AVAILABILITY AND UTILIZATION OF GRAPHICS INSTRUCTIONAL MATERIAL IN TEACHING AND LEARNING OF BIOLOGY AT SENIOR SECONDARY SCHOOL IN BOSSO LOCAL GOVERNMENT AREA

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TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

This study examined the availability and utilization of graphics instructional material in teaching and learning of Biology at senior secondary school in Bosso Local Government Area, Niger State. The study adopted the descriptive survey design while the study population comprised all the secondary schools in Bosso Local Government Area, Niger State. The sample consisted of five (5) randomly selected secondary schools and twenty (20) respondents drawn randomly from the study population. The instrument used to collect data for the study was a questionnaire titled "Questionnaire on the Availability and Utilization of Graphic Instructional Material" (QAUGIM))" while the data collected was analysed using mean and percentage. The findings showed that graphic instructionalmaterials are available but are not utilized in senior secondary schools in Bosso Local Governement Area, Niger State. The null hypothesis was test for the study at 0.05 level of significance. The finding revealed that, there was no significant difference in the gender of teachers and the utilization of graphic instructional materials in senior secondary schools; The study recommended among others that, graphics instructional materials should be made available in senior secondary schools so as to promote effective teaching metho

1.0   **INTRODUCTION**

1.1 Background to The Study

Nwabuaku (2016) noted that Biology is one of the core subjects offered at the senior secondary level of education. The Biology curriculum is composed of both practical and theoretical aspects. Students of Biology are required to be examined in these two aspects in their senior secondary school certificate examination, this makes it mandatory that students must pass both the theoretical and practical aspects of the Biology curriculum in order to be certified. Biology is a fundamental part of science taught at the secondary school level in Nigeria. It centers on the understanding of life and includes the study of plants and animals. Basically, it studies the function, structure, evolution, taxonomy, growth and distribution of living organisms. Biology is essential because it informs about the natural world around us (Umar, 2011). It is a science subject taught through theory and practical components. Practical activities in Biology provide the chance for students to execute scientific processes in the laboratory and outside the laboratory, which is different from the theoretical learning of science.

Biology is undoubtedly an essential discipline. Its application could help to provide answers to some challenging issues of our time, most especially the challenges of population explosion, human impacts on ecosystems and climate change (Kim & Doing, 2012). Practical work is a crucial and important feature of science-oriented subjects. Many science teachers believe that a student's participation in practical work leads to better learning, because real learning is achieved when a person comes up with the meaning of things they stumble upon on their own.

Wiley et al, (2017) noted that Graphics presented alongside expository science texts can have a number of positive effects for instruction, including facilitating engagement, arousing interest, and improving understanding. Graphics refer to visual images that convey crucial

information or provide aesthetic appeal to the information presented. A few common examples of graphics are icons, illustrations, photographs, graphs, diagrams, maps, art, and animations. Graphic materials are used as instructional material in the classroom, they are said to enhance the teaching and learning process by capturing the learner's attention.

Hence, there is need for graphic instructional materials to be available and adequately utilized in the classroom as they greatly influence education quality and standards and they affect the teaching and learning process (Dhakal, 2017). Instructional materials are intermediate or mediating materials used in instruction or teaching learners so as to make the learning objectives clearer and teaching easier.

For teaching and learning activities to be effective and purposeful, the teacher has to make available and use the appropriate instructional materials. The term availability relates to how much instructional materials are on hand, to which teachers and learners have access to. As a concept, it is an umbrella term that denotes the serviceability, resilience, reliability and maintainability of a component instrument (Uzuegbu, et al, 2013). Instructional materials provide the core information that students will experience, learn, and apply during a course. They hold the power to engage students and motivate them to learn.

Despite the importance of instructional materials, they are available and not utilized when teaching in the classroom. The inadequate use of instructional materials in most schools and majority of the teachers did not take cognisance of the importance derived from the use of instructional materials while teaching (Bukoye, 2016).

The teacher must know the instructional materials that are available for teaching and be able to utilize them for achieving the educational objectives. This implies that the use of instructional materials is inevitable if effective teaching and learning must be achieved. It is said that one picture is equal to one thousand words. This agrees with the Chinese proverb that state: The

thing which I hear, I may forget, the thing which I see, I may remember, the thing which I do, I cannot forget. When instructional materials are properly used, they help to consolidate learning in the learner's mind. The use of instructional materials therefore, becomes very crucial in improving the overall quality of the learning experiences of students. (Dhakal, 2017).

1.2 Statement of Research Problem

The teaching of Biology in most schools is not pleasant either due to poor teaching strategy or the unavailability of instructional materials, thereby causing poor performance and sapping the interest of student in Biology (Akinbobola, 2011). Despite the importance of Biology to man, most science teachers in Nigeria lay emphasis on the theoretical aspects of science and expose science students to few or no practical activities. Therefore, many students see science as abstract and irrelevant to their lives due to the lack of laboratory practical lessons (Kolawole & Oginni, 2009). The West African Examination Council (WAEC) Chief Examiners' Report (2015) on May/June & Nov/Dec WASSCE Biology practical from 2009 to 2013 showed inconsistency in the performance of students in Biology practical. There were marginal improvements in the performance, but generally, the students' performance in Biology practical is unsatisfactory. Several studies have made known the factors responsible for ineffective teaching and learning as well as poor enrolment of students in Biology. The factors include lack of exposure to practical work, lack of qualified teachers, ineffective use of teaching methods and inadequacy of computers (Ahmed & Abimbola, 2011; Akinfe, Olofinniyi & Fashiku, 2012; Auwalu, Mohd & Muhammad, 2014; Kareem, 2003; Nzelum, 2010). It is in this light that the above study focuses on investigating the availability and utilization of graphics instructional material in teaching and learning of Biology at secondary schools in Bosso Local Government Area.

1.3 Aims and Objectives of the Study

The aim of this study is to investigate availability and utilization of graphics instructional material in teaching and learning of Biology at senior secondary school in Bosso local government area. Specifically, the study is designed to achieve the following objectives:

- Examine the availability of graphics instructional materials in senior secondary schools in the teaching and learning of Biology.

- To determine the utilization of graphics instructional materials in senior secondary schools in the teaching and learning of Biology.

- To find out the gender of teachers in relation to the utilization of graphics instructional material in teaching of Biology at senior secondary schools.

1.4 Research Questions

The following research questions were raised to guide this study:

1. To what extent are instructional materials available in senior secondary schools in the teaching and learning of Biology?

2. To what extent are instructional materials utilized in senior secondary schools in the teaching and learning of Biology?

3. To what extent is the relationship between the gender of teachers and the utilization of graphics instructional material in teaching of Biology at senior secondary schools?

1.5 Research Hypothesis

The following research hypothesis was tested in the study

HO_1 There is no significant difference in the gender of teachers and the utilization of graphics instructional material in teaching of Biology at senior secondary schools.

1.6 Significance of the Study

The result of this research will be of immense importance or benefit to teachers, students, parents, government and the society at large.

The findings of this study will help students to overcome the challenges or difficulties they are facing in learning many concepts in Biology as they will realize the importance of graphic instructional materials in teaching and learning.

The findings of this study will also help teachers in selecting the desirable instructional material; graphics to be specific to use during teaching. This will enhance the teaching and learning process in the classroom and improve communication as concepts taught will be better comprehended and understood by students.

The result of this research will be of immense benefit to parents and the society at large since parents will realize the importance of graphics and how it directly stimulates their wards and provide efficiency during learning and also to the society since it will improve literacy level and build adequate comprehension and understanding skills.

Furthermore, this research work will serve as reference source to the government when formulating and implementing policies that will improve teacher's competency with a view of making learning easier and enhance national growth.

1.7 Scope of the Study

This study examines the availability and utilization of graphics instructional material for teaching and learning of Biology at senior secondary schools in Bosso Local Government Area. Graphics instructional materials is the independent variable while availability and utilization are the dependent variables. The study is expected to last for a period of four (4) weeks.

1.8 Operational Definition of Terms

Biology: Biology is the studies of the function, structure, evolution, taxonomy, growth and distribution of living organisms

Graphics: Graphics refer to visual images that convey crucial information or provide aesthetic appeal to the information presented.

CHAPTER TWO

2.0   **REVIEW OF RELATED LITERATURE**

The major areas reviewed under this project work are classified into:

Conceptual framework

Theoretical framework

Empirical studies

Summary of Literature Reviewed

2.1 Conceptual Framework

2.1.1 Concept of Teaching and Learning

Learning can be reinforced with different teaching and learning resources because they stimulate, motivate as well as focus the learners' attention for a while during the instructional process (Saidu & Garba, 2016). Instructional materials in teaching and learning are highly important in teaching and learning since they are stimulating and motivate learners by capturing their attention and make the learning process concrete since they transform spoken words and writings into vivid and "eye-catching" illustrations.

Graphic instructional materials are designated teaching and learning materials that may be locally or commercially produced. Research in graphics instructional materials has shown promise in the aspect of teaching and learning due to its stimulating, engaging and motivating components but there is need to investigate its real-life impact on classroom teaching and learning, hence this study is aimed at investigating the availability and utilization of graphics instructional material in teaching and learning of Biology at senior secondary schools in Bosso Local Government Area of Niger State.

2.1.2 Concept of Biology

Biology is the study of living things and their vital processes (Rogers, 2019). The field deals with all the physicochemical aspects of life. The modern tendency toward cross-disciplinary research and the unification of scientific knowledge and investigation from different fields has resulted in significant overlap of the field of Biology with other scientific disciplines. Modern principles of other fields—chemistry, medicine, and physics, for example—are integrated with those of Biology in areas such as biochemistry, biomedicine, and biophysics.

Biology is a science that studies living things; which involves plants and animals. If science is defined as the study of natural world, Biology focuses on the systematic study of the living world. As a result of its importance, the subject Biology is one of the core subjects in senior secondary schools' curriculum in Nigeria. Biology is important in school curriculum and serves as a foundation to several courses and careers such as medicine, which included Ophthalmology, Morphology, and Anatomy, physiology, Hematology, Dentistry, Gynecology and so many related careers. Biology has a role to play in Agriculture, Environmental control, 15 population control, pharmacy, Laboratory analysis and in some areas of Biology such as Anatomy, Botany, Zoology, Biological Science, Genetics, Ecology and others. Biology enables one to become more aware of one's changing environment such as effect of drought on plants, explores it and adapt to it better. Chileshe (2016) explains that Biology is one of the most important subjects that should be taught meaningfully by creating awareness in the minds of the learners hence the use of instructional materials or concrete materials should be used to enhance effective learning.

2.1.3 Educational Technology

Educational technology is concerned with the systemic implementation of science and technology in the field of education (Edufocus, 2015), and can thus be described as the

application of technology to education in order to advance teaching and learning. Much as science and technology aid in the performance of practical tasks in general, educational technology aids in the effectiveness of teaching and learning tasks (Waddell, 2015). Educational technology offers technological guidance and solutions to educational issues (Oureducare, 2020). Teaching is a form of communication, and educational technology can help teachers and students communicate more effectively (Silver, 2018). Education technology covers the entire teaching and learning process, which includes elements such as the ones mentioned below (Kumari & Gupta, 2019):

- Specification of goals and behavioral objectives.

- Analysis of the characteristics of the learner.

- Selection and organization of the content or subject matter to be learned.

- Methods and strategies of the presentation of the content.

- Use of aid-materials, software and hardware, mass media and communication techniques.

- Effective arrangement of learning situations and learning environment.

- Effective classroom control and management.

- Continuous feedback and evaluation of the results.

Kumari and Gupta (2019) argued that educational technology is more than just the use of audio-visual aids and does not just refer to sophisticated gadgets and mechanical equipment used in schools. It tends to use the outcomes of all goods, experiments, and researches in the area of human learning and the art of communication for the successful management of the overall teaching-learning process and uses a mixture of all possible human and non-human tools to accomplish the required educational objectives (Kumari & Gupta, 2019). In summary, educational technology should represent the wise use of accessible human and non-human capital to provide effective solutions to educational challenges and to enhance the educational process and goods (Kurt, 2017).

Objectives of Educational Technology

Educational technology, through the capacity of technology in education, provides valuable assistance in the overall teaching-learning process for delivering the best possible outcomes in the most cost-effective manner using accessible human and non-human capital (US Department of Education, 2017). In this regard, the main goals of educational technologies can be outlined as follows (Shafi, 2016):

1. To identify educational needs aspiration of the community.
2. To determine the aims of education, broad strategies and structure of education.
3. To develop a sustainable curriculum with interaction with science, art and human values
4. To identify man-material resources and strategies for achieving the stipulated aims of education.
5. To develop certain models leading to improvement of the process of teaching and learning.
6. To develop the appropriate aids and equipment to meet the educational purposes.
7. To identify the major constraints in the environment and the ways and means to tackle those.
8. To help in extending educational opportunities to the masses especially the neglected section of the community.
9. To manage the whole educational system covering planning, implementation and the evaluation phases.

Scope and Significance of Educational Technology

Educational technology attempts to address the concept of teaching, analyse the teaching method, variables of teaching, phases of teaching, stages of teaching, theories of teaching, principles and maxims of teaching, the concept of learning, the importance of theories, and the relationship between teaching and learning. Educational technology is concerned with the production and development of suitable teaching and learning materials in light of defined

goals, curriculum design, and available resources. The teacher is a pivotal figure in every teaching and learning process. As a result, educational technology is responsible for ensuring that teachers are well prepared to carry out their diverse duties. It assists in the discovery, acquisition, and implementation of effective teaching techniques and tactics, as well as the development, collection, and usage of appropriate audio-visual aids: the use of appropriate audio-visual aids has a significant impact and advantage on teaching-learning. This subject is covered by educational technology by addressing different forms of audio-visual aids used for educational purposes, as well as their correct selection for a specific teaching and learning scenario. The efficient use of hardware and mass media: various sophisticated instrument, tools, gadget, and networking technologies brought on by the mechanization and electronics revolution play an effective role in the attainment of educational objectives by assisting teachers and learners in their respective roles. Thus, educational technology is concerned with all variables, phases, levels, and aspects of the teaching and learning process.

2.1.4 Instructional materials

Meaning/definition of instructional materials

Instructional materials are alternate channels of communication that a classroom teacher may use to help a student understand a concept during the teaching and learning process. Classroom teachers have traditionally relied heavily on the "talk-chalk" system of instruction. However, instructional materials have recently aided in providing variations in how messages are communicated. When teachers and students use educational materials, they not only broaden the number of sense organs available to them, but they also broaden the range of materials available for conveying the same message using the same organ. An instructor, for example, can control actual objects or use stimulators when teaching a subject. Instructional materials therefore constitute the media of exchange through which a message transaction is facilitated between a source and a receiver. In addition to extending the range of materials that can be

used to convey the same instructional message to learner's instructional materials also facilitate the 'process' nature of communication. Since communication is a mechanism, both the sender and the recipient of a message are actively involved in a communication encounter. In reality, it means that in every exchange, both the receiver and the sender share and exchange thoughts and feelings (Tyler, 1987, Dike 1989). What role do instructional materials play in emphasizing the 'process' essence of communication? Instructional materials do so because they are physical items that learners can use. A learner engages with the content during such use. Such interaction may involve a learner manipulating the instructional material and expressing his or her thoughts on the issue and concept encapsulated in the material. Then, any feedback obtained from such usage informs the teacher (which is the source) the extent to which a learner has attained an instructional objective. Besides, Nigeria is aware of the importance of instructional materials for effective communication in her school system. For example, in 1975, the Federal Ministry of Education arranged an exhibition of improved instructional materials created by classroom teachers from across the federation in four centres: Lagos, Ibadan, Kaduna, and Enugu. At these exhibitions, participants showed a variety of instructional materials that they had improvised to aid learners' concretive learning in various subject areas. People who attended this show felt that a follow-up to these exhibits should have been a compilation of all improvised instructional materials with the aim of building infrastructure to promote the mass manufacturing of appropriate ones. Unfortunately, this kind of follow-up was hindered. Nonetheless, in recognition of the value of instructional materials, the Federal Ministry of Education established a National Education Technology Center (NETC) in Kaduna. Furthermore, state ministries of education have developed units responsible for instructional materials, and several colleges of education, polytechnics, and universities have established Departments of Educational Technology, aimed at training mechanics in the manufacture and use of various software/hardware materials (Federal Republic of Nigeria, 1977,1991,2004).

Despite this increased understanding on the part of educators, which contributed to the creation of these establishments, Nigerian teachers continue to focus on the conventional 'talk-chalk' method of teaching. This explains why, in 1985, the federal ministry of Education held another show of classroom teachers' homemade instructional materials. As a new dimension, the 1985 exhibition took the form of a competition among the federation's nineteen (19) nations. A Task Force on National Festival of Instructional Materials, for example, was established in Rivers state. These task force organized competitions in each local government headquarter with a view to selecting winners to represent the state at the national level in Kaduna. Hopefully, the outcome of this competition will be the establishments of other infrastructures which will eventually lead to mass production, distribution and utilization of these instructional materials-since it (instructional materials) provide a wide range of alternative Avenue through which the same unit of instruction can be presented to an audience.

Type of instructional materials

(1) Graphic materials: - This represents the charts, graphics, posters and diagrams, cartoons, comics, maps, and globes that we draw on cardboard paper or cloth and bring to our students to help them understand what we have worked so hard to illustrate orally. Graphic materials are a kind of two-dimensional material with proportional relationships that may occur between variables in a phenomenon. Graphic materials are used to simplify information, focus and captivate attention, vary the stimulus displayed, and assist in recall. Graphic materials when properly produced can help in attaining all processes in the information processing model of learning as well as serve as avenue for applying principles from other learning theories.

(2) Three-Dimensional Materials: -They are different from charts and graphs which are illustration of two-dimensional materials because of the incorporation of a third element-department. Thus, whereas graphs and charts embrace the width and height of a visualized

object, a three-dimensional embrace this third element department, a feature that makes the three-dimensional material a replica of the real thing. Different types of three-dimensional materials exist, namely: Models and mock-ups, regalia, specimen, kits and dioramas-which is the creation of a scene in an event.

(3) Still pictures: -This refers to flat opaque pictures which we take during festivals or when we are commemorating an event. They also refer to pictures we fined in journals and magazines. They are called still pictures because in admiring them, we hold them in our hands or place them on a surface, which is we do not view them with the aid of projector, as is the case with motion pictures or still projected pictures. Like graphic materials, still pictures belong to the group of two -dimensional materials.

(4) Still projected pictures: -Still projected pictures is a class of instructional materials which our learners may not be familiar with. Therefore, in order to assist then to better, understand what is meant by still projected pictures, is the negative format. Still projected pictures can be projected with a projector. The projector has powerful electronic bulbs, which throw light on to the image on the negative, and image is finally projected on to a screen or wall. Therefore, when dealing with still projected pictures, one is automatically dealing with a whole range of materials (such as slides, overhead transparency, filmstrip etc.) whose image are imprinted in a negative/film and which has to be projected using different types of projector. A major characteristic is still projected pictures is that the images are projected one frame at a time. This is a major difference between still projected pictures and motion pictures. This characteristic enables a still projected picture to stay for as long as a learner wants it on a screen.

(5) Motion pictures: -Motion pictures are distinct from the other types of pictures because of the speed at which they are projected. It is this speed of projection that intact gives the impression of motion. Motion pictures range from the 8 mm standard format to 8 mm supper

and finally to the 16 mm format. The width of the film thus constitutes a basic for classifying them. Motion pictures films have sprocket holes along both edges or along only one edge. The presence of sprocket holes facilitates projection. Motion pictures can be projected at 16 or 24fps (frame per second.) They can be silent or accompanied with sound. Sound films use either a magnetic tape or optical sound track for sound recording. If a film is sound, only one edge bears the sprocket holes while the other edge bears the sound components.

(6) Audio Materials: -This is a class name for tape recordings and discs. A disc or record as it is popularly called here is a round and flat acetate containing grooves, which produces sound vibrations through the action of a needled. Discs usually come in different sizes and play at different speeds. The clarity of sound production from disc rests on the quality of needle, the speed and state of the grooves. Obviously, in oversea countries records exist for almost all subjects. People in music department appreciate the importance of records in their studies. Special effects such as the sound of thunder the cry of owl at night, the noise produced in a factory during work can all be recorded in disc and synchronized with other events to create special effects during production. To use a record, a teacher has to specify his objectives thoroughly. Hence, students can listen to a record as a group or individually.

Importance of instructional materials

1. The aim of producing instructional materials is to make the teaching and learning process easier. The point is not to use such instructional materials as decoration in our classrooms or as exhibits to be displayed at award-winning national exhibits on enhanced instructional materials. If the aim of creating educational materials is to use them to promote teaching and learning, it seems obvious that the best path to take in any development exercise is to base production on research results on how individuals learn. Furthermore, there are several causes that influence human interest. There are also ideas about how we perceive objects. Hence, for

a classroom teacher, who wants .to produce instructional materials, his production has to be on sound principles.

2. While presenting various learning theories, one has to be sure that a classroom teacher guided by expert ideas during his production and utilization of instructional materials.

3. They supply a concrete basis for concept tonal thinking and reduce meaning less work responses for pupils as it makes learning more permanent.

4. Instructional materials have a high degree of interest for the learner; for they offer a reality of experience, which stimulates self-activity on the part of pupils.

5. Instructional materials develop a continuity of thought, this is especially true of motion pictures, as they provide experiences not, easily obtained through other materials and contribute to the efficiency, department and variety of learning. Therefore, the use of instructional materials in teaching/learning process exposes the learner to primary experiences and this enriches learning. In order to use instructional materials and aid more effectively, Instructional materials must make learning more real and meaningful to the learner, the materials should not be substitute for learning but must contribute to the learning process itself. It is suggested that the time spent on the use of instructional materials to facilitate learning should commensurate with the lesson period, allowed. Instructional materials should be useable and not so ' complex that the time is spent on just learning to use them (instructional materials). Instructional materials to be used must make learning more real and meaningful to the learner. And finally, the use of several kinds of instructional materials to explain one particular concept must also take cognizance of individual difference among the learners.

2.1.5 Graphics in Teaching and Learning

Mudasir and Aqueel (2012), outlined the main graphic aids used in teaching and learning as follows:

i.   Diagrams: A diagram is a drawing that shows arrangements and relations of parts to the whole. It is a visual symbol made up of lines, curves and geometrical forms. These are used for teaching science, geometry, geography, and so on.

ii.   Graphs: A graph is a diagrammatic representation of numeric or quantitative data. They are considered as pictures which are self –explanatory and tell their story at a glance. They are used for analysis, interpretation and for comparison. The different types of graphs include line graph, bar graph, circle or pie graph, pictorial graph and flannel graph.

iii.   Maps: A map is an accurate representation of plain surface in the form of a diagram drawn to scale, the details of boundaries of continents, countries etc. Geographical details like location of mountains, rivers, altitude of a place, contours of the earth surface and important locations can also be represented accurately with reference to a convenient scale with suitable colour scheme. Maps are of different types such as topographical maps, wall maps, atlas maps, relief maps, geographical maps, mineral maps, agricultural maps etc. As teaching aids, they are indispensable in teaching fundamental concepts such as size, distance, space, location and direction.

iv.   Posters: A poster is a bold and symbolic representation of a single idea. It is used in all walks of life, to convey, forcibly the desired information to a layman.

v.   Cartoons: A cartoon is a metaphorical presentation in the form of picture or a sketch. It is universal in appeal and conveys only one idea.

vi.   Flashcards: Flash cards are pieces of card board or hand paper on which a word or words are written or some picture is drawn. These can be used for word recognition, team competitions, teaching in speaking, and teaching writing.

vii. Charts: A chart is a combination of pictorial, graphic, or numerical materials which presents a clear visual summary. The most commonly used types of charts include outline charts, tabular chart, and organization charts.

2.1.5.1 Principles and Elements of Graphics Design

Graphic design is the process of visually transmitting knowledge by using text and photographs. The structural concepts and ideals are the building blocks that are used to make a piece of art. The elements of graphic design can be thought of as the components that go into creating a successful painting, drawing, or other work of art. Azi (2011) identified seven design elements:

- Line: Line can be considered in two ways. The linear marks made with a pen or brush or the edge created when two shapes meet. The eye travels around the space created by the line. It defines the position and direction of design. The design should identify some sort of line so that human eye can recognize which side is the top of the design or on which side the design is supposed to start with interest.

- Shape: Shape is something distinguished from its surroundings by its outline within a design. It is a self-contained area of geometric or organic form. Shapes are powerful communicators as well, even when they are not used directly in a contrasting manner. For example, circles have always been associated with the endless rhythmic patterns of time, symbolizing eternity without clear beginnings or endings, triangle convey direction, and so on.

- Direction: All lines have direction; horizontal, vertical, or oblique. Horizontal lines suggest calmness, stability and tranquility. Vertical gives a feeling of balance, formality and alertness. Oblique suggest movement and action.

- Size: Size is simply the relationship of the area occupied by one shape to that of another. Proportion can be achieved by incorporating elements of varying sizes or shapes in a layout.

- Texture: Texture is the surface quality of a shape –rough, smooth, soft, hard, glossy, etc. Texture can be physical (tactile) or visual. It helps a design to distinctive characteristics.

- Colour: Colour is the most visible component of light that falls on a retina of the eye. Colour is of value when it emphasizes relevant cues, is used as a coding device, or when it is part of the content to be learned (Clark and Lyons, 2004). Warm colors (red, orange) come forward and command our attention, while cool colors (blue, green) recede. Also the colours on one side of the design should matches with the other.

- Tone–This is the relative lightness or darkness of a colour. The colours on a design should be light or dark enough for the proper mood.

Principles of graphic designs

Graphic design principles are essentially the rules for creating graphic visuals (Jiskha, 2012). They can be thought about as what designers do to design elements. The application of design principles influences the success of designing a piece of art. Palilonis (2006) identified the following principles of "good" graphic design:

- Balance–This refers to designing of graphics for a comfortable sense of equilibrium. Asymmetry creates a sense of movement and helps to guide the eye; symmetry conveys stability and uniformity and is thus more conservative. For instance, a large shape close to the center can be balance by a small shape close to edge. Visuals that lack balance disrupt the perception process of learners.

- Harmony: This means how well individual parts of a page work together, and are consistent, like typefaces, shapes, and lines. Harmony is the visually satisfying effects of combining similar, related elements. E.g. adjacent colours on the colour wheel, similar shapes etc.

- Repetition (rhythm): This concerns the arrangement of elements in the visual that moves the viewers" eyes across a graphic. Repetition with variation is interesting, without variation is monotonous.

- Contrast: This helps to define what is important, and can be used with text, color, and shapes. It is the juxtaposition of opposing elements e.g. opposite colours on the colour wheel, contrast in value or tone –light/dark, contrast in direction –horizontal/vertical etc. Contrasting elements guide the eyes around the page, create a hierarchy of information, and enable viewer to skim through the vast array of information pick out what was needed (Illian, 2012). The major contrast in a graphic should be located at the center of interest. Too much contrast scattered throughout a graphic can destroy unity and make a work difficult to look at.

- Textures-The spatial arrangements of elements in a graphic to attract attention, in such a way that it enhances recognition.

- Proximity–This refers to the placement of objects being either close together, if they "belong" together or far apart if they don't. should help the teacher to design and evaluate instructional graphics based on whether the intent of a graphic is to contribute to learning or to the affective appeal of a lesson.

2.1.6 Impact of Graphics on Learners' Memory

Graphics have been used in teaching materials for decades to improve literacy (Rieber, 1994). If computing technology has evolved, so has the possible scope and overall quality of graphics. Pictures, illustrations, charts, maps, diagrams, outlines, animations, and so on are examples of

graphics. Color, transparency, and animation are several examples of improved features that are now widely used. Alesandrini (2002) explains that graphics can help to simplify difficult, complex, and/or abstract material (e.g., a government organisational chart), and graphics can be used as an analogical bridge between familiar, already learned materials and unfamiliar, or to be learned material (e.g., a graphic of a familiar truck to facilitate learning the functions of an unfamiliar red blood cell). Tversky et al. (2002) provided some compelling reasons why graphics should be used to enhance learning. In such instances, an image truly is "worth a thousand words." Hence, the use of graphics can contribute to more efficient information processing by using the visual channel while reducing the amount of information that must be processed through the verbal channel. Second, well-designed graphics can arrange complicated materials so that main aspects are more easily ascertained and interpreted, as well as reveal spatial relationships between crucial elements that a learner would otherwise miss. Mayer (2003), noted that active processing assumption, well-designed graphics will provide the necessary framework for learners to efficiently select, arrange, and incorporate new material. Based on the current Occupational Safety and Health Administration (Osha, 2012), graphic depictions have a significant effect on growing learners' comprehension and retention. This assertion has the potential to be supported. Thus, Osha (2012) noted that empirical studies on human learning and memory show the following fascinating statistics that support these findings: Experimental psychologists and educators discovered that memory retention three days after a conference or other event is six times better when conveyed visually and orally than when presented verbally alone. Studies by educational researchers suggest that approximately 83% of human learning occurs visually, and the remaining 17% through the other senses -11% through hearing, 3.5% through smell, 1% through taste, and 1.5% through touch. The studies suggest that three days after an event, people retain 10% of what they heard from an oral presentation, 35% from a visual presentation, and 65% from a visual and oral

presentation (Osha, 2012). A general benefit of graphics is that they are visually appealing. Viewers' attention is attracted to these displays, and viewers are more likely to study them for longer periods of time. This, in turn, can lead to enhancement of memory for information depicted in them. For example, one study of memory for materials taught in introductory psychology courses found that students recalled ideas and examples presented in pictures and in-class demonstrations better than information presented in the text alone (Vanderstoep, 2000). Mayer (2001) asserted that, in addition to specifically improving knowledge memory, graphics would also make abstract information easier to understand. As a result, they necessitate less cognitive effort to comprehend than text-based representations of the same content. Better comprehension, along with more cognitive resources that can be allocated to learning and memory, will together enhance memory for the information to be learned. Mirchas and Berry (2001) go on to say that visual displays are especially useful for concept comprehension. They further asserted that graphics enhance learning in four dimensions: First, it communicates cause –and-effect information. For instance, a diagram can help illustrate how turning a key can unlock a door. When such displays are designed to highlight the cause-and-effect sequence (e.g., by animating one portion at a time or by using a sequence of arrows), viewers' comprehension and memory for the cause-and-effect information is enhanced. Second, visual displays are frequently useful for representing relationships amongst elements (e.g. A Venn diagram, a text-based graphic organizer, a scientific model). One benefit of such representations is that they can facilitate problem solving. Another benefit is that they provide concrete representation of key concepts or elements and their relationships. Again, graphic organizers are often used to represent relationships among the main ideas in a text. For example, information in a text can be summarized in matrix form such that similar concepts are closer together along one or more dimensions. Research has suggested that representations that group relevant concepts, such as matrices, can significantly enhance memory for text

compared to representations that simply summarize materials, such as outlines (Rieber, 2000). Third, visual displays are useful for communicating information that is intrinsically spatial. For instance, visual displays of a map of a building or a drawing of how different parts of a car engine fit together communicate information that is difficult to describe verbally. One general guideline is to design displays that facilitate integrating relevant information (placing text and graphics together) to reduce working memory load and allow viewers to focus on learning relevant content. Fourth, visual displays provide natural mappings to quantitative information (using graph to show annual economic growth) and thus increase comprehension and memory for quantitative information. One difficulty associated with graphs is that students often make interpretation errors and therefore remember erroneous data. Shah and Hoeffner, (2002) opined that it is pertinent for instructors to acquaint themselves with the guidelines for designing graphs to depict data to students for instructional purposes. The functions of graphics in learning are not limited to presenting visual information to students, but also asking them to create them. Creating visual artifacts or inscriptions appears to be motivating to students, especially when they share their products with fellow students. Furthermore, developing the visuals forces students to consider the important elements and relationships in a topic and also to identify what information they understand and what they do not (Roberson, 2012). Thus, the creation of graphics can be used to enhance comprehension and memory for to-be-learned information. In a nutshell, graphics develop motivation, understanding, retention of concepts, as well as discovery potentials among learners. It reduces the cognitive load on learning new material because learners" attentions are directed to the significant elements in a topic and away from items of less importance. Based on these theoretical justifications, graphics can impact upon overall learning.

2.1.7 The Availability and Utilization of Graphics Instructional Materials in Schools

Graphics can be described as visual images or designs on some surface, such as a wall, screen, paper, or stone to inform, illustrate, or entertain. Dhakal (2017) noted that for teaching and learning activities to be effective and purposeful, the teacher has to make and use of the appropriate instructional materials. Bassey and Amie-Ogan (2019) observed it is perceived that students in Public Junior Secondary Schools sometimes find it difficult to comprehend immediately what is being taught by the teacher due to non-availability of instructional materials to convey the concept and topics taught to the learners. Saidu and Garba (2017) noted that visual teaching and learning materials were inadequate for teaching and learning. Similarly, Nwafor and Eze (2014) noted that instructional materials which included graphic materials are unavailable or lacking in most schools in Nigeria. Graphics help illustrate the concepts to be taught by making abstract teaching to become concrete, graphics are essential since they improve students' performance (Odewumi & Gambari, 2019). But as most researchers have observed, graphics materials and other related instructional materials are either unavailable in most secondary schools or they are underutilized. Although Dhakal (2018) in his study noted that graphic materials are available and utilization is high. This is in contrast to Okobia (2011) who concluded that instructional materials and resources available were grossly inadequate. Kurgatt and Omuna (2016) observed that teaching and learning largely depends on visual materials such as graphics but they are grossly inadequate in schools, in an effort to reduce workload on the working memory for enhanced efficiency, the use of visual materials has proved effective in the teaching of subjects. The use of multiple representations in general is an important part of teachers' knowledge, Kurgatt and Omuna (2016) noted that visual learning style is effective and useful to the learners where they are expected among others to replace words with symbols or initials, translate concepts into pictures and diagrams. They are also expected to highlight personal notes or textbooks with different colors, practice

turning visuals back into words and making flashcards of key information with words, symbols and diagrams. There are very few materials available and used during the actual teaching in the classroom, the low usage of visual materials could suggest that most lessons are dominated by 'teacher-talk' yet they are meant to enhance creative writing skills' development (Kurgatt & Omuna, 2016). Many benefits that accrue from the use of these visual materials to teaching and learning.

2.1.8 Functions of Graphics as Instructional Materials

Livingston and Shaw (2017) noted that graphics carryout the following functions:

1. Representational

Representational images are graphics that describe or portray content that focus on the components that students should learn. When selecting a representational graphic, the purpose is to depict the physical appearance of an object. Think of illustrations and diagrams that provide a realistic outline to accompany the text. The science, health, and engineering fields frequently use these types of graphics to explain or clarify a complex topic. Moreover, they add instructional value to the course, especially for visual learners. For instance, a Biology class might consider a representational graphic when describing the complex anatomy of an eye.

2. Organizational

These graphics help students grasp the flow or sequence of a difficult topic. Possible organizational graphics include drawings, maps, flowcharts, or animations. For example, an instructor could create a flowchart that demonstrates the steps a customer will make to purchase a product so that students not only read about the process but also see it laid out in a way that complements the written text. For instructors interested in creating their own graphics,

programs such as Piktochart or even just PowerPoint can help individuals leverage their subject matter expertise to create them instead of relying on publisher material.

3. Relational

This type of graphic relies on data to display trends and other relations between different variables. Examples include bar graphs, pie charts, histograms, and scatter plots. Instructors shouldn't shy away from utilizing these figures in their online classroom. Graphics can be crucial for helping students interpret and analyze data to form their own understanding. Consider a political science instructor who creates a bar chart based on the frequency of political stories posted online for each local new agency. Students could then interpret this graphic to form arguments for the final assessment on trending online stories.

4. Decorative

Lastly, there's one graphic type that's frequently used in online courses but adds little instructional value. Decorative graphics should be used sparingly, since they do not contribute to students' comprehension of the learning material. These types of graphics are aesthetic in nature. Think of clip art, stock photos, and gifs. Instructor may add decorative graphics to add appeal to text-heavy content. Many times, these types of images can actually cause more harm than good to students' cognitive load! You're better off with no images than irrelevant and distracting graphics. Much research in science education has revealed that pupils are usually more interested in Biology than other science subjects (Uitto, 2006). Aloraini (2012) argued that graphic elements when mainstreamed in a comprehensive presentation so as to provide effective education, which in turn will support the participation of the different senses of the learners in diverse syllabi. Valli (2017) stressed that graphic elements help teachers to illustrate their educational materials. When chosen and applied carefully, graphics can add valuable context and information. integrating graphics into learning environment may motivate students

effectively, enhance interactions between learners and educators, allow students to autonomously resolve.

2.1.9 Rationale for Integrating Graphics to Teaching and Learning

Teachers are responsible for instilling knowledge, skills, and values in hundreds of students as well as ensuring that learning occurs (Roberson, 2012). Graphic instructional materials have been a common classroom teaching tool in Nigerian secondary schools over the years. The following considerations demonstrate the importance of graphics in the teaching-learning process:

i)   Motivating Learners: An optimal amount of arousal (not too little and not too much) is essential to activate the learners" interest and induce them for acceptable levels of performance. Graphics has the potential to increase the intrinsic motivation of a learning environment by arousing students' curiosity, optimizing the challenge of an activity, and encouraging students to use their imaginations (Rieber, 2000). This makes the students to concentrate fully on the learning task at hand.

ii)   Differentiating Instructional Strategy: As educators learn more about how to reach all types of learners, graphic instructional media are used to assist teachers in differentiating instructional methods e.g. from verbal to visual instruction and practical activities. Today's students need constant stimulation therefore oral instruction / lecturing alone is not an effective teaching strategy by itself (especially at lower levels of education). The use of graphic aids allows teachers to vary the delivery of lessons and keep students interested in learning (Roberson, 2012). This caters for the different learning styles and abilities among the students.

iii)   Provides Access to instructional Content Graphics are more concise than words and enable us to communicate ideas which are difficult, if not impossible to describe in words. They provide opportunities for much needed access to content especially when learners are low-level readers.

27

Using pictures, concept maps etc. are ways to teach these students the lessons' objectives while also keeping them interested in the material. Without graphic aids, these students will find it difficult to comprehend the lesson and keep up with instruction.

iv) Facilitates Greater Comprehension: Graphics make instruction meaningful for students and help the teacher attain lesson objectives by providing emphasis in a different way than speaking. Clear pictures, graphs, or models multiply the students" level of understanding of the material presented, and they can be used to reinforce a message, clarify points, and create interest. As observed by Clark and Lyons, (2004) visuals help learners see the relationships among information in a lesson and in turn help learners build mental models that are a basis for higher-level thinking and problem-solving (Illian, 2012). They allow students to spend more time with the content and solidify understanding. When students work together on graphic aids, there's a scaffolding of information and an exchange of ideas. This experience helps students to the master materials, increasing their confidence and ability.

v) Engages Learners: Visual aids engage more students in the lesson because it requires a change from one activity to another: from hearing to seeing and sometimes touching. This enables the teacher to appeal to more than one sense at the same time, thereby increasing student's understanding and retention level. With drawings, posters, transparencies and other visuals, the concepts or ideas presented are no longer simply words -but words plus images. Therefore, graphics are great tools to use for engaging all students in the learning process. It helps to cater for the individual differences among students in terms of learning styles, intelligence, and maturity, this way all learners are carried along during the instructional process.

vi) Illustration for Abstract Concepts /Information: Graphics prove valuable in teaching abstract information by providing spatial metaphors for logical structure (Rieber, 2000). Using space, lines, boxes, arrows, color, and the relative distance between elements, for instance, an illustration can provide a concrete equivalent of abstract ideas. Many writers have outlined

methods of making graphic representations of the common structures of information, such as comparison and contrast, procedural steps, description, causation, and chronology. For example, column charts are efficient for comparing or contrasting the characteristics of items; time lines are good at showing chronological relationships; flow charts can show causation clearly.

vii)   Attention Capturing: Gaining the attention of students is a precondition to any kind of learning. It appears first in most lists of events in the instructional process. In the terms of cognitive psychology, gaining attention is critical because of the limited capacity and duration of the "short-term" or "working" memory. Graphics help in focusing attention and motivating learners. These are key factors in any successful learning activity. The efficiency of the receptive mechanism of sight is fully exploited for optimum learning. Research has shown that attention is naturally drawn to the novel or unique (Fleming, 1987). Obviously, the use of graphics can be an important strategy for influencing attention, if they are used deliberately in novel or unique ways.

viii) Enhancing Content Retention: Studies suggest that when information is presented verbally and visually it has a better chance of being remembered. Corroborating research shows that concrete words are remembered better than abstract words, and that pictures alone are remembered better than words alone (Fleming and Levie, 1978). Learners are more likely to retain and recall contents that are presented visually with a greater percentage than what they hear only. The visual dimensions added to the learning material concretise learners" experiences. This is vital because memory is frail and fickle, unless it rests on understanding. This assertion corroborates with the Chinese dictum: What I hear, I Forget, What I see, I remember, What I do, I understand (Adewoyin, 1991).

The Educational Significance of graphic aids as enumerated by Mudasir and Aqueel, (2012) is to: help in Showing relationship by means of facts, figures and statistics; understanding of

abstract concepts and ideas in visual form; securing the attention of the pupils by their attractive format and simplicity of layout; Gaining of concepts of size, distance, space, location and direction by means of maps; developing the power of analysis, synthesis and deriving conclusions from a data; and the grasping of information easily. Baker and Bixler (1990), states that the purpose of most instructional graphics is to help explain something to the viewer in a manner that hopefully increases retention of the subject matter. To him Instructional graphics have seven possible functions in instruction:

i.   Descriptive -To show what an object looks like.

ii.   Expressive -To make an impact on the learner.

iii.   Constructional -To show how the parts fit together into the whole.

iv.   Functional -To show a process or the organization of a system in a simplified manner.

v.   Logico-mathematical -To display a mathematical concept such as a curve graph. Some line graphs and charts with a scaled X and Y axis fall into this category.

vi.   Algorithmic -To show a holistic picture of the range of possibilities. Flow charts fall into this category.

vii.   Data display -Illustrating textual data visually. Bar charts, pie charts, and histograms fall into this category.

2.2 Theoretical framework

2.2.1 Cognitive Learning Theory

During the 1950s, the cognitive revolution became visible in American psychology. Learning, according to cognitive psychologists such as Piaget, Bruner, and Ausubel, is an internal process that cannot be directly observed. Learners remember first, then recall facts from memory. Cognitivists are interested in how the human mind works. They place an emphasis on memory (Mergel, 1998). Mergel (1998) stressed that cognitive theorists accept that most learning requires connections formed by contiguity and repetition. They also acknowledge the

importance of reinforcement, although they stress its role in providing feedback about the correctness of responses over its role as a motivator. Cognitive theorists view learning as involving the acquisition or reorganization of the cognitive structures through which humans process and store information. To cognitive theorist, practice is an important aspect of learning because it gives increased opportunities for reward and reinforcement. Cognitive structures are also created through practice, which leads to an efficient use of long-term memory. Di Vesta, (1987), maintained that in contrast to focusing on strengthening S-R bonds, cognitive orientations to learning consider the actual thought processes occurring in between the stimulus and the response as the most important aspects to learning. The emphasis is on how a learner selects, perceives processes, encodes, and retrieves information from memory. The implication of this theory to instructional designers is that they could use various techniques of teaching such as chunking, mnemonics etc. for meaningful organization of content and give practice for storing and retrieving information.

2.2.2 Dual Coding Theory

Given the subject matter, the research work is expected to focus on the viewpoints of the Dual Coding Theory of Memory (Clark and Paivio, 1991). Dual coding theory is an empirically supported description of the mental mechanisms that underpin human behaviour and experience. It describes psychological phenomena through the combined intervention of nonverbal and verbal structures that are specialised in the processing of imagery and linguistic knowledge (Paivio, 1986). The theory of dual coding is a general theory of cognition and the mind (Paivio, 2007). Allan Paivio developed it in the 1960s to illustrate the strong influence of mental visualization on memory. It is also known as a theory of mental imagery, especially visual imagery. Dual coding theory is a comprehensive collection of assumptions and hypotheses about how information is encoded in memory (Sadoski & Paivio, 2001). According to the theory, memory is made up of two different mental images, or codes, one verbal and one

nonverbal. The verbal system is "language-like" in that it specializes in linguistic activities associated with words, sentences, and so on. The nonverbal system includes memory for all nonverbal phenomenon, including such things as emotional reactions, images, and other „picture like" representations. Dual coding supports the idea that knowledge is represented on a concreteness-abstractness continuum and that human cognition is predisposed to storing mental representations in one of two forms corresponding to the ends of the continuum. At one end are the visually based representations in which knowledge is stored in concrete and non-arbitrary ways. At the other end are the verbal, or semantic, representations in which knowledge is stored in discrete and arbitrary ways. The most fundamental memory units in this theory are termed logogens in the verbal system and imagens in the visual system (Rieber, 2000). The verbal and visual subsystems each have their own set of characteristics. Logogens are stored in the verbal system as discrete items similar to words and sentences, while imagens are stored in the visual system as continuous units of a "all-in-oneness" consistency. According to dual coding, three distinct stages of processing may take place within and between the verbal and visual systems: representational, referential, and associative (Paivio, 1986). Representational processing describes the connections between incoming stimuli and either the verbal or visual system. Verbal stimuli directly activate verbal memory codes, whereas visual stimuli activate visual memory codes. For example, hearing the word "cat" first activates the verbal system, but seeing a picture of a cat directly activates the visual system. Referential processing is the building of connections between the verbal and visual systems. Hearing or reading the word "cat" will stimulate the appropriate logogen in the verbal system. Subsequently forming a mental image of a cat implies that the verbal system has directly activated the imagen corresponding to cat. Associative processing leads to the activation of informational units within either of the systems (Paivio, 1986). Paivio, (1971) postulates that the core idea behind dual coding theory of memory is very simple and intuitive: He proposes that the human mind

operates with two distinct classes of mental representation (or "codes"), verbal representations and mental images, and that human memory thus comprises two functionally independent (although interacting) systems or stores, verbal memory and image memory. Imagery potentiates recall of verbal material because when a word evokes an associated image (either spontaneously, or through deliberate effort) two separate but linked memory traces are laid down, one in each of the memory stores. Obviously, the chances that a memory will be retained and retrieved are much greater if it is stored in two distinct functional locations rather than in just one (Thomas, 2010). Teachers should be most interested in ways to increase the likelihood that information will be dual encoded in long-term memory. Encoding information in both verbal and visual formats, with strong and flexible links between the codes, improves retention, recovery, and transmission. Klausmeier (1990) observed that dual coding is more likely to arise as the content lends itself to photography. Concrete concepts, such as "tree" or "house," for example, are easier for people to visualise when they apply to real structures with physical forms. People, on the other hand, do not immediately form internal images for abstract terms such as "patriotism" or "kindness." In these cases, it is often useful to provide the learner with a prototype image that communicates the most important characteristics or attributes of the concept, such as two people shaking hands to represent "friendship." This prototypical image is mostly analogical to the concept e.g. the portrait of a blindfolded woman holding a set of scales to represent justice. It can be seen that theoretical foundations of dual coding theory have definite implications on the value and use of graphic instructional media. Marzano, Pickering and Pollock (2001) stated that graphic visuals enhance the development of non-linguistic representations in students, thus enhances the development of the content to be learned. The use of graphic media also helps students generates linguistic representations. Visuals help student to process and remember learning content by facilitating the development of corresponding imagens. Again, being a linguistic tool, text based graphic visuals enhances the

development of logogens thereby dual-coding the information. Thus, the theory provides a plausible explanation and empirical evidence that concepts are better recalled when presented in both verbal and visual cues.

2.3 Empirical Studies

The use of graphics as an instructional resource has been a popular research issue. Various studies dealing with the effects of pictures and other graphics on learning were conducted by chain of educationists to throw more light on the phenomenon.

Dhakal (2017) examined the availability and utilization of instructional materials in geography teaching in community secondary schools in Kathmandu district. There are altogether sixteen community secondary schools offering geography as an optional subject. Out of sixteen secondary schools offering geography as an optional subject eight schools are selected for the study on the basis of random sampling. The sample for this study comprised of one hundred seventy-four students from selected secondary schools. The survey and observation are used for primary data collection. The data are analyzed using percentage. The results reveal that printed and graphic instructional materials for teaching geography in secondary schools are available and their utilization is of high extent while audio, visual and audio-visual instructional materials for teaching geography are not available sufficiently and they are used less often in the classrooms for teaching geography. The local materials are rarely utilized in schools by the teachers. All stakeholders in education must rise to the challenges of making instructional materials are available and utilized in secondary schools.

Nwafor and Eze (2014) focused on the availability and utilization of instructional material in teaching and learning of Basic Science in selected junior secondary school in Abakaliki education zone of Ebonyi State-Nigeria. The survey research design was used for the study; population of the study was 92,414. The sample for this study comprised of one hundred

students from ten selected junior secondary schools. Structured questionnaire was the instrument used for data collection, and the instrument was face validated by three experts. Three research questions guided the study. The data were analyzed using percentages. The result revealed that only two-dimensional instructional materials are available in schools. Other instructional materials e.g. Audio materials, Audio-visual materials are lacking in most schools. The study also revealed that teachers do not improvise instructional materials to facilitate their teaching. The researchers therefore recommend that teachers should be given orientations/workshops from time to time on the improvisation and utilization of instructional materials and that the government should also assist in the provision and supply of these instructional materials for use in schools.

Onajite et al. (2019) examined teachers' utilization of instructional materials for effective teaching of business studies in junior secondary schools in Delta State. The study was guide by three research questions. The study employed the descriptive survey research design. Population for the study consisted of 665 business studies teachers in the 448 public junior secondary schools in Delta State. The proportionate stratified random sampling technique was used to select a sample size of 50% of 333 out from 665 business studies teachers from 224 public junior secondary schools in Delta State. A questionnaire titled: Teachers' Utilization of Instructional Materials for Teaching Business Studies Questionnaire (TUIMTBSQ), containing 38 items was used in conducting the study. Both the validity and reliability of the research instrument were established. Data were analyzed using mean score at 2.50 rating and standard deviation. Findings of the study revealed among others that business studies teachers' utilization of instructional materials such as printed and non-printed materials for effective teaching of the subject in junior secondary schools in Delta State was to a low extent, which was minimal. The study recommended among others that: State Government and State Education Board should support teachers' utilization of printed and non-printed instructional

materials in business studies through adequate funding and procurement of materials needed in teaching business studies in the junior secondary schools in Delta State. Principals should also improvise the required printed and non-printed instructional materials for business studies teachers in the school. This must be accorded with constant supervision and continuous staff training and retraining programmes that will improve teachers' utilization of printed and non-printed technological devices that will aid effective teaching in the

Tuimur and Chemwei (2015) examined the availability and use of instructional resources necessary for teaching Conflict and Conflict Resolution as a topic in Social Studies subject in primary schools in Nandi North District in Kenya. The study was carried out through descriptive survey. The study population included Social Studies teachers in Kosirai Division of Nandi North District. From this population, a sample of 45 standard seven Social Studies teachers was drawn using purposive sampling. The instruments used for data collection were: a questionnaire, document analysis and classroom observation checklist. Descriptive statistics namely: frequencies and percentages were used to analyze the data. The findings of the study showed that many of the primary school Social Studies teachers had not attended any in-service courses to induct them on how to teach emerging issues like Conflict and Conflict Resolution in the current primary curriculum. The teachers also lacked sufficient instructional materials for effective teaching of the topic. The conclusion drawn from the study was that the current preparation of teachers to teach Conflict and Conflict Resolution is inadequate with regards to their ability to design relevant teaching and learning resources and effectively use them in the teaching and learning process. In addition, the available instructional materials in the sampled schools were insufficient. The study recommended the need for Social Studies teachers to be retrained and sensitized on the appropriate instructional materials for teaching Conflict and Conflict Resolution.

2.4 Summary of the Literature Reviewed

In the review, the concept of educational technology and instructional materials were discussed and the types of instructional materials were identified and these included printed and referenced materials, graphic materials, display materials and project materials. The principles and elements of graphic instructional materials were also identified as including the following tone, contrast, balance, harmony, repetition. Also, the availability and utilization of instructional materials in our educational setting were treated. This is because, they are of prime importance to make the lesson more interesting, directing teaching to its goals, arousing students' interest and motivating them to learn and develop the sense of imagination and comparison. The rationale affecting the usage of graphics instructional materials were discussed, among which included engaging learners, motivating learners, illustrating abstract concepts etc. The cognitive learning theory and the dual coding theory were identified as the theories that support the usage of graphics instructional materials in teaching and learning. And lastly, from empirical studies; it was proven that usage of graphic instructional materials is instrumental to enhancing teaching and learning.

CHAPTER THREE

3.0   METHODOLOGY

3.1 Introduction

This chapter presents the research procedures employed by the researcher to carryout the research. This includes the research design, population, sample and sampling techniques, instrument for data collection, validity of instrument, reliability of instrument, procedure for data collection and data analysis.

3.2 Research Design

The researcher adopted descriptive survey research design in this study. Emaikwu (2010) observed that survey research is one in which a group of people or items is studied by collecting and analyzing data from a few people considered to be representative sample of the entire population. It specifies how such data will be collected and analyzed. Agbulu and Aboiyar (2007) said surveys gather data and information from a large number of cases at a particular point in a time for the purposes of describing the nature of existing conditions, identifying standard against which existing conditions can be compared and determining relationship that exist between specific event. The study was carried out in line with the above design. Osuala (2005) noted that descriptive survey design gives the accurate assessment of the characteristics of the whole populations of people.

3.3 Population of the Study

The total population of the study consisted of all the teachers in senior secondary schools in Bosso Local Government Area of Niger state. The target population for this study will be all the teachers in senior secondary schools in Bosso Local Government Area of Niger State.

3.4 Sample and Sampling Technique

The sample size for this study is twenty (20) teachers selected from five (5) secondary schools of study in Bosso Local Government, Niger state. The schools were purposively sampled while the teachers were sampled using the simple random sampling.

S/N	Schools	Population
1	Ahmadu Bahago Secondary school, Bosso	4
2	Bosso Secondary school, Bosso.	3
3	FUT Model secondary school	5
4	Government Day secondary school, Bosso.	4
5	Fr. O'Connell secondary school, Bosso	4
	Total	**20**

3.5 Research Instrument

The researcher used questionnaire titled "Questionnaire on the Availability and Utilization of Graphic Instructional Material" (QAUGIM) as the instrument for the data collection which is made up of questions arranged systematically to collect data and information from teachers in the five (5) selected secondary schools in the area of study. The questionnaire for the teachers is divided into three (3) sections: Section 'A' is on bio-data and section **'B'** and '**C'** is on questions related to the research. Section **'B'** takes care of the availability of graphics instructional materials while section **C** assess the utilization of graphics instructional materials

3.6 Validity of instrument

The instrument used in this study was validated by two experts in the Department of Educational Technology, School of Science and Technology Education (SSTE), Federal

University of Technology, Minna. This was to determine the face and content validity of the instruments. Johnson (2013) defines face validity as the extent to which a test appears to measure what it is intended to measure while Salkind (2010) defines content validity as the extent to which the items on a test are fairly representative of the entire domain the test seeks to measure. However, all necessary corrections and modifications made by the experts were affected accordingly.

3.7 Reliability of the instrument

Reliability is regarded as the extent to which a measurement is free from random error which can be said to be reliable (Asika, 2004). In order, to ascertain the reliability of the instrument (questionnaire) intended to be used for the purpose of this study, a pilot test was carried out using Government Girls Secondary School Bosso, Niger State which is not among the sampled schools for the study. A total of five (5) copies of questionnaire were administered to (five) 5 teachers. The test-retest method was used to measure the reliability of the instrument. The scores obtained were analyzed using Pearson Product Moment Coefficient. A coefficient reliability of 0.82 and 0.89 was obtained which indicated the instrument was reliable as supported by Glen (2016).

3.8 Method of Data Collection

The researcher visited the five (5) secondary schools and administered the questionnaire to the selected students and teachers. A letter of introduction is attached to the questionnaire which introduced the researcher, indicate the purpose of the study and give instruction on how to complete the questionnaire with the help of research assistant so as to return it, to avoid missing or misplacement of questionnaire, the questionnaire was collected by the researcher immediately with the help of a research assistant

3.9 Method of Data Analysis

All the questionnaires were collected from the respondents as soon as they finished with their response. Their responses were scored and organized in tabular forms. The four Likert-types rating scale will be used for the questionnaire, responses were of the types Strongly Agreed, Agreed, Disagreed and Strongly Disagreed. Simple percentages were used to analyze the data. In decision making, any calculated mean (x) below the mean rating (Xr) of 2.50 is "Rejected" while above 2.50 is accepted as valid.

4.0   **RESULTS AND DISCUSSION OF DATA**

4.1 Introduction

The purpose of the study is to determine the availability and utilization of graphics instructional materials for teaching and learning Biology at senior secondary schools in Bosso Local Government Area. This chapter discusses the data analysis, presentation of the results of data analyzed and discussion of the results. The data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 25. The biodata of the respondents was analyzed using frequencies and percentage table, while the research questions were analyzed using mean and standard deviation. A satisfactory scale was set to infer disagree and agree for the availability and utilization of graphics instructional materials; 1.0 – 2.4 disagree, 2.5 – 4.0 agree. Disagree and strongly disagree were merged together while agree and strongly were merged together. The research hypothesis was tested using the independent t-test statistics at 0.05 level of significance.

4.2 Description of Study Variables

A total of twenty (20) questionnaire was retrieved out of the twenty (20) questionnaire distributed.

Table 4.1 Gender Distribution of students

Gender	Frequency	Percent
Male	11	55.0
Female	9	45.0
Total	20	100.0

In Table 4.1, the respondents are classified by gender. The table shows the respondents by their gender. The male respondents are greater than that of the female respondents, with the males

making 55.0% of the sampled population and females making up the remaining 45.0% of the population.

4.3 Response to Research Questions

This research determined the availability and utilization of graphics instructional materials for teaching and learning Biology at senior secondary schools in Bosso Local Government Area. In the analysis of the variables, the researcher made use of the descriptive analysis. These variables are assessed independently with specific research questions and objectives as follows:

Research Question One: Instructional materials available in senior secondary schools in the teaching and learning of Biology? The response is shown below on table 4.2

Table 4.2 Availability of graphics instructional materials

S/N	Items	N	Mean	Std. Deviation	Decision
1	There are enough graphs for teaching and learning in my school	20	2.45	1.14	Disagree
2	There are charts in the classroom for teaching topics	20	2.75	0.71	Agree
3	My school has drawings for teaching and learning	20	2.75	1.02	Agree
4	There are posters on the walls of the classroom for teaching and learning.	20	3.00	1.21	Agree
5	There are diagrams in my school for delivering instruction.	20	2.70	1.21	Agree
6	My school has maps used for teaching	20	3.20	1.19	Agree
7	There are cartoons in my school that can be used for teaching and learning.	20	2.30	1.03	Disagree
8	There are flashcards used for teaching and learning in the classroom	20	2.50	1.27	Agree

S/N	Items	N	Mean	Std. Deviation	Decision
9	There are infographics in the school for instructional delivery.	20	2.65	1.08	Agree
10	There are pictures in my school for teaching and learning.	20	2.10	0.96	Disagree
	Grand Mean	**20**	**2.64**		**Agree**

Decision mean: 2.50

Table 4.2 shows the Mean and Standard Deviation of student's response on the availability of graphics instructional materials in senior secondary schools in the teaching and learning of Biology. The table reveals the computed mean score of 2.45 with Standard Deviation of 1.14 for item one, 2.75 with Standard Deviation of 0.71 for item two, 2.75 with Standard Deviation of 1.02 for item three, 3.00 with Standard Deviation of 1.21 for item four, 2.70 with Standard Deviation of 1.21 for item five, 3.20 with Standard Deviation of 1.19 for item six, 2.30 with Standard Deviation of 1.03 for item seven, 2.50 with Standard Deviation of 1.27 for item eight, 2.65 with Standard Deviation of 1.08 for item nine, 2.10 with Standard Deviation of 0.96 for item ten. The table revealed further that, the grand mean score of responses to the ten items was 2.64 which was greater than the decision mean score of 2.50. This implies the availability of graphics instructional materials in senior secondary schools in the teaching and learning of Biology.

Research Question 2: Are graphics instructional materials utilized in senior secondary schools in the teaching and learning of Biology? The answer is revealed in Table 4.3

Table 4.3 Utilization of graphics instructional materials

S/N	Items	N	Mean	Std. Deviation	Decision
1	Teachers make use of graphs when teaching in the classroom	20	2.15	0.98	Disagree
2	Charts are utilized during teaching and learning	20	2.55	1.23	Agree

3	Drawings are used to teach during classroom instruction	20	2.65	0.93	Agree
4	Teachers use posters when teaching	20	2.65	0.98	Agree
5	During teaching, teachers make use of diagrams to teach	20	2.25	0.55	Disagree
6	Maps are appropriately utilized to teach in the classroom	20	1.90	0.85	Disagree
7	Teachers use cartoons for delivering lessons in the classroom	20	2.15	0.93	Disagree
8	Flashcards are used to teach and learn	20	2.30	0.73	Disagree
9	Teachers make use of infographics to explain concepts	20	2.40	0.94	Disagree
10	The teacher uses pictures to teach in the classroom	20	2.75	1.07	Agree
	Grand Mean	**20**		**2.37**	**Disagree**

Decision Mean: 2.50

From Table 4.3, The table reveals the computed mean score of 2.15 with Standard Deviation of 0.98 for item one, 2.55 with Standard Deviation of 1.23 for item two, 2.65 with Standard Deviation of 0.93 for item three, 2.65 with Standard Deviation of 0.98 for item four, 2.25 with Standard Deviation of 0.55 for item five, 1.90 with Standard Deviation of 0.85 for item six, 2.15 with Standard Deviation of 0.93 for item seven, 2.30 with Standard Deviation of 0.73 for item eight, 2.40 with Standard Deviation of 0.94 for item nine, 2.75 with Standard Deviation of 1.75 for item ten. The table revealed further that, the grand mean score of responses to the ten items was 2.37 which was less than the decision mean score of 2.50. This implies that graphics instructional materials are not been utilized in senior secondary schools in the teaching and learning of Biology.

4.4 Hypothesis Testing

Hypothesis 1: There is no significant difference in the gender of teachers and the utilization of graphics instructional material in teaching of Biology at senior secondary schools.

Table 4.5 T-test for the gender difference and the utilization of graphics

Group	N	Df	$\bar{x}$	SD	t-value	p-value	Decision
Male	11		2.32	0.43			
		18			-0.60	0.55	NS
Female	9		2.43	0.32			

Not Significant at 0.55>0.05 level

The t-test for table 4.5 revealed that there was no significant difference on gender and the utilization of graphics instructional materials. The p-value of 0.55>0.05 which was greater than 0.05 which was the level of significance, confirmed that There is no significant difference in the gender of teachers and the utilization of graphics instructional material in teaching of Biology at senior secondary schools. Hence, the null hypothesis was accepted.

4.5 Discussion of Findings

Findings revealed that graphics instructional materials are available in senior secondary schools in the teaching and learning of Biology as the responses gave a grand mean score of 2.55 indicating the availability of graphics instructional materials. This finding is in line with Dhakal (2017) who revealed that graphic instructional materials are available in secondary schools.

The data analyzed also revealed that there was no adequate utilization of graphics instructional materials in teaching Biology in senior secondary schools in Minna Metropolis, with the grand mean score of 2.37 indicating the non-utilization of graphic instructional materials which was in line with findings of Nwafor and Eze (2014) who revealed that graphic instructional materials are not been utilized in secondary schools. The grand mean scores on the availability

of graphics instructional materials was above the established mean of 2.50 and the grand mean scores on utilization of graphics instructional materials were below the already established decision mean of 2.50.

The t-test statistics also revealed that there was no significant difference in the gender of teachers and the utilization of graphics instructional material in teaching of Biology at senior secondary schools as the p-value gave a score of 0.55 which was above 0.05 level of significance.

<div align="center">**CHAPTER FIVE**</div>

5.0   **SUMMARY, CONCLUSION AND RECOMMENDATIONS**

5.1   Summary of the Study

The research determines the availability and utilization of graphics instructional materials in senior secondary schools in the teaching and learning of Biology. However, the study is divided into five chapters in which each chapter is discussed extensively.

Chapter one of the research contains the background of the study, statement of the problem, research questions, significance of the study, scope of the study, methodology, limitations of the study and definition of the terms. Similarly, in Chapter two, many relevant literatures from several authors were used to expose what various writers have done in the area of instructional materials for teaching and learning. In Chapter three of the study that based on research methodology, the descriptive survey research design was adopted in which questionnaires were administered. Simple random sampling technique was also adopted to select respondents. Chapter four of the project revolved on the data analysis and interpretations of findings. The frequency and percentage method of data analysis was used. This chapter contains the summary, conclusion and recommendation of the study.

5.2 Major Findings of the Study

The following findings have been made from the research work

1. The findings of the study revealed that graphics instructional materials are available in senior secondary schools in Bosso Local Government Area, Niger State.

2. The findings of this study also revealed that there is no adequate utilization of graphics instructional materials in senior secondary schools in Bosso Local Government Area, Niger State.

3. The findings of this study also revealed that there was no gender difference in the use of graphics instructional materials by teachers in senior secondary schools in Bosso Local Government Area, Niger State.

5.3 Implications of the Major Findings

The following are the implication of the major findings.

1. The study revealed that graphics instructional materials are available in senior secondary schools in Bosso Local Government Area, Niger State.

2. The study revealed that there is no utilization of graphics instructional materials in senior secondary schools in Bosso Local Government Area, Niger State.

3. The study also revealed that there is are no gender difference in the use of graphics instructional materials in senior secondary schools in Bosso Local Government Area, Niger State.

5.4 Contribution of Study to Exiting Knowledge

The finding will contribute to exiting knowledge in the following ways:

1. It will expose relevant stakeholder such as students, teachers, school administrators etc. On the influence of graphics instructional materials on the academic performance of students.

2. It will enlighten the government on the need to make provision of graphics instructional materials in schools.

3. It will prompt school administrators to ensure adequate utilization of graphic in schools.

4. It will help contribute to already exiting literature and source of reference on the availability and utilization of graphics instructional materials.

5.5 Recommendations

The following can be recommended after critical examination of the responses and review of the previous literature.

1. Graphics instructional materials should be made available in senior secondary schools so as to promote effective teaching methods.

2. There should be strict adherence to the use of instructional materials in teaching Biology in senior secondary schools

3. It is important to note that the current study utilizes quantitative research method and uses only a survey questionnaire to collect date. Therefore, it is recommended that for a more comprehensive study, other instruments such as interviews and class observations be conducted to get a more through picture on availability and utilization of graphics instructional materials to teach Biology in senior secondary schools.

5.6 Suggestions for Further Research

1. Further research should not be limited to a specific area, it should cover a wider geographic area

2. Further research should investigate the impact of graphics instructional materials on learning outcomes (achievement, retention and interest) using the experimental research design to enlighten teachers on the impact of graphics instructional materials.

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF EDUCATIONAL TECHNOLOGY

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Thanks for your anticipated assistance.

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Dept of Educational Technology
Fed. University of Technology
15 JUN 2021
P.M.B. 65 Minna, Niger State

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Head of Department (Signature, Date & Official Stamp)

Student's Surname.... **S.ULAYMAN** .... Other Names.. **HABEEBA UTHMAN**

Registration Number.. **2015711555091BT** Programme.... **EDU-TECH**

Title of the Instrument. **AVAILABILITY AND UTILIZATION OF GRAPHICS INSTRUCTIONAL MATERIALS FOR TEACHING AND LEARNING OF BIOLOGY AT SENIOR SECONDARY SCHOOLS IN BOSSO LOCAL GOVERNMENT AREA**

ATTESTATION SECTION

Summary of the Remark on the Instrument. **STANDARD**

I hereby attest that the above named student brought his instrument for validation

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Designation.... **SENIOR LECTURER**

Name and Address of Institution... **FUT, MINNA**

Phone Number.... **08035828887** .... E.- Mail...........

51

Please comment on the following

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2. Clarity and simplicity for the level of the language used... CLEANED
3. Suability for the level of the targeted audience... SUITABLE
4. The extent in which the items cover the topic it meant to cover... COVERED
5. The structuring of the Questionnaire... STANDARD
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7. General overview of the Instrument... OKAY

Suggestions for improving the quality of the Instrument

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2.
3.
4.
5.

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Area of Specialization... EDUCATIONAL TECHNOLOGY

Name of Institution... FU. MINNA ... Designation... Sr.

Signature... ... Date. 09/07/2021

Thank You

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Thanks for your anticipated assistance.

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~~Fed. University of Technology~~
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~~P.M.B. 65 Minna, Niger State~~

Sign....................

Head of Department (Signature, Date & Official Stamp)

Student's Surname... SULAYMAN

Registration Number... 2015/1/55691BT .... Other Names HABEEBA UTHMAN

Title of the Instrument. AVAILABILITY AND UTILIZATION OF GRAPHICS INSTRUCTIONAL MATERIALS FOR TEACHING AND LEARNING OF BIOLOGY, IN SENIOR SECONDARY SCHOOLS IN BOSSO LOCAL GOVERNMENT AREA . Programme.. EDU - TECH

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.....level....of...the...language...used...clear...and...Simple

3. Suability for the level of the targeted audience...
..................Suitable.........................

4. The extent in which the items cover the topic it meant to cover......items..
.....Effectively...covered...the...topic...meant...to...cover

5. The structuring of the Questionnaire......well...Structured...
....

6. Others (grammatical errors, spelling errors and others....Other...grammatical
...errors...such...as...spelling...errors...were...minimal

7. General overview of the Instrument....Good...for...............
...administration........................

Suggestions for improving the quality of the Instrument

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2. also suggest the instrument to other
3. experts to improve its quality
4. ....
5. ....

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Area of Specialization...Educational Technology...

Name of Institution.....FUT Minna.............Designation...lecturer

Signature.........HHC..........................Date.9/7/2024

Thank You