational levels and subjects.

1.Enhanced Engagement

Interactive learning media plays a significant role in enhancing student engagement, academic achievement, and motivation in educational contexts.

2.Improved Learning Outcomes

The use of interactive learning media, such as interactive videos, multimedia, and other interactive applications, can improve students' understanding and learning outcomes.

3.Increased Motivation

Multimedia instruction, including digital educational games and gamification, boosts students' motivation for learning by fostering an engaging learning environment

Gap in Literature

While existing research highlights the positive impact of multimedia instruction on student engagement and motivation, there are areas that require further investigation:

1.Contextual Factors: More research is needed on how contextual factors, such as the digital environment and students' characteristics, influence the effectiveness of multimedia instruction.

2. Optimal Usage Strategies: There's a need to study optimal usage strategies for interactive multimedia to increase interest and motivation in the educational process.

3. Diverse Educational Settings: Further research could explore the impact of gamification and multimedia instruction across various educational settings and subjects [4] [2] [3].

Overall, multimedia instruction shows promise in enhancing student engagement and motivation. However, continued research is necessary to address gaps in literature and optimize the use of multimedia in education.

2.9 Benefits of multimedia application tools for teaching and learning

Benefits of multimedia applications in teaching and learning often highlight how they can enhance engagement, cater to diverse learning styles, improve information retention, and make abstract concepts more concrete through the combination of text, visuals, audio, and animation, ultimately leading to a more effective learning experience for students; some relevant research can be found in publications discussing topics like "Multimedia Learning Theory,"

"Impact of Multimedia Tools on Student Engagement," "Accessibility in Digital Learning," and "Interactive Learning Environments.".

Key benefits of multimedia applications in education:

- Increased Engagement

Multimedia elements like videos, animations, and interactive features can capture students' attention and make learning more enjoyable, leading to higher participation and motivation.

- Accessibility for Diverse Learners

By incorporating features like captions, audio descriptions, and adjustable playback speeds, multimedia can cater to students with different learning styles and abilities.

- Improved Information Retention

Presenting information through multiple sensory channels (visual, auditory) can enhance memory and understanding of complex concepts.

- Visual Representation of Abstract Ideas

Multimedia tools can effectively visualize abstract concepts through diagrams, simulations, and 3D models, making them easier to grasp.

- Personalized Learning

Some multimedia applications allow for self-paced learning, enabling students to review materials at their own speed and focus on areas where they need more support.

- Collaborative Learning

Interactive features in multimedia tools can facilitate collaboration among students, promoting discussion and critical thinking.

2.9 Role of multimedia technology in teaching and learning

Technology is evolving and scholars in the areas of Information Technology (IT) and education technology are continuing to study how multimedia technologies can be harnessed for the enhancement of teaching and learning. A software tool can be used to expand teaching and learning in various fields. It is important to provide students with practical experience in most fields of learning.

The importance of multimedia technologies and applications in education as a teaching or learning tool cannot be over emphasized. This has been confirmed in several studies that have investigated the impact of multimedia technology to the education system. Milovanovi et al. (2013) demonstrated the importance of using multimedia tools in Mathematics classes and found that the multimedia tool greatly enhances students' learning. Several works exist that show that multimedia enhances students' learning (Aloraini, 2012; Al-Hariri & Al-Hattami, 2017; Barzegar et al., 2012; Chen & Xia, 2012; Dalacosta et al., 2009; Jian-hua & Hong, 2012; Janda, 1992; Keengwe et al., 2008b; Kingsley & Boone, 2008; Shah & Khan, 2015; Taradi et al., 2005; Zin et al., 2013).

Multimedia communication has close similarities to face-to-face communications. It is less restricted than text and ensures better understanding (Pea, 1991). Multimedia technology helps simplify abstract content, allows for differences from individuals and allows for coordination of diverse representation with a different perspective. The use of the computer-based technique as an interface between students and what they are learning with suitable fonts and design can be very valuable.

Certainly, multimedia technology brings about improvement in teaching and learning, however, there are a number of limitations in this technology for educational purposes. Some of these limitations include unfriendly programming or user interface, limited resources, lack of required knowledge and skill, limited time and high cost of maintenance among others (Al-Ajmi and Aljazzaf, 2020).

2.10 Multimedia evaluation techniques

Evaluation entails assessing whether a multimedia programme fulfils the purposes set including being useful for its target audience. Kennedy and Judd (2007) make the point that developers of multimedia tools have expectations about the way they will be used

which could be functional (focused on the interface) or educational (involving the learning designs, processes and outcomes). It is important to note that there are different methods used in the evaluation of multimedia and most evaluations entail experiments, comparisons and surveys. The primary goal is to balance assessment validity with efficiency of the evaluation process (Mayer, 2005).

Survey research has two common key features – questionnaires (or interviews) and sampling, and is ideally suited for collecting data from a population that is too large to observe directly and is economical in terms of researcher time, cost and effort when compared to experimental research. However, survey research is subject to biases from the questionnaire design and sampling including non-response, social desirability and recall and may not allow researchers to have an in-depth understanding of the underlying reasons for respondent behaviour (West, 2019; Kelley et al., 2003).

Generally, comparison studies follow the format of comparing outcome from an experimental group using the multimedia being evaluated against a control group. This method has been criticised for having inadequate treatment definition, not specifying all treatment dimensions and failure to measure treatment implementation, among others (Yildiz & Atkins, 1992).

Faced with the subjective nature of surveys and the limitations from comparison studies, eye tracking and other student behaviour such as emotional response, provides information not consciously controlled by the student or researcher and is used as an objective data gathering technique. Eye tracking research is a multi-disciplinary field that tracks eye movements in response to visual stimuli (Horsley et al., 2014). Data from eye-tracking allows researchers to validate empirically and objectively, how learners comprehend the multimedia content, the attention of the learner while analysing the multimedia content, and the cognitive demand of the content (Molina et

al., 2018). Eye tracking is quite interesting as it provides a useful source of information in the case of children. This is because gathering information using the traditional techniques is more difficult especially when it involves children's interests and preferences (Molina et al., 2018).

Earlier attempts at analysing student behaviour while engaging with online material included analysing student access computer logs, and the frequency of participation and duration of participation (Morris et al., 2005). Nie and Zhe (2020) demonstrated that the conventional method of manually analysing student behaviour is gradually becoming less effective compared to online classroom visual tracking. They found that the online classroom visual tracking behaviour can be divided into several components: selection, presentation, mapping, analysis and collection, as well as the analysis from students' facial expression.

Several works exist that use student behaviour tracking to examine how students interact with multimedia learning tools. For instance, Agulla et al. (2009), incorporated in a learning management system (LMS), student behaviour tracking that provided information on how much time the student spent in front of the computer examining the contents. They did so through the use of face tracking, fingerprint and speaker verification. Alemdag and Cagiltay (2018) conducted a systematic review of eye-tracking research on multimedia learning and found that while this research method was on the rise it was mainly used to understand the effects of multimedia use among higher education students. They also identified that although eye movements were linked to how students select, organise and integrate information presented through multimedia technologies, metacognition and emotions were rarely investigated with eye movements.

Molina et al. (2018) used eye-tracking in evaluating multimedia use by primary school children. Some studies have used a combination of eye tracking data and verbal data in order to gain insight into the learners' cognitions during learning and how they perceived the learning material (Stark et al., 2018).

As much as eye-tracking and other behavioural research present opportunity for objective evaluation, difficulty of interpretation is one of the limitations of eye-movement data (Miller, 2015), and it is not surprising that the traditional methods of evaluation through questionnaire administration and surveys are still commonly used.

2.11 Traditional Method of Teaching and Learning versus Multimedia Teaching and Learning

"Teacher-Dominated Interaction" is the traditional approach to teaching. Teachers are the main sources of knowledge in education and students are primarily passive recipients who must memorize information. Teaching is simply the act of imparting knowledge and assisting students in mastering material in preparation for exams through lectures, explanations, and illustrations. Students are passive learners in this type of teaching and learning environment. There is little room for teacher-student interaction in this kind of teaching (Soumerz, 1986). The method's primary form of instruction is lecturing. When lecturing, the teacher presents information orally to the class. This method has the benefit of allowing for speedy communication of a lot of information to students (Erinosho, 2008). This makes teachers to rush through the curriculum without worrying about students not understanding the essential points of the sessions.

The traditional technique is implemented in a classroom setting where students sit in rows and the teacher stands in front of them while offering instructions and explanations. Chalk is typically used by the teacher to write on the board. The lecturer

or facilitator starts a series of questions to break up the monotony (Joshi, 2012). In many schools, the techniques of delivering lessons have changed as a result of the introduction of multimedia into teaching and learning. This is referred to as "Multimedia Delivery" (Smith et al., 1999). Computer-controlled integration of texts, graphics, drawings, still and moving images, animations, and audios are all examples of multimedia delivery in Science education. Others include any type of information that may be digitally represented, saved, sent, and analyzed to aid students in understanding biological concepts. Interactive multimedia and computer-assisted interaction (CAI) is included in this research and practical applications demonstrate that using multimedia enhances learning and increases students' satisfaction with instruction (Falk & Calson, 1992). Arnold (2007) defines computer-assisted instruction (CAI) as a technology that supports the teaching and learning process. Applications of CAI include guided practice drills, computer visualization of complex things, and computer-assisted communication between students and teachers, as examples.

To account for variations in student's aptitude or speed, these programs are frequently personalized or self-paced. Students can take advantage of the comprehensive interactions' immediate reactivity and enjoy the self-directed, private learning environment, thanks to it. Additionally, computer-based learning experiences afterwards maintain students' interest, inspiring them to learn and boost their independence and sense of personal responsibility for their education.

In contrast, traditional classrooms with rows of chairs and a blackboard in front differ dramatically from multimedia classroom settings. Learners' seats in multimedia classrooms can be adjusted based on the contexts required for the lesson. The students feel at ease studying because they are well-equipped and are seated nicely and comfortably. According to Zhang (2007), using multimedia in education "is

advantageous to learning." He claimed that when interactive video training was compared to traditional instruction, achievement increased by over 38% while the amount of time needed to teach the material fell by 31%.

2.12 The effect of multimedia as a tool in teaching Biology

The study of Biology has a special place in the school curriculum. Several science-related courses, including those in medical, pharmacy, agriculture, nursing, biochemistry, genetics, and few others place strong emphasis on Biology. It goes without saying that no student planning to study these subjects needs Biology. These and other considerations have caused scholars and curriculum developers to focus on Biology as a subject for the school curriculum (Kareem, 2003). Despite importance of Biology and its popularity among students, results recorded in schools had been subpar (Ahmed, 2008). For some time now, academics has concentrated on trying to understand the reasons for the low performance in Biology.

According to research, inadequate science professors, packed classrooms and a lack of relevant and inadequate science equipment are some of the factors contributing to students' low performance in the sciences (Yusuf & Afolabi, 2010). Because Biology classes are mostly overly large and have a wide range of skill levels, students struggle in them. Also, the Biology curriculum is overloaded and the laboratories lack adequate equipment (Ahmed, 2008; Ajayi, 1998). Researchers work to comprehend how these teaching tools affect students' learning as their use and promotion of multimedia teaching technology in education grows. Technology advancements provide for pedagogical improvements that some think will revolutionize current teaching and learning practices (Gatlin-Watts, et al , 1999).

A range of results have been reported by studies on multimedia-based teaching. Collectively, these studies found that cutting-edge technologies, particularly

multimedia instruction, which frequently involves introducing or enhancing the visual aspects of the presentation of course materials, improved students' performances, fostered positive attitudes towards learning difficult concepts, increased communication and could be tailored to all learning styles and levels of instruction (Harris, 2002). According to research, classes using multimedia appear to be liked more by students and to produce slight but statistically significant improvements in student learning when compared to classes using a traditional teaching method approach, as measured by both students' self-report and objective outcome testing (Dimitrov, et al; 2002) Feeg, et al; 2005, Wang, L. 2008; Worthington, Welsh, Archer, Mindes, & Forsyth, 1996). These positive results have sped up the broad use of these technologies. Although numerous studies have identified some benefits students get from multimedia instruction, some have also found no appreciable differences between multimedia and conventional classes (Everhart, et al; 2002; Homer et al ; 2000; Lee et al; 1996). Thus, there is a need to improve instructors' comprehension of how multimedia technologies affect the effectiveness of students learning. So, it would be appropriate to compare multimedia to classroom instruction to determine its effectiveness. Studies have been done in the field to determine the efficacy of multimedia training (Najjar, 1998). Almost two hundred studies have been analysed by Fletcher (1990), Kulik et al ;(1983), Kulik et al . (1985), and Cohen (1980). Science, other languages and electronics were all covered in the information. The information was typically taught to the control group through lectures or classroom sessions combined with practical experiments. The comparison group received instruction online or from interactive video discs. Tests administered after lessons were used to gauge students' level of learning. A meta-analysis of this large group of students revealed that learning was improved when

computer-based instruction was used. Moreover, learning seemed better when multimedia education was used.

Studies have been carried out by researchers in India and other parts of the world and at various levels of education to ascertain the impact of multimedia teaching on various measures in different subject areas such as Mathematics (Nirmala et al., 2006; Tsai & chang 2014), Science (Vellaisamy, 2007), Writing Proficiency (Sangeeta, 2005), Environmental Science, according to Satyaprakasha and Behera (2014). Many studies on multimedia have also been conducted in Ghana and other countries around the world. Researchers who have examined the use of multimedia in English training, including Acha (2009), Kumar (2011), and others, have found encouraging results. Ellaisamy (2007) conducted another study employing the multimedia strategy to teach science and found that this approach to instruction is effective.

To date, many studies have been conducted in a wide range of topical areas to ascertain the effectiveness of multimedia in training. The bulk of the results are positive, and most students are enthusiastic about new learning techniques. The majority of the experiments indicate that multimedia instruction is more efficient than the conventional methods of instruction. Numerous schools have also begun implementing the multimedia approach to teaching in their classrooms in light of the results of such studies. Due to the increasing use of multimedia in teaching and learning, researchers and other stakeholders are getting more curious about how these technologies affect students' learning at all educational levels. Several studies predict that technological advancements will radically change how traditional teaching and learning are carried out.

Multimedia instruction involves not only improving the visual aspects of how the course material is presented, but also improving the learning environments,

encouraging optimistic attitudes toward understanding abstract and challenging concepts, increasing student achievements, and improving communications that consider all learning preferences. Multimedia has shown to be a better option for students and has greatly improved student learning.

2.13 Advantages of Multimedia

Multimedia can be used for practice and drills, mastering fundamental skills, developing writing abilities, understanding abstract scientific concepts, simulating science, manipulating data, acquiring computer skills for general use, business and vocational training, access and communication to understand population, students access for teachers and students in remote locations, individual and cooperative learning, management and administration (Satyaprakasha & Behera, 2014).(It gives students the freedom to study anytime, anywhere.) Since audio is not the only form of communication, multimedia can overcome language barriers.

According to Aggarwal (2007) and Morris and Lambe (2017), the usage of synchronized audio, visual, and multimedia in the classroom stimulate the learner's senses, which increase their engagement in the learning process. Additionally, Staylor (2002) agreed with the opinions expressed above but added that in order for multimedia resources to capture and hold students' attention, they must be created or packaged in accordance with multimedia principles.

Research has shown that using multimedia in the classroom helps pupils learn both "from" and "with" it. Because of their advantages in terms of repeatability and access equity, media and technology are currently the emphasis. The use of multiple senses at once, group collaboration, and active knowledge construction are all facilitated by multimedia. Text, images, sound, animation, and video are all components of multimedia, some or all of which are arranged into a single, coherent program

(Kolarovszki et al., 2016). Multimedia content of today is a skillfully crafted synthesis of texts, graphic arts, sounds, animations, and video elements. It becomes interactive multimedia when you provide the end user, or the viewer of a multimedia project, power over "what," "when," and "how" the pieces are delivered and presented. As a result, multimedia can be described as the combination of many media elements (audio, video, graphics, text, animation, etc.) into a cohesive whole that offers the end user advantages that no single media element alone could.

However, most of the research works reviewed suggest that multimedia use could have some positive effects on the academic performance of students. This necessitated the present study on the effects of using multimedia on the academic performance of JHS 2 students in learning Digestion in humans at Oshiyie Basic School.

2.14 The Human Digestive System

The digestive system of the human body comprises a group of organs working together to convert food into energy for the body. Anatomically, the digestive system is made up of the gastrointestinal tract, along with accessory organs such as the liver, pancreas and gallbladder. The hollow organs that make up the gastrointestinal tract (GI tract) include the mouth, stomach, oesophagus, small intestine and large intestine that contains the rectum and anus.

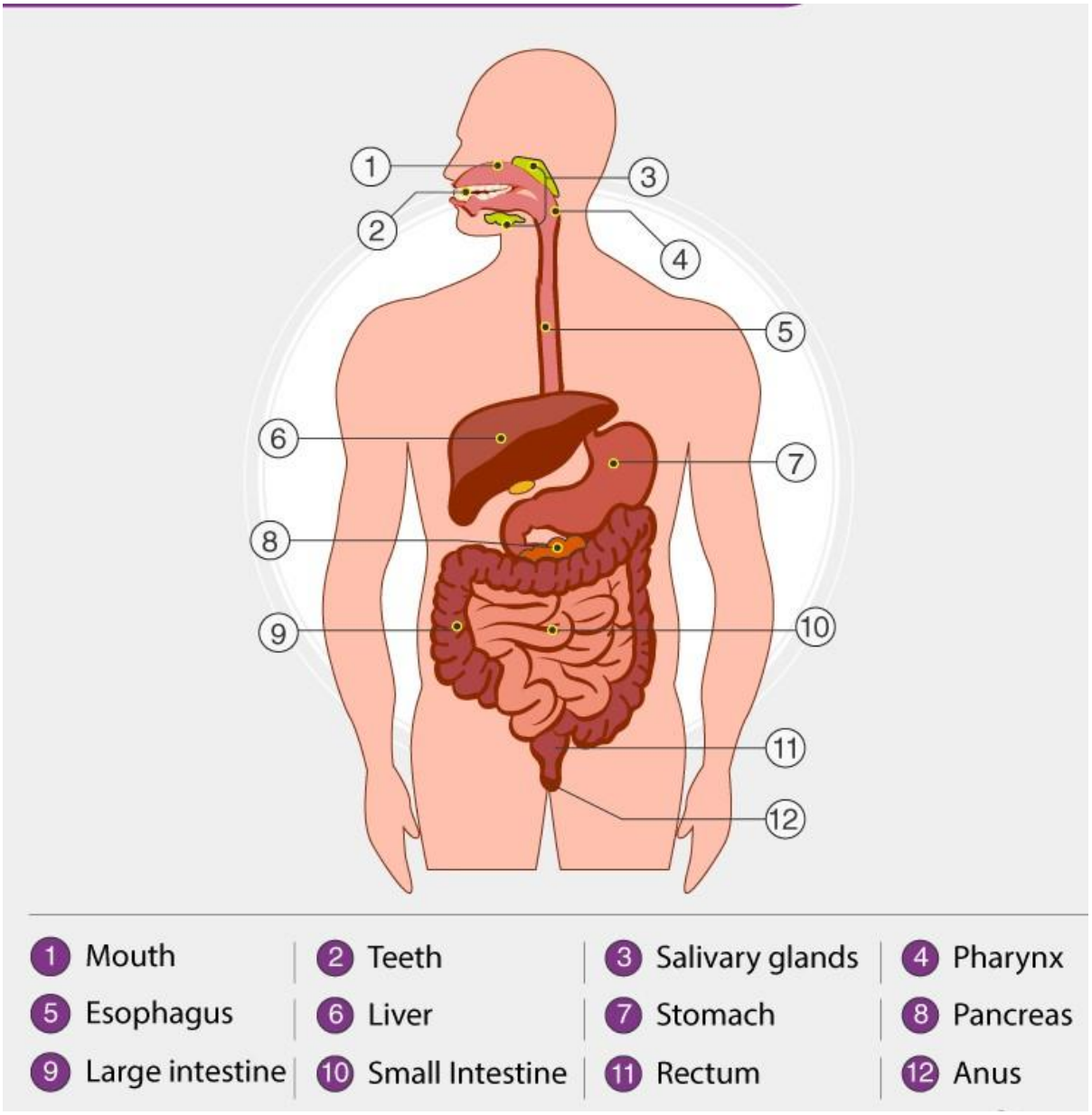
Human Digestive System and Nutrition involve the intake of food by an organism and its utilization for energy. This is a vital process which helps living beings to obtain their energy from various sources. The food which we eat undergoes much processing before the nutrients present in them are utilized to generate energy. This processing is known as digestion. Humans and other animals have specialized organs and systems for this process.

The digestion process involves the alimentary canal along with various accessory organs and organ systems. In humans, the process is quite simple due to our monogastric nature. This means that we have a one-chambered stomach, unlike other animals such as cows, which have four chambers.

Some parts of nervous and circulatory systems also play a significant role in the digestion process. A combination of nerves, bacteria, hormones, blood and other organs of the digestive system completes the task of digestion.

2.15 Diagram of the Human Digestive System

The diagram given below represents different parts of the human digestive system that convert food into essential nutrients absorbed by the body.



Source: BYJU'S Learning

2.16 Parts of the Human Digestive System

The digestive system of the human body comprises a group of organs that work together in converting food into energy and other basic nutrients to power the body. The food we take in is digested and utilized by our body, and the unused parts of the food are defecated.

The digestive system of the human body is the sum of the gastrointestinal tract (GIT; also called alimentary canal) and accessory organs (tongue, liver, pancreas, etc.). These two parts together help in the digestion process.

The alimentary canal is the long tube through which the food that we eat is passed. It begins at the mouth (buccal or oral cavity), passes through the pharynx, oesophagus or food pipe, stomach, small intestines, large intestines, rectum and finally ends at the anus. The food particles gradually get digested as they travel through various compartments of the alimentary canal.

Accessory organs are organs which participate in the digestion process but are not actually a part of GIT. They stimulate the digestion by releasing certain enzymes that help in breaking down the food.

Mouth

Food starts its journey from the mouth or the oral cavity. There are many other organs that contribute to the digestion process, including teeth, salivary glands, and tongue. Teeth are designed for grinding food particles into small pieces and are moistened with saliva before the tongue pushes the food into the pharynx.

Pharynx

A fibromuscular y-shaped tube attached to the terminal end of the mouth. It is mainly involved in the passage of chewed/crushed food from the mouth through the oesophagus. It also has a major part in the respiratory system, as air travels through the pharynx from the nasal cavity on its way to the lungs.

Oesophagus

This is a muscular tube that connects the pharynx, which is a part of an upper section of the gastrointestinal tract. It supplies swallowed food along with its length.

Stomach

It serves as a muscular bag which is situated towards the left side of the abdominal cavity, beneath the diaphragm. This vital organ acts as a storage for the food and provides enough time to digest meals. The stomach also produces digestive enzymes and hydrochloric acid that maintains the process of digestion.

Mucous: It is an aqueous secretion produced by the mucous membranes. It functions by protecting the stomach lining and gastric pits from the acid, which is produced by the glands to destroy the bacteria that entered along with the food particles.

Digestive enzymes: They are the group of enzymes which functions by breaking down polymeric macromolecules like biopolymers into their smaller and simpler substances.

Hydrochloric acid: It is the digestive fluid formed by the stomach during the process of digestion. It functions by destroying harmful microorganisms present in the food particles.

Small Intestine

The small intestine is a thin, long tube of about 10 feet long and a part of the lower gastrointestinal tract. It is present just behind the stomach and acquires a maximum area of the abdominal cavity. The complete small intestine is coiled and the inner surface consists of folds and ridges.

Large Intestine

This is a thick, long tube measuring around 5 feet in length. It is present just beneath the stomach and wraps over the superior and lateral edges of the small intestine. It absorbs water and consists of bacteria (symbiotic) that support the breakdown of wastes to fetch small nutrients.

Rectum

Waste products are passed into the end of the large intestine called the rectum and eliminated out of the body as a solid matter called stool. It is stored in the rectum as semi-solid faeces which later exits from the body through the anal canal through the process of defecation.

Accessory Organs

Pancreas

It is a large gland present just behind the stomach. It is short with its anterior connected to the duodenum and posterior pointing towards the left part of the abdominal cavity. The pancreas releases digestive enzymes to complete the process of chemical digestion.

Liver

The liver is a roughly triangular, reddish-brown accessory organ of the digestive system located to the right of the stomach. It produces bile, which helps in the digestion of fat in the small intestine. The bile is stored and recycled in the gallbladder. It is a small, pear-shaped organ which is located just next to the liver.

2.17 Digestion Process

The process of digestion begins from the mouth and ends in the small intestine – the large intestines' main function is to absorb the remaining water from the undigested food and enable bacterial fermentation of materials that can no longer be digested (Medicine Net,2024).

The alimentary canal or the gastrointestinal tract is a series of hollow organs and tubes that begins from the mouth cavity and continues into the pharynx, through the stomach, small intestines, large intestines, and finally ending at the anus. Food particles gradually get digested as they travel through various compartments of the gastrointestinal tract.

The digestion process takes place in the following steps.

(i)Ingestion

The very first step involves mastication (chewing). The salivary glands, along with the tongue, helps to moisten and lubricate food, before being pushed down into the food pipe.

(ii)Mixing and Movement

It involves the process of lubricating and manipulating food and pushing it down the food through the food pipe (using peristalsis), and into the stomach.

(iii)Secretion

The stomach, small intestine, liver, and pancreas secrete enzymes and acids to aid the process of digestion. It functions by breaking down food particles into simple components and easily absorbable components.

2.18 Digestion

The process of converting complex food particles into simpler substances in the presence of enzymes and acids secreted by different digestive organs.

(i)Absorption

This process begins in the small intestine where most of the nutrients and minerals are absorbed.

The excess water in the indigestible matter is absorbed by the large intestines.

(ii)Excretion

The process of removing indigestible substances and waste by-products from the body through the process of defecation in a nutshell, the digestion process consists of the six following steps:

Ingestion ⇒Mixing and Movement ⇒ Secretion ⇒ Digestion ⇒Absorption ⇒Excretion

2.19 Disorders of the Human Digestive System

Vomiting: It is the ejection of stomach contents through the mouth.

Diarrhoea: It is the abnormal watery bowel movement. Prolonged diarrhoea eventually leads to dehydration.

Constipation: A condition in which the faeces are clutched within the rectum due to an irregular bowel movement.

Indigestion: A pain or discomfort in the stomach which is caused when food is not digested properly, resulting in the feeling of fullness. Indigestion is mainly caused due to inadequate enzyme secretion, food poisoning, anxiety, overeating and eating spicy foods.

2.20 Functions of the Human Digestive System

Digestion and absorption are the two main functions of the digestive system.

Digestion is necessary for breaking down food particles into nutrients that are used by the body as an energy source, cell repair and growth food and drink need to be converted into smaller molecules of nutrients before it is absorbed by the blood and carried to the cells throughout the body. The body breaks the nutrients present in the drinks and food into carbohydrates, vitamins, fats and proteins (Berne & Levy, 2010)

Human Digestive System Notes

The human digestive system breaks down food to release energy essential for the body to carry out its activities the process of digestion takes place in 6 major steps.

The food is ingested by the alimentary canal and is propelled through the body for further processing.

The autonomous nervous system controls the peristalsis, contraction and relaxation of muscles within the alimentary canal wall the food is passed to the small intestine where it is digested, and the nutrients are absorbed.

Water, electrolytes and vitamins are absorbed by the large intestine and the waste is defecated (Berne & Levy ,2010).

2.21Summary

The medium a teacher chooses does not affect whether learning will take place, claims Fenrich (2005). The learner only hears the teacher's message through the media. The message must be heard and understood by the students for learning to take place. The media does not influence this. The quantity of learning that can take place, however, can vary depending on the medium one uses. If educators use instructional methods that benefit from the media's advantages, this can have a good impact on student learning. Comprehensive multimedia packages do not always need to include every type of media. Learning from materials created using several media is typically more effective than learning from materials created using only one medium. This is partially because various brain regions process information in various ways. For instance, certain areas of the brain process texts while others handle visual information (Kandel et al ; 2013). Information is learned and retained more effectively when multimedia programs engage more brain areas. One can and should utilize more than one medium to teach a skill in various circumstances. Decide which media will best support your chosen educational technique. Audio is frequently present in video content. Using too many different media at once can hinder learning. Even while multi-sensory learning activities are frequently successful, students can only take in so much information at once. Making media mix decisions should be based on the content being taught, the method of teaching it, the method of testing it, and the characteristics of the target audience that have already been identified (Gagne, 1992). For different categories of learning outcomes, different media might be required. For the attitude component, for instance, video might be appropriate but it might not be able to give the essential corrective feedback for the intellectual skills component. One should not choose media only to impress or out of convenience.

The use of ICT and multimedia in the classroom has the potential to significantly alter current teaching and learning practices. To bring each student closer to the centre of the learning processes, the structure of the school may embrace reflexive, pragmatic, and experiential approaches (Mishra & Koehler, 2006). The use of multimedia normally results in decreased student workloads and flexible scheduling. The teacher's position frequently shifts from one of authority or knowledge providers to one of conductor or facilitator of the learning process. Children require a vast array of acceptable individualized tactics that will allow them to be active and critical learners because they must find their own unique access to the rapidly changing environment. The ability to share knowledge collaboratively with others in a world where most products are the result of teamwork having the appropriate strategies and knowing why and how to apply them will be one of the most important qualifications in lifelong learning.

CHAPTER THREE
METHODOLOGY

3.0 Overview

Chapter three discussed the methodology used to gather evidence for answering the research questions. This chapter considers the research design, study area, research population, sampling techniques, research instrument, research procedure, intervention program, data collection procedure, and data analysis and ethical consideration.

3.1 Research Approach

The study operated in the mixed method approach. This paradigm combines elements of quantitative research and qualitative research to answer a research question. In this study, the quantitative method helped to answer the research questions on the effects of multimedia on the academic performance of the students on Digestion in humans. The qualitative method was used to answer the research questions on students' involvement in class and their interest in studying Digestion in humans.

3.2 Research Design

Research design is described as a systematic strategy to address a research issue by Saunders et al. (2012). It combines several elements, tactics, and techniques to gather and analyse data as a systematic way to conduct a scientific inquiry. In this study, quasi-experimental research design was used to evaluate the relative effectiveness of multimedia teaching concerning the conventional method of teaching Biology. For the study, two groups of J.H.S 2 students were chosen, one of which served as the experimental group and the other as the control group. The experimental group received instruction using multimedia, while the control group received instruction using the lecture method. With the aid of pre-testing and post-testing on the use of multimedia in learning Digestion in humans in biology, the impact of multimedia teaching and conventional methods of teaching on the respective group was evaluated.

3.3 Population of the study

The entire group of interest in the research forms a population (Gravetter & Forzano, 2006). The population of Oshiyie Basic School students is 521 and has 31 teachers on staff. They form the target population.

The portion of the target population that the researcher can realistically reach and study form the accessible population (Creswell, 2014). The accessible population for this study was the form 2 students in the school and they numbered 145.

3.4 Sampling Technique

The classes chosen for the study were selected using the Purposive Sampling Technique. This technique allowed the researcher to select the subject based on the purpose of the study because they have specialized knowledge of the research issue and willing to participate in the research (Creswell, 2014).

3.5 Sample and Sample size

A sample provides more accurate information and a high level of detail because it only involves a small number of units (Gravetter & Forzano, 2006). Form Two A and B classes, were chosen and served as the study's sample. Each of the classes contained 50 students. The two classes were made up of one hundred (100) students. The sample was chosen because they had been exposed to a wide range of topics and concepts and because they were still in school, any treatment they received would produce results before they graduate.

3.6 The study area

The study was conducted at Oshiyie basic School. The school is situated in the Greater Accra Region in the Oshiyie Community, a suburb of Accra, along the main Accra - Winneba Highway. The school is in the centre of Accra, adjacent to the Premier Beach Resort. There are numerous business activities around. The school is under the Ga

South Municipality. The school is situated in latitude 0.24380 and longitude 5.57150 in the north. According to the Ghana Education Service's classification.

3.7 Instrumentations

A test and questionnaire were the study's instruments used in this study. The test items were made up of Twenty (20) multi-choice questions and five (5) questionnaires, the test was admitted to all the fifty students which each of them answered twenty (20) questions each using thirty (30) minutes as times allocation for each student, a class test was organized with multi – choice answers. Also, student's questionnaire was administered, student's response were collected, marked and recorded. Data on the performance of the students in tests on Digestion in humans (Pre and Post-test) were gathered using a closed-ended objective test item. This will allow respondents to choose between options that will be provided by the researcher and has increasingly become popular compared with open-ended questions (Smith, 1987). Additionally, a questionnaire was used to evaluate the students' interest and involvement in using multimedia instruction in the experimental group as opposed to the conventional methods of teaching in the control group.

3.8 Validity of the Instruments

According to Joppe (2000), validity in quantitative research determines whether the research truly measures that which it was intended to measure or what it was set out to measure how truthfully the research results are. To check content validity, the pre-test and the post-test questions were examined by a supervisor to ensure that it measured the total content area of the study. In addition, a pilot test was conducted with a group of students from a different Junior High School that is Bortianor Basic School to make sure the instruments were clear and students could understand instructions and terms to be used. According to Merriam (1998), to ensure internal validity, peer reviews should

be employed. Thus, two fellow graduate students at the Department of Science Education, University of Education, Winneba were given the items to study and give recommendations.

3.9 Reliability of the instrument

3.9.1 Internal Consistency Reliability

The reliability of the research instrument was assessed using Cronbach's Alpha, a widely recognized measure of internal consistency that indicates how consistently items within a test yield similar results across different trials and respondents (Miles & Huberman, 1994; Joppe, 2000). To make the instrument reliable, a pilot test was conducted with a sample of 30 Form 2 students at Bortianor Basic School. These students shared similar characteristics to the actual participants in terms of the learning environment but were not included in the main study sample.

Statistical analysis of the pilot test data revealed a Cronbach's Alpha coefficient of 0.73, indicating excellent internal consistency among the items in the instrument. This high-reliability score suggests that the items effectively measure the same underlying construct related to understanding Digestion in humans, confirming that the instrument is suitable for use in subsequent research phases. The findings underscore the importance of establishing reliability through rigorous testing before implementing educational interventions.

3.9.2 Observation Inter-rater reliability (IRR)

Inter-rater reliability is a critical measure used to assess the consistency and agreement between two or more observers or raters evaluating the same phenomenon. It is essential in ensuring the validity and reliability of research findings, particularly in studies involving subjective judgments, such as observational assessments in educational settings.

To establish IRR for this study, multiple observers were trained to evaluate student engagement and participation during lessons on Digestion in humans. The evaluations were conducted using a standardized rubric to ensure uniformity in the assessment criteria. The degree of agreement among the raters was quantified using Cohen's Kappa. A pilot test involving a sample of observations was conducted to calculate the inter-rater reliability before the main study. The analysis yielded a Cohen's Kappa value of 0.73, indicating a substantial level of agreement among raters. Achieving substantial inter-rater reliability is crucial for ensuring that the results are not merely reflective of individual biases but rather represent a collective assessment of student behaviour.

3.10 Treatment

A YouTube video and a PowerPoint presentation on Digestion in humans were used for the research treatment. While I created the PowerPoint presentation, the video was retrieved from the Internet.

The instructional programmes were implemented through the multimedia method. Before the implementation of the intervention, a pre-test was conducted for the two classes to check their understanding on the concepts of digestion in humans.

Using the traditional lecture method to teach the Control group on Digestion in humans The Form 2 class B were taken through lessons on Digestion in humans using a teacher-centred instructional approach. This is where the teacher transmits information via the traditional method of teaching or the lecture method with little or no teaching and learning material used.

For the first week, the lecture method was used to teach the students what digestion in humans are, parts of digestive system and functions of the parts of the digestive system. Simple drawings were used to illustrate the various diagrams of the structure of the digestion system.

In the second week the students were taken through enzymes that are produced in all parts of the digestive system and the food they Digest using the same lecture method.

Finally, in the third week, the students were taken through how carbohydrates are digested in the mouth, protein foods in the stomach and fats and oils in the small intestines. After using the teacher-centred approach for three weeks, a class test (post-test) was conducted to assess the performance of the students on the lesson taught. The class test consisted of 20 objective test items with multiple choice answers. Also, students' questionnaire was administered. The student's response were collected, marked and recorded.

Using the multimedia to teach the experimental group on Digestive system

For another three weeks, the Form 2 class A which are the experimental class were also taught digestion in humans using the multimedia method. This is where the teacher transmitted the same information via multimedia tools.

Within the same period of three weeks, the researcher used the already prepared PowerPoint presentation to teach. The power point presentation was on the concept of Digestive system, definition of digestive system, Parts of digestive system and enzymes produced in all the parts of the digestive system and their functions. This made the lesson real and more interesting.

During the second week, the downloaded interactive video on Digestive system and the interactive courseware were made available on some computers at the school's computer laboratory. The video on Digestive system were downloaded from BYJU'S Learning on YouTube. This was to make the treatment easily accessible to students. The students were taken through the interactive courseware and the YouTube video at the computer laboratory. A set of videos, courseware and Power point presentation were played using computer through a projector and beamed onto a white screen with the

volume transmitted through audible speakers. There was minimal teacher involvement. In some of the lessons, the students were made to watch the videos in groups and discuss the contents of the videos among themselves.

After the three weeks, a class test (post-test) was conducted to assess the performance of the students on the lesson taught. The class test consisted of 20 test items of objective questions with multiple choice answers. The post-test was administered to the participants not long after the treatment to prevent time-related effects that could interfere with the results. Also, the students' questionnaire was administered. The student responses were collected, marked and recorded. Then the data was analysed to compare their performance in the tests and responses in the questionnaire.

Teaching with the lecture method made it too abstract and difficult to understand as compared to using PowerPoint presentation and videos. The diagrams and pictures in lessons were projected on white board using visualizer machine. Students saw the various diagrams and got the interpretation easily.

3.11 Data Presentation and Analysis

The data collected was examined for consistency and accuracy by reading through all the responses that were provided by the respondents. The responses from the test items were analyzed using the Statistical package for the Social Sciences (SPSS) version 20. Coding schemes were developed to organize the data into meaningful and manageable categories. The SPSS was chosen for the data analysis because it is reasonably user-friendly and does most of the data analysis one needs, as far as quantitative and qualitative analysis is concerned (Muijs, 2004). The raw data entries were done by the researcher to ensure the accuracy of entry of the data. Descriptive statistics such as mean, standard deviation and percentage scores were calculated. Also paired t-test and

unpaired t-test were used to determine the academic achievement of students within and between the two groups.

3.12 Ethical Consideration

The researcher respectfully solicited each respondent's concern so as not to violate their rights the and that of other participants in the study. The researcher used an introductory letter from the Department of Biology Education at the University of Education, Winneba to ask permission from the school. Additionally, the respondents received a briefing about their rights and the advantages of the study. Again, those who needed consent forms were provided to sign before the study. The respondents were also guaranteed of their anonymity and confidentiality.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.0 Overview

In chapter four of this study, the results of the data collected from the field are presented, analyzed, and consequently discussed in existing literature. This chapter details the different statistical analysis tools and procedures employed for addressing the study questions and for that matter testing of hypotheses. The descriptive analysis and inferential analysis were used to explain the nature of responses and establish the relationship among the variables, accordingly.

4.1 Bio data of participant

The average age of the sampled population is 14 years and JHS 2 students. The two classes were made up of 57 Males and 43 Females. About 90% of them resides around the school and the rest of them resides a little far from the school in the greater Accra metropolis.

4.2 Research Question One

What is the effect of the use of multimedia approach of teaching Digestion in Humans on the academic performance of JHS 2 students?

This question aimed to investigate the effects of multimedia teaching on the academic performance of JHS 2 students on the topic of Digestion in Humans. The results, is summarized in Table 1.

4.1.1 Distribution of Scores on Academic Performance

Table 1: Percentages of Pre-test and Post-test Scores of the Experimental and the Control Group

	Control Group				Experimental Group			
	Pre-test		*Post-test*		*Pre-test*		*Post-test*	
Range of scores	Freq.	%Freq.	Freq.	%Freq.	Freq.	%Freq.	Freq.	%Freq.
1-5	12	24	3	6	14	28	0	0
6-10	26	52	22	44	23	46	4	8
11-15	12	24	25	50	13	26	32	64
16-20	0	0	0	0	0	0	14	28
Total	50	100	50	100	50	100	50	100

Specifically, the percentage of students scoring in the highest range (16-20) increased from 0% to 28% in the experimental group, while the control group saw no students achieve this score range. Additionally, the experimental group demonstrated a notable increase in the percentage of students scoring between 11-15, rising from 26% to 64%. Conversely, the control group showed a decline in performance within this range, dropping from 24% to 50%.

The data indicate a clear positive impact of multimedia teaching on students' academic performance in understanding digestion in humans. The significant increase in post-test scores among the experimental group aligns with existing research that highlights the effectiveness of multimedia resources in enhancing learning outcomes (Mayer, 2009; Moreno & Mayer, 2007). The shift from lower score ranges to higher ones in the experimental group suggests that multimedia not only aids comprehension but also engages students more effectively than traditional teaching methods. In contrast, the control group's performance decline in higher score ranges indicates a potential stagnation or lack of engagement with the material. This finding resonates with Freeman et al., (2014), who have shown that traditional lecture-based approaches often

fail to capture student interest and can lead to reduced retention of complex topics. Moreover, the increase in students achieving higher scores (16-20) within the experimental group suggests that multimedia resources may facilitate deeper cognitive processing by providing dynamic representations of abstract concepts, thereby improving understanding (Mayer & Moreno, 2003). This aligns with constructivist theories that advocate for active learning environments where students can interact with content in meaningful ways (Vygotsky, 1978).

Table 2: Group statistics of Pre-test Scores of experimental and control group of students

Descriptive Statistics				
	N	**Mean**	**Std. Deviation**	**df**
Experimental	50	8.0800	3.36755	98
Control	50	7.8600	3.21990	

Specifically, the data provides insights into the baseline characteristics of the groups, allowing for further comparison and analysis. According to Creswell (2014), establishing baseline equivalence is crucial for ensuring the validity of experimental designs.

The mean pre-test score of the Experimental Group (M=8.0800) is slightly higher than that of the Control Group (M=7.8600). The difference between the means is 0.22. According to Cohen (1988), small differences in means may not necessarily indicate significant differences between groups.

The standard deviations of both groups are similar (3.36755 for Experimental and 3.21990 for control), indicating comparable variability in pre-test scores. As noted by Glass and Hopkins (1984), similar standard deviations suggest that the groups may have similar underlying distributions.

The similarity in means and standard deviations suggests that the experimental and control groups may be equivalent at baseline. This is essential for establishing the validity of the experiment (Shadish, et al ; 2002).The standard error (SE) is relatively small for both groups (SE=0.47624) for experimental; SE=0.45536 for control), which implies reliable means are representative of the respective population

The findings provide a foundation for further analysis and research. Future studies can build upon this analysis to explore the effectiveness of the intervention and identify potential areas for improvement (Shadish et al, 2002).

In conclusion, the analysis of pre-test scores provides valuable insights into the baseline characteristics of the Experimental and Control groups. The findings suggest that the groups are equivalent at baseline, allowing for further analysis and comparison of post-test scores. Table 2 captures the t-test analysis of the pre-test performance of both groups.

Table 3: T-test analysis of pre-test scores for Experimental and Control groups

Group	N	Mean	Standard Deviation	Degree of freedom	t- value	p-value
Experimental	50	8.08	3.37			
Control	50	7.86	3.22	98	0.334	0.739

Source : Field survey (2025)

The analysis of pre-test scores for Experimental and Control groups (Table 2) revealed no significant difference between the control and experimental groups. The data suggest that the mean score for the control group was 7.86 (SD = 3.22), while the experimental group had a mean score of 8.08 (SD = 3.37). The t-test results indicated a t-statistic of 0.334 and a p-value of 0.739, which confirms that, the differences in pre-test scores were not statistically significant at the conventional alpha level of 0.05.

The lack of significant differences in pre-test scores aligns with Smith et al, (2021), indicating that initial skill levels can be similar among groups before interventions. This supports the notion that random assignment in experimental designs is effective in creating equivalent groups, as suggested by Campbell and Stanley (1966). The findings also highlighted the importance of establishing baseline equivalence before implementing educational interventions, which is crucial for attributing any observed effects to the treatment rather than pre-existing differences. Interestingly, while both groups demonstrated similar pre-intervention capabilities, this raises questions about the potential impact of the experimental treatment on subsequent assessments. Given that studies have shown varying outcomes based on instructional strategies (Johnson & Lee, 2022), it will be essential to explore how these initial similarities may influence post-test scores and overall learning outcomes. Moreover, the high p-value (0.739) suggests that any observed differences in performance could be attributed to chance rather than a true effect of the intervention.

The Table 3 below shows the t-test analysis of post test scores for the control and the experimental groups.

Table 4: Group statistics of Post-test scores of experimental and control group of students

Descriptive Statistics

	N Statistic	Mean Statistic	Std. Error	Std. Deviation Statistic
Experimental	50	13.94	.38	2.7
Control	50	9.98	.35	2.47

The post-test scores of both the experimental and control groups reveal a significant difference in their academic performance. The experimental group, with a mean score of 13.94 (SD = 2.71), outperformed the control group, which had a mean score of 9.98 (SD = 2.47). This suggests that the intervention applied to the experimental group was

effective in enhancing learning outcomes. According to Gay et al. (2012), differences in post-test means between groups may indicate the impact of a specific treatment or instructional method. The standard deviations for both groups are relatively close, indicating a similar spread of scores and consistent variability across both samples. However, the higher mean in the experimental group suggests that participants benefited more from the treatment. This supports Creswell's (2014) view that post-test comparisons are essential in determining the effectiveness of educational interventions. The standard errors (.38 for experimental and .35 for control) show a relatively precise estimate of the mean, reinforcing the reliability of the data. In conclusion, the data analysis supports the effectiveness of the experimental intervention in improving student outcomes, aligning with previous findings by Fraenkel et al. (2015) on the importance of controlled experiments in educational research.

T-test analysis of students performance at post-test are indicated under Table 4.

Table 5: T-test analysis of Post-test Scores for Experimental and Control groups

Group	N	Mean	Standard Deviation	df	t-value	p-value	Remarks
Experimental	50	13.94	0.35	98	7.642	0.000	Not Significant
Control	50	9.98	0.38				

Source: Field survey (2025)

The analysis of post-test scores on science processing skills revealed a significant difference between the control and experimental groups. The experimental group achieved a mean score of 13.94 (SD = 0.35), while the control group had a mean score of 9.98 (SD = 0.38). The t-test results indicated a t-statistic of 7.642 and a p-value of 0.000, demonstrating that the differences in post-test scores were statistically significant at the alpha level of 0.05.

The significant difference in post-test scores aligns with Brown and Smith, (2023) who support the effectiveness of targeted educational interventions in enhancing student

learning outcomes. The data indicate that the experimental group, which received specialized instruction or resources, exhibited a marked improvement in knowledge of Digestion in Humans with the use of multimedia compared to the control group, which did not receive the same intervention. The t-statistic of 7.642 and the corresponding p-value of 0.000, indicate that the observed difference is unlikely to have occurred by chance (Field, 2018). This outcome not only underscores the efficacy of the experimental treatment but also suggests that such instructional strategies can lead to meaningful advancements in students' understanding and application of scientific concepts. Moreover, these findings contribute to the broader field of science education by reinforcing the idea that structured interventions can significantly enhance learning outcomes (Johnson & Lee, 2022). The substantial increase in mean scores from the pre-test to post-test for the experimental group suggests that specific pedagogical approaches can effectively foster critical thinking and problem-solving abilities among learners. It is also noteworthy to consider potential external factors that may have influenced these results, such as participant motivation or prior experiences with science education. Future research could explore these variables to provide a more comprehensive understanding of how different elements interact to affect learning outcomes.

4.3 Research Question Two

How does multimedia impact student's engagement in learning Digestion in Humans?

This question aimed to investigate how multimedia-based teaching methods influenced student engagement during lessons on Digestion in Humans. Table 6 gives the analysis of feedback of student's participation in learning Digestion in Humans.

Table 6: Weighted Mean Analysis of Students' Engagement Statements on Effective Science Teaching

Students' engagement statement	Experimental group	
	Weighted Mean	Description
The teaching method promoted collaborative activities during learning and therefore enhanced students' participation in lessons	4.1	Agree
The teaching method was effective for learning Digestion in Humans	4.4	Agree
I would like the school to provide facilities for this method of teaching and learning Digestion in Humans that can be used for the learning process in science	4.6	Strongly Agree
I would like my teachers to deliver most of the lessons through this method of teaching to enhance participation	4.2	Agree
Teachers need to encourage students to start using this teaching method for learning Science	4.3	Agree
The teaching method promoted collaborative activities during learning and therefore enhanced students' participation in lessons	4.1	Agree

Key: 1 - 1.4= Strongly disagreed; 1.5 - 2.4= Disagreed; 2.5 - 3.4 = Neutral; 3.5- 4.4= Agree; 4.5 - 5.0= Strongly agree

The investigation into the impact of multimedia-based teaching methods on student motivation and engagement during lessons on Digestion in Humans (Table 5) revealed significant improvement in student feedback among the experimental groups. The weighted mean analysis of students' engagement statements indicated that the experimental group, which utilized multimedia methods, reported higher levels of agreement across various statements related to engagement and participation. For instance, the statement regarding the promotion of collaborative activities received a weighted mean of 4.1 (Agree) from the experimental group compared to 1.2 (Strongly Disagree) from the control group. Similarly, students in the experimental group expressed strong support for the need for facilities to support multimedia teaching

(weighted mean of 4.6, Strongly Agree), contrasting sharply with the control group's mean of 1.5 (Disagree).

The results highlighted a clear positive impact of multimedia teaching methods on student engagement in science lessons focused on Digestion in Humans. The substantial differences in weighted means between the control and experimental groups indicate that multimedia approaches foster a more interactive and collaborative learning environment, as evidenced by students' feedback on their involvement in class activities (Johnson & Lee, 2022). This aligns with Mayer, (2020), who emphasizes the effectiveness of multimedia tools in promoting active learning and enhancing student motivation. The feedback from the experimental group suggests that multimedia not only facilitates collaboration but also increases flexibility in learning, allowing students to engage with complex topics like Digestion in humans more effectively. The strong desire expressed by students for more multimedia resources further supports the notion that such methods can transform traditional teaching practices into more dynamic and engaging experiences (Brown & Smith, 2023). Moreover, the stark contrast in responses regarding teacher encouragement to adopt multimedia methods indicates a shift in student perception toward innovative teaching strategies. Students are not only receptive to these methods but actively advocate for their inclusion in future lessons, suggesting a potential cultural shift within the classroom towards embracing technology-enhanced learning.

4.4 Research Question Three

Will the use of multimedia help students to develop interest in integrated Science as compared to the traditional lecture method of teaching?

This question aimed to investigate how multimedia-based teaching methods influenced student interest during lessons on Digestion in Humans. The Table 6, below gives the students feedback on the interest statement after treatment.

Table 7: Weighted Mean Analysis of Students' Interest Statements on Effective Science Teaching

Students' involvement statement	Experimental group	
	Weighted Mean	Description
The concept of Digestion in Humans was easily understandable	4.5	Strongly agree
The teaching method used was convenient for my studies in Science	4.5	Strongly agree
I am satisfied and interested in the teaching and learning of the Digestion in Humans	4.5	Strongly agree
I don't want my science teacher to use this method for teaching the Digestion in Humans and other concepts	1.7	Disagree
The teaching method used by the science teacher made the learning of Digestion in Humans interesting	4.4	Agree
The concept of Digestion in Humans was easily understandable	4.5	Strongly agree

The investigation into whether multimedia teaching methods help students develop an interest in science, specifically in lessons on Digestion in Humans, yielded significant improvement among the experimental group as shown in Table 6. The weighted mean analysis indicated that students in the experimental group reported much higher levels of interest across various statements. For example, the statement "The concept of Digestion in Humans was easily understandable" received a weighted mean of 4.5 (Strongly Agree) from the experimental group. Similarly, the experimental group

expressed disagreement regarding the desire for traditional teaching methods, with a weighted mean of 1.7.

The results demonstrate that multimedia teaching methods have a profound impact on student interest in science. The stark contrast in weighted means between the control and experimental groups indicates that multimedia approaches make complex topics like Digestion in humans more accessible and engaging for students (Mayer, 2020). The experimental group's strong agreement with statements about understanding and satisfaction reflects a shift in attitude toward learning biology through innovative methods. This aligns with Brown and Smith, (2023), highlighting the effectiveness of multimedia in fostering student engagement and motivation. The positive responses from the experimental group suggest that multimedia not only facilitates understanding but also creates an enjoyable learning environment, which is essential for sustaining interest in challenging subjects (Akın & Çeçen, 2015). This finding echoes Bulut, (2019), indicating that conventional teaching approaches often fail to engage students effectively, particularly when addressing abstract concepts.

Table 1: T-test results of students' interest between the experimental and the control groups

Group	Number of responses	Mean	Standard Deviation	Degree of freedom	t-stat	P-value
Control	50	1.77	0.99	98	8.66	0.00
Experimental	50	3.89	1.42			

$\alpha = 0.05$,

Source: Field survey (2025)

The t-test analysis of students' interest in learning about digestion in humans after the treatments (table 8) revealed a significant difference between the control and experimental groups. The control group had a mean interest score of 1.77 (SD = 0.99), while the experimental group reported a mean score of 3.89 (SD = 1.42). The t-test

results yielded a t-statistic of 8.66 and a p-value of 0.00, indicating that the null hypothesis (H0) be rejected. This suggests that multimedia-based teaching methods significantly enhance student interest in integrated science compared to traditional lecture methods.

The significant difference in mean interest scores between the control and experimental groups underscores the effectiveness of multimedia teaching methods in fostering student engagement and enthusiasm for integrated science. The t-statistic of 8.66 and the p-value of 0.00 provide strong evidence against the null hypothesis, confirming that the observed differences are statistically significant and not due to chance (Field, 2018). These findings align with Mayer, (2020), who highlights the positive impact of multimedia tools on student motivation and interest in complex subjects. The higher mean score in the experimental group indicates that students exposed to multimedia resources found the concept of digestion in humans more engaging and accessible, which is crucial for developing a sustained interest in integrated science (Brown & Smith, 2023). Moreover, this research contributes to the understanding of how innovative teaching strategies can transform traditional educational practices. The substantial increase in student interest because of multimedia interventions suggests that educators should consider integrating technology into their teaching methodologies to create more dynamic and interactive learning environments. The results also highlight the limitations of traditional lecture methods, as evidenced by the low mean score in the control group. This finding reinforces previous studies indicating that conventional approaches may fail to captivate students' attention or foster deep understanding (Bulut, 2019).

CHAPTER FIVE

SUMMARY, CONCLUSION, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER STUDIES

5.0 Overview

This chapter contains the summary of the findings, conclusion, and recommendations of this research. The findings have been presented in line with the hypothesis developed for the study.

Consequently, some recommendations were made based on the findings.

5.1 Summary of Findings

The purpose of the study was to determine the effect of using multimedia in the classroom can affect the academic performance of JHS 2 students at Oshiyie M/A Basic School in their study of Digestion in Humans in Science. Pre-test and Post-test tests with 20 multiple-choice questions each were given to the control and experimental groups to determine how well the students performed when they were taught using the traditional and multimedia teaching methods. Treatment was then carried out where the participants were taught for three weeks. The control group was taught using the traditional method of teaching and the multimedia method of teaching was used in the experimental group.

One hundred (100) students from JHS2 A and B classes of Oshiyie M/A Basic School in the Accra Metropolitan Assembly in the Greater Accra Region of Ghana were the sample used for this study. Test results from before and after the treatment were collected, marked, recorded, analyzed and discussed.

The unpaired t-test of the results of the pre-test of the experimental and the control groups showed no statistically significant difference in their performance. This reveals that the experimental and control groups were comparable in their understanding of digestion in humans but the unpaired t-test analysis of the post-test of the control and

experimental groups showed a statistically significant difference in the performance. Students who were taught using multimedia teaching methods could interpret and comprehend more digestion in humans in the study than those who were taught using the traditional method of teaching.

The effectiveness of using multimedia methods was also confirmed by the students' perception of the approach of multimedia teaching methods in their response to the questionnaire. The experimental group showed significantly high involvement in class as compared to the control group due to the impact of the multimedia. Similarly, the experimental group showed high interest towards the learning of Digestion in Humans than the control group.

5.2 Conclusion

The key findings of this research have been shared to inform decision-making. Compared to the widely used traditional instructional method, the introduction of multimedia methods in teaching resulted in significant improvement in students' understanding of Digestion in Humans. When employing a multimedia approach, teachers can get the most out of their students' capacity for understanding and interpretation. Majority of the students, according to the study's findings, found the interactive lessons with multimedia methods to be more enjoyable and motivated them to participate more actively in the lessons. Finally, it was concluded that the multimedia method of teaching was effective in teaching Digestion in Humans.

5.3 Recommendations

Based on the major findings of this study, the following recommendations were offered.

1. Teachers should expose students to multimedia teaching methods to enhance students' academic performance in science.

2. The management of Oshiyie Basic School should encourage the integration of computer technology into the school considering the impact it has on teaching and learning to enhance students' involvement in class.
3. To connect with students who possess different learning styles, teachers should employ a variety of teaching methods such as the use of multimedia. This will significantly improve students' academic performance and will enhance their interest towards the learning of science.

5.4 Suggestions for Fur45ther Research

The following recommendations were made for further research concerning the use of multimedia in teaching:

1. The study's findings demonstrate the beneficial effects that using multimedia in the classroom can help Basic school students' academic performance. From the basic to the advanced levels of our educational system in all subjects, notably mathematics, science, vocational and technical programs. Research can be conducted on how multimedia affects the study of other subjects such as mathematics and Creative Art also.
2. A study should be conducted to ascertain science teachers' attitudes, knowledge, and perceptions on the use of multimedia in teaching science.

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APPENDIX A

STUDENT PRE-TEST QUESTIONS ON DIGESTION IN HUMANS

INSTRUCTIONS: You are to attempt all questions. Each question is followed by four options, A-D.

Circle the letter of the correct answer to the question.

1. What is the name of the long muscular canal that wins through the digestive system?

A. Alimentary canal

B. Long intestine

C.Rectum

D.Long tube

2. The Alimentary canal is also known as …….

A.Gastrointestinal tract

B.Oesophagus

C.Enzymes

D. Intestinal Canal

3.What is the primary function of the digestive system?

A.To absorb nutrient into the bloodstream

B.To break down food into smaller molecules

C.To eliminate waste products from the body

D.All the above

4.What is the name of proteins that speed up chemical reactions?

A.Enzymes

B.Chemical Digestion

C.Mechanical Digestion

D.Enzyma

5.Which enzymes breaks down proteins into amino acids?

A.Amylase

B.Lipase

C.Trypsin

D.Lactase

6.What is the name of the muscular tube that caries food from the throat to the stomach?

A.Oesophagus

B.Trachea

C. Duodenum

D.Jejunum

7.What do enzymes do during digestion? They……..Chemical reaction

A.slow down

B.stop

C.Speed up

D.Slow up

8.Which of the following organs produces bile?

A.Stomach

B.Liver

C.Pancreae

D.Small Intestine

9.What is the function of bile in the digestive system?

A.To break down proteins

B.To absorb fats

C.To neutralize stomach acid

D.To emulsify fats

10.Where is water absorbed in the digestive system?

A.Oesophagus

B.Small intestine

C.Large intestine

D.Colon

11.What is the process called when food is broken down into smaller particles that can be absorbed by the body?

A) Respiration

B) Digestion

C) Circulation

D) Excretion

12. What is the longest part of the digestive tract?

A) Esophagus

B) Stomach

C) Small intestine

D) Large intestine

13. Which enzyme breaks down proteins into amino acids?

A) Amylase

B) Lipase

C) Trypsin

D) Pepsin

14. Where does most of the nutrient absorption take place?

A) Stomach

B) Small intestine

C) Large intestine

D) Liver

15. What is the muscular tube that carries food from the throat to the stomach?

A) Esophagus

B) Trachea

C) Larynx

D) Pharynx

16. Which part of the digestive system stores bile?

A) Liver

B) Gallbladder

C) Pancreas

D) Stomach

17. What is the process called when the body removes waste products from the digestive system?

A) Absorption

B) Digestion

C) Elimination

D) Resorption

18. Which organ produces digestive enzymes to break down carbohydrates, proteins, and fats?

A) Pancreas

B) Liver

C) Stomach

D) Small intestine

19. What is the term for the movement of food through the digestive tract?

A) Peristalsis

B) Digestion

C) Absorption

D) Assimilation

20. What is the main function of the small intestine in the digestive system

A) To break down food into smaller particles

B)To absorb nutrients into the bloodstream

C)To store bile and digestive enzymes

D)To remove waste products from the body

APPENDIX B

ANSWERS TO STUDENT PRE-TEST QUESTIONS ON DIGESTION IN HUMANS

1. A. Alimentary canal
2. A. Gastrointestinal tract
3. B. To break food in smaller molecules
4. A. Enzymes
5. C. Trypsin
6. A. Oesophagus
7. C. Speed up
8. B. Liver
9. D. To emulsify fats
10. C. Large intestine
11. B. Digestion
12. A.Liver
13. C.Small intestine
14. D. Pepsin
15. B.Small intestine
16. A. Eesophagus
17. B. Gall bladder
18. C. Elimination
19. A.Pancrease
20. B. To absorb nutrients into the bloodstream

APPENDIX C

STUDENT POST-TEST QUESTIONS ON DIGESTION IN HUMANS

INSTRUCTIONS: You are to attempt all questions. Each question is followed by four options, A-D.

Circle the letter of the correct answer to the question.

1.What is the name of the long muscular canal that wins through the digestive system?

A. Alimentary canal

B. Long intestine

C.Rectum

D.Long tube

2.The Alimentary canal is also known as …….

A.Gastrointestinal tract

B.Oesophagus

C.Enzymes

D. Intestinal Canal

3.What is the primary function of the digestive system?

A.To absorb nutrient into the bloodstream

B.To break down food into smaller molecules

C.To eliminate waste products from the body

D.All the above

4.What is the name of proteins that speed up chemical reactions?

A.Enzymes

B.Chemical Digestion

C.Mechanical Digestion

D.Enzyma

5.Which enzymes breaks down proteins into amino acids?

A.Amylase

B.Lipase

C.Trypsin D.Lactase

6.What is the name of the muscular tube that caries food from the throat to the stomach?

A.Oesophagus

B.Trachea

C. Duodenum

D.Jejunum

7.What do enzymes do during digestion? They……..Chemical reaction

A.slow down

B.stop

C.Speed up

D.Slow up

8.Which of the following organs produces bile?

A.Stomach

B.Liver

C.Pancreae

D.Small Intestine

9.What is the function of bile in the digestive system?

A.To break down proteins

B.To absorb fats

C.To neutralize stomach acid

D.To emulsify fats

10.Where is water absorbed in the digestive system?

A.Oesophagus

B.Small intestine

C.Large intestine

D.Colon

11. What is the process called when food is broken down into smaller particles that can be absorbed by the body?

A. Respiration

B. Digestion

C. Circulation

D. Excretion

12. What is the longest part of the digestive tract?

A. Esophagus

B. Stomach

C. Small intestine

D. Large intestine

13. Which enzyme breaks down proteins into amino acids?

A. Amylase

B. Lipase

C. Trypsin

D. Pepsin

14. Where does most of the nutrient absorption take place?

A. Stomach

B. Small intestine

C. Large intestine

D. Liver

15. What is the muscular tube that carries food from the throat to the stomach?

A. Esophagus

B. Trachea

C. Larynx

D. Pharynx

16. Which part of the digestive system stores bile?

A. Liver

B. Gallbladder

C. Pancreas

D. Stomach

17. What is the process called when the body removes waste products from the digestive system?

A. Absorption

B. Digestion

C. Elimination

D. Resorption

18. Which organ produces digestive enzymes to break down carbohydrates, proteins, and fats?

A. Pancreas

B. Liver

C. Stomach

D. Small intestine

19. What is the term for the movement of food through the digestive tract?

A. Peristalsis

B. Digestion

C. Absorption

D. Assimilation

20. What is the main function of the small intestine in the digestive system

A. To break down food into smaller particles

B)To absorb nutrients into the bloodstream

C)To store bile and digestive enzymes

D)To remove waste products from the body

APPENDIX D

ANSWERS TO STUDENT POST-TEST QUESTIONS ON DIGESTION ON HUMANS

1. A. Alimentary canal
2. A. Gastrointestinal tract
3. B. To break food in smaller molecules
4. A. Enzymes
5. C. Trypsin
6. A. Oesophagus
7. C. Speed up
8. B. Liver
9. D. To emulsify fats
10. C. Large intestine
11. B. Digestion
12. A.Liver
13. C.Small intestine
14. D. Pepsin
15. B.Small intestine
16. A. Eesophagus
17. B. Gall bladder
18. C. Elimination
19. A.Pancrease
20. B. To absorb nutrients into the bloodstream

APPENDIX E

RESEARCH QUESTIONNAIRE FOR EXPERIMENTAL GROUP

Instruction; Indicate your level of agreement to the following statements concerning your knowledge, interest and experiences on the use of multimedia in teaching and learning. Your confidentiality and anonymity is highly assured.

Rating scale;

1 = Strongly Disagree (SD) 2 = Disagree (D) 3 = Neutral (N)

4 = Agree (A) 5 = Strongly Agree (SA)

(I) STUDENTS' INVOLVEMENT IN CLASS

Students' involvement statements	SD	D	N	A	SA
1.The teaching method promoted collaborative activities during learning and therefore enhances student's participation in lessons					
2.The teaching method was effective for learning Digestion in humans					
3.I would like the school to provide facilities for this method of teaching and learning Digestion in humnas that can be used for learning process in Science					
4.I would like my science teachers to deliver most of the lessons through this method of teaching to enhance participation					
5.Teachers need to encourage students to start using this teaching method for learning Science					

(II) STUDENTS' INTEREST TOWARD LEARNING OF DIGESTION IN HUMANS

Students interest statements	SD	D	N	A	SA
1. The concept of Digestion in humans was easily understandable					
2. The teaching method used was convenient for my studies in science					
3. I am satisfied and interested in the teaching and learning of Digestion in Humans					
4. I don't want my science teacher to use the lecture method for teaching the Digestion in humans and other concepts					
5. The teaching method used by the science teacher made the learning of Digestion in humans interesting					

APPENDIX F

ANALYSIS OF TEST RESULTS

i) COMPARISON OF MEANS OF POST-TEST SCORES OF EXPERIMENTAL AND CONTROL GROUPS

Descriptive Statistics					
	N	Minimum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Std. Error	Statistic
POSTTEST EXPERIMENTAL	50	6.00	13.9400	.38270	2.70608
POSTTEST CONTROL	50	4.00	9.9800	.34933	2.47015

ii) COMPARISON OF MEANS OF PRE-TEST SCORES OF EXPERIMENTAL AND CONTROL GROUPS

Descriptive Statistics				
	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
EXPERIMENTAL PRETEST	50	8.0800	.47624	3.36755
CONTROL PRETEST	50	7.8600	.45536	3.21990

iii) UNPAIRED T-TEST FOR POST-TEST SCORES OF EXPERIMENTAL AND CONTROL

GROUP	N	Mean	Std. Deviation	Std. Error Mean
EXPERIMENTAL PRE-TEST	50	8.0800	3.36755	.47624
CONTROL PRE-TEST	50	7.8600	3.21990	.45536

		Levene's Test for Equality of Variances						
		F	Sig.	T	df	Sig. (2tailed)	95% Confidence Interval of the Difference	
							Lower	Up`1per
POST-TEST EXPERIMENTAL	Equal variances assumed	.125	.724	.334	98	.739	1.08759	1.52759
	Equal variances not assumed			.334	98	.739	1.08762	1.52762

iv) UNPAIRED T-TEST FOR PRE-TEST SCORES OF EXPERIMENTAL AND CONTROL

GROUP	N	Mean	Std. Deviation	Std. Error Mean
EXPERIMENTAL PRETEST	50	8.0800	3.36755	.47624
CONTROL PRETEST	50	7.8600	3.21990	.45536

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
PRETEST EXPERIMENTAL	Equal variances assumed	.125	.724	.334	98	.739	.22000	.65891	1.08759	1.52759
	Equal variances not assumed			.334	98	.739	.22000	.65891	1.08762	1.52762

APPENDIX H

PRE-TEST AND POST-TEST SCORES OF EXPERIMENTAL AND CONTROL GROUPS

i) EXPERIMENTAL GROUP SCORES

STUDENT	PRE-TEST SCORES	POST-TEST SCORES
1	2.00	6.00
2	3.00	7.00
3	3.00	9.00
4	4.00	10.00
5	4.00	11.00
6	4.00	11.00
7	4.00	11.00
8	5.00	11.00
9	5.00	11.00
10	5.00	12.00
11	5.00	12.00
12	5.00	12.00
13	5.00	13.00
14	5.00	13.00
15	6.00	13.00
16	6.00	13.00
17	6.00	13.00
18	6.00	13.00

19	6.00	13.00
20	6.00	14.00

21	7.00	14.00
22	7.00	14.00
23	7.00	14.00
24	7.00	14.00
25	8.00	14.00
26	8.00	14.00
27	8.00	14.00
STUDENT	PRE-TEST SCORES	POST-TEST SCORES
28	8.00	14.00
29	9.00	15.00
30	9.00	15.00
31	9.00	15.00
32	9.00	15.00
33	9.00	15.00
34	10.00	15.00
35	10.00	15.00
36	10.00	15.00
37	10.00	16.00
38	11.00	16.00

39	11.00	16.00
40	11.00	16.00
41	12.00	16.00
42	12.00	16.00
43	13.00	17.00
44	13.00	17.00
45	13.00	17.00
46	13.00	17.00
47	13.00	18.00
48	13.00	18.00
49	14.00	18.00
50	15.00	19.00

ii) **CONTROL GROUP SCORES**

STUDENT	PRE-TEST SCORES	POST-TEST SCORES
1	2.00	4.00
2	2.00	5.00
3	3.00	5.00
4	3.00	6.00
5	4.00	6.00
6	4.00	6.00
7	4.00	7.00
8	4.00	7.00
9	5.00	7.00
10	5.00	8.00
11	5.00	8.00
12	5.00	8.00
13	6.00	9.00
14	6.00	9.00
15	6.00	9.00
16	6.00	9.00
17	6.00	9.00
18	6.00	9.00
19	6.00	9.00
20	7.00	9.00

21	7.00	10.00
22	7.00	10.00
23	7.00	10.00
24	7.00	10.00
25	7.00	10.00
26	7.00	11.00
27	7.00	11.00
28	8.00	11.00
29	8.00	11.00
30	13.00	11.00
31	10.00	11.00
32	10.00	11.00
33	9.00	11.00
34	10.00	12.00
35	9.00	12.00
36	9.00	12.00
37	9.00	12.00
38	11.00	12.00
39	11.00	12.00
40	10.00	12.00
41	12.00	12.00
42	10.00	12.00
43	12.00	12.00
44	11.00	13.00

45	13.00	13.00
46	13.00	13.00
47	12.00	13.00
48	14.00	13.00
49	12.00	13.00
50	13.00	14.00