Chapter One

Introduction

1.1 Background to the study

Science subjects are mostly abstract in nature and the use of audio-visuals aids is required more and more on daily basis to make it more understandable. One of the topics in Basic Science curriculum at the junior secondary school level is radioactivity. It is the term used to define disintegration of atoms, characterized by the number of protons in the nucleus. Some natural atoms are unstable. Therefore, their nuclei disintegrate or decay, thus releasing energy in form of radiation. The physical event displayed in this phenomenon is called radioactivity, while the radioactive atoms are called nuclei [1].

The widespread use of radioactivity in medical, industrial and other aspects of modern life makes the teaching of radioactivity an important aspect of the educational curriculum. A very basic introduction of this topic is contained in the junior secondary education curriculum. This is often presented by unspecialized instructors and can leave the students with limited and disordered understanding on the subject. New approaches in education which have become quite important today, aim to bring up children who are far from rote learning, to learn by doing and participate, think and reproduce what they learnt.

In the medical world, hospitals, doctors, and dentists use a variety of nuclear materials and procedures to diagnose, monitor, and treat a wide assortment of metabolic processes and medical conditions in humans. In fact, diagnostic x-rays or radiation therapy have been administered to about 7 out of every 10 Americans. As a result, medical procedures using radiation have saved thousands of lives through the detection and treatment of conditions ranging from hyperthyroidism to bone cancer[2].

The most common of these medical procedures involve the use of x-rays -a type of radiation that can pass through our skin. When x-rayed, our bones and other structures cast shadows because they are denser than our skin, and those shadows can be detected on photographic film. The effect is similar to placing a pencil behind a piece of paper and holding the pencil and paper in front of a light. The shadow of the pencil is revealed because most light has enough energy to pass through the paper, but the denser pencil stops all the light. The difference is that x-rays are invisible, so we need photographic film to "see" them for us. This allows doctors and dentists to spot broken bones and dental problems.

X-rays and other forms of radiation also have a variety of therapeutic uses. When used in this way, they are most often intended to kill cancerous tissue, reduce the size of a tumor, or reduce pain. For example, radioactive iodine is frequently used to treat thyroid cancer. X-ray machines have also been connected to computers in machines called computerized axial tomography (CAT) or computed tomography (CT) scanners. These instruments provide doctors with color images that show the shapes and details of internal organs. This helps physicians locate and identify tumors, size anomalies, or other physiological or functional organ problems. Doctors administer slightly radioactive substances to patients, which are attracted to certain internal organs such as the pancreas, kidney, thyroid, liver, or brain, to diagnose clinical conditions to treat and monitor ailments.

The use of audio-visuals is one of the methods in teaching and learning that is student centered. Audio-visual materials are materials which do not depend solely upon reading to convey meaning but may present information through the sense of hearing as in audio resources, sight, as in visual resources or through a combination of the senses[2]. This method of teaching helps the students to be able to visualize the learning content, understand the subject matter better and helps them retain what is being taught[3]. Audio-visual add clarity to the topic taught and make learning more interesting. Audio-visual materials are commonly used to refer to those instructional materials that may be used to convey meaning without complete dependence upon verbal symbols or language[3].Thus according to the above description of an audio-visual, a textbook or a reference material does not fall within this grouping of instructional material, a text book or a reference material does not fall within this grouping of instructional materials but an illustration in a book does.

Some audio-visual components are in the nature of process and experience, for example, dramatizing an event and simulation. Some of the audio-visual materials like the motion pictures require the use of specialized equipment to release their latent value. Some do not need equipment at all like an exhibit or a study print. This term designates in common usage both material things as well as processes such as field trips which provide alternative educational opportunities for students, helps students to take a break from their normal routine and experience more hands-on learning. Such visual and practical experience enable students to learn, understand and remember the subject matter throughout their life time. Such trips provide students with the opportunity to visualize, experience and discuss information.

The importance of audio-visual materials in the teaching and learning processes cannot be over emphasized. Some of the roles of audio-visual materials are Basing learning in sense experience, Extending experience, Encouraging participation, Stimulating interest, Individualizes instructions, Serves as a source of information, making learning permanent. Human being learnt more easily and faster by audio-visual processes than by verbal explanations alone as audio-visual materials help in this regard to explain information more coherently and add variety to presentation which makes learning interesting. Audio-visual materials help to engage the students more, thereby increasing their retention level, helps them to ask relevant questions and also independently provide solution to some classroom tasks[4].

Audio-visual materials when effectively used have many advantages among which are the ability to lessen major weaknesses of verbalism, humanize and vitalize subject matter, provide interesting approach to new topics and give initial correct impressions on subject matters; economy of time in learning, supply concrete materials needed, stimulate the initiatives of the students among others, make information more attractive and appealing. Students are able to pick more information through the audio-visual experience, Audio-visual materials help teachers to demonstrate things to students that, otherwise, may not be clearly conveyed. Experienced Science teachers have observed that audio-visual materials help in keeping students focused on the lesson.[5]

It has also been observed that the use of verbal method of teaching radioactivity over the years has made the subject uninteresting, hence the need for effective teaching and learning of the topic to students at this level of education. Teachers still use mainly traditional method of teaching which has led to poor performance of students in radioactivity at the Junior Secondary Schools[6]. Radioactivity like other topics, can be effectively taught by employing various Audio-visual aids that appeal to three senses sight, touch and hearing. Among the numerous possible factors affecting teaching and learning in our schools are the poor teaching strategies[6].

Studies have shown that two (2) out of the five (5) sense organs used for acquiring knowledge are adequately taken care of by the use of audio-visual materials[7]. Therefore, Audio-visual instructional materials have made qualitative and quantitative education more meaningful because they have produced desirable results. However, this topic on radioactivity does not seem to be receiving adequate attention from all concerned, such as from the students, the science teachers, sponsors of education and educational administrators and school managers.

Audio-visual materials have been discovered to facilitate effective communication transfer of information, knowledge skills, attitudes and other useful capabilities. It is however important for teachers to pay attention to instructional aids that will motivate teaching and learning of difficult and abstract school subjects and topics for effectiveness of instructional program. Audio-visual materials could be said to be one of such aids or devices used to disseminate information in the teaching andlearning process, which Basic Science teachers need to use to enhance students'better understanding of scientific topics such as Radioactivity.

Another major challenge is the lack of materials such as quality textbooks on radioactivity to teach students. Over the years, teachers have had to rely on advanced textbooks which did not simplify the subject matter. Teachers use this textbook to disseminate without much feedback from students. Science book authors also did not dwell much on the subject matter, this is due to the fact that they do not have a robust knowledge about the topic[7]. Radioactivity is one of the core topics in atomic chemistry and it requires a lot of study and preparedness to be able to deliver a lesson on this subject matter.

Lack of mastery of the subject matter is another major challenge in teaching Radioactivity. Teachers that do not possess vast knowledge on radioactivity tend to do garbage in, garbage out type of teaching, thereby leaving the students helpless and less interested in the subject matter[8]. In today's 21st-century, students are faced with multiple problems in the field of science education. These problems have decreased their level of interest and also increased poor performance in science subjects. Explanations based on science and technology are likely to offer corrective measures to some of these difficulties. Yet, as we recognize today, science and technology are not accessible to a vast human population. Some of society's persistent problems today are linked to the depletion of natural resources, growing poverty, hunger, and illiteracy in many nations worldwide.

There were several challenges interrelated to the lack of infrastructure and resources for teaching science. Challenges related to learners' background, the language of instruction, and lack of parental support are also present. Having these challenges, learning is negatively affected which should be immediately addressed. The inadequacy of resources could lead to lack of efficiency and productivity among learners. Students in institutions with scarce instruction and learning amenities performed lower, unlike their counterparts in schools with enough facilities[7].

Researchers worldwide have observed a widespread collection of issues and problems in education faced by students today. The quick advancement in science and technology, newly recognized societal and cultural norms and values, and changes in the climate and environment, as well as the depletion of natural resources all significantly impact the lives of children and youths, and hence their ways of learning, viewing the world, experiencing phenomena around them and interacting with others[8].

These changes challenge science educators to rethink the epistemology and pedagogy in science classrooms today as the practice of science education needs to be proactive and relevant to students and prepare them for life in the present and in the future. Some of the challenges encountered in the field of science education include the unavailability of classroom resources, appropriate textbooks and the preparation and training of science teachers the requirement to meet standard and to formulate students for standardized examinations, and the dramatically increasing information using the internet as a source[9].

It is tremendously important to understand, recognize, and build upon the abilities of adolescent learners, while at the same time tailoring instruction to address the exclusive challenges faced by this age group[10]. The significant place occupied these subjects in the school curricula is a role out of Science and Technology in scientific and technological development, as a required condition or requirement in national building. However, the teaching of these relevant subjects is bound by problems; such as the problem of inadequate and substandard learning materials, culture/belief, class size, students' general attitudes, and poor reading habit.

Science education at all levels of schooling is consistently seen as abstract and irrelevant to real-life situation. Students in biology and chemistry are burdened with memorization of truths, and students in physics and mathematics feel that their discipline contents are abstract and cannot relate these materials to the real world. Students in all-purpose fail to see that science is in nature all around them, and the scientific method is widely applied in different aspects of their lives.

Students' poor attitude and interest towards school science is an issue identified across the world[10]. In some instances, students' lack of interest in science is associated with the use of science to select a small fraction of elite students at the early ages to become science specialists in Ibadan. Students' lack of interest in science may also be attributed to scarcity of well-paid jobs for science professionals, less practical nature of science teaching and learning, higher demands of students' time in learning science, emotional difficulties, difficulty in concentrating, the abstract nature of science subjects, lack of proper explanation of complex concepts on the part of teachers and also requires a lot effort, skill and perseverance from the students for effective learning to take place.[11]

Students' lack of interest in science is anchored on the time consuming and less practical nature of learning school science as well as the learning of science which is basically knowledge transfer from science teachers and textbooks, Students lack of interest in science could also be attributed to perceived lack of relevance of science topics such as chemical equations and bonding for career aspirations later in life. Science teachers' decisions about instructional practices such as procedures for assessment, grouping of students, and the types of rewards and punishments are crucial to influence and increase students' interest and attitude in pursuing any science related subject or course in the future[12].

It is therefore recommended that teachers should inculcate in students the interest and adequate knowledge of the contribution of school science to the development and technological advancement of the society they live in. Students hold different conceptions that might need to change is one thing: concluding that it is the teacher's responsibility to engage in teaching practices that might facilitate conceptual change to occur is a separate matter. It is therefore the responsibility of teachers to identify students' conceptions and to instruct them in ways that will facilitate conceptual change.

Teachers should not compel students to surrender their alternative conceptions but adopt appropriate instructional strategies that will offer students' alternative conceptions the opportunity to equally compete with teachers' or scientific conceptions for acceptance. This can be achieved when science teachers encourage students to challenge any information presented to them and to discuss the information with respect to its personal advantages. In addition, to make science education effective teachers need to transform how students think to assist them to make meaning and apply scientific knowledge as scientists do. This transformation can be done if only science teachers can instruct science like a science.

It must further be noted that students' pre-representations, which are assembly of ideas and images students use to solve problems can be more or less accurate. It is expected of science teachers to discover and confront such representations to confirm or contradict them. This will help teachers to build new scientific knowledge in class. Teachers are intimidated by the challenge of learning new instructional strategies and therefore resist any change in their respective instructions[11]. Science education is for teachers to develop a mindset that their instruction should be deployed in a similar way with all the rigor and standard as scientists conduct scientific research.

Consequently, science teachers are expected to create an environment conducive for students' active questioning and identification of issues and answers by employing appropriate instructional strategies. These instructional strategies will motivate the students to find the scientific concept interesting and widen their horizon. Instructional strategies such as the use of audio-visuals to stimulate learning and understanding of the concept on radioactivity in Basic Science at Junior secondary school level will not only help the students understand the topic on radioactivity better but will also erase the school of thought that science-based topics are vague and abstract in nature[11].

1.2 Statement of the problem

Over the years, the topic on radioactivity is seen as vague and as a result of this development, students are being faced with challenges of inability to comprehend the topic which has in turn led to lack of interest on the subject matter. Radioactivity is been seen by students as uninteresting, ambiguous and not relatable. Basic Science teachers have also found this topic very challenging due to lack of mastery of the subject matter which has led to poor delivery of the topic to the students. Another major challenge is the lack of instructional materials such as audio-visual aids in teaching radioactivity in schools which has also contributed to the ambiguity of the subject matter thereby making the topic on radioactivity incomprehensible to students. It has also been observed that the use of verbalization method of teaching radioactivity over the years has made the topic uninteresting and has led to poor students` achievement in the topic on radioactivity in Junior Secondary Schools. Among the numerous possible factors that can be responsible for unproductive outcome of teaching and learning in our schools are the ineffective teaching strategies. Also, lack of adequate and appropriate audio-visual materials essentially for the effective teaching and learning of radioactivity could be responsible for this dearth in productive teaching and learning of radioactivity topic at the Junior Secondary School level. It is against this background that this study investigate the Effects of Audio-visual Intervention on Basic Science Students' Academic Achievement in Radioactivity at the Junior Secondary Schools in Ibadan Metropolis.

1.3 Aim and objectives of the study

The aim of this study is to investigate the effects of audio-visual intervention on Basic Science students' academic achievement in radioactivity at the junior secondary schools in Ibadan Metropolis.

Specifically, the objectives of this study are to:

i. determine the academic achievement of students in the pre-test and post-test based on gender and school type at Junior secondary schools in Ibadan Metropolis

ii. investigate effect of audio-visual intervention on students' achievement when taught radioactivity in Basic science at the Junior Secondary School in Ibadan metropolis based on gender, and:

iii. investigate effect of audio-visual intervention on students' achievement when taught radioactivity in Basic science at Junior Secondary Schools based on school type.

1.4 Research Questions

1. What is the academic achievement of students in the pre-test and post-test based on gender and school type at Junior Secondary schools in Ibadan metropolis?

1.5 Hypotheses

$H0_1$: There will be no significant effect of audio-visual intervention on Basic Science Students' academic achievement in radioactivity at Junior secondary school in Ibadan metropolis.

$H0_2$: There will be no significant effect of audio-visual intervention on students' achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on gender

$H0_3$: There will be no significant effect of audio-visual intervention on students' achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on school type.

1.6 Significance of the study

The study will invariably be of tremendous importance to students, teachers and researchers in Basic Science accordingly.

This research work will enable students read and understand the concept of radioactivity rather than viewing it as an ambiguous topic using various audio-visual aids that facilitate teaching learning process, particularly video show.

The Study will serve as reference to teachers who wish to find out the impact of audio-visual aids (video-show) on students' academic achievement particularly in junior secondary schools. It will also highlight the appropriate materials of teaching radioactivity in Basic science which will spur student's interest and active participation in the topic and in Basic science as a whole.

This research work will enable the teachers to understand that the success of any teaching- learning activities is determined by how much the students are able to learn or gain from teaching whichcan be achieved through the appropriate use of audio-visual aids.

The study will serve as a reference to researchers who wish to embark on further research on effects of audio-visual aids in teaching radioactivity in Basic science. This work will also enable researcher to understand the impact of comprehension, demonstration and co-operation in the use of audio-visual aids in teaching-learning process.

Policy makers such as governmental agencies at the helm of affairs will see this work in order to establish substantial policies that would help in the teaching of radioactivity in Basic Science.

1.7 Scope of the study

The study covers teaching of radioactivity at Junior secondary schools in Ibadan metropolis, Nigeria.

The subject scope for the study is on teaching radioactivity in Basic Science using the audio-visual intervention.

1.8 Operational Definition of Terms

Audio materials: These are materials such as recorded sounds like YouTube videos and the voice of the researcher in administering the instrument.

Visual materials: These are materials such as YouTube videos and charts that are used in the administration of instrument.

Audio-visuals: These are materials such as recorded sound, YouTube videos used to convey information

Radioactivity: The disintegration of radioactive elements such as atoms.

School type: These are private and public Secondary Schools used in the study.

Gender: This comprises of male and female students used in the study.

Academic Achievement: These are scores obtained during the pre and post intervention during the study.

Basic Science: One of the core Science subjects that teaches students the introductory part of scientific topics.

Endnotes

1. http://www.iaea.org/Publications/Factsheets/English/radlife.html

2. V.W. Dike. Library Resources in Education, 2016.

3. I. Anzaku. *Library Experts Speaks on Audio-Visual Material. A paper presented at the United Nations Educational, Scientific and Cultured Organization (UNESCO) World Day for Audio-Visual Heritage*. Lafia, 2017

4. E.U. Eze. *Effect of Instructional Materials on the Academic Performance of Junior Secondary School Students in Social Studies, Unpublished PGDE Thesis*, Imo State University-Nigeria, 2015

5. I. Oketunji & I. K. Nwalo. *Application for Information Technologies in Nigerian Libraries: Problems and Prospects in Information Technology in Library and Information Technology Education in Nigeria. National Association of Library and Information Science*2015

6. Y. Suleiman. *International Journal of Mathematical Studies in Mathematics*,6(1), 2019;19-33

7. K. Kaptan, & O. Timurlen. *Challenges for Science Education. Procedia - Social and Behavioral Sciences,* 51,2016; 763–771.

8. K.C.D. Tan, & M. Kim, *Issues and Challenges in Science Education Research*, 1-4. https://doi.org/10.1007/9 78-94-007-3980-2 2012

9. E.M Anderman, G.M Sinatra, & D.L Gray, *The challenges of teaching and learning about science in the twenty-first century: Exploring the abilities and constraints of adolescent learners. Studies in Science Education*, 48(1), 2015;89-117.

10. A.M. Hassan, *Functional science and technology education tool for national economic empowerment and development. A Journal of Science, Technology and Mathematics Education*, 1(1), 2016;46-51.

11. J.E. Idiaghe. *Relationship between educational facilities, teachers' qualifications, school location and academic performance in secondary schools in the Delta State (Doctoral dissertation).* Delta State University 2014.

12. K, Adu-Gyamfi. *Journal Article on Problems of Education in the 21st Century,* Vol 53, 2013;7-21.

Chapter Two

Review of Literature

This chapter reviewed materials and other works related to the use of audio-visual aids and they were presented in the chapter under the following sub-headings:

2.1 Conceptual Review

2.1.1 Concept of Radioactivity at Junior Secondary Schools

2.1.2Historical Perspective

2.1.3 Types of Ionizing Radiation

2.1.4Importance of Radioactivity in the 21^{st} Century

2.1.4.1Ultraviolet Rays and the skin

2.1.5 Audio-visual Aids

2.1.5.1 Concept of Audio-visual Aids

2.1.5.2 Qualities of Audio-visual Aids

2.1.5.3 Selection Criterion for Audio-Visual Aids

2.1.5.4 Kinds of Audio-Visual Aids

2.1.5.5 Visual Aids

2.1.5.6 Audio Aids

2.1.5.7 Audio-Visual Aids

2.1.5.8 Action aids

2.1 Conceptual Review

Learning is a mind-boggling process. It is a moderately perpetual change in conduct after some time and this is achieved halfway by information. Learning can occur as a result ofachieved abilities, standards, recognition, learning, certainties, and new data.Learning can be strengthened with various educating assets since they invigorate for some time amid the instructional methods. Audio-visual aids stir the enthusiasm of students and help the instructors to clarify the ideas effectively. Audio-visual aids are those instructional aids which are utilized in the classroom to energize showing learning process[1].

2.1.1 Concept of Radioactivity

Radioactivity is exhibited by certain types of matter of emitting energy and atomic particles spontaneously. An unstable nucleus will decompose spontaneously, or decay, into a more stable configuration but will do so only in a few specific ways by emitting certain radioactive particles. Radioactive decay is a property of several naturally occurring elements as well as of artificially produced isotopes of the elements. The rate at which a radioactive element decays is expressed in terms of its half-life i.e., the time required for one-half of any given quantity of the isotope to decay. Half-lives range from more than 10^{24} years for some nuclei to less than 10^{-23} second. The product of a radioactive decay process—called the daughter of the parent isotope may itself be unstable, in which case it, too, will decay. The process continues until a stable nuclide has been formed[2].

Radiation is a form of energy which travels from a source as waves or as energized particles. At the lower end of the radiation spectrum we find radio waves and microwaves, which are generally considered harmless (Figure 1). Sunlight consists of radiation from long wavelength infrared to short wavelength ultraviolet. Beyond the ultraviolet range, the types of radiation we find have so much energy that they can knock electrons out of atoms, in a process known as ionization. We all experience low doses of ionizing radiation from space, from the air and from rocks and earth around us. When appropriately harnessed, ionizing radiation also has a number of useful applications in medicine, which can increase our exposure. However, in affecting the atoms of living things, this form of radiation poses a health risk, through potential damage to tissue, genes and DNA. Controlled exposure and the risk/benefit equation must therefore always be at the forefront of clinical decision-making.[3]

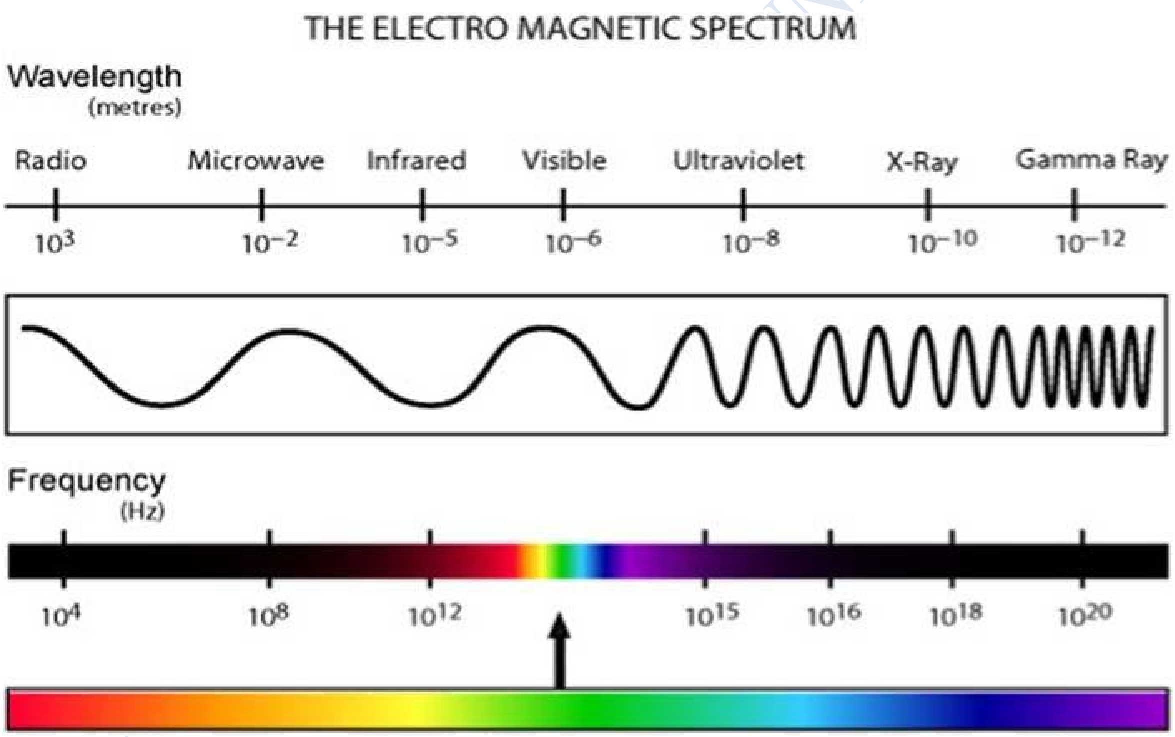

Figure 1: The Electro Magnetic Spectrum

Source: www.wikipedia.com

2.1.2 Historical Perspective

The invention of the x-ray was a transformative moment in the history of medicine, for the first time making the inner workings of the body visible without a need to cut into the flesh.[4] Roentgen, a Professor of Physics in Wu¨rzburg in Germany, was at the time experimenting with electrical currents through cathode ray tubes (Figure 2). Although the glass tube he was using was covered in thick black cardboard, and the room was completely dark, Roentgen noticed that a nearby screen, covered in barium platinocyanide (a fluorescent material), became illuminated.

He quickly realized that this was due to radiation being emitted from his experimental apparatus. Furthermore, a number of different objects could be penetrated by this radiation, and a projected image of his hand on the screen showed a contrast between opaque bones and translucent flesh. One week after his initial discovery, Roentgen replaced the screen with a photographic plate, and x-ray imaging was born.3

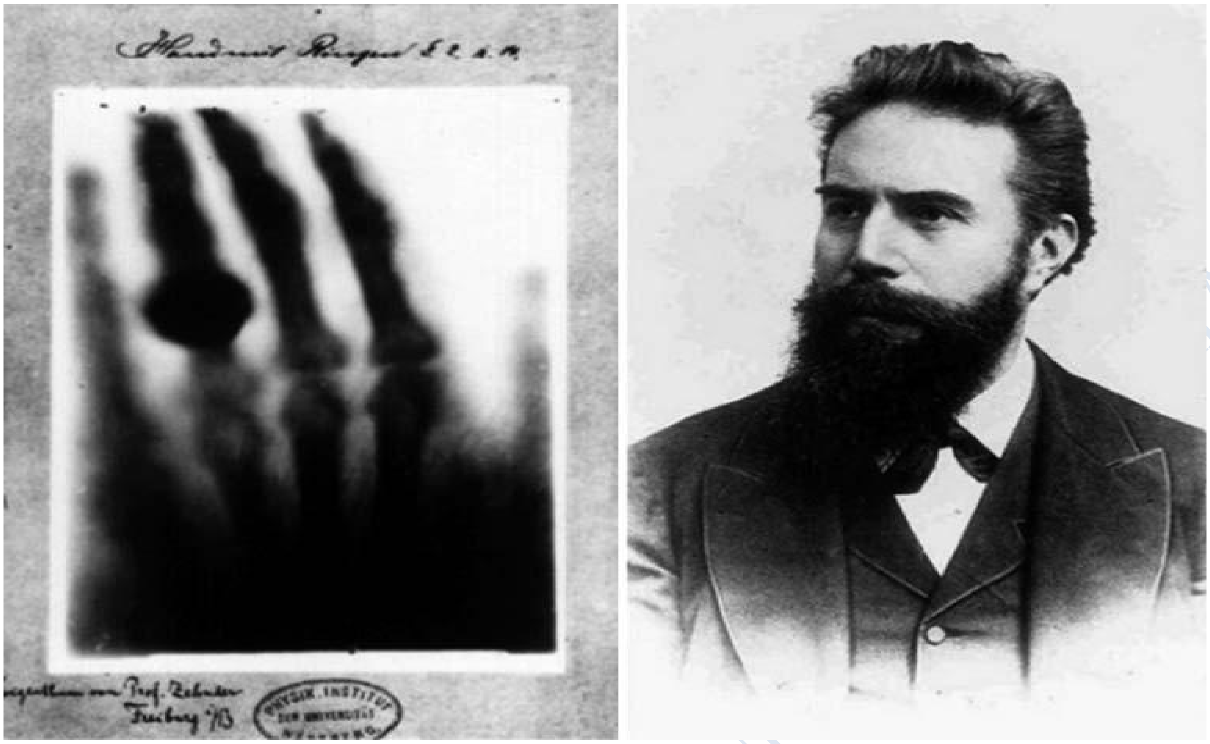

Figure 2: Roentgen's discovery of X-ray

Source: www.aps.org

Roentgen began lecturing on his invention and a few weeks later an X-ray was used in Canada to find a bullet in a patient's leg. Within a year, the world's first Radiology Department was set up at Glasgow Royal Infirmary, and quickly produced images of kidney stones and of a penny lodged in a child's throat. Shortly after, an American physiologist used a similar system to actively trace food going through the digestive system. During the 20 years following Roentgen's discovery, x-rays gained increasing popularity, both as a fairground curiosity and as a powerful diagnostic tool in the medical setting. Their use in the treatment of wounded soldiers in the Boer War and World War 1 cemented the use of X-rays (Figure 2).

Roentgen was awarded the very first Nobel Prize for Physics for his discovery Around the same time as Roentgen's work, scientists like Henri Becquerel and Marie and Pierre Curie were among the first to discover natural radiation, whilst investigating the properties of fluorescent minerals. When storing some such minerals (a uranium compound) in a drawer with photographic plates, Becquerel noticed that the latter became exposed, and concluded that this must be due to a type of highly penetrative radiation being given off by the mineral itself.4 As scientists began to look at this phenomenon more closely, they discovered that radioactive atoms are naturally unstable, and that in order to become stable, they emit particles and/or energy, in a process known as radioactive decay. Polonium and radium were discovered by the Curies over this period. Radium would become particularly important as a source for gamma rays, first extensively used in industrial radiography during the US Navy's ship-building program in World War 2. Cobalt and iridium were developed as man-made sources of gamma radiation for industry. Since these were cheaper to produce and more powerful than radium, they quickly replaced it in all industrial applications.[5]

The widespread and unrestrained use of x-rays and other radiation technologies in their early years inevitably led to serious injuries. It took time to establish a direct link between radiation exposure and such injuries however, due to the slow onset of many conditions, and to a lack of understanding. Thomas Edison, Nikola Tesla and William J Morton all reported eye irritation as a common symptom from their experimentation with x-rays and fluorescent materials, but it would be many years before the science of radiation protection, or 'Health Physics' as it is known today, properly took hold.[6]

2.1.3 Types of Ionizing Radiation

The major types of ionizing radiation emitted during radioactive decay are alpha particles, beta particles and gamma rays . Other types, such as x-rays, can be both naturally occurring, or machine-produced.

Alpha particles

Alpha particles gained particular notoriety during the early days of particle physics, when they were used to bombard a variety of targets. One of the most celebrated experiments of this kind was Figure 2. Wilhelm Roentgen (the first person to discover the potential for using electromagnetic radiation to create X-ray images) (right). The X-ray of his wife's hand with a wedding ring, first ever captured X-ray on a photographic plateconducted by Earnest Rutherford leading to the discovery of the atom's structure. Consisting of two protons and two neutrons, Alpha particles are relatively large in atomic terms. They are generally emitted from the decay of only the heaviest radioactive nuclei, such as uranium, actinium and radium. Although very energetic, and high in ionizing properties, the weight and size of alpha particles means they lose their energy over relatively short distances, and can easily be stopped by a layer of paper or human skin. As such, 'external' bodily exposure to alpha radiation carries little risk to health. However, if somehow inhaled or ingested, alpha particles can cause highly focused ionization, releasing all their energy just across a few cells and causing severe damage at both cellular and genetic level. This makes alpha particles possibly the most dangerous form of radiation.[8,9]

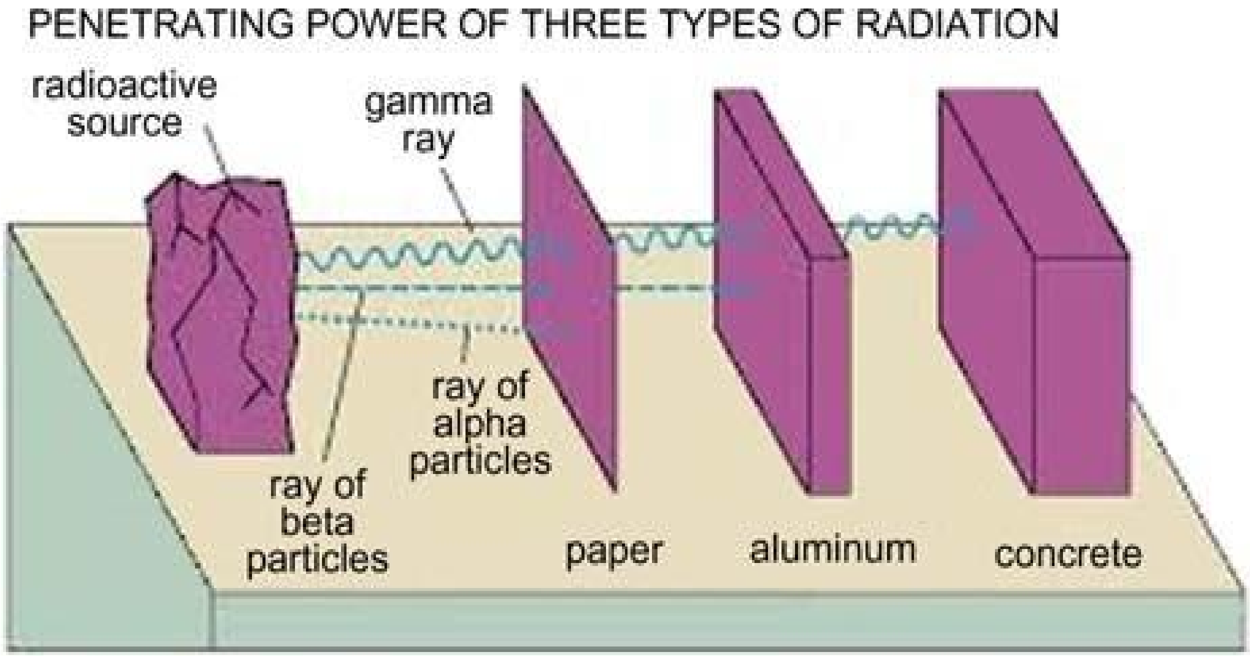

Figure 3: Penetrating power of three types of radiation

Source: pinterest.com

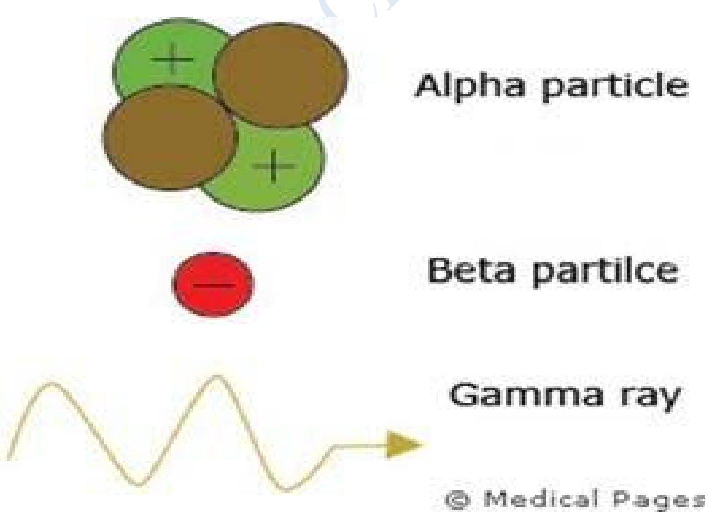

Figure 4: diagram of radioactive elements

Source: www.sciencedirect.com

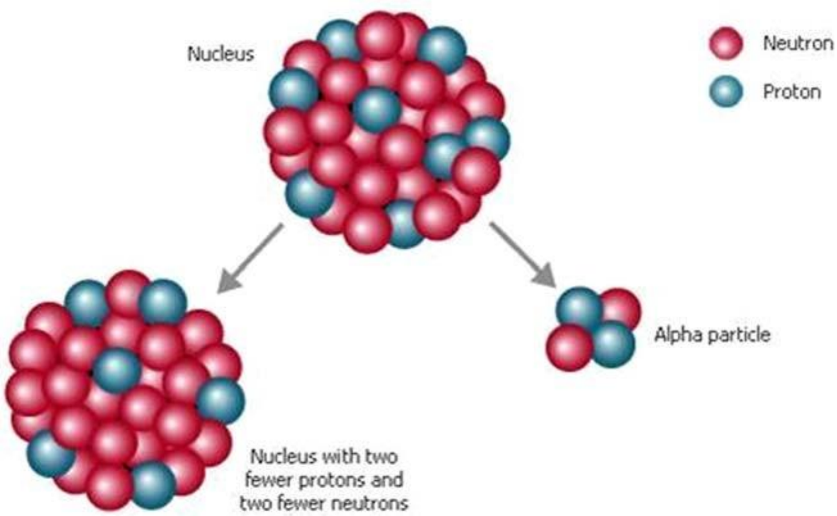

Figure 5: Radioactive decay

Source: www.wikipedia.com

Beta particles Beta particles are small, fast moving, negatively charged electron-like particles, emitted from an atom's nucleus during radioactive decay (Figure 6). Beta particle emission occurs when the ratio of neutrons to protons in an atom's nucleus is too high. In such cases, the excess neutrons transform into a proton and an electron. The proton remains in the nucleus whilst the electron is ejected with high energy. Common emitters of beta particles include carbon-14 and strontium-90. Beta particles are more penetrating than alpha ones, but cause less damage due to their ionization being spaced over a larger area. They can travel further in air, but are easily stopped by a layer of clothing or a thin sheet of aluminum. Some beta particles are capable of penetrating the skin and causing a degree of skin burn, but on the whole, as with alpha particles, ingestion or inhalation remains the principal cause for concern.[10]

Gamma rays

Gamma rays, emitted both in radioactive decay and nuclear explosions, have the smallest wavelength and the greatest energy of any waves known in the electromagnetic spectrum (Figure 7).

Unlike alpha and beta particles, which have both energy and mass, gamma rays are just pure energy.[11]

The penetrative power of gamma rays is such that several inches of a material such as lead, or several feet of concrete are required as a barrier to stop them. Gamma rays can pass through the whole human body easily, potentially causing severe damage to tissue and DNA. However, their power to kill cells has been successfully harnessed and focused by medical science, in the form of radiation therapy for cancer.[12]

Figure 6: Gamma decay

Source: google sites

X-rays Due to their widespread use in the clinical setting, x-rays are familiar to almost everyone. Like gamma rays, x-rays are photons of pure energy, but they are generally less penetrating, due to their lower energy. They share many basic properties, but are emitted from different parts of the atom; gamma rays from within the nucleus, and x-rays from outside. X-rays occur naturally, but can also be produced by machines, using electricity, many millions of x-ray machines are in daily use around the world, ranging from medical (x-ray and CT scans), used to make detailed images of bones and soft tissue in the body, to airport security screening and industrial inspection and process controls. Medical diagnostic radiology, based on x-rays, is the single largest source of man-made radiation exposure.[13]

2.1.4. Importance of Radioactivity in the 21st Century

Industrial tracers such as radioisotopes are used by manufacturers as tracers to monitor fluid flow and filtration, detect leaks, and gauge engine wear and corrosion of process equipment. Small concentrations of short-lived isotopes can be detected whilst no residues remain in the environment. By adding small amounts of radioactive substances to materials used in various processes it is possible to study the mixing and flow rates of a wide range of materials, including liquids, powders, and gases and to locate leaks.

Radiotracers are used widely in industry to investigate processes and highlight the causes of inefficiency. They are particularly useful where process optimization can bring material benefits, such as in the transport of sediments. Radiotracers are also used in the oil and gas industry to help determine the extent of oil fields. In terms of inspection, radioactive materials are used to inspect metal parts and the integrity of welds across a range of industries. Industrial gamma radiography exploits the ability of various types of radiation to penetrate materials to different extents.

Gamma radiography works in much the same way as X-rays screen luggage at airports. Instead of the bulky machine needed to produce X-rays, all that is needed to produce effective gamma rays is a small pellet of radioactive material in a sealed titanium capsule. The capsule is placed on one side of the object being screened, and photographic film is placed on the other side. The gamma rays, like X-rays, pass through the object and create an image on the film. Just as X-rays show a break in a bone, gamma rays show flaws in metal castings or welded joints. The technique allows critical components to be inspected for internal defects without damage.

X-ray sets can be used when electric power is available and the object to be scanned can be taken to the X-ray source and radiographed. Radioisotopes have the supreme advantage that they can be taken to the site when an examination is required – and no power is needed. However, they cannot be simply turned off, and so must be properly shielded both when in use and at other times. The process of gamma radiography, a type of non-destructive testing (NDT), is used to validate the integrity of poured concrete and welds on fluid vessels, pipelines, or critical structural elements.

The unique characteristics of gamma radiography have resulted in the technique becoming a crucial tool throughout many industries. For example, to inspect new oil or gas pipelines, special film is taped over the weld around the outside of the pipe. A machine called a 'pipe crawler' carries a shielded radioactive source down the inside of the pipe to the position of the weld. There, the radioactive source is remotely exposed and a radiographic image of the weld is produced on the film. This film is later developed and examined for signs of flaws in the weld.

Gamma radiography has found use outside of core industrial applications, with the technique successfully employed following the devastating earthquake in Nepal in April 2015. NDT was used to test the integrity of critical buildings such as schools and hospitals, as well as historical attractions. Some technological advanced countries in the world have since backed an IAEA initiative to use NDT for the inspection of civil structures more widely following natural disasters.

Although scientists have only known about radiation many centuries ago, they have developed a wide variety of uses for this natural force. Today, to benefit humankind, radiation is used in medicine, academics, and industry, as well as for generating electricity. In addition, radiation has useful applications in such areas as agriculture, archaeology such as carbon dating, space exploration, law enforcement, geology which includes mining, and many others.

In the medical world, hospitals, doctors, and dentists use a variety of nuclear materials and procedures to diagnose, monitor, and treat a wide assortment of metabolic processes and medical conditions in humans. In fact, diagnostic x-rays or radiation therapy have been administered to about 7 out of every 10 Americans. As a result, medical procedures using radiation have saved thousands of lives through the detection and treatment of conditions ranging from hyperthyroidism to bone cancer.

The most common of these medical procedures involve the use of x-rays -a type of radiation that can pass through our skin. When x-rayed, our bones and other structures cast shadows because they are denser than our skin, and those shadows can be detected on photographic film. The effect is similar to placing a pencil behind a piece of paper and holding the pencil and paper in front of a light. The shadow of the pencil is revealed because most light has enough energy to pass through the paper, but the denser pencil stops all the light. The difference is that x-rays are invisible, so we need photographic film to "see" them for us. This allows doctors and dentists to spot broken bones and dental problems.

X-rays and other forms of radiation also have a variety of therapeutic uses. When used in this way, they are most often intended to kill cancerous tissue, reduce the size of a tumor, or reduce pain. For example, radioactive iodine is frequently used to treat thyroid cancer. X-ray machines have also been connected to computers in machines called computerized axial tomography (CAT) or computed tomography (CT) scanners. These instruments provide doctors with color images that show the shapes and details of internal organs. This helps physicians locate and identify tumors, size anomalies, or other physiological or functional organ problems. Doctors administer slightly radioactive substances to patients, which are attracted to certain internal organs such as the pancreas, kidney, thyroid, liver, or brain, to diagnose clinical conditions.

In the academic sector, universities, colleges, high schools, and other academic and scientific institutions use nuclear materials in course work, laboratory demonstrations, experimental research, and a variety of health application. For example, just as doctors can label substances inside people's bodies, scientists can label substances that passed through plants, animals, or our world. This allows researchers to study such things as the paths that different types of air and water pollution take through the environment. Similarly, radiation has helped us learn more about the types of soil that different plants need to grow, the sizes of newly discovered oil fields, and the tracks of ocean currents. In addition, researchers use low-energy radioactive sources in gas chromatography to identify the components of petroleum products, smog and cigarette smoke, and even complex proteins and enzymes used in medical research.

Archaeologists also use radioactive substances to determine the ages of fossils and other objects through a process called carbon dating. For example, in the upper levels of our atmosphere, cosmic rays strike nitrogen atoms and form a naturally radioactive isotope called carbon-14. Carbon is found in all living things, and a small percentage of this is carbon-14. When a plant or animal dies, it no longer takes in new carbon and the carbon-14 that it accumulated throughout its life begins the process of radioactive decay. As a result, after a few years, an old object has a lower percent of radioactivity than a newer object. By measuring this difference, archaeologists are able to determine the object's approximate age.

In the industrial world, we could talk all day about the many and varied uses of radiation in industry and not complete the list, but a few examples illustrate the point. In irradiation, for instance, foods, medical equipment, and other substances are exposed to certain types of radiation such as x-rays to kill germs without harming the substance that is being disinfected and without making it radioactive. When treated in this manner, foods take much longer to spoil, and medical equipment such as bandages, hypodermic syringes, and surgical instruments are sterilized without being exposed to toxic chemicals or extreme heat. As a result, where we now use chlorine, a chemical that is toxic and difficult-to-handle, we may someday use radiation to disinfect our drinking water and kill the germs in our sewage. In fact, ultraviolet light which is a form of radiation is already used to disinfect drinking water in some homes.

Similarly, radiation is used to help remove toxic pollutants, such as exhaust gases from coal-fired power stations and industry. For example, electron beam radiation can remove dangerous sulphur dioxides and nitrogen oxides from our environment. Closer to home, many of the fabrics used to make our clothing have been irradiated (treated with radiation) before being exposed to a soil-releasing or wrinkle-resistant chemical. This treatment makes the chemicals bind to the fabric, to keep our clothing fresh and wrinkle-free all day, yet our clothing does not become radioactive. Similarly, nonstick cookware is treated with gamma rays to keep food from sticking to the metal surface.

The agricultural industry makes use of radiation to improve food production and packaging. Plant seeds, for example, have been exposed to radiation to bring about new and better types of plants. Besides making plants stronger, radiation can be used to control insect populations, thereby decreasing the use of dangerous pesticides. Radioactive material is also used in gauges that measure the thickness of eggshells to screen out thin, breakable eggs before they are packaged in egg cartons. In addition, many of our foods are packaged in polyethylene shrink wrap that has been irradiated so that it can be heated above its usual melting point and wrapped around the foods to provide an airtight protective covering.

All around us, we see reflective signs that have been treated with radioactive tritium and phosphorescent paint. Ionizing smoke detectors, using a tiny bit of americium-241, keep watch while we sleep. Gauges containing radioisotopes measure the amount of air whipped into our ice cream, while others prevent spillover as our soda bottles are carefully filled at the factory. Engineers also use gauges containing radioactive substances to measure the thickness of paper products, fluid levels in oil and chemical tanks, and the moisture and density of soils and material at construction sites. They also use an x-ray process, called radiography, to find otherwise imperceptible defects in metallic castings and welds.

Radiography is also used to check the flow of oil in sealed engines and the rate and way that various materials wear out. Well-logging devices use a radioactive source and detection equipment to identify and record formations deep within a bore hole (or well) for oil, gas, mineral, groundwater, or geological exploration. Radioactive materials also power our dreams of outer space, as they fuel our spacecraft and supply electricity to satellites that are sent on missions to the outermost regions of our solar system.

In Nuclear Power plants, electricity produced by nuclear fission splitting the atom is one of the greatest uses of radiation. As our country becomes a nation of electricity users, we need a reliable, abundant, clean, and affordable source of electricity. We depend on it to give us light, to help us groom and feed ourselves, to keep our homes and businesses running, and to power the many machines we use. As a result, we use about one-third of our energy resources to produce electricity.

Electricity can be produced in many ways — using generators powered by the sun, wind, water, coal, oil, gas, or nuclear fission. In America, nuclear power plants are the second largest source of electricity (after coal-fired plants) — producing approximately 21 percent of our Nation's electricity.

The purpose of a nuclear power plant is to boil water to produce steam to power a generator *to* produce electricity. While nuclear power plants have many similarities to other types of plants that generate electricity, there are some significant differences. With the exception of solar, wind, and hydroelectric plants, power plants (including those that use nuclear fission) boil water to produce steam that spins the propeller-like blades of a turbine that turns the shaft of a generator. Inside the generator, coils of wire and magnetic fields interact to create electricity. In these plants, the energy needed to boil water into steam is produced either by burning coal, oil, or gas (fossil fuels) in a furnace, or by splitting atoms of uranium in a nuclear power plant. Nothing is burned or exploded in a nuclear power plant. Rather, the uranium fuel generates heat through a process called fission.

Nuclear power plants are fueled by uranium, which emits radioactive substances. Most of these substances are trapped in uranium fuel pellets or in sealed metal fuel rods. However, small amounts of these radioactive substances (mostly gases) become mixed with the water that is used to cool the reactor. Other impurities in the water are also made radioactive as they pass through the reactor. The water that passes through a reactor is processed and filtered to remove these radioactive impurities before being returned to the environment. Nonetheless, minute quantities of radioactive gases and liquids are ultimately released to the environment under controlled and monitored conditions.

2.1.4.1UltraViolet Rays and the skin

Comprising roughly 16% of body mass, the skin is the largest organ of the body. Skin is organized into two primary layers, epidermis and dermis, which together are made up of epithelial, mesenchymal, glandular and neurovascular components. The epidermis, of ectodermal origin, is the outermost layer and serves as the body's point of contact with the environment. As such, epidermal biological and physical characteristics play an enormous role in resistance to environmental stressors such as infectious pathogens, chemical agents and UV[14]. Keratinocytes are the most abundant cells in the epidermis and are characterized by their expression of cytokeratins and formation of desmosomes and tight junctions with each other to form an effective physicochemical barrier. The dermis, derived from mesoderm, underlies the epidermis and harbors cutaneous structures including hair follicles, nerves, sebaceous glands and sweat glands.

The dermis also contains abundant immune cells and fibroblasts, which actively participate in many physiologic responses in the skin. The epidermis, demarcated from the dermis by a basement membrane, is organized into functional layers defined largely by keratinocyte characteristics such as size, shape, nucleation and keratin expression [15]. Nascent epidermal keratinocytes formed as a result of cell division by keratinocyte stem cells in the stratum basale undergo a programmed differentiation as they migrate outward toward the surface of the skin to eventually form corneocytes, which are tightly-linked dead but intact cells that form the principle barrier of the outermost epidermal layer [16]. Besides the creation of a highly effective physical barrier, keratinocytes also accumulate melanin pigments as they mature, and epidermal melanin functions to potently block UV penetration into the skin. Although melanin may be found in abundance in epidermal keratinocytes, it is not manufactured in these cells. Rather, melanin synthesis is restricted to melanocytes, which are derived from neural crest and are the second most abundant cell in the epidermis [17]. In fact, melanocytes can be found both in the dermis and epidermis.

Epidermal melanocytes are generally positioned in the basal layer above the basement membrane. Melanocytes are also found in hair follicles to impart pigment to nascent hair[18]. Dermal melanocytes can be found in nevi (moles). Because melanocytes are the only source of pigment in the skin, inherited pigmentary defects such as albinism tend to be caused by melanocytic genetic defects [19]. Through dendritic extensions, melanocytes may be in intimate contact with as many as fifty neighboring keratinocytes in what is known as an ―epidermal melanin unit‖[20]. There are many contact-dependent and paracrine interactions that occur between keratinocytes and melanocytes in the epidermal melanin unit. Pigment made by melanocytes is transferred to adjacent keratinocytes in cellular organelles termed melanosomes by way of melanocytic dendrites[21]. In fact, most of the melanin in the skin is found in keratinocytes where it accumulates to function as a ―natural sunscreen‖ to protect the skin against incoming UV photons. Besides blocking UV penetration into the skin, melanin may have many other important physiologic effects including regulatory influences over epidermal homeostasis, free radical scavenging to protect against oxidative injury, and possibly even antimicrobial activity [22].

Melanin

The amount and type of epidermal melanin is the main factor that determines skin complexion and UV sensitivity. Melanin is a large bio-aggregate composed of subunits of different pigment species formed by oxidation and cyclization of the amino acid tyrosine[24]. Intriguingly, the intermediates of melanogenesis may have important regulatory roles in the skin [25]. Melanin exists in two main chemical forms: eumelanin, a dark pigment expressed abundantly in the skin of heavily pigmented individuals, and pheomelanin, a light-colored sulfated pigment resulting from incorporation of cysteines into melanin precursors [26]. Eumelanin is much more efficient at blocking UV photons than pheomelanin, thus the more eumelanin in the skin, the less UV-permeable is the epidermis [27]. Fair-skinned people who are almost always UV-sensitive and have high risk of skin cancer have little epidermal eumelanin and therefore ―realize‖ much more UV than darker-skinned individuals. Therefore, the fairer the skin, the more damaging UV exposure will be. In fact, pheomelanin levels are similar between dark-skinned and light-skinned individuals, and it is the amount of epidermal eumelanin that determines skin complexion, UV sensitivity and cancer risk. Data suggest that pheomelanin may promote oxidative DNA injury and melanomagenesis by generating free radicals in melanocytes even in the absence of UV [28].

Skin Pigmentation Skin complexion is among the most important determinants of UV sensitivity and skin cancer risk. The ―Fitzpatrick Scale‖ is a semi-quantitative scale made up of six phototypes that describe skin color by basal complexion, melanin level, inflammatory response to UV and cancer risk [29]. Minimal erythematous dose (MED) is a quantitative method to report the amount of UV (particularly UVB) needed to induce sunburn in the skin 24 to 48 hours after exposure by determining erythema (redness) and edema (swelling) as endpoints. The fairer the skin, the easier it is for UV to cause inflammation (sunburn). MED, therefore is highest in dark-skinned persons since more UV radiation is needed to ―burn‖ eumelanin-rich skin [30]. In contrast, fair-skinned people whose skin expresses predominantly pheomelanin have low MEDs. Low Fitzpatrick phototype correlates with both MED and with melanoma and other skin cancer risk

Ultraviolet Radiation (UV) is Abundant in the environment, UV contributes to a variety of skin maladies including inflammation, degenerative aging and cancer [32]. Historically, humans have been exposed to UV radiation mainly through occupational exposure to sunlight. Recreational UV exposure, however, has increased dramatically in recent years because of outdoor leisure activities and to purposely tan for cosmetic purposes [33]. Being a component of the electromagnetic spectrum, UV photons fall between the wavelengths of visible light and gamma radiation. UV energy can be subdivided into UV-A, -B and -C components based on electro physical properties, with UV-C photons having the shortest wavelengths (100–280 nm) and highest energy, UV-A having the longest (315–400 nm) but least energetic photons and UV-B falling in between . Each component of UV can exert a variety of effects on cells, tissues and molecules.

Ambient UV exposure varies geographically according to intensity of sunlight in a particular location on Earth. Since UV radiation can be reflected, scattered and dampened by atmospheric particles, ambient UV dose varies according to the amount of atmosphere it must pass through, making UV doses higher nearest the Equator (where sunlight strikes the Earth most directly), at higher altitudes and in conditions of minimal cloud or particulate cover. Personal UV dosing depends not only on strength of solar radiation, but also on time spent outdoors occupationally or recreationally and the usage of UV-protective clothing, shade and sun blocks. Since equatorial locations tend to be warm and conducive to recreational or occupational outdoor activities, people living such locales typically wear less clothing and have more contact with ambient sunlight and usually receive much higher ambient UV doses than persons inhabiting temperate climates. Not surprisingly, skin cancer risk generally mirrors this geographic pattern, particularly among fair-skinned sun-sensitive persons

The number and use of indoor tanning salons has skyrocketed over the last several years Now it is estimated that over 25% of. Indoor tanning machines are poorly regulated and vary widely with respect to UV composition and strength. UV output from tanning beds can be up to ten times more powerful than sunlight , making the tanning bed an authentic carcinogenic instrument. Tanning can be addictive, leading to frequent and significant UV exposure over time , and since tanning often appeals to adolescents and young adults, tanning patrons' UV history can be significant for many years. Indoor tanning clearly increases incidence of skin cancers . With respect to melanoma, the deadliest of skin malignancies, lifetime risk increases by a large percentage if people engage in artificial tanning before the age of 35 years .

Cancer risk increases with years of use, number of sessions, and total number of UV h exposed. Since the molecular pathways in the skin that activate UV-induced tanning result from cellular and DNA damage which underlie skin damage and carcinogenesis , it appears as though there is no ―safe‖ use of tanning salons . The tanning industry has engaged a powerful political lobby to further its commercial interests by downplaying the adverse health risks of UV. Instead, the industry publicizes the health benefits of UV to its clients, emphasizing vitamin D production which is naturally made in the skin by the chemical conversion of 7-dehydrocholesterol into vitamin D3 (cholecalciferol) after UVB exposure . In fact, UV doses that induce tanning far exceed what is required for adequate vitamin D production and the widespread availability of vitamin D in supplements and fortified foods minimizes the need for UV exposure to avoid symptoms of rickets and vitamin D deficiency .

Multiple studies report overwhelming evidence that the risks of indoor tanning far outweigh potential health benefits, most significantly for malignancy. Decreasing UV radiation exposure, both naturally from sunlight and artificially from tanning bed use, may be the single best way to reduce incidence of melanoma and other skin cancer. Cutaneous Responses to UV has many effects on skin physiology, with some consequences occurring acutely and others in a delayed manner. One of the most obvious acute effects of UV on the skin is the induction of inflammation. UVB induces a cascade of cytokines, vasoactive and neuroactive mediators in the skin that together result in an inflammatory response and causes ―sunburn‖ . If the dose of UV exceeds a threshold damage response, keratinocytes activate apoptotic pathways and die. Such apoptotic keratinocytes can be identified by their pyknotic nuclei and are known as ―sunburn cells‖ . UV also leads to an increase in epidermal thickness, termed hyperkeratosis. By causing cell injury, UV induces damage response pathways in keratinocytes.

Damage signals such as p53 activation profoundly alter keratinocyte physiology, mediating cell cycle arrest, activating DNA repair and inducing apoptosis if the damage is sufficiently great. Several h after UV exposure, however, and damage response signals abate, epidermal keratinocytes proliferate robustly , mediated by a variety of epidermal growth factors. Increased keratinocyte cell division after UV exposure leads to accumulation of epidermal keratinocytes which increases epidermal thickness. Epidermal hyperplasia protects the skin better against UV penetration[31].

Coupled with epidermal hyperkeratosis is adaptive melanization of the skin, also known as tanning. UV up-regulates production and epidermal accumulation of melanin pigment in the skin. This important physiologic response protects the skin against subsequent UV damage, and defects in this pathway are linked with cancer susceptibility. UV-mediated skin darkening is actually biphasic, with initial skin darkening occurring from redistribution and/or molecular changes to existing epidermal melanin pigments. Delayed increases in skin darkening, mediated by actual up-regulation in melanin synthesis and transfer to keratinocytes, begin several h to days after UV exposure. Adaptive melanization is likely a complex physiologic response involving multiple skin cell types interacting in a variety of ways. UV has many other effects on the skin, including induction of an immune-tolerant or immunosuppressive state and production of vitamin D by direct conversion of 7-dehydrocholesterol into vitamin D3 (cholecalciferol). Ambient sunlight, for the most part, is a mixture of UVA and UVB, yet each UV component may exert different and distinct effects on the skin . UVB, for example, is a potent stimulator of inflammation and the formation of DNA photolesions (such as mutagenic thymine dimers) [32], whereas UVA is much less active in these measures but instead is a potent driver of oxidative free radical damage to DNA and other macromolecules . Thus, each may contribute to carcinogenesis through different mechanisms. The influence of UVA and UVB on skin physiology is an active area of investigation.

Skin Cancer Skin cancers are by far the most common malignancies of humans, with well over a million cases diagnosed each year . . They account for nearly 15,000 deaths and more than three billion dollars each year in medical costs in the United States alone . Like many other cancers contributed to by environmental etiologies (in this case UV), skin cancer incidence increases markedly with age presumably reflecting the long latency between carcinogen exposure and cancer formation. Skin cancers are commonly grouped into two main categories, melanoma and non-melanoma skin cancers (NMSC), based on cell of origin and clinical behavior. Risk of skin cancer is heavily influenced by UV exposure and by skin pigmentation [33].

One of the greatest risk factors for the development of cutaneous melanoma is having a fair skin complexion, which is characterized by low levels of a UV-blocking dark pigment called eumelanin in the epidermis. Individuals with light skin pigmentation suffer comparatively more skin damage from UV because it is relatively easy for UV rays to penetrate the epidermis to damage both keratinocytes and melanocytes in the deeper layers of the epidermis. Fair-skinned individuals are exposed to higher ―realized‖ doses of UV radiation in the skin and UV-induced mutations, which directly contribute to melanoma and other forms of skin cancer, accumulate over time. Much UV-induced pathology, including skin cancer, can be avoided by minimizing UV exposure.

2.1.5 Audiovisual Aids

Audio-visual aids are those aids which help in completing the procedure of learning for example, inspiration, arrangement and animation, they can also be referred to as those gadgets by the utilization of which correspondence of thoughts and ideas among people in different instructing and preparing circumstances is made a difference.As such the articulation of audio-visual aids are considered as an assistance for instructors to illuminate, build up, co-relate, integrate, co-ordinate exact ideas and translations just as it empowers the educator to make adapting progressively concrete, successful, fascinating and distinctive. When audio-visual aids are properly utilized, it encourages the students to appreciate, comprehend and convey for better outcomes which expects to include the correspondence of thoughts through the faculties either orally through the mechanism of discourse or visually by the utilization of composed literature[34].

2.1.5.1 Concept of Audio-visual Materials

Audio-visual materials are those materials which depend only on reading to transmit information. Audio-visual materials can also be defined as any gadgets that can be utilized in teaching in order to make learning more dynamic and realistic.

The utilization of audio-visual materials in teaching Basic Science at the Junior Secondary Schools refers to those materials available to teachers that help students understand the subject matter. Science is an exploratory subject that seeks to understand every kind thing that occur in nature, patterns invented by human mind. Students must be exposed to a rich variety of appropriate teaching aids to understand learning contents.

The application of audio-visual materials makes learning effective. Audio-visual materialshas been effective in bridging the gap between students who have low retention ability and the high achievers in the classroom.

The utilization of audio-visual materials in teaching and learning activities does not only involve the use of reference materials such as textbooks but also includes other instructional materials that help students to visualize the concept of what is being taught.

Audio-visual materials help teachers by imparting knowledge in all levels of education. It has also assisted teachers in presenting teaching in a more practical way thereby overcoming difficulties that exist in teaching a particular subject matter and also help students to solve problem when they are able to view them practically.The use of audio-visual materials in teaching and learning has made teaching interesting to students and also their teachers. this has created a better teacher-student relationship in the classroom as well as promoting effective communication between the students and their teachers.

Teaching aids such as audio-visual materials have help students to retain knowledge thereby making learning to be permanent. It enables students to recall what they have learnt and this is made possible because they were able to visualize what was been taught in the classroom. The availability of audio-visual materials at secondary schools enhances and increases the rate of learning thereby saving the time of the teachers which can be a pathway through which other activities such as teachers' participation in curriculum development. The inculcation of teaching aids helps students to experience concept virtually which result in making lessons explicit to the students and widen their horizon of experience [35].

2.1.5.2 Qualities of Audio-visual Aids

The audio-visual aids have a few qualities that can essentially be divided in two categories, the characteristics and the qualities of good audiovisual aids, or at the end of the day in what manner should it be for better utilization and a productive outcome.Audio-visual aids are utilized as a system to help to introduce information, ideas and thoughts,they help spur the students into learning, not methods for stimulation and they are not synonymous with film, and so forth, yet they are represented in gadgets.

The audio-visual aids are neither substitute for the instructor nor for the books, they are integral to other showing materials and gadgets by the educator. Be that as it may, they may make an intrigue to the visual sense or the sound-related sense or to both in the meantime, the experience ends up significant and increasingly successful when enhanced by legitimate clarification by the instructor. As it were, their prosperity relies on the utilization to which they are put, they might be set up with the assistance of the understudies, and notwithstanding the advantage that every one of their sort has its own specific points of interest in delineating particular sorts of subjects[36].

2.1.5.3 Selection Criteria for Audio-Visual Aids

Before utilizing any audio-visual aids an educator should remember a few criteria determinations which are considered as qualities of good audio-visual aids. The definite point in the exercise where a guide is required to be utilized must be clearly stated in the psyche of the educator, the monetary utilization of the season of both the instructor and of the understudy is an imperative thought in the choice of audio-visual aids, in addition to that they ought to be fit to the age, knowledge and experience of students, despite the fact that the instructive parts ought not be made subservient to the sensational components[37].

The audio-visual aids should exhibit precise and true material, to be successful they should speak to an entire thought in succinct yet complete way, they ought to be set up as indicated by the arrangement, and an instructor must guarantee their legitimate use in connection to 'when', 'how' and 'what', yet it ought not be abused just as their utilization ought to be continually assessed.

To put it plainly, those criteria determination just as the qualities of good audio-visual aids are very pivotal at whatever point an educator needs to utilize the audio-visual aids in the study hall. They help them and encourage the students' obtaining of the objective language, for example those qualities give the educator a chance to utilize the audio-visual aids viably and suitably to accomplish the structured objectives.

2.1.5.4 Kinds of Audio-visual Aids:

Innovation developed in the day to day life of the people far and wide, in various regions especially the understudies learning procedure, it influences them decidedly or contrarily, contingent upon the utilization of the hardware. For example, the utilization of the various kinds of audiovisual aids that are accessible could be visual aids, audio aids, audiovisual aids and action aids. These aids help to spur the thinking ability of the students and also increase the pace at which they learn and understand learning concepts. Proper utilization of various kinds of audio-visual aids will help increase interest in learning, performing tasks, solving problems and becoming a better student.

2.1.5.5 Visual Aids

Visual Aids speak to that guide material which helps the student in obtaining the learning encounters through his visual faculties.

1. Anticipated aids for example Movies, Filmstrips, Opaque Projector, Overhead Projector and Slide Projector.
2. Realistic aids for example Kid's shows, Charts, Comics, Diagrams, Flashcards, Graphs, Maps, Photographs, Pictures, Posters, Printed materials, Globe, Flip books, Illustrated books, Models, Specimens, Text Books, Silent Motion Pictures.
3. Boards for example Writing board, Bulletin board, Flannel board, Magnetic board, PEG board.
4. 3-D Aids, for example Graphs, Models, Mock-ups, Objects, Puppets, Specimen and show.

2.1.5.6 Audio Aids

These are guide material which encourages the student to procure the learning through his sound-related faculties. Like Radio, Recordings (tape disc) and Television, Video tapes, Language research facilities, Sound appropriation frameworks, Public Addressing System. The students are limited to listening to the recorded audio alone without the inclusion of visuals.

The students may not be able to perform some tasks that may be given to them at the end of the audio lesson.

2.1.5.7Audio-visual Aids

It speaks to every one of those types of gear and help material in which the student gets chance to use the two his sound-related and visual faculties for picking up the ideal learning encounters. Like Television, Video-films, Video Compact Disks, Cartoon films, Motion Pictures, Computers.

2.1.5.8 Action Aids

Such aids are those aids in which the understudies learn by taking part in some helpful exercises. These aids encourage learning through sight and sound just as through doing. Like Computer Assisted Instructions, Demonstrations, Dramatics, Experimentations, Field trips, Programmed guidance Teaching Machines. Subsequently, there are different sorts of the audiovisual aids that serve the students' needs to secure learning in an unexpected way, explicitly the understudies of unknown dialects, regardless of whether inside the homeroom with the educators' assistance and direction, or at home utilizing audio, visual or audiovisual gadgets to obtain the objective language, for example the utilization of TV, radio or recordings to be close with the unknown dialect alongside its local speakers. Notwithstanding the past arrangement of the various kinds of audiovisual aids gave a tiny divisional grouping based of the method of introduction is the most major clarification to comprehend the sorts of audiovisual aids[37].

2.1.5.9 Instructors' Role when Using-Audio Visual Aids in Classroom

It is notable that the base of the instructive framework is neither the setting nor the educational modules however the productive work of an individual called the educator. Regardless of the way that audiovisual aids have an incredible significance in the training procedure however an instructors' job in utilizing audiovisual aids inside the homeroom is critical. The job of an instructor is somewhat changing to that of a facilitator and administrator of learning. The teacher needs to assume an essential job in the accomplishment of the instructive innovation. The showing aids either present day or customary just enhancement the endeavors of the educator to upgrade the learning procedure. They can't be a substitute for him, the advances help him to do his work in a proficient way to accomplish the instructive destinations.

2.1.6. Challenges in the use of audiovisual resources

Several factors negatively affect the ability of teachers to provide access to audio-visual resources. Inconsistent power is a disturbing problem in the use of audio-visual resources in the classroom. Rampant interruption of electric power has reduced the use of available audio-visual resources in dissemination of information. Some of these resources require electricity and every Nigerian has witnessed and experienced irregular supply of electricity in the recent past. There is insufficient power supply to operate the equipment that is available.

Improper management and maintenance of audio-visual resources constitute a problem to their use. Some schools have audio-visual resources but cannot adequately maintain them because of lack of funds and lack of preservative measures. Some materials are carelessly handled i.e. they are heaped where dust, dirt or even rain can easily reach them. Users at times even use them while they are eating, which introduces virus to them. When these resources are not properly handled or preserved, by using jackets cases or whatever they require to protect them, they will definitely get spoiled in time[38].

Problems militating against the use of audio-visual resource in teaching includes,poor level of audio-visual literacy within the school environment, poor audio-visual facilities, and poor level of awareness of audio-visual resources in the school. Audio-visual equipment requires a separate room for use. In most libraries that have this equipment, they need to create room designed for their use as in the case of microfilm reader[39].

There is also the problem of students opting for alternative, more convenient, and qualitative sources of information (the internet). Users will prefer more computer content, digitalized finding aids, digital repositories of articles, online access to books[40].Some problems that also negatively affect the use of audio-visual resources in schools is insufficient fund. The cost of purchase and maintenance of audio-visual resources is so much that it is becoming almost impossible for most schools to either purchase or maintain these resources. In most cases, only a few can be acquired and in few numbers, which may not be enough for the users[41]. There is a gross lack of trained personnel to handle the few available audio-visual resources. This disrupts the proper usage of these resources in schools. In a situation where teachers are not computer literate, it becomes difficult to operate the system. This limits the proper usage of audio-visual resources in schools because it is the knowledge a man has that he can put into proper usage to help others acquire something from it.

Audio-visual resources such as films and sound recording seem particularly complex in terms of their format, specification and conservation or preservation needs and are not easy to categorize, catalogue, handle, store or distribute, thereby hampering their accessibility. There are several factors that negatively affect the ability of schools in providing access to audiovisual resources.

Philosophical barriers: The continued reliance on print over audiovisual resources is due to the supremacy that print has enjoyed more than 500 years as the main medium of communication.

Financial issues: There are financial implications attached to the acquisition of each non-print format. For schools pressed to provide a book-based service, the funding requirements of audiovisual resources are often incomprehensive.

Education: Many libraries have not had the benefit of pursuing any level of training in audio visual services. The absence of staff trained in audio visual services and sensitive to the needs of an audiovisual is detrimental to the development of quality non-print service.

Staffing: Audiovisual service have specific staffing requirements. Particular skills are needed to develop and manage audio visual collections, maintain audio visual equipment in good running condition, and also set up and dismantle the range of equipment attendant on the type of software found in the collection.

Inadequate infrastructural facilities: Many schools do not have the infrastructural service needed to support audiovisual service. Some lack the power supply that meets hardware needs; e.g. incompatibility of voltage and ampere ratings. Advances in solar-powered technologies are being made, but current prices still make such equipment unaffordable for most institutions.

Content issues: Most audiovisual resources currently available on the market have been produced in the West, by persons from the West and from Western perspective. Cultural bias and misrepresentation of social cultural factors in audio visual programs are therefore realities. Audiovisuals that represent the realities of developing countries from the perspective of such regions are not easily available because of such factors as cost, lack of expertise and access to technological resources. Audio-visual resources that are archaic is another content issue affecting accessibility. Dated images give wrong impression of a person, place or situation. Unlike printed materials, updating editions are not part of the audio-visual world. Therefore, recordings that convey up-to-date information are not always available.

Distribution and legal issues: The rights governing distribution arrangements for audio visual resources are quite different from that of books. Audio-visual distribution right is governed by licenses granted on territorial basis. Identifying and locating a vendor of Audio-visual resources can be quite challenging; knowing who sells what and to whom is one of the greatest challenges of providing Audio-visual service. Even when the distribution licenses exist, locating the appropriate vendor is quite difficult.

Technophobia: Audio-visual services are highly dependent on the use of technology; every item of software usually has its own piece of hardware. Not many teachers are comfortable with technology; making use of several different types of hardware associated with audio visual service are a problem for a number of teachers.

Rapid changes in technology: Constant upgrading and technological changes of audio-visual resources pose a problem to schools. They are financially unable to entertain such changes; this often hinders access to the most recent release of audio-visual products. Access to spare parts is also problematic. Maintaining equipment in good running condition can be challenging due to the cost of parts, obsolesce of equipment owned and difficulties in sourcing vendors of replacement parts. Repair and maintenance issues are also affected by the lack of skilled personnel in the maintenance of a particular technology[40].

Teachers need knowledge of the audio-visual resources itself, technological literacy has fast become one of the basic skills of teaching. If teachers are going to be able to prepare their students to be technologically capable, they need to have, at the very least, basic technology skills. The acquisition and use of this skill will enable instructor to act more as a guide to the learner instead of being the ultimate source of information and leader of the process[41].

Several additional challenges associated with the use of audio-visual resources as follows: Time constraints: Time is also a problem that impedes the effective use of audiovisual resources in effective instructional delivery, because in most cases the time allotted for a lesson on the timetable might not be enough for the teacher to present his content alongside effective use of the resources which will affect the wholesome delivery of the content.

Poor maintenance culture is one of the major challenges associated with the use of audio-visual resources**.** The available resources are not properly preserved, thereby limiting their use by the users.Professional knowledge and technical know-how: In developing communities today, the whole idea and its implementation is still strange to a larger percentage of the population, even those who know about it know very little of its capabilities and operational functionalities. For one to effectively use the resources, one first has to understand the operational functionality of the resource kits[42].

2.1.6.1Strategies for solving the problems associated with the use of audiovisual resources

Having identified some problems associated with the use of audio-visual resources in libraries, there are some strategies suggested in order to enhance their accessibility in schools. Countries should include technical information and information on legal position for usage. Teachers in all schools must possess literacy among other competencies so that they can make use of the resources effectively. Such competencies include: expertise in the concepts of the organization of knowledge; skills in information transfer theories; appreciation of the use of information to gain competitive advantage; training in worldwide information resources and experience in the techniques and skills of information retrieval[43].

There is also the need for the school to function to acquire a standby generator. Natural factors like rain, thunder could contribute to power failure; and as a result of this, Audio-visual services in the school may have to stand-still which includes the use of computers, internet and especially some electronic Audio-visual resources. Absolute provision of power supply boosts the use of Audio-visual resources in the school. Other facilities like fan, photocopier will be able to function well when there is total black out in the classroom[44].

Lack of trained personnel could be solved by giving teachers opportunities for training on those areas especially ICT. In view of this, he also noted that schools should ensure that staff and even their students are given opportunity to learn the knowledge on potentials of Audio-visual resources; through practical classes, industrial training. The knowledge of Audio-visual resources makes them able to compete with others outside their environment, and to be able to cope with challenges that may arise from user's search of information.

The need for funds for library development must be taken seriously. The problems of availability and proper usage of Audio-visual resources in the school need proper and adequate funding to be solved, to enable them acquire all necessary Audio-visual resources and maintain them. There should be a defined percentage for the collection, equipment and development budget for the school, bearing in mind the contributions of Audio-visual resources. This should be a priority in the school budget, and in agreement with the government[45].

The following steps can be taken to enhance access to audio-visual resources.Attitudinal Changes: There is need for teachers to understand the important role that Audio-visual resources can play on the services they provided. They also need to involve themselves with sensitizing policy makers about the importance of extending collections to include all information formats. Thescreening of

Audio-visual program serves as an important means of transferring information, knowledge and communication.

2 Scoring Level and Academic Achievement

Grades is one of the yard-stick for measuring students' academic achievement within the four walls of the classroom. Based on the Center for Research and Development Academic Achievement (CRIRES) report, academic achievement is an instrument to measure students‟ achievement, knowledge and skills. This measurement is based on the students' age, previous experience, and the students‟ capacity related to social and education skills. Seasoned educators use various assessments to measure students' academic achievement . Assessment is a continuous process that brings some valuable information about the learning process . It was commented that the grading process is supposed to be motivating and provide goals[46] . On the other hand, grades can provide the leverage for students to cheat. Grading has the additional benefit of provide data on students academic achievements. To achieve excellent result in any of their assessments, students are subjected to factors such as motivation which helps boosts their confidence in the subject matter. Seasoned educators possess instruments that will not only correct the students when they fall short of expectation but will also guide on the right path. In the usual lecture/lab form of classroom instruction, midterms and final examinations are common. However, a large number of researchers criticize these examinations formats as not conducive to retaining information and student inclination to cram large volume of text which will eventually lead to them forgetting every iota of what has been taught. A large body of research literature encourages alternative testing strategies to better support student achievement and information retention. With regard to the alternative testing strategies, the purpose of this study was to perform a qualitative assessment of student performance versus examination format. Two assessment methods of academic achievement among undergraduate students enrolled in two computer 62 technology courses were applied: a standard midterm examination structure and a practical (hands-on) examination[47]. The hypothesis guiding this research is that one examination format is correlated to the other and could serve as a predictor. There are a number of studies that examine correlations in examination formats and quizzes. A researcher studied undergraduate students and found no statistical correlation between weekly quizzes and examinations[48].

School Type on Academic Performance

Research on effect of school type on academic performance has been ongoing for decades. School type in this study refers to public and private secondary schools. Public secondary schools are owned and funded by the government while private schools are owned are funded by individuals. In Nigeria, secondary schools irrespective of ownership are expected to function in compliance with the achievement of the national education objectives. Students are expected to perform excellently in the final examination as this determines the quality of output of secondary schools. This is one of the parameters used to measure the effectiveness of a school system. The better the achievement of the students, the more effective the system is assumed to be[49].

There are two broad groups of definitions of academic achievement[50]. The first one which is more objective refers to numerical scores of a student's knowledge which measures the degree of a student's adaptation of school work while the second one is a more subjective one, as its determination of academic success in reliant upon the student's attitudes towards his academic achievement and himself, as well as by the attitude of others towards his or her success.

Research has found out in recent times that private schools students outperform their counterparts in the Public schools due to the presence of physical facilities, diligence from private school teachers, funding by the school owners to equip the school with scientific apparatus and other instruments for learning, smaller class size which makes it conducive for the students to learn and for teachers to be able to reach out to every student's need per time.

2.1.6.2 Education

Exposition to all aspect of Audio-visual intervention, the curriculum of all schools must be revisited so that their products will be tooled in this branch of profession. Exposition to all aspects of Audio-visual services including the practical aspects of service delivery will help to reduce technophobia, enable teachers to advance the need for Audio-visual services and generally support the development of Audio-visual collection and activities based on such materials.

2.1.6.3 Fundraising

Fundraising can help to overcome the financial barriers on the availability of Audio-visual resources. Students may lack interest in using some Audio-visual resources either because of laziness, insufficient skill in proper handling of machines or equipment or even staff unfriendliness.

The present world now depends to a large extent on intensive information transfer by means of ICTs, therefore Nigerian students must be given the kind of training that would impart sufficient understanding of the technology that empowers the information society. It is the duty of the school authority to organize orientation programs for at least new students of the institutions, organize training in ICTs and use of other electronic gadgets especially those available in the school during the orientation program either by lecture, seminars or otherwise[51].

The instruction on how to use Audio-visual resources available in the library could be written down with each material so that users can be following the written procedure in operating Audio-visual equipment.

2.1.6.4 Students Motivation

Motivation has been defined as a cognitive and affective force that initiates, sustains and directs engagement behaviors, as an internalized process of formation drawn from the individual's experiences, perceptions and interpretations. It consists of an inner psychological drive leading to action, i.e. engagement behavior[52]. Engagement is defined as a motivation-driven mental construct predictive of and predicted by students' perceptions of positive interpersonal relationships (relatedness) at school in tandem with the cognitive and affective desire to initiate and sustain participation in a range of learning contexts and activities therein[53].

Engagement is observable as manifestations of the motivated desire to be involved within learning activities. Engagement has been argued as being synonymous with self-regulated learning through motivation-informed and driven desires or needs, as common behaviors include persistence, attitude, concentration, the management of time, focus upon the main ideas and objectives, and the processing of information. Other forms of engagement include affective, behavioral and cognitive. However, for simplicity, this study primarily focuses upon motivational leading to behavioral engagement: that is, pro social behaviors exhibited through participation in school-based activities, and involvement in, for example, related extra-curricular activities and actively studying a subject area beyond the classroom out of personal interest.

Three reasons for researching and understanding the motivational processes and influences that impact upon student engagement include defining different types of engagement and their observable indicatorsto help disengaged and disadvantaged students achieve and participate as well as to reduce drop out, to assist in classroom management and finally, to engage students in learning and to help them become skilled life-long learners as opposed to well-behaved, attentive students.

The current research posits that student engagement is an outcome manifested in response to the motivation that students gain from the teacher satisfying the need for competence or autonomy, or both. Cognitive and emotional engagement precede and inform the quality and persistence of behavioral engagement[54]. The evidence and interpretations within the current research are significant in that it reveals means of informing teachers' understanding of how they have and can have a direct impact upon their students' motivated engagement. This understanding may be used to inform practitioners' evidence-based practice. For example, these identified factors and the associated understanding of the interplay between them may be used in the design and implementation of interventions with the objective of teachers successfully enhancing their students' engagement with learning.

Student engagement is, therefore, of immense significance within classrooms as a measurable multidimensional construct in the form of a dynamic, malleable outcome of students' motivation for learning through affective, verbal and behavioral responses that are, reciprocally, predictive of students' motivational inclinations [54]. Engagement has been posited as a significant predictor and indicator of students' motivation and well-being within formal learning environments. Therefore, students' engagement with learning in general is regarded as essential for the long-term commitment of students to their learning goals and prosocial approaches to academic success. The converse of engagement is disengagement (also known as disaffection).

Disengagement has been empirically asserted to be a cause of increased school drop-out rates, reduced attendance levels, and ultimately students not achieving their own self-perceived or their teacher regarded potential. As engagement has a positive association with improved educational outcomes such as achievement levels, for teachers, the primary appeal of the engagement construct is that it is relevant for all students. With regards to academic achievement and enjoyment of learning, considerable evidence now reveals that students who are intrinsically motivated and inherently interested or engaged in the learning process will more effectively master classroom assignments and achieve at higher levels.

The three most frequently mentioned forms of engagement within classroom-based learning are affective engagement, cognitive engagement and behavioral engagement.

Affective, cognitive and behaviors engagement are asserted as combining to inform behaviors indicative of student engagement within classroom-based learning. The four subtypes of student engagement should be considered together when seeking to understand and enhance students' academic engagement. Within each, engagement behaviors are viewed as initiated by psychological responses and physical actions underpinned by motivational constructs.

Affective engagement encompasses positive and negative reactions to teachers, classmates, academics, and school and is presumed to create ties to an institution and influence willingness to do the work. Indicators of positive affective engagement during learning activities include enthusiasm, interest, enjoyment, satisfaction, pride, vitality and zest. Conversely, indicators of affective disaffection include boredom, disinterest, frustration, anger, sadness, worry, anxiety, shame and self-blame, Behavioral indicators of positive affective engagement include excitement, elation, happiness, hope, joy, pride and gratitude. Negative indicators include tension, anger, sadness, frustration, anxiety and shame.

Cognitive engagement consists of inherently different internal psychological processes from those of affective engagement. Cognitive engagement acts as the mediating bridge between context and learning outcomes. Cognitive engagement has been defined as drawing on the idea of investment; it incorporates thoughtfulness and willingness to exert the effort necessary to comprehend complex ideas and master difficult skills[55]. Indicators of positive cognitive engagement include observations that a student is purposeful, approaches learning activities with enthusiasm, strives to achieve a variety of learning goals, is a willing participant in learning activities, actively seeks challenges, and exhibits a thoroughness and desire to achieve the best possible learning outcomes [56].

Indicators of cognitive disengagement include a lack of self-direction, presenting themselves as helpless, unwilling or opposed to tackling learning challenges, avoiding or being apathetic during learning activities, and presenting themselves as incapable, incompetent or under undue pressure. Agentic engagement centers upon the active and volitional cognitive contributions that students make to learning activities. Agentic engagement is asserted as predictive of cognitive, affective and behavioral engagement, as well as an independent predictor of achievement within the classroom, particularly in terms of students feeling empowered to make constructive contributions to their learning activities.

Motivation and engagement are usually dependent on an individual's self-perceptions of their actual achievements and perceived competence. These two perceptions are purported to act as motivational precursors of self-efficacy, which act, in turn, as predictors of sustained and effortful engagement within an activity. Such engagement involves the expenditure and sustaining of effort which is optimally catalyzed when the causes of competence are regarded as controllable.

Relatedness in the classroom involves the development of meaningful relationships with significant others, such as teachers and peers, through a sense of shared purpose and meaning. Competence is the psychological need to feel effective and confident within learning activities, so that students feel or perceive that they are capable of successfully performing within and completing a learning task and refers to the need to experience oneself as effective in one's interactions with the social and physical environments.

Perceived competence is a precursor that informs an individual's sense of selfefficacy in terms of perceived capability of achieving further competence within a specific domain or context, and self-agency, in the form of motivation to be autonomous and self-determined in working towards further competence. An individual's need for and satisfaction of autonomy is linked to their cognitive and affective perceptions of their ability to achieve self-determined or externally-regulated goals. Therefore, perceptions of competence act as initiators of persistence, autonomy and sustained engagement during learning activities. Children's perceptions of the teacher-student relationship quality appear to be influential predictors of children's engagement with learning activities. Several studies have reported a specific relationship between teachers' interpersonal behaviors and students' positive engagement and attitudes to their learning in science. Within the reviewed literature to date, there has been a plethora of research relating to specific teacher influences upon student engagement within schooling and the classroom in general.

There is a wealth of empirical support for positively correlating student engagement as a predictor of academic achievement and motivated involvement within school in general. By comparison, there has been a paucity of research regarding domain-specific or subject-specific engagement factors in science. Despite such a paucity, engagement-enhancing factors specific to children's positive perceptions of science have been investigated within a number of prior studies [57].

These have been reported, to varying degrees, that there are several common key elements central to an engaging science education, including teaching behaviors and approaches that promote autonomous learning and strong teacher-student interpersonal relationships. There was a further identified gap in the research in that vast majority of studies were only informed by data collected using questionnaires. However, the emergent common themes were rarely explored by researchers through discussions with students through focus group interviews. Finally, none of the prior research has involved the in-situ testing of SDT within a British school as means of identifying and understanding some of the key antecedents that inform students' engagement within science education. To date, the majority of research applying SDT within education has been situated in the USA. The current research has addressed the identified gaps.

2.2 Theoretical Framework

2.2.1 Constructivist theory

The constructivists, the theoretical frame upon which the research is based, suggested that learning is more effective when a student is actively engaged in the learning process rather than attempting to receive knowledge passively [58]. Learners are the makers of meaning and knowledge. When they encounter something new, they tend to reconcile it with their previous ideas and experience, maybe changing what they believe, or maybe discarding the new information as irrelevant.

Knowledge based on constructivist learning theory involves some form of guided discovery where the teacher avoids most direct instruction and attempts to lead the student through questions and activities (using relevant instructional materials) to discover, discuss, appreciate, and verbalize the new knowledge. This ideology has given birth to teaching and learning strategies, tools and resources involving the use of computers, simulations, multimedia projectors, animations, the Internet etc.

Constructivism is often associated with pedagogic approaches that promote active learning such as the use of audio-visuals in teaching and learning activities. This theory further states that the major assignment of school is to help students develop new meanings in response to new experiences. Audio-visual develops in the mind of the students the cognitive skills to facilitate learning. Audio -

visual methods in teaching can enhance classroom instruction and understanding of students. Technology offers many possibilities for the teacher that wants to capitalize on the appetite of a new generation of multimedia presentations. Lesson plans on the use of the media must be consistent with the objectives of the program to have a maximum effect on student's performance.

This theory is relevant to this study because in the classroom the constructivist view of learning can point towards a number of different teaching practices which consist of audio-visual. This means that students are encouraged to use active techniques such as experiments, real-world problem-solving techniques using audio-visual aid which can create an indelible mark in the mind of the student go create more knowledge and also to reflect on and talk about what they are doing and how their understanding of the learning content is changing.

2.2.2 Cooperative Learning Theory

Cooperative Learning theory, an offshoot of Constructivism, incorporates the idea that the best learning occurs when students are actively engaged in the learning process and working in collaboration with other students to accomplish a shared goal. While Constructivism focuses on personal experience as the foundation for learning new material, Cooperative Learning utilizes not only the student's own experience to solidify knowledge, but also uses the experiences of others. Both theories emphasize the importance of interactivity with respect to the design and implementation of lesson plans.

In cooperative learning, the focus moves from teacher-centred to student-centred education. Instead of sitting in a lecture or reading text, students are given a task or problem and are asked to identify a possible solution on their own and with the help of others. Rather than disseminating information directly, the teacher guides students to the source of the information they may require. In contrast to traditional teaching methods where students are perceived to be empty vessels awaiting the teachers' knowledge, Cooperative Learning theory recognizes the importance of the student's existing knowledge and puts that knowledge to work.

In cooperative learning, the focus moves from teacher-centered to student-centered Education. Instead of sitting in a lecture or reading text, students are given a task to perform and to identify the solution on their own or with the help of others. Rather than disseminating information directly, the teacher guides students to the source of the information they may require. In contrast to traditional teaching methods where students are perceived to be empty vessels awaiting the teachers' knowledge, Cooperative Learning theory recognizes the importance of the student's existing knowledge and put that knowledge to work.

Bloom's Taxonomy of Learning

The Bloom's taxonomy encompasses six domains in teaching philosophies which include, knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation. It serves as the backbone of teaching activities, in particular those that tend to lean towards skills rather than content. Bloom's taxonomy can be used as a teaching tool to help balance evaluative and assessment-based questions, assignments and also to ensure that all orders of thinking are exercised in students' learning which includes aspect of information searching[59].

The cognitive domain is knowledge based which helps students recognize basic concepts, comprehension involves demonstrating an understanding of a subject matter. Application involves using the acquired knowledge or skill to solve problems. Analysis involves examining and breaking information into component part, this will help the learner make genuine inferences about the topic. Synthesis involves building a structure whereby students will be able to put some information together to form a new meaning. Evaluation involves making judgement about Radioactivity. The teacher analyzes the topic to the students for better understanding by allowing them make inferences about the topic and in turn form new meaning to it[60].

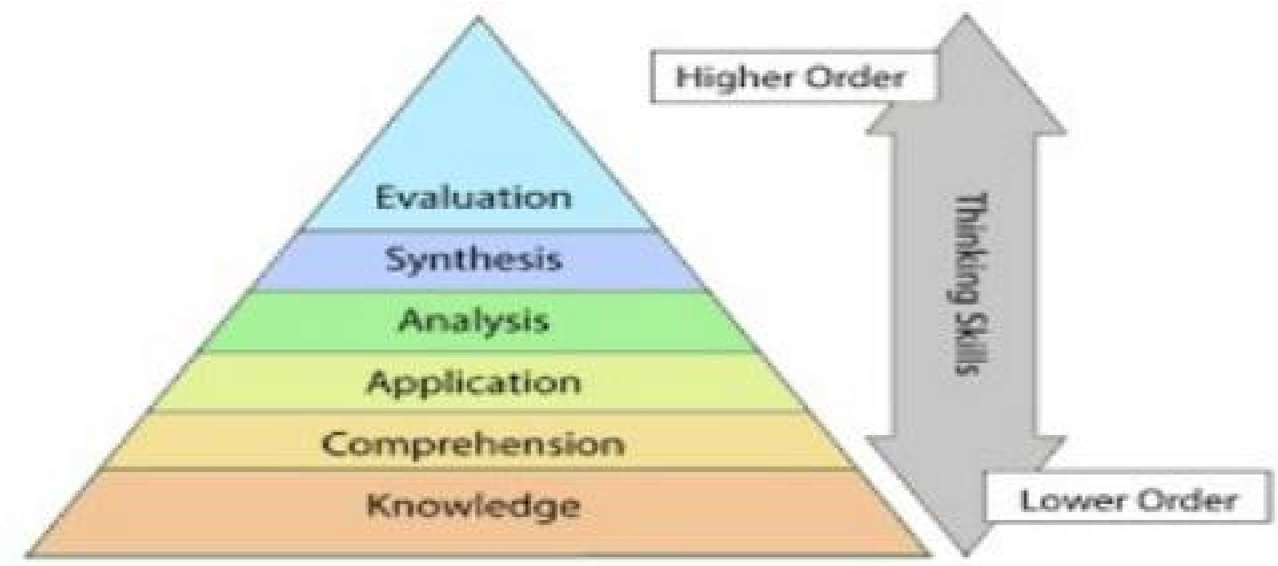

Figure 7: Bloom's Taxonomy

Source: www.wikipedia.com

2.3 Review of Related Empirical Studies

It should be noted that subjects vary in nature, context and depth. A tool that is suitable for one subject matter may not be suitable for another.

Single medium is absolutely capable of teaching the different types of subject in a single, tool. The teacher's ability to select and utilize efficiently the appropriate material goes a long way in achieving good result[60].

A research work which sought to determine whether the available instructionalmaterials and their level of utilization for the teaching of Biology in Senior Secondary Schools in Lagos State, Nigeria, was adequate for effective implementation of the new Biology curriculum. Survey research design, proportionate random sampling, and research instrument like Teachers' Assessment

Questionnaire/Checklist (TAQC), Students' Assessment Questionnaire (SAQ), and Observation Guide (OG) were used. For data analysis, mean, frequency count, chart, and percentages were used. Arum found out that of the 24 essential Biology instructional materials earmarked as the bench mark for the study, only one item (pig's bladder) was completely unavailable in all the schools within the sample[61]. This, according to him , was an indication of government's awareness of the relevance of instructional materials in making learning meaningful to the learner.

Ironically however, most of the Public and Private senior secondary schools in the district were hardly properly equipped with relevant audio-visual materials. 67% of the schools observed did not have computers, multimedia projectors, and Biology software let alone internet facilities. There is also a heavy reliance on obsolete instructional materials such as textbooks, model/mock-up, white board, preserved specimen, charts. In some schools where they are privileged to have the audio-visual resources, they were under-utilized. Research findings shows that 69% of teachers are trained and they scored highly with average score 3.46. But the untrained non-professional teachers who constitute 39% of teachers do not perform creditably well with the mean score of 2.35.

2.4 Conceptual Model

The conceptual framework of this study shows the relationship between the Dependent variable and the independent variables. This is illustrated in the figure below;

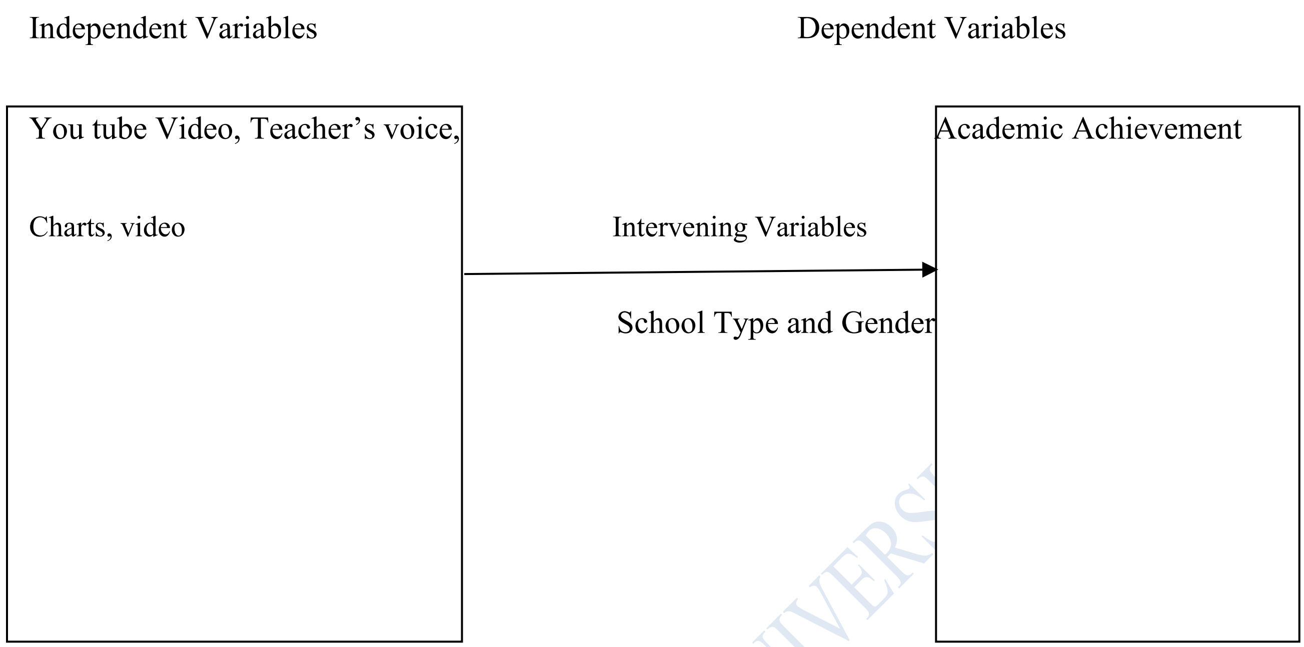

Figure 8: Conceptual model

Source: Researcher's field work 2022

Independent Variables

Audio-Visuals such as Video, YouTube, Voice, Charts.

The utilization of Audio-visuals such as YouTube videos, Teacher's voice, Videos and Pictorial charts to teach Radioactivity

Dependent Variables

Academic achievement in Radioactivity

Intervening Variables

School type: public and private schools

Gender: male and female students

2.5 Summary of Literature Review

Chapter Two reviewed different concepts such as Radioactivity, students' motivation, challenges faced by teachers while using audio visual aids, constructivists theory, cooperative learning theory solutions, audio visual aids. From the above views, it is clear that instructional materials (Audio-visual materials) are essential for effective teaching of Radioactivity in Basic Science and should be made adequately available in all schools. To help Science teachers become better teachers, most schools in developed countries are provided with a variety of instructional materials and equipment. However, this is not the case with developing countries like Nigeria. Most secondary schools in Nigeria lack instructional materials (Audio-visual materials) and in places where there are, they are under-utilized. The traditional concept of teaching is being redefined from using just textbooks to teach to one that also encourages the use of audio visual to disseminate information, including CD-ROM, internet, laptop, projectors, YouTube videos and remote access to wide range of resources. The primary role of a teacher is to meet the needs of the students by delivering the subject matter with absolute mastery to the students for better understanding and also to widen their horizon in such field of study using audiovisual resources.

Therefore, this study seeks to ascertain the effects of the use of Audio-visual intervention in teaching of Radioactivity in Basic Science at secondary schools in Ibadan Metropolis. This is the gap that the study attempts to fill.

Endnotes

1. J. Ebere, *Effects of cooperative learning: students achievement and interest in science and their perception of their psychosocial learning environment* Sci.Teach.Assoc.Nigeria,51(1),2016;19-31

2. J.O Rasmussen, *Models of Heavy Nuclei in Nuclear Spectroscopy, University ofCalifornia, Berkeley. Retrieved from* https://www.britannica.com/science/radioactivity; 2021

3. https://www.britannica.com/science/radioactivity

4. G.Young, *Institute of Physics; Radioactivity*, 2016

5. A. Diamantis, E. Magiorkinis, A. Papadimitriou, G. Androutsos. *The contribution of Maria Sklodowska Curie and Pierre Curie to nuclear and Medical Physics. A hundred and ten years after the discovery of radium. Hell J Nucl Med.* 2018 Jan;11(1):33–38.

6. M.A Zmijewski, C. Skobowiat, B. Zbytek, R.M Slominski, J.D Steketee, *Sensing the environment: Regulation of local and global homeostasis by the skin's neuroendocrine system. Adv. Anat. Embryol. Cell. Biol. 2012, 212, v-115. 7. Fuchs, E.; Raghavan, S. Getting under the skin of epidermal morphogenesis. Nat. Rev. Genet*. 2016, 3, 199–209.

7. K.C Madison, *Barrier function of the skin: ―la raison d'etre‖ of the epidermis. J. Invest. Dermatol*. 2003, 121, 231–241.

8. E. Proksch, J.M Brandner, The skin: *An indispensable barrier. Exp. Dermatol*. 2008, 17, 1063–1072.

9. A. Slominski, D.J Tobin, S. Shibahara, J. Wortsman, *Melanin pigmentation in mammalian skin and its hormonal regulation. Physiol*. Rev. 2004, 84, 1155–1228.

10. J.J Nordlund, *The melanocyte and the epidermal melanin unit: An expanded concept*. Dermatol. Clin. 2007, 25, 271–2

11. A. Slominski, J. Wortsman, P.M Plonka, K.U Schallreuter, R. Paus, D.J Tobin,. *Hair follicle pigmentation. J. Invest. Dermatol*. 2005, 124, 13–21.

12. Scherer, D.; Kumar, R. *Genetics of pigmentation in skin cancer*—A review. Mutat. Res. 2010, 705, 141–153. 14.

13. K. Jimbow, T.G Salopek, W.T Dixon, G.E Searles, G. Yamada, *The epidermal melanin unit in the pathophysiology of malignant melanoma. Am. J. Dermatopathol*. 2011, 13, 179–188.

14. P.G Joshi, N. Nair, G. Begum, N.B. Joshi, V.P Sinkar, S. Vora,. *Melanocyte-keratinocyte interaction induces calcium signalling and melanin transfer to keratinocytes. Pigment. Cell* Res. 2007, 20, 380–384.

15. G. Cardinali, G. Bolasco, N. Aspite, Lucania, G.; Lotti, L.V.; Torrisi, M.R.; Picardo, M. *Melanosome transfer promoted by keratinocyte growth factor in light and dark skin-derived keratinocytes. J. Invest. Dermatol*. 2008, 128, 558–567.

16. Yamaguchi, Y.; Hearing, V.J. *Physiological factors that regulate skin pigmentation. Biofactors* 2009, 35, 193–199.

17 Slominski, A.; Paus, R.; Schadendorf, D. *Melanocytes as ―sensory‖ and regulatory cells in the epidermis. J. Theor. Biol*. 2014, 164, 103–120.

18 Kalka, K.; Mukhtar, H.; Turowski-Wanke, A.; Merk, H. *Biomelanin antioxidants in cosmetics: Assessment based on inhibition of lipid peroxidation. Skin Pharmacol. Appl. Skin Physiol*. 2000, 13, 143–149. 20.

19.Mackintosh, J.A. *The antimicrobial properties of melanocytes, melanosomes and melanin and the evolution of black skin. J. Theor. Biol*. 2001, 211, 101–113. 21.

20. Meyskens, F.L., Jr.; Farmer, P.; Fruehauf, J.P. Redox regulation in human melanocytes and melanoma. Pigment. Cell Res. 2001, 14, 148–154. 21.Timins, J.K. *Communication of benefits and risks of medical radiation: A historical perspective. Health Phys*. 2011 Nov;101(5):562–565.

22.Christensen, D.M, Iddins C.J, Sugarman S.L. *Ionizing radiation injuries and illnesses. Emerg Med Clin North Am*. 2016 Feb;32(1):245–265.

23.Krane Kenneth S. *Introductory nuclear physics. John Wiley & Sons*; 2018:246–269

24. Madu, E.C. *The basics of audiovisual librarianship. Ibadan*: Evi-Coleman Publication 2017.

25. Rutherford E.*Uranium radiation and the electrical conduction produced by it. Philos. Mag.* 2009;47(284):109–113

26. Aharmian F, Akhperjanian A, Barrio J, Bernlohr K, Borst H, Cortina J, Gotting N. *The Tev energy spectrum of Markarian 501 measured with sterscopic telescope system of HEGRA during 1998 and 1999*. APJ. 2017;546(2):898.

27. Hamada N, Fujmichi Y. *Classification of radiation effects for dose limitation purposes: History, current situation, and future prospects. J. Radiation resources* 2018 Jul;55(4):629–640.

28. Grupen Claus, Cowan G, Eidelman SD, Stroh T. *Astroparticle physics. Springer*; 2015:p.109

29. •Double, K.L.; Ben-Shachar, D.; Youdim, M.B.; Zecca, L.; Riederer, P.; Gerlach, M. *Influence of neuromelanin on oxidative pathways within the human substantia nigra. Neurotoxicol. Teratol.* 2012, 24, 621–628. 23.

30. Herrling, T.; Jung, K.; Fuchs, J. *The role of melanin as protector against free radicals in skin and its role as free radical indicator in hair. Biomolecular Spectroscopy*. 2018, 69, 1429–1435. 24.

31. Wang, A., Marino, A.R., Gasyna, Z.; Gasyna, E.; Norris, J., Jr. *Photoprotection by porcine eumelanin against singlet oxygen production. Photochem. PhotoBiol.* 2018, 84, 679–682. 25.

32. Riley, P.A. Melanin. Int. J. Biochem. Cell. Biol. 2017, 29, 1235–1239

33. Jimoh, M.F. *Teaching aids: a panacea for effective instructional delivery. Jos, Plateau state: Saints academy* 2018.

34. Mohammed, Z.*Towards bridging the information gap in developed countries: the case of Nigeria. The international information and Library review.* 26 (2): 2014;91- 105.

35. Odusanya, A.K & Osinulu, L.F. *The impact of ETF funding on university libraries: a case study approach. African Journal of Library Archives and Information Science* 14(2):2012; 185- 192.

36. Okiy, R.B. *Funding Nigerian libraries in the 21st century: will funding from alternative sources suffice? The Bottom Line: Managing Library Finances* 18 (2): 2015;71-77.

37. Abrahams, I. *Does Practical Work Really Motivate? A study of the affective value of practical work in secondary school science. International Journal of Science Education,* 31(17), 2015;2335–2353.

38. Fredricks, J.A, Blumenfeld, P.C & Paris, A.H, *School Engagement: Potential of the Concept, State of the Evidence. Review of Educational Research*, 74(1), 2014;59–109.

39. Christenson, S.L, Reschly, A.L &Wylie, C. *The Handbook of Research on Student Engagement. New York: Springer Science* 2017

40. Klem, A.M & Connell, J.P. *Relationships Matter: linking Teacher Support to Student Engagement and Achievement. Journal of School Health,* 74(7), 2013;262–273.

41. Goossens, L. Soenens, B & Dochy, F. *Identifying Configurations of Perceived Teacher Autonomy Support and Structure: Associations with Self-Regulated Learning, Motivation and Problem Behavior. Learning and Instruction,* 22(6), 2015;431-439.

42. Jang, H; Kim, E.J &Reeve, J. *Longitudinal Test of Self-Determination Theory's Motivation Mediation Model in a Naturally Occurring Classroom Context. Journal of Educational Psychology*, 104(4), 2012;1175-1188.

43. Pajares, F. *Self-efficacy beliefs in achievement settings. Review of Educational Research*, 66, 2016;543-578.

44. Painter, J. *Autonomy, Competence, and Intrinsic Motivation in Science Education: A Self-Determination Theory Perspective (Unpublished Ph.D. thesis)*, University of North Carolina 2018.

45. Ainsley, M. *Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about science. Contemporary Educational Psychology*, 36, 2016;4–12.

46. *Mathematics and Science Study at the Fourth and Eighth Grades. Chestnut Hill, MA: IMSS & PIRLS International Study Center*, Boston College 2015.

47. Taber, G.M. *How do we learn our lesson? Taking students through the process*; 2013.

48. Olufunke, B.T. *Effects of availability and Utilization of Physic laboratory on students" academic achievement in secondary school physic World J. Educ*., 2012, 2 (5).

49. Kumwenda, B, Cleland, J.A, Walker, J, Dee, A.J & Greatrix, R. *The Relationship between school type and academic achievement at Medical School in a National, Multi-Cohort Study*. BMJ 2017; Open 7, 1-11.

50.Ikhwari, T.D, *A study of the relationship between motivation, self concept and academic achievement of students at a university in Limpopo province, South Africa. International Journal of Educational Science,* 2014 6(1), 19-25

51. Onah, E.N, *Effect of Multimedia Projection on Secondary Students" Achievement and Interest in Set in Enugu State. Unpublished M.ED thesis Department of Science Education, University of Nigeria, Nsukka* (2015). 43.

52 Onochie, E.U, *Effects of cooperative learning and analogy on students achievement and interest in Biology. Unpublished MED project Department of Science Education, University of Nigeria, Nsukka 2010.*

53 *International journal of innovative research & development* (2019).

54. Dale, E. *Audio-visual methods in teaching (3rd ed.). New York: Holt Rinehart & Winston.*

55. Eubanks, P.K, *Art is a visual language. Language*, (2011).

56. Akanbi, S.F, *Productivity loss in brainstorming groups*; British Universities Film 2015.

57. Arum, A.M, *Advances in the development and Validation of instruments for assessing students' science knowledge.* Enugu: ABIC Publisher 2015.

58 Jimoh, I, *Guidelines for Audio-Visual and Multimedia Materials in Libraries and other Institutions* 2011.

59. Newton, M. Philip, Lee George. *A pragmatic master list of action verbs for Bloom's taxonomy.* Retrieved on 10th July 2020

60. Kress, G, Selander, S. Multimodal design, learning and cultures of recognition. Internet and Higher Education. 2012 15 (1): 265-268

Chapter Three

Methodology

This chapter is presented under the following subheadings: Research Design, Population of the Study, Sample and Sampling Techniques, Research Instrument, Validation of the Research Instrument, Reliability of the Instrument, Administration of Research Instruments and Method of Data Analysis.

3.1 Research Design

This study adopted a quasi-experimental design which involved a pretest, post-test, control and experimental group. School types were of two levels (public and private schools) and students' gender were of two levels (male and female). Audio visuals intervention at four levels (YouTube Video, Teacher's Voice, Charts and Video) was the independent variable and it was the treatment for the experimental group while the conventional teaching method was used for the control group. The dependent variable was the academic achievement in Radioactivity in pretest and post-test approach. School types and Gender served as the intervening variable.

Groups	**Gender**	**School type**
Control	Male Female	Private Public
Treatment	Male Female	Private Public

3.2 Population of the Study

The population of the study comprises of all Junior Secondary 2 students in Ibadan Metropolis.

3.3. Sample and Sampling Technique

Sixty students from two classes selected from two Junior secondary schools in Ibadan North-West Local Government Area, Ibadan Metropolis participated in the study. The selected schools were purposively chosen to focus on particular characteristics of a population that are of interest to the study. One of the schools served as the experimental group, while the other school served as the control group.

3.4 Research instrument

The instrument used to obtain data for this study were (i) Basic Science Achievement Test (BSAT), (ii) Prepared lesson plan, (iii) YouTube videos, (iv) recorded video, (v) teacher's voice, (vi) Projector, and charts. The Basic Science achievement Test (BSAT) comprise of two parts A and B. Part A is on demographic information of the respondent while part B comprised a 20-item multiple choice test.

Table of specification for Basic Science Test Achievement

Content	Weight	Knowledge	Comprehension	Application	Synthesis	Analysis	Evaluation	Total
Radioactivity	20	1	2	1	1	-	-	5
Atoms	10	1	1			-	-	2
Types of Radioactive elements	20	1	2	-	1	-	-	4
Types of radioactive decay	20	1	1	-	-	-	-	2
Importance of Radioactivity	15	1	1	1	1	-	-	4
Dangers of Radioactivity	15	1	1	1	-	-	-	3
Total	100	6	8	3	3	0	0	20

3.5 Validation of the Instrument

To ensure face and content validity of the instrument, it was given to the researcher's supervisor and two (2) other lecturers in the Department of Science Education, Lead City University, Ibadan to validate. All corrections and modifications were effected before producing the final draft.

3.6 Reliability of the Instrument

The Reliability of the instrument was carried out in two schools within the population who did not partake in the main study. Reliability coefficient of the Basic Science Achievement Test (BSAT) was determined using Kuder Richardson formula 21. The procedure helped to establish the internal consistency of the test items that was developed for the study and a reliability index of 0.71 was obtained from the exercise.

3.7 Administration of Research Instrument

The two groups (experimental and control) were subjected to the Basic Science Achievement Test (BSAT) as pre-test prior to the study. Then, the students in the experimental group were exposed to the content with a laptop, speaker and a projector, the video content was projected on a projector board in a way all students in the class were able to see and to hear what was been displayed. Other applications such as Internet access, games and utility programs were disabled. The students were encouraged to take enough notes that could be useful to them.

The control group students were taught using the conventional teaching method on the same content used for the experimental group. The classroom contained a board and charts which was used for the instruction. A well-prepared lesson plan was used to guide the researcher in the course of the administration of instruments. The exercise lasted six weeks.

Before the study, the instrument Basic Science achievement Test (BSAT) was administered to the two group of students and their scores recorded. At the end of the study, the two groups were exposed to the Basic Science Achievement (BSAT). The study lasted six weeks. Week one was used to administer pre-test for control and treatment group, week two was used to train teachers in the control school, week three, four and five was used to teach the experimental group on Radioactivity using Audio-visual intervention, week six was used to administer post-test on the experimental and control groups after which the result was collated and analyzed.

3.8 Methods of Data Analysis

The research questions were answered using frequency count. The hypotheses were tested at 0.05 alpha levels using the analysis of covariance (ANCOVA) on the post-test using pre-test scores as covariates.

Chapter Four

Result and Discussion of Findings

This chapter is concerned with the presentation, analysis, and interpretation of data gathered from the responses to the administered instruments. It also includes an empirical testing of hypothesis made about this study and each of their interpretations. It should be noted that Statistical Package for Social Science (SPSS) version 20.0 was used for analyzing frequencies and testing research hypothesis. The researchers first present the general descriptive analysis of the data set and then follow-up with the statistical analysis.

4.1 Presentation of Data

The researcher carried out a field experiment on group of students in public and private schools in Ibadan North west local government area, Oyo State where 60 students at the two schools were sub-divided into a smaller group of control and treatment of 30 students each which is the sample size in representing the study population of the selected junior secondary schools in Ibadan, Oyo State, Nigeria. The table below shows the details at a glance.

TABLE 4.1 Analysis of Response Rate

Public School			Private School	Total	
Variable	**Control**	**Treatment**	**Control**	**Treatment**	
Pre-test	15	15	15	15	60
Post-test	15	15	15	15	60
Total	30	30	30	30	120

Source: Field survey (2022)

4.2 Data Analysis and Interpretation

The study revealed that the following Audio-Visual materials are available to teach radioactivity in Basic Science at secondary school in Ibadan metropolis.

- YouTube Video
- Teachers' Voice
- Video
- Pictorial Charts

Multiple Regression Analysis

As a predictive analysis, multiple linear regression was used to describe data and to explain the relationship between one dependent variable (academic achievement) and one independent variable which is Audio-visual intervention at four levels (YouTube Video, Teacher's Voice, Video and Pictorial Charts).

Table 4.2: Model Summary of the Predictors of Audio-visual Intervention

Model Summary

Model	R	RSquare	Adjusted R Square	Std. Error of the Estimate
1	.867[a]	.744	.222	6.17783

a. Predictors: (Constant), Video, Teacher's Voice, YouTube Video, Pictorial Charts

ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	305.277	4	76.319	5.000	.007[b]

Residual	381.656	10	38.166
Total	686.933	14	

a. Dependent Variable: Academic Achievement

b. Predictors: (Constant), Video, Teacher's Voice, YouTube Video, Pictorial Charts

The table above represents the results from the multiple regressions that disclose the correlation between the Audio-visual interventions. The model summary table above revealed that Video, Teacher's Voice, YouTube Video, and Pictorial Charts have significant impact on the student's academic achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis is 74.4% i.e. (R square =0.744). The ANOVA table shows the Fcal 5.00 at (0.0001) significance level. The result revealed that there is a positive strong correlation between Video, Teachers" Voice, YouTube Video, Pictorial Charts and academic achievement. However, the table below shows the exact strength that a particular audio-visual intervention has the students' academic achievement in Basic Science at the Junior Secondary Schools.

Table 4.3: Multiple Linear Progression Coefficients

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std.Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-25.617	15.297		-1.675	.125
	Teachers" Voice	.082	.352	.068	.232	.821
	YouTube Video	2.100	.781	.733	2.690	.023
	Pictorial Charts	.555	.483	.507	1.147	.278
	Video	-.581	.317	-.773	-1.831	.097

a. Dependent Variable: Academic Achievement

The table above shows the multiple linear regression coefficient estimates including the intercept and the significance levels. The coefficient table above shows the simple model that Video, Teachers' Voice, YouTube Video, and Pictorial Charts have significant impact on academic achievement of students when taught radioactivity in Basic Science at the Junior Secondary Schools. Of all the Audio-visual intervention, YouTube Video with the p-value of 0.023 is statistically significant to academic achievement less than 5% level.

A series multiple linear regression models were run in order to isolate some of the factors which could explain the academic achievement between Video, Teachers' Voice, YouTube Video, and Pictorial Charts. The aim was to distinguish the significant effects of Audio-visual intervention from other confounding variables. These variables were grouped into the following categories: Video, Teacher’s Voice, YouTube Video, and Pictorial Charts. The analysis conducted in this research has stipulated that YouTube Video has the greatest significant effect on academic achievement in Basic Science at the Junior Secondary Schools in Oyo State.

The model is shown mathematically as follows;

$= {}_{0} + {}_{1}.X_{i2} + {}_{2}.X_{i2} + {}_{3}.X_{i2} + {}_{4}.X_{i2}$

where “y” is internal audit function and “β_1” is Teachers‟ Voice, “β_2" is YouTube Video, “β_3" is Video, $\beta_4$is Pictorial Charts “β_0” is a constant factor and X_{i2} is the value of coefficient. From this table therefore,$Academic\ Achievement = -25.617 + 0.082\ Teacher's\ Voice +$ $2.1\ YouTube\ Video - 0.581\ Video. + 0.555 Pictorial\ Charts$

4.2 Test of Hypotheses and Discussion of Results

Analysis of Covariance (ANCOVA) was used to measure the impact of the independent variable to the dependent variable of hypothesis which determine the significance of the contribution of the Covariate (control), as well as whether the nominal variables (treatment) significantly predict the dependent variable, over and above the "effect" of the covariate. Proper interpretation and analysis techniques were used to explain the hypotheses testing.

ANCOVA first conducts a regression of the independent variable (i.e., the covariate) on the dependent variable. The residuals (the unexplained variance in the regression model) are then subject to an ANOVA. Thus the ANCOVA tests whether the independent variable still influences the dependent variable after the influence of the covariate(s)has been removed.

Hypothesis1

($H0_1$): There will be no significant effect of audio-visual intervention on the Basic Science Students’ achievement in radioactivity at junior secondary school in Ibadan metropolis.

Table 4.4: Levene's Test of Equality of Error Variances

Dependent Variable: Academic Achievement

F	df1	df2	Sig.
4636.838	6	8	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept +Control +Treatment

This is significant; therefore, it indicates that the assumption of homogeneity of variances has been violated with Fcal 4636.838 at (0.000) significance level. Therefore, there is significant effect of audio-visual intervention on the teaching of radioactivity in Basic Science at secondary school in Ibadan metropolis.

Table 4.5: Analysis of Covariance(ANCOVA) Test of Between Subjects

Dependent Variable: Academic Achievement

Source	Type III Sum Of Squares	Df	Mean Square	F	Sig.	Non cent. Parameter	Observed Power[b]
Corrected Model	555.629[a]	7	79.376	8.158	.006	57.109	.959
Intercept	519.041	1	519.041	53.349	.000	53.349	1.000
Treatment	177.562	1	177.562	18.250	.004	18.250	.953
Control	514.820	6	85.803	.819	.806	.915	.964
Error	68.105	7	9.729				
Total	4691.000	15					
Corrected Total	623.733	14					

a. R Squared=.891(Adjusted R Squared =.782)

b. Computed using alpha=.05

Interpretation of Results

The ANCOVA (Tests of Between Subject Effects) table interprets that the covariate (Treatment) has a highly significant "effect" on academic achievement, as should be the case of students taught radioactivity in Basic Science at secondary school Fcal 18.250 at (0.004) significance level. However, in the "effect" of students used as control are not significant with Fcal 0.819 at (0.806) significance level.

Since the R Squared = 0.891, the implication of the result is that for every 100% change in academic achievement of students, audio-visual intervention treatment is responsible for 89.1% of the change.

Decision

The significance level below 0.05 implies a statistical confidence of above 95%.This implies that there is significant effect of audio- visual intervention on the teaching of radioactivity inBasic Science at secondary school in Ibadan metropolis. Thus, the decision would be to reject the null hypothesis (H_0), and accept the alternative hypothesis (H_1).

Hypothesis2

H_o: There will be no significant effect of audio-visual intervention on students' achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on gender.

Table 4.6: Levene's Test of Equality of Error Variances

Dependent Variable: Academic Achievement

F	df1	df2	Sig.
2.852	6	8	.086

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept +Male +Female

There is no significant; therefore, it does not indicate that the assumption of homogeneity of variances has been violated with Fcal 2.852 at (0.086) significance level. Therefore, there will be no significant effect of audio-visual intervention on students' achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on gender.

Table 4.7: Analysis of Covariance (ANCOVA) Tests of Between-Subjects Effects

Dependent Variable: Academic Achievement

Source	Type III Sum Of Squares	Df	Mean Square	F	Sig.	Non cent. Parameter	Observed Power[b]
Corrected Model	107.971[a]	7	15.424	.409	.869	2.865	.106
Intercept	549.677	1	549.677	14.588	.007	14.588	.904
Male	.238	1	.238	.006	.939	.006	.051
Female	80.707	6	13.451	.357	.885	2.142	.097
Error	263.762	7	37.680				
Total	6696.000	15					
Corrected Total	371.733	14					

a. R Squared=.290(Adjusted R Squared=-.419)

b. Computed using alpha=.05

Interpretation of Results

The ANCOVA (Tests of Between Subject Effects) table interprets that the covariate (Male) has no significant effect on academic achievement, as should be the case of students taught radioactivity in Basic Science at secondary school Fcal 0.006 at (0.939) significance level. Also, the "effect" of Female students have no significant, Fcal 0.357 at (0.885) significance level.

Since the R Squared = 0.290, the implication of the result is that for every 100% change in academic achievement of students, audio- visual intervention gender based is responsible for 29.0% of the change.

Decision

The significance level below 0.05 implies a statistical confidence of above 95%. This implies that there will be no significant effect of audio-visual intervention on students achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan Metropolis based on gender. Thus, the decision would be to accept the null hypothesis (H_0), and reject the alternative hypothesis (H_1).

Hypothesis3

H_o: There will be no significant effect of audio-visual intervention on students achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on school type.

Table 4.8: Levene's Test of Equality of Error Variances [a]
Dependent Variable: Academic Achievement

F	df1	df2	Sig.
20.351	6	8	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept +Public School +Private School

a. Design: Intercept+ Public School+ Private School

This is significant; therefore, it indicates that the assumption of homogeneity of variances has been violated with Fcal 20.35 at (0.000) significance level. Therefore, there is a significant effect of audio-visual intervention on students‟ achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on school type.

Table 4.9: Analysis of Covariance (ANCOVA) Tests of Between-Subjects Effects

Dependent Variable: Academic Achievement

Source	Type III Sum Of Squares	df	Mean Square	F	Sig.	Non cent. Parameter	Observed Power[b]
Corrected Model	349.874[a]	7	49.982	3.508	.060	24.558	.643
Intercept	18.752	1	18.752	1.316	.289	1.316	.169
Private School	134.274	1	134.274	9.425	.018	9.425	.750
Public School	244.813	6	40.802	2.864	.097	17.184	.528
Error	99.726	7	14.247				
Total	5096.000	15					
Corrected Total	449.600	14					

a. R Squared=.778(Adjusted R Squared =.556)

b. Computed using alpha=.05

Interpretation of Results

The ANCOVA (Tests of Between Subject Effects) table interprets that the covariate (Private School) has a significant "effect" on academic achievement, as should be the case of students taught radioactivity in Basic Science at secondary school Fcal 9.425 at (0.018) significance level. However, the "effect" on Public School is no longer significant, Fcal 2.864 at (0.097) significance level.

Since the R Squared = 0.778, the implication of the result is that for every 100% change in academic achievement of students, audio- visual intervention school type based is responsible for 77.8% of the change.

Decision

The significance level below 0.05 implies a statistical confidence of above 95%. This implies that there is a significant effect of audio-visual intervention on students' achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on school type. Thus, the decision would be to reject the null hypothesis (H0), and accept the alternative hypothesis (H1).

4.4 Discussion of Findings

This study examines the effect of Audio-visual intervention on the teaching of radioactivity in Basic Science at the Junior Secondary Schools in Ibadan Metropolis and the variable used for the independent construct are Video, Teacher's Voice, YouTube Video and Pictorial Charts while for the dependent construct is academic achievement. The study aimed to contribute immensely towards designing an appropriate teaching intervention that is different from the conventional methods used in various junior secondary schools in order to teach Basic Science effectively and to increase their success rate. Three hypotheses were postulated and the results derived shows that there is strong and linear relationship between the variables used to measure the two construct in terms of school type and score level which invariably mean Audio-visual intervention have significant impact on academic achievement of junior secondary school students base on the covariance treatment, school type (private school).

The first hypothesis indicate that the ANCOVA (Tests of Between Subject Effects) table interprets that the covariate (Treatment) has a highly significant effect on academic achievement, as should be the case of students taught radioactivity in Basic Science at secondary school Fcal 18.250 at (0.004) significance level. However, in the "effect" of students used as control are not significant with Fcal 0.819 at (0.806) significance level. Since the R Squared =0.891, the implication of the result is that for every 100% change in academic achievement of students, audio- visual intervention treatment is responsible for 89.1% of the change. The significance level below 0.05 implies a statistical confidence of above 95%.

This implies that there is significant effect of audio- visual intervention on the teaching of radioactivity in Basic Science at secondary school in Ibadan metropolis. Thus, the decision would be to reject the null hypothesis (H_0), and accept the alternative hypothesis (H_1).

In a study on the effects of audiovisual technological aids on students' achievement and interest in secondary school biology in Nigeria revealed that while Science teaching and learning is changing at an amazing pace in developed countries, same cannot be said of developing countries. Nigeria secondary school classrooms have remained chalk and board affair with students seated in rows copying notes.

In a developing country such as Nigeria, teachers need sustained support from colleagues at tertiary level who are compliant with the new technologies to help them learn how best to integrate technology into their teaching, it was revealed that the group exposed to lessons with Audio-visual technological contents integrated achieved higher in test scores than the group not exposed to[1]. However, this result support our finding that Video, Teachers" Voice, YouTube Video, and Pictorial Charts have significant effect on the students' academic achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis

The second hypothesis states that there will be no significant effect of audio-visual intervention on students" achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on gender. The result from the ANCOVA (Tests of Between Subject

Effects) table interprets that the covariate (Male) has no significant "effect" on academic achievement, as should be the case of students taught radioactivity in Basic Science at secondary school Fcal 0.006 at (0.939) significance level. Also, the "effect" of Female students have no significant, Fcal 0.357 at (0.885) significance level. Since the R Squared = 0.290, the implication of the result is that for every 100% change in academic achievement of students, audio-visual intervention gender based is responsible for 29.0% of the change.

The significance level below 0.05 implies a statistical confidence of above 95%. This implies that there will be no significant effect of audio-visual intervention on students' achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on gender. Thus, the decision would be to accept the null hypothesis (H_0), and reject the alternative hypothesis (H_1). The findings however support the results of the work conducted which discussed the impact of Audio-visual aids in teaching of social studies in primary schools in Dass Local government area of Bauchi State. The topic of this research tallied with that of this work as both of them focused on the impact of audio-visual aids on academic pursuit in term of gender. In their study, they used the quasi-experimental design which involved one treatment group and one control group with standardized achievement tests of students to determine the effect of audio-visual aids on students' performance and the same design was used in this research to determine the effect of audio-visual aids on students' academic achievement. The research findings revealed that there is no significant difference in the mean of social studies scores of students taught using audio-visual aids and the ones taught using the conventional teaching method in terms of gender[2].

The third hypothesis indicate that the ANCOVA (Tests of Between Subject Effects) table interprets that the covariate (Private School) has a highly significant "effect" on academic achievement, as should be the case of students taught radioactivity in Basic Science at secondary school Fcal 9.425 at (0.018) significance level. However, the "effect" on Public School is no longer significant, Fcal 2.864 at (0.097) significance level. Since the R Squared = 0.778, the implication of the result is that for every 100% change in academic achievement of students, audio-visual inter vention school type based is responsible for77.8% of the change.

The significance level below 0.05 implies a statistical confidence of above 95%.This implies that there is a significant effect of audio-visual intervention on students' achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on school type. Thus, the decision would be to reject the null hypothesis (H_0), and accept the alternative hypothesis (H_1).

Also in a study on effects of audio-visual materials in the teaching and learning of the speaking skill in Junior Secondary Schools in Katsina local government area of Katsina State, where all the findings from the data collection support that audio-visual aids facilitate language learning. Both the teachers and learners benefit from different audio-visuals materials in language classrooms. Audio-visuals make the language teaching and learning effective, making the class interactive and interesting, motivating the learners, facilitating language skills and so many[3].

However, one of the hypotheses had to be rejected base on the result from the analysis that there will be no significant effect of audio-visual intervention on students' achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on gender in terms of male and female students.

In a study on the impact of visual aids on students' academic performance in Mkuranga District secondary schools, the motive behind the study was to find out whether use of visual aids in teaching influences students" learning and academic performance. The study examined different visual aids used by teachers of Mkuranga district secondary schools and their effectiveness to students learning as well as challenges facing teachers in preparation and use of visual aids.

Findings of the study established that appropriate use of visual aids has influence on students' academic performance. Through study findings, it was revealed that many students in the schools studied performed poorly academically, as reflected in Form Four National examinations results, because teachers mostly relied on chalkboard as their major visual aid. They failed to supplement it with other visual aids in order to increase students" understanding and retention of what they taught them. This was caused by absence of different visual aids at schools as well as lack of fund to purchase and repair available visual aids. The situation was worsened by lack of skills and experience among most teachers. Apart from pre service training, teachers in the schools visited had not received any other training on preparation and use of visual aids[4].

Endnotes

1. M. T., Jaiyeola, & A. A. Adeyemo. *Quality of life of deaf and hard of hearing students in Ibadan metropolis, Nigeria. PLoSONE, 13(1), e0190130.2018.*
2. E.Ibeand J.Abamuche. *Effects of audio visual technological aids on students' achievement and interest in secondary school biology in Nigeria. Department of Science Education, Faculty of Education, University of Nigeria, Nsukka, Nigeria*. https://doi.org/10.1016/j.heliyon.2019
3. O. I. Akinwole. *The Effects of Audio-Visual Materials in the Teaching and Learning of the Speaking Skill in Junior Secondary Schools. International Journal of Social Science and Humanities Research ISSN 2348-3164. 2015.*
4. H. Ngonyani. *The impact of visual aids on students' academic performance: a case of Mkuranga district secondary schools. University of Tanzania. 2018.*

Chapter Five

Conclusion

This chapter gives a broad spectrum of the entire research work as this begins with the summary of the work from the first chapter to the last chapter, the findings that are to be thoroughly checked from the empirical point of view, the conclusion of this research work, recommendations that were proposed by the researcher will serve as a benchmark for further studies and research after this research work as to what is expected from them, suggestions were also made for further studies. The purpose of this study is to evaluate the effect of Audio-visual intervention on the teaching of Radioactivity in Basic Science in Junior Secondary Schools in Ibadan Metropolis. In the course of this research work, three hypotheses were proposed and tested using the analysis of Covariance (ANCOVA) to measure the impact of the independent variable to the dependent variable of hypothesis which determine the significance of the contribution of the Covariate (control), as well as whether the nominal variables (treatment) significantly predict the dependent variable, over and above the "effect" of the covariate.

5.1 Summary of Findings

Three hypotheses were postulated and the results derived shows that there is strong and linear relationship between the variables used to measure the two construct which invariably mean the teaching of Radioactivity as a topic in Basic Science in Junior secondary school improved drastically as a result of Audio - visual intervention. However, based on the information derived from field, it was discovered that students taught using Audio-visuals such as YouTube and audio-visual video CD achieved better in the topic Radioactivity in Basic Science than their counterpart taught using the conventional method.

The study was carried out on the "Effects of Audio-visual Intervention on Basic Science Students' Academic Achievement in Radioactivity at the Junior Secondary Schools in Ibadan Metropolis. A 2 x 2 x 2 quasi-experimental design which involved pre-test, post-test and intact group was used for the study. Sixty (60) JSS 2 students were selected from two junior secondary schools. One school was used for treatment and the other school for control. Three hypotheses tested at 0.05 level of significance guided the study. The Basic Science Achievement Test (BSAT)(KR20 = 0.71) was used for data collection. Data were analyzed using mean, standard deviation and ANCOVA. The results revealed that there was a significant effect of audio-visual intervention on the teaching of radioactivity in Basic Science at Junior Secondary schools in Ibadan Metropolis($F=4636.838$, $p = 0.00$) there was no significant effect of audio-visual intervention on the teaching of radioactivity based on gender ($F=2.852$, $p = 0.086$) while there was a significant effect of audio-visual intervention on the teaching of radioactivity based on school type ($F = 20.351$, $p = 0.000$) at Junior Secondary Schools in Ibadan Metropolis. It was recommended that Basic Science teachers in Junior Secondary schools should adopt the use of audio-visual materials while teaching radioactivity in class for better understanding of the subject matter.

5.2 Conclusion

Literature visited in this study has, without biasness, supported Audio- visual intervention as effective in the classroom learning compared to presentations encapsulated by words. Using a sample size of students of Junior secondary schools in Ibadan Metropolis, the study has found that students of Junior secondary schools in Ibadan Metropolis when taught Radioactivity in Basic Science with the use of Audio-Visual intervention did better in the posttest. The study has also established that students are motivated better when teachers make use of Audio-Visual aids in teaching learning process. This study has further established that the use of Audio-visual aids helps in supplementing the attention level of low ability students while increasing their understanding and intellectual capacity.

5.3 Recommendations

Based on the findings of this study, the following recommendations are made:

1. School administrators and Basic Science teachers should encourage students to participate in the learning process by making provision for them to access the school audio-visual facilities intermittently to discover and learn new things for themselves.

2. Policy makers in the Education ministry should ensure audio-visual aids is made compulsory at the Junior secondary level for effective teaching.

3. The Ministry of Education should redesign subjects' syllabuses to emphasize on the use of audio-visual aids and incorporate information about different visual aids in some topics.

4. Heads of schools should make sure that the budget allocated for the purchase of teaching materials such as audio-visual is fully spent on purchasing those items.

5.4 Suggestions for Further Studies

This study focused on the effect of Audio- visual intervention on the teaching of Radioactivity in Basic Science at Junior secondary school students in Ibadan Metropolis. Quasi-experimental approach was used and only two (2) secondary schools were sampled. The study findings are therefore a reflection of the visited schools and they cannot be generalized or claim to be inclusive. Given the sensitive nature of Audiovisual intervention and the link established between them and students' academic achievement, it would be reasonable to conduct another study using survey design that will involve a large sample in order to establish the magnitude of the challenges and be able to generalize the research findings.

5.5 Contributions to Knowledge

This study has provided a yardstick for bridging the gap of past research on the effect of Audio-Visual Intervention on the teaching of Radioactivity in Basic Science in Ibadan Metropolis, Nigeria. The study showed that the use of various Audio-Visual materials are strong predictors to Academic Achievements of Junior secondary school students while being taught Radioactivity in Basic Science

Bibliography

Journals

Adu-Gyamfi, K. *Education in Nigeria. Journal Article on Problems of Education in the 21st Century,* 53, 2013;7-21

Akinwole, O.I. *The Effects of Audio-Visual Materials in the Teaching and Learning ofthe Speaking Skill in Junior Secondary Schools. International Journal of Social Science and Humanities Research* ISSN 2348-3164. 2015.

Ainsley, M. *Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about science. Contemporary Educational Psychology*, 36, 2016;4–12.

Anderman, E.M, Sinatra, G.M & Gray, D.L. *The challenges of teaching and learning about science in the twenty-first century: Exploring the abilities and constraints of adolescent learners. Studies in Science Education*, 48(1), 2015;89-117.

Diamantis A, Magiorkinis E, Papadimitriou A, Androutsos G. *The contribution of Maria Sklodowska Curie and Pierre Curie to nuclear and Medical Physics. A hundred and ten years after the discovery of radium. Hell J Nucl Med.* 2018 Jan;11(1):33–38.

Cardinali, G.; Bolasco, G.; Aspite, N.; Lucania, G.; Lotti, L.V.; Torrisi, M.R.; Picardo, M. *Melanosome transfer promoted by keratinocyte growth factor in light and dark skin-derived keratinocytes. J. Invest. Dermatol*. 2008, 128, 558–567.

Christensen, D.M, Iddins C.J, Sugarman S.L. *Ionizing radiation injuries and illnesses. Emerg Med Clin North Am*. 2016 Feb;32(1):245–265.

Double, K.L.; Ben-Shachar, D.; Youdim, M.B.; Zecca, L.; Riederer, P.;Gerlach, M. *Influence of neuromelanin on oxidative pathways within the human substantia nigra. Neurotoxicol. Teratol.* 2012, 24, 621–628. 23.

Fredricks, J.A, Blumenfeld, P.C & Paris, A.H, *School Engagement: Potential of the Concept, State of the Evidence. Review of Educational Research*, 74(1), 2014;59–109.
Fuchs, E.; Raghavan, S. Getting under the skin of epidermal morphogenesis. Nat. Rev. Genet. 2016, 3, 199–209.

Goossens, L. Soenens, B & Dochy, F. *Identifying Configurations of Perceived Teacher Autonomy Support and Structure: Associations with Self-Regulated Learning, Motivation and Problem Behavior. Learning and Instruction,* 22(6), 2015;431-439.

Grupen Claus, Cowan G, Eidelman SD, Stroh T. *Astroparticle physics. Springer*; 2015:p.109
Hamada N, Fujmichi Y. *Classification of radiation effects for dose limitation purposes: History, current situation, and future prospects. J. Radiation resources* 2018 Jul;55(4):629–640.

Hassan, A.M. *Functional science and technology education tool for national economic empowerment and development. A Journal of Science, Technology and Mathematics Education*, 1(1), 2016;46-51.

Herrling, T.; Jung, K.; Fuchs, J. *The role of melanin as protector against free radicals in skin and its role as free radical indicator in hair. Biomolecular Spectroscopy*. 2018, 69, 1429–1435. 24.

Joshi, P.G.; Nair, N.; Begum, G.; Joshi, N.B.; Sinkar, V.P.; Vora, S. *Melanocyte-keratinocyte interaction induces calcium signalling and melanin transfer to keratinocytes. Pigment. Cell* Res. 2007, 20, 380–384.

Jang, H; Kim, E.J &Reeve, J. *Longitudinal Test of Self-Determination Theory's Motivation Mediation Model in a Naturally Occurring Classroom Context. Journal of Educational Psychology*, 104(4), 2012;1175-1188.

Jimbow, K.; Salopek, T.G.; Dixon, W.T.; Searles, G.E.; Yamada, K. *The epidermal melanin unit in the pathophysiology of malignant melanoma. Am. J. Dermatopathol*. 2011, 13, 179–188. Jimoh, M.F. *Teaching aids: a panacea for effective instructional delivery. Jos, Plateau state: Saints academy* 2018.

Kaptan, K& Timurlenk, O.*Challenges for Science Education. Procedia - Social and Behavioral Sciences,* 51,2016; 763–771.
Kalka, K.; Mukhtar, H.; Turowski-Wanke, A.; Merk, H. *Biomelanin antioxidants in cosmetics: Assessment based on inhibition of lipid peroxidation. Skin Pharmacol. Appl. Skin Physiol*. 2000, 13, 143–149. 20.

Klem, A.M & Connell, J.P. *Relationships Matter: linking Teacher Support to Student Engagement and Achievement. Journal of School Health,* 74(7), 2013;262–273.

Krane Kenneth S. *Introductory nuclear physics. John Wiley & Sons*; 2018:246–269
Mackintosh, J.A. *The antimicrobial properties of melanocytes, melanosomes and melanin and the evolution of black skin. J. Theor. Biol*. 2001, 211, 101–113. 21.

Madison, K.C. *Barrier function of the skin: ―la raison d'etre‖ of the epidermis. J. Invest. Dermatol*. 2003, 121, 231–241.

Madu, E.C. *The basics of audiovisual librarianship. Ibadan*: Evi-Coleman Publication 2017.
Mathematics and Science Study at the Fourth and Eighth Grades. Chestnut Hill, MA: IMSS & PIRLS International Study Center, Boston College 2015.

Meyskens, F.L., Jr.; Farmer, P.; Fruehauf, J.P. Redox regulation in human melanocytes and melanoma. Pigment. Cell Res. 2001, 14, 148–154.

Mohammed, Z. *Towards bridging the information gap in developed countries: the case of Nigeria. The international information and Library review.* 26 (2): 2014;91- 105.

Ngonyani, H. *The impact of visual aids on students" academic performance: a case of Mkuranga district secondary schools.* University of Tanzania. 2018.

Nordlund, J.J. *The melanocyte and the epidermal melanin unit: An expanded concept*. Dermatol. Clin. 2007, 25, 271–281.

Odusanya, A.K & Osinulu, L.F. *The impact of ETF funding on university libraries: a case study approach. African Journal of Library Archives and Information Science* 14(2):2012; 185- 192.

Oketunji, I &Nwalo, I.K. *Application for Information Technologies in Nigerian Libraries: Problems and Prospects in Information Technology in Library and Information Technology Education in Nigeria. National Association of Library and Information Science* 2015.

Okiy, R.B. *Funding Nigerian libraries in the 21st century: will funding from alternative sources suffice? The Bottom Line: Managing Library Finances* 18 (2): 2015;71-77.

Pajares, F. *Self-efficacy beliefs in achievement settings. Review of Educational Research*, 66, 2016;543-578.

Painter, J. *Autonomy, Competence, and Intrinsic Motivation in Science Education: A Self-Determination Theory Perspective (Unpublished Ph.D. thesis)*, University of North Carolina 2018.

Proksch, E.; Brandner, J.M.; Jensen, J.M. The skin: *An indispensable barrier. Exp. Dermatol*. 2008, 17, 1063–1072.

Rasmussen, J.O. *Models of Heavy Nuclei in Nuclear Spectroscopy, University ofCalifornia, Berkeley. Retrieved from* https://www.britannica.com/science/radioactivity; 2021.

Riley, P.A. Melanin. Int. J. Biochem. Cell. Biol. 2017, 29, 1235–1239.

Rutherford E.*Uranium radiation and the electrical conduction produced by it. Philos. Mag.* 2009;47(284):109–113.

Suleiman, Y. *International Journal of Mathematical Studies in Mathematics*,6(1), 2019;19-33

Scherer, D.; Kumar, R. *Genetics of pigmentation in skin cancer*—A review. Mutat. Res. 2010, 705, 141–153. 14.

Slominski, A.; Paus, R.; Schadendorf, D. *Melanocytes as ―sensory‖ and regulatory cells in the epidermis. J. Theor. Biol*. 2014, 164, 103–120.

Slominski, A.; Tobin, D.J.; Shibahara, S.; Wortsman, J. *Melanin pigmentation in mammalian skin and its hormonal regulation. Physiol*. Rev. 2005, 84, 1155–1228.

Tan,K.C.D & Kim, M. *Issues and Challenges in Science Education Research*, 1-4. **https://doi.org/10.1007/9 78-94-007-3980-2 2012**

Timins, J.K. *Communication of benefits and risks of medical radiation: A historical perspective. Health Phys*. 2011 Nov;101(5):562–565.

Wang, A., Marino, A.R., Gasyna, Z.; Gasyna, E.; Norris, J., Jr. *Photoprotection by porcine eumelanin against singlet oxygen production. Photochem. PhotoBiol.* 2018, 84, 679–682. 25.

Yamaguchi, Y.; Hearing, V.J. *Physiological factors that regulate skin pigmentation. Biofactors* 2009, 35, 193–199.

Young, G. *Institute of Physics; Radioactivity*, 2016

Zmijewski, M.A.; Skobowiat, C.; Zbytek, B.; Slominski, R.M.; Steketee, J.D. *Sensing the environment: Regulation of local and global homeostasis by the skin's neuroendocrine system. Adv. Anat. Embryol. Cell. Biol. 2012, 212, v-115.*

Books

Aharmian F, Akhperjanian A, Barrio J, Bernlohr K, Borst H, Cortina J & Gotting N. *The Tev energy spectrum of Markarian 501 measured with sterscopic telescope system of HEGRA during 1998 and 1999*. APJ. 2017;546(2):898**.**

Akanbi, S.F, *Productivity loss in brainstorming groups*; British Universities Film 2015.

Arum, A.M, *Advances in the development and Validation of instruments for assessing students' science knowledge.* Enugu: ABIC Publisher 2015.

Jaiyeola, M.T. & Adeyemo, A.A. *Quality of life of deaf and hard of hearing students in Ibadan metropolis, Nigeria.* PLoSONE, 13(1), e0190130.2018.

Dike,V.W. *Library Resources in Education* , 2016.

Paper Presentation

Anzaku, I.F *Library Experts Speaks on Audio-Visual Material. A paper presented at the United Nations Educational, Scientific and Cultured Organization (UNESCO) World Day for Audio-Visual Heritage*. Lafia, 2017

Theses

Eze, E.U. *Effect of Instructional Materials on the Academic Performance of Junior Secondary School Students in Social Studies, Unpublished PGDE Thesis*, Imo State University-Nigeria, 2015.

Ibe, E and Abamuche, J. Effects of audio visual technological aids on students' achievement and interest in secondary school biology in Nigeria. Department of Science Education, Faculty of Education, University of Nigeria, Nsukka, Nigeria. https://doi.org/10.1016/j.heliyon.2019

Appendix I

Lead City University, Ibadan
Department of Science Education
Basic Science Achievement Test (BSAT)

Dear Respondents,

This achievement test is designed to examine the effects of audio-visual intervention on the teaching of radioactivity in Basic Science at secondary schools in Ibadan Metropolis. It is basically for a research purpose. All information provided would be treated confidentially.

Please, be honest while providing your responses.

Thanks.

Section A

Demographic Information

Name: …………………………………………………………………………..

Name of school: …………………………………………………………..

Gender: Male () Female ()

Class: ……………………………………………………………………….

Age: …………………………………………………………………………

Appendix II

Basic Science Achievement Test on Radioactivity.

1. Which of the following is the spontaneous emission of radioactive elements?

a. Nuclear weapon

b. Radioactivity

c. Isotope

d. Electronic configuration.

2. The three major types of radioactive decays includes;

a. Radon, Uranium, Saturn

b. Titanium, Vanadium , Scandium

c. Alpha ray, Beta ray and Gamma ray

d. Thorium, Radium, Radiography

3. Which of the following scientists discovered Radioactivity?

a. John Dalton

b. Alfred marshal

c. Gregor Mendel

d. Henri Becquerel & Marie Curie

4. Which of the following makes up the atomic structure?

a. Protons, Neutrons and Electrons

b. Neurons, Nephrons and Dendrites

c. Neutrons and Protons only

d. Electrons only.

5. Unstable elements such as thorium and uranium are made stable through the process called

a. Reaction

b. Emission

c. Radioactivity

d. Atomic wavelength.

6. Which is the correct definition for an isotope?

a. Isotopes have more electrons than protons.

b. Isotopes have more protons than electrons.

c. Isotopes have more neutrons than protons.

d. Isotopes are unstable radioactive fossils.

7. What is true of atoms?

a. Atoms are made of two particles - protons and neutrons.

b. Atoms are made up of a nucleus and electrons.

c. Atoms are found in only a few objects on Earth.

d. All atoms are unstable and radioactive.

8. Isotopes of the same element have a different number of what atomic particles?

a. Protons

b. Neutrons

c. Electrons

d. Quarks

9. What type of radioactive decay will emit particles with no overall charge?

a. Alpha decay

b. Gamma decay

c. Beta decay

d. Theta decay.

10. What type of isotopes are termed radioactive isotopes?

a. Even

b. Stable

c. Unstable

d. Unbalanced

11. What type of radioactive decay is caused when there are too many neutrons in the nucleus?

a. Beta decay

b. Gamma decay

c. Alpha decay

d. Isotope decay.

12. What type of radioactive decay is caused when there are too many protons in the nucleus?

a. Alpha decay

b. Gamma decay

c. Beta decay

d. Delta decay.

13. What famous scientist was the original unit of measure for radioactivity named after?

a. Albert Einstein

b. Marie Curie

c. Nicolas Tesla

d. Robert Smith

14. What is the half-life of an isotope?

a. The time it takes for isotope to fully form

b. The average time it takes for an isotope to begin decaying

c. The average time it takes for half of the atoms to decay

d. The radioactivity of an isotope after 50% of it has decayed

15. What disease can be caused by the radiation from isotopes?

a. Influenza

b. Chicken pox

c. Cancer

d. Malaria

16. Which of the following is an example of the use of radiation in modern technology?

a. X-rays

b. Carbon dating

c. Energy generation

d. All of the above.

17. Which of the following is uranium used for?

a. Carbon dating

b. Radiography

c. Manufacture of military ammunitions

d. Making of aluminum.

18. What is a substance called that consists of a single type of atom?

a. Compound

b. Element

c. Mixture

d. Separation

19. What positively charged particle is located at the center of the atom in the nucleus?

a. Neutron

b. Electron

c. Proton

d. Neuron

20. What particle has no charge and affects the mass of the atom?

a. Electron

b. Proton

c. Neutron

d. Quark .

Appendix III

Table of specification for Basic Science Test Achievement

Content	Weight	Knowledge	Comprehension	Application	Synthesis	Analysis	Evaluation	Total
Radioactivity	20	1	2	1	1	-	-	5
Atoms	10	1	1			-	-	2
Types of Radioactive elements	20	1	2	-	1	-	-	4
Types of radioactive decay	20	1	1	-	-	-	-	2
Importance of Radioactivity	15	1	1	1	1	-	-	4
Dangers of Radioactivity	15	1	1	1	-	-	-	3
Total	100	6	8	3	3	0	0	20

Appendix IV

Answers to the Basic Science Test Achievement

1. B
2. C
3. D
4. A
5. C
6. C
7. A
8. B
9. B
10. C
11. A
12. A
13. B
14. C
15. C
16. D
17. C
18. B
19. C
20. C

Appendix V

LESSON NOTE

PERIOD 1

DATE:

TOPIC: Radioactivity

REFERENCE MATERIALS: Easy way to Basic Science for junior secondary schools book 3

INSTRUCTIONAL MATERIALS: YouTube videos and charts on atoms

LEARNING DIRECTIONS: Students will understand radioactivity

PERIOD:1

DURATION: 35 minutes

BEHAVIOURAL OBJECTIVES: By the end of the lesson, students should be able to;

1. Define radioactivity
2. State the meaning of atoms
3. Identify the parts of atomic structure
4. Give the types of radioactive decay
5. State the uses of radioactivity
6. Highlight the disadvantages of radioactivity

PREVIOUS KNOWLEDGE: The students are familiar with some elements of the periodic table.

PRESENTATION

STEP 1: The teacher revises the previous topic with the students.

STEP 2: Introduction and explanation of radioactivity to the students.

STEP 3: The teacher states the meaning of atoms and describes its structure to students.

STEP 4: The teacher explains the three types of radioactive decays as well as some examples of radioactive elements to the students

STEP 5: the teacher states the uses of radioactivity as well as its demerits.

STEP 6: The teacher summarizes the lesson for better understanding of the students.

EVALUATION

1. Define radioactivity.
2. State three uses of radioactivity
3. Give some examples of radioactive elements.

LESSON NOTE

PERIOD 2

DATE:

TOPIC: Radioactivity

REFERENCE MATERIALS: Easy way to Basic Science for junior secondary schools book 3

INSTRUCTIONAL MATERIALS: YouTube videos and charts on atoms

LEARNING DIRECTIONS: Students will understand radioactivity

DURATION: 35 minutes

BEHAVIOURAL OBJECTIVES: By the end of the lesson, students should be able to;

1. Define radioactivity
2. State the meaning of atoms
3. Identify the parts of atomic structure using audio-visuals
4. Give the types of radioactive decay using audio-visuals
5. State the uses of radioactivity using audio-visuals
6. Highlight the disadvantages of radioactivity using audio-visuals

PREVIOUS KNOWLEDGE: The students are familiar with some elements of the periodic table.

PRESENTATION

STEP 1: The teacher revises the previous topic with the students.

STEP 2: Introduction and explanation of radioactivity to the students.

STEP 3: The teacher states the meaning of atoms and describes its structure to students by showing them a YouTube video on atoms.

STEP 4: The teacher explains the three types of radioactive decays as well as some examples of radioactive elements to the students by showing them a video on beta rays,alpha rays and gamma rays

STEP 5: the teacher states the uses of radioactivity as well as its demerits such as carbon dating, radiography by showing them a video on some of the uses of radioactivity.

STEP 6: The teacher summarizes the lesson for better understanding of the students.

EVALUATION

1. Define radioactivity.
2. State three uses of radioactivity
3. Give some examples of radioactive elements.

TABLE 4.1.1 Analysis of Response Rate

Public School			Private School	Total	
Variable	**Control**	**Treatment**	**Control**	**Treatment**	
Pre-test	15	15	15	15	60
Post-test	15	15	15	15	60
Total	30	30	30	30	120

Source: Field survey(2021)

Model Summary

Model	R	RSquare	Adjusted R Square	Std. Error of the Estimate
1	.867[a]	.744	.222	6.17783

a. Predictors: (Constant), Video, Teacher's Voice, YouTube Video, Pictorial Charts

ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	305.277	4	76.319	5.000	.007[b]
Residual	381.656	10	38.166		

Total	686.933	14

a. Dependent Variable: Academic Achievement

b. Predictors: (Constant), Video, Teacher's Voice, YouTube Video, Pictorial Charts.

Levene's Test of Equality of Error Variances a

Dependent Variable: Academic Achievement

F	df1	df2	Sig.
4636.838	6	8	.000

Analysis of Co-Variance(ANCOVA)
Tests of Between-Subjects Effects

Dependent Variable: Academic Achievement

Source	Type III Sum Of Squares	Df	Mean Square	F	Sig.	Non cent. Parameter	Observed Power[b]
Corrected Model	555.629[a]	7	79.376	8.158	.006	57.109	.959
Intercept	519.041	1	519.041	53.349	.000	53.349	1.000
Treatment	177.562	1	177.562	18.250	.004	18.250	.953
Control	514.820	6	85.803	.819	.806	.915	.964
Error	68.105	7	9.729				
Total	4691.000	15					
Corrected Total	623.733	14					

a. R Squared=.891(Adjusted R Squared =.782)

b. Computed using alpha=.05

Hypothesis 2

H_o: There will be no significant effect of audio-visual intervention on students' achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on gender.

Levene's Test of Equality of Error Variances [a]

Dependent Variable: Academic Achievement

F	df1	df2	Sig.
2.852	6	8	.086

Analysis of Covariance (ANCOVA)

Tests of Between-Subjects Effects

Dependent Variable: Academic Achievement

Source	Type III Sum Of Squares	Df	Mean Square	F	Sig.	Non cent. Parameter	Observed Power[b]
Corrected Model	107.971[a]	7	15.424	.409	.869	2.865	.106
Intercept	549.677	1	549.677	14.588	.007	14.588	.904
Male	.238	1	.238	.006	.939	.006	.051
Female	80.707	6	13.451	.357	.885	2.142	.097
Error	263.762	7	37.680				
Total	6696.000	15					
Corrected Total	371.733	14					

a. R Squared=.290(Adjusted R Squared=-.419)

b. Computed using alpha=.05

Hypothesis3

H_0: There will be no significant effect of audio-visual intervention on students achievement when taught radioactivity in Basic Science at the Junior Secondary Schools in Ibadan metropolis based on school type.

Levene's Test of Equality of Error Variances [a]

Dependent Variable: Academic Achievement

F	df1	df2	Sig.
20.351	6	8	.000

Analysis of Covariance (ANCOVA)

Tests of Between Subjects Effects

Dependent Variable: Academic Achievement

Source	Type III Sum Of Squares	Df	Mean Square	F	Sig.	Non cent. Parameter	Observed Power[b]
Corrected Model	349.874[a]	7	49.982	3.508	.060	24.558	.643
Intercept	18.752	1	18.752	1.316	.289	1.316	.169
Private School	134.274	1	134.274	9.425	.018	9.425	.750
Public School	244.813	6	40.802	2.864	.097	17.184	.528
Error	99.726	7	14.247				
Total	5096.000	15					
Corrected Total	449.600	14					

a. R Squared=.778(Adjusted R Squared =.556)

b. Computed using alpha=.05

Bio-Data

Name:	Oluwatobi Favour FOLADE
Sex:	Female
Date of Birth:	20th March
State of Origin:	Ondo
L.G.A:	Ondo West
Nationality:	Nigerian
Marital Status:	Single
Languages spoken:	English, Igbo, Yoruba
Residential Address:	Lagos, Nigeria.
Email/Phone Number:	favourfolade@gmail.com/08160966925

Institutions Attended With Dates

Lead City University, Ibadan	2019 till date
Obafemi Awolowo University, Ile-ife	2017
Akinrotoye Memorial High School,Lagos	2009
Christ the Saviour School, Lagos	2002

Academic and Professional Qualifications With Dates

M.ed Biology Education (in view)	
B.sc(Ed) Biology	2017
Senior Secondary School Certificate	2009

Membership of Professional Bodies

Member, Teachers Registration Council of Nigeria (TRCN)

Work Experience

Lead City International School, Ibadan	2018-2021

Hobbies

Reading, Teaching, Cooking and Travelling

Referees

1. Dr. Christianah Sam-Kayode

   Department of Science Education

   Lead City University, Ibadan.

   08165357640.

2. Mr. Samuel Olorunfemi

   Site Administrator

   Design Union, Lagos Nigeria

   07030562300

The University Compliance Form

This is to certify that the thesis by Oluwatobi Favour FOLADE in the department of Science Education, Faculty of Arts and Education, Lead city University, Ibadan, Oyo Metropolis is in full compliance with the approved University Format and Style