# EFFECTS OF ANIMATION AND CONCEPT MAPPING VISUALIZATION ELEMENTS ON ACHIEVEMENT, RETENTION AND INTEREST IN GEOGRAPHY AMONG SECONDARY SCHOOL STUDENTS, ABUJA

**BY**

There is no significance difference between male and female secondary school science teacher's perception towards STEM instructional practices

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**MTech/SSTE/FT/2017/7580**

**DEPARTMENT OF EDUCATIONAL TECHNOLOGY**
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**THESIS SUBMITTED TO POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY IN EDUCATION TECHNOLOGY**

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## ABSTRACT

This study investigated the effects of animation and concept map visualization elements on achievement, retention, and interest in geography among Secondary School Students in Wuse, Abuja, Nigeria. It also examined the influence of gender on students' achievement, retention, and interest. The research used a pre-test post-test experimental and control group design. 120 secondary school students were drawn from three secondary schools within the Abuja metropolis. A stratified random sampling technique was used to select 120 students (53 males and 67 females). Nine research questions and hypotheses guided the study; Weather Interest Questionnaire and Weather Achievement Test (WAT) was used as instruments for data collection while animation and concept map visualization were used as the treatment instruments. The treatment instruments, questionnaire, and achievement test were validated by educational technology experts and Geography Education experts respectively. Pilot tests were carried out and a Reliability coefficient of 0.87 was obtained using Pearson Product Moment Correlation (PPMC) for WAT and 0.75 was obtained using Cronbach alpha for the questionnaire. WAT was administered to students as pre-test and post-test. The students' pre-test and post-test scores and the questionnaire were analyzed using ANCOVA ($F = 8.839$, $p = 0.005$) and t-test statistics ($t(52) = 0.179$, $p = 0.947$) respectively. The results indicated that the students taught weather using animation and concept map visualization performed significantly better in the post-test and retention test than their counterparts taught weather using the lecture method respectively. However, there was no significant difference reported in the post-test achievement scores of male and female students taught weather using animation and concept map visualization respectively ($t= 1.916$, $p = 0.059$). These findings indicated that weather concepts in geography could be taught and learned meaningfully through the use of animation and concept map visualization. Based on these findings, it was recommended among others that Government and school administrators should make provision of infrastructure that support the learners through the use of technology. This will encourage and enable learners to communicate with each other and give them the opportunity to share and access different teaching materials that can aid their learning.

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# CHAPTER ONE

## 1.0 INTRODUCTION

### 1.0. Background to the Study

Science and technology occupy a predominant position in the contemporary world today, the characteristics of societies in this modern time is determined by the prolific advancement in the two interrelated human activities which are science and technology in the society (Nsofor, 2014). Brown (2011) opined that apart from the acceleration of man's standard of living, science and technology have facilitated the development of the third world nations to improve upon their needs and the desire to compete with the industrialized nations in all spheres of development such as agriculture, medicine, engineering, architecture, communication and geography. The assumptions that modern developments had been made possible within the framework of science and technology is not an overstatement (Aiyede 2016). Consequently, it has become necessary that the teaching of science subjects such as Physics, Chemistry, Biology, geography and technology related courses be given adequate attention as they play a pivotal role in the advancement of the nation. In the past decade, the utilization of computers and other related technologies have expanded from been used primarily as instructional delivery medium to technology as a transformational tool and an integral part of the learning process (Abdullahi, 2014).

Basically, the proponents of the current reform agenda in Nigeria see technology as a veritable tool of a new educational tool paradigm in which the curriculum, teaching methods, and student learning outcomes are conceptualized (O'Day, 2016). Educational animations are produced for the specific purpose of fostering learning. It is associated with educational technology with the way it supports teaching and learning through the use of technological tools to facilitate learning and to improve critical thinking and

performance. Current educational use of animations suggests the two main roles in learning. First purpose of animations in academics is to fulfill a cognitive function. In this role, animations are intended to support students' cognitive processes that ultimately result in them understanding the subject matter. Secondly, animation is used as an effective learning tool that attracts attention, engages the learner, and sustains motivation aspects. The use of animations instructions in teaching offers exciting possibilities for meeting the needs of 21st century learners as it enhances students' learning if properly designed and implemented.

One of the cardinal components of school reforms is the desire for higher academic standards and stronger focus on higher order thinking, problem solving skills, and learning associated with "real world" applications, Federal Ministry of Education (FME, 2004). To achieve the above reforms, a need for new learning environment and learning tools for schools is necessary. Many people have advocated for the increasing application of new technologies in the schools based on the fact that the students' need to be technologically literate for success in the twenty first century, and that this literacy is best achieved in classrooms where technology become the integral part of the environment and where it is used as a daily tool for learning and solving "real world" problems. Quite a number of people support increasing technology usage in schools for this reason this is supported by the assertion that for any nation to obtain the status of self-reliance, science and technology must be an integral component of the knowledge to be impacted to all the citizenry of that nation irrespective of race, creed or sex (Nsofor, 2014). Related to or associated with these technologies is the use of concept map and Visualization. Unfortunately, for majority of students, technological literacy is still lacking (Gana, 2013).

Concept mapping had been defined differently by various authors. According to Ezenwa (2009), concept maps are words used to illustrate some kind of object, event or idea, key to human learning and meaning making a mental impression or mental constructs people have of words, objects, or events; source of human understanding, what we think with in science. Concept maps are diagram that represent knowledge as networks of concepts, pictured as nodes connected by labeled links. They present a way to visualize concept and the hierarchical relationship between them (Novak *et al*. 2010). Researchers have shown great interest for the educational uses and potential benefits of concept maps. In 2006, the number of peer- reviewed articles related to concept maps was estimated to approximately five hundred (Nesbit & Adesope, 2011). Within the educational settings, concept maps can be used to help students consolidate their understanding of a given knowledge domain or to anchor collaborative earning activities. Concept maps constructed by learners illuminate their current knowledge about a particular issue, and can be used as assessment tools. It can also be used to organize and present information as learning material.

Nesbit and Adesope (2011) performed a meta- analysis focused on 55 experimental and quasi- experimental studies involving 5, 818 participants in total, outlining the efficiency of concept maps for learning. The authors found that compared to other activities, concept maps were more effective in fostering knowledge retention and transfer." concept mapping was found to benefit learners across a broad range of educational levels, subject areas, and settings (Nesbit & Adesope 2011). In this work, we focus on the use of animated concept maps and visualization. A concept map is a type of graphic organizer used to help students organize and represent knowledge of a subject. Concept maps is a strong educational tool in establishing meaningful learning. Concept maps are visual and graphical representations students create to connect ideas, concepts and terms. It is often represented in circles or boxes, concepts are linked by words and phrases that explain the

connection between the ideas, helping the students organize and structure their thought to further understand information and discover new relationship, most concept maps represent a hierarchical structure, with the overall, broad concept first with connected subtopics, more specific concepts, following. It was developed by Joseph Donald Novak, and his colleagues Bob Gowin, and Johansen in 1970's. Novak's work is based on the cognitive theories, of David Ausubel who stressed the importance of prior knowledge in being able to learn (assimilate) new concept.

Despite these advantages of concept maps, in this twenty first century, the plan behind concept mapping suffers big evolution in theory. First, when used inadequately, the spatial layout of nodes and links can prove to make the concept map harder to process, as when spatial relationships between nodes and links fail to map onto the semantic relationships of presented knowledge domain. This problem can be described as a violation of the congruence principles, formulated by (Caldwell & Reilly, 2010)

Morrison and Tversky (2001) as follow; "the structure and contents of the external representation should correspond to the desired structure and content of the internal representation." Second, concept maps impose repeated choices of what node to attend or what link to follow on the learner, which increases the extrinsic cognitive load entailed by the processing of the map (Nesbit & Adesope, 2011). Third, learners first confronted with complex concept maps may experience map shock and feel overwhelmed by their complexity (Caldwell & Reilly, 2010). This feeling can cause learner to lack motivation to process the map and to fail to attend to and process it completely, resulting in poor educational outcomes. It is good to note that concept mapping is an active learning which when combined with other strategy, plan and technology (C Map tools – concept mapping software) can change the classroom and cause huge impact in the students. This is because it enables students to be protagonist of their own learning as they are involved more in

the process. Concept maps typically represent ideas and information as boxes or circles which it connects with labeled arrows in a downward branching hierarchical structure. The relationship between concepts can be articulated in linking phrases, it aids creativity and sometimes used for brain storming. Active learning happens when students participate in the process of teaching and learning and do not passively listen to what the teacher has to say about specific content (Joel *et al.*, 2005). According to Novak and Canas (2006), concept maps are graphical tools that are used to facilitate and demonstrate student's comprehension through the use of visual medium (Biensterm). Concept maps are two or three dimensional spatial or graphical displays that make use of labeled nodes or represent relationship between pairs of concepts (Bamidele, 2013).

Concept mapping teaching strategy have been found to enhance learning in the following ways as scaffolds for understanding, for consolidation of educational experiences, to improve affective conditions for learning, as an aid or alternative to traditional writing and as a mediating representation (Cana *et al.*, 2003), help students integrate new concepts with older concepts, encourage students to discover new concepts and the propositions that connect them, helps students brainstorm and generate new ideas. According to Novak's theory of meaningful learning, the students should have related background knowledge, the new knowledge should be given in a meaningful way to the students and the students should want actively engaged in the learning process (Novak & Canas 2006; Novak 2010). The act of mapping is a creative creativity in which the learner must exert effort to clarify meaning, by identifying important concepts, relationships, and structures within a specific domain of knowledge. The activity fosters reflection on one's knowledge and understanding, providing a kind of feedback that helps student monitors their learning needs, concept mapping is activity oriented, which involves students to think reflectively when linking concepts together to give meaning. "Proficient readers

spontaneously and purposely create mental images while and after they read. The image emerges from all five senses as well as the emotions and are anchored in a reader's prior knowledge" Keene and Zimmerman, Mosaic of thoughts.

People encounter visual communication every day. Human sees everything happening around him by eyes, receives back some information and responds to it according to the current situation. Communication with the image and using the image is now inevitable. The enormous importance of visualization on the Internet is where information is presented in various forms to enhance visual experience.

Animation and concept maps have been proposed as a potential solution to map shock. Animation and concept maps use animation to display parts of the map incrementally, in a node – by- node fashion, thereby directing the learner's attention towards the newly displayed information. It synchronizes animation and concept map with an audio narration. Nesbit and Adesope (2011) compared learning by subjects presented with an animated presentation of Weiner's attribution theory, in the form of either text with concurrent audio narration, animated text with delayed audio narration, an animated black and white concept map synchronized with audio narration, or the same dynamic concept map enhanced with color coding to denote concept similarity. Students were asked to complete a free recall test as well as a 25 - item multiple choice test measuring recall, understanding and application. The concept map groups scored better than results than the text groups on free recall, and the black -and -white concept map group scored better result than the text groups on the multiple - choice test. No significant difference or benefit from the graphical enhancement of the concept map was detected. Nesbit *et al.* (2009) compared the result of a transfer test completed by participants randomly assigned to one of four multimedia presentations. One group was presented with an animated concept -map, another group with a static concept map, the third group with, an animated

text and the last with, a static test. The concept map groups obtained better results on a transfer test, but there was no significant difference between the static and animated presentations.

Assessing the educational benefit of concept maps, Novak and Gowin (2010) seminal work envisioned concept maps as a means of promoting meaningful learning, based on Ausubel (2008) cognitive theory of learning, which distinguished between rote and meaningful learning. Meaningful learning is the kind of learning "that occurs when students build the knowledge and cognitive processes needed for successful problem solving" (Mayer, 2002). From this standpoint, concept maps can act as advance organizers (Novak & Gowin, 2010; Novak *et al.* 2010) that help learners visualize the semantic structure of a given subject matter, hence supporting the subsumption process.

Visualization, however, is a part of all scientific fields such as construction, engineering, architecture, but also in geography and chemistry. Digital technology is becoming their organic components and brings a significant discovery of new knowledge, principles, and shift in the perception of existing theories. This was still significantly recognizing for most of the teachers, students and pupils of various grades of school systems. (Bamidele, 2013). Visualization is the thinking view of facts, when the results are shown so as to be perceived by the visual receptors. In education, visualization is associated with the application of clear rules. Prucha (2009) poised that visualization of information has universal clarity regardless of the diversity of languages, decoding speed, relativity, and more. The danger is that it is often weakened by ambiguity of the information. The current trend has allowed just thorough visualization speed up communication and creates a single and comprehensive tool that allows communication in routine matters, but also for the unification of terms in science and is a key of importance of education at school and lifelong learning. Prucha (2009) also points out that visual expression using different

brands, diagrams and symbols becomes a permanent part of the communication of many professions and therefore, it is necessary to pay attention to the overall level of visual and aesthetic impact of phraseology, as it creates a new visual culture, a new sensibility of person. Active visual culture is characterized by the fact that a man is able to visually communicate and create visual communication itself.

To strengthen this ability, it is necessary to strengthen the development of visual culture by using didactic tools (what is intended to be taught – moral lesson). Visualization is encountered in science, where it is an important tool for performing the role of cognitive learning, also the presentation of science and technology. The advantage is that the computer technology in cooperation with visualization allows the development of critical thinking (Wiebe *et al.* 2001). Visual attribute has been used since the second half of the 19th century, thanks to technological breakthroughs associated with the use of pictures. This does not directly specify research subject or a clear goal. It is therefore a crucial research context of visual perception and social environment. The first indication for visual literacy used in 1969 by John Deeb. Visual literacy has many definitions, which varies according to the discipline that gives this literacy in context. Definition of International Visual Literacy Association describes visual literacy as an interdisciplinary effort to understand and learn about the process of visual communication as an effort to define the relevant knowledge, skills and competencies that are required for the acquisition of trivia and other skills for successful learning process (Wetman, 2007). The key is to understand different perceptions of reality. It is important to note that for visualization to be effective, it must draw upon the knowledge base of the viewer (learner), if the viewer does not possess the knowledge to understand the relationship between them, the visualization does not achieve its goal in the sphere of education.

Geography is an academic science subject taught in senior secondary schools and tertiary institution in Nigeria. It involves the study of natural features and phenomena on the earth surface and in the atmosphere. The subject also focuses on location, space relationship and changes of physical phenomena on the earth's surface; it is geared towards teaching the interrelationship among phenomena on the earth surface and those in the atmosphere based on stated objectives (Abdulkarim, 2010; Aderogba, 2011).

The basic objectives of Education at the secondary school level includes; the acquisition of laboratory and field skills, meaningful and relevant knowledge, ability to apply scientific knowledge to everyday life in matters of personal and community health, agriculture and reasonable functional scientific attitudes, Federal Republic of Nigeria (FRN, 2009). The objectives of teaching Geography as a science subject at senior secondary school level was spelt out by National Policy on Education of Federal Ministry of Education (FME, 2004) and reinforced by examination bodies such as the West African Examination Council, (WAEC) and National Examinations Council (NECO) and curriculum development body such as Nigerian Educational Research and Development Council (NERDC, 2008).

These objectives have been thought of in terms of what Geography can contribute to the realization of the aims of secondary education in Nigeria which include, giving students a sound knowledge of their immediate environment, inculcate in them useful skills and outlooks that will enable them to make useful contribution to their community and nation at large, to develop in the student critical thinking ability, accuracy and objectivity to proper and logical investigation among others (Aderogba, 2011). In line with the realization of these objectives, the senior secondary school Geography's curriculum was designed to include what the National Geographic Society (2003) considered as "Five themes of Geography", the themes are location, place, movement, interaction and region.

NERDC, (2008) in an attempt to restructure Geography curriculum of Senior Secondary School in Nigeria classified these themes as, environment and its resources (weather and climate inclusive); Regional Geography, Economic and Human geography, introductory GIS, Map reading and interpretation, these themes were planned to be taught within thirteen weeks of school calendar period. Curriculum review in geography by WAEC was carried out to facilitate the realizations of manpower needs of Nigeria.

Weather is the condition of the atmosphere within short periods. Parameters of weather includes temperature, cloud cover, precipitation, wind and pressure variance (Iwena, 2008). The concept of weather is a component of Geography course of study that develops students' skills of observation, measurement and recording, experimenting and drawing inference of geographic data (Abdulkarim, 2010). The elements of weather being directly observed, measured, recorded and predicted range from solar intensities; wind direction and velocity; humidity and precipitation indices; temperature variations; pressure gradients, cloud covers and soil moisture. Wind is the air in motion characterized by speed and direction and measured by wind vane and anemometer. Humidity is the measure of the dampness of the atmosphere due to water in the gaseous state and which varies from place to place at different times of the day and is measured using hygrometer. Precipitation refers to the rain of the earth's surface from the atmosphere measured by rain gauge. Atmospheric pressure refers to the weight of air overtime (Saulawa, 2006). These can be taught using various techniques.

A technique of teaching weather relies on students making direct observation, measuring, recording and analyzing weather changes. Another technique relies on students' use of maps, photographs, model, sketches and the internet. Meteorological or weather instruments used by teachers and student have processing of weather data; on daily, monthly and annual basis. The use of these instruments has also made the teaching of

weather concepts easier for teachers, more interesting and meaningful to students. Schools without such facilities make learning theoretical and boring. (Abdulkarim, 2010). Strategies for teaching Geography outlined by researchers range from the use of laboratory activities, lecture, discovery/visualizations, inquiry, demonstration, problem solving, process approach, deductive and inductive methods, simulation, animation methods, concept maps among others.

In addition, efficacy of the methods and their effects on students' academic achievements were also outlined. Obeka (2013), revealed the inquiry and demonstration methods among the most effective strategies of teaching because students' cognitive achievement, interest, and retention of environmental concepts of Geography are attained and facilitated faster than in the other methods. Mahmud (2010) posited that discovery / visualization method enhances academic achievement of students in genetic concepts of Biology. Usman (2010), reinforced this idea through the outdoor laboratory activities in genetic concepts of junior secondary Basic Science, while Nsofor and Ala (2013), recommends the use media technology respectively.

Academic achievement has long been recognized as one of the important goals of education the world over. It is a general observation that learners placed in an identical set of academic situations vary in their scholastic achievement. Research conducted to prove into the academic achievement phenomenon has convincingly demonstrated that it is the product of a number of factors operating within the individual and outside him. Academic achievement was defined by Ogundokun and Adeyomi, (2010) as the exhibition of knowledge attains or skills developed by students in a subject designed by test scores assigned by teachers. However, the Science Teachers Association of Nigeria (STAN, 2012) identified gross under funding, large class size, shortage of qualified science teachers, and poor teaching strategies among others as contributory to students

under achievement in science subjects including geography. Other challenges in learning geography outlined by Aderogba (2012), include large classes, students, students' limited interest in geography compounded by limited teaching aids and poor teaching techniques. Apart from obstacle and inadequacy of equipment and laboratories for teaching geography, some teachers lacked in-depth knowledge of the subject matter and application of inappropriate teaching methods (Abdulkarim, 2010).

Atadoga and Onaolapo (2008), reported that the kinds of instructional strategies to be adopted by teachers for meaningful learning is dependent on teacher's competency, concept to be taught, learner' age and available resources and space. Researchers; Lawal (2007); Atadoga and Lakpini, (2013) found that the present low academic achievement in science education is attributed to teacher instructional strategies among others. Thus, instructional strategies used by teachers in teaching –learning process have significant influence on learners; academic achievement. In this study, the researcher investigated the effect of concept mapping and visualization on Geography students' academic achievement, retention and interest in weather concepts of secondary schools' students as compared to lecture method.

The lecture method in this study is one where a teacher does most of the talking, while the students listen and take notes. The method involves verbal presentation of ideas, concept and generalization of facts. Lecture method is less tedious, save times and provides fascinating and aesthetically stimulating experience especially for the new students on topics of interest (Obeka, 2009). However, Joshi (2008) opines that lecture method is teacher-centered with little or no participation of students; consequently, they remain passive listeners. Therefore, in this study lecture method was used as a control variable to determine its effectiveness in relation to concept maps and visualization instruction strategies as they translate to students' interest.

Reninger and Hidi (2011), put interest as a critical cognitive and affective motivational variable that guides attention, facilitates learning in different content areas, for all students of all ages and develops experience. Aggarwal, (2008), ascertained that the aim of teaching is to secure the students attention through arousing and maintaining interest in lessons of multidimensional instructions. Mangal, (2010), reported that idle learning environment and methods, functional teaching material and a motivating teacher have positive effect on students' interest in learning. Spatial topography can also be taught through concept maps and visualization in the measurement of seasonal and weather changes, vegetation transition, terrain and hydrological features, thus enhancing the student's retention.

Retention in this study is the ability to remember task, or material concepts, Bichi (2002) defined retention as the ability to retain and recall information or knowledge gained after learning. Retention is the repeat of performance of a task of learnt behavior earlier acquired. It is the preservative factor of the mind (Gana, 2013). Other researchers such as Mangal (2010); Obeka (2010), investigated and defined several variables that affect retention. Factors effecting retention include the content or tasks to be performed, learners' past experiences, the interval between lesson and evaluation and instructional strategies employed. This this study incorporated the use of concept maps and visualization instructional strategy in teaching and observed its impact on students' retention ability in weather of concept maps and visualization instructional strategy on students' academic achievement, retention, and interest of weather concepts in Secondary Schools of Wuse, Abuja.

The recurring theme among educators especially science educators and the society at large are gender equity or gender friendliness in teaching and learning (Eze, 2008). Gender as one of the variables to be investigated in this study could help clarify the

assumptions and other associated issues in gender study which includes perception of visual information by males and females, differences in acquisition of scientific knowledge through concept map and visualization and disparity in academic achievement in science courses. Other previous research studies revealed that male students perform better than the females in Physics, chemistry and biology Okeke and Okafor (2007); Wushishi *et al.* (2011), while others posit that female students were better off than males. Wushishi *et al.* (2011) found no significant influence of gender on the achievement of college students – mathematics when exposed to mathematics courseware in online and traditional environment. Wushishi *et al.* (2011) found no significant difference between male and female students taught physics, mathematics, Chemistry and history respectively using concept map and visualization. Gender issues also have been linked with performance of students in academic task in several studies but without any definite conclusion (Yusuf & Afolabi, 2010).

This study therefore is intended to investigate the effects of animated concept maps and visualization on students' achievement, retention and interest in geography among secondary schools in Wuse II, Abuja.

### 1.2 Statement of the Research Problem

Despite an increasing availability of technological packages such as animation, concept maps, computer assisted instruction, digital video displayer (DVD) and textbooks, it has been observed that there is low academic achievement, low retention of the learned concepts as well as of WAEC limited interest by the student. This has been associated to inadequacy and dismal utilization of Geography equipment for teaching, like using computers, animations, concept maps, globes, meteorological stations, water reservoirs, forest reserve amongst others as well as poor teaching strategies characterized by teacher centeredness. Teachers often uses lecture method in teaching the subject, ignoring

animations and concept maps, this a gap in the application of technology to improve students' performance in weather concept, teachers consider the cognitive aspect of learners and neglects affective aspect (interest) (Aderogba, 2012).

There is limited literature on the effect of animation and concept map visualization on students' achievement, retention and interest in geography among secondary school students in the study area. Therefore, the need for a more efficient and effective method of instruction that will hopefully cover cognitive, affective, and psychomotor domains of students like the use of animation and concept map visualization strategy. An interactive strategy that can be used for improving this present trend of poor performance may be the use of animation and concept maps visualization (Abdulkarim, 2010). The research problem is, the effects of animation and concept map visualization on achievement, retention and interest in Geography among secondary school students, Abuja? It also investigated the moderating effects of gender on achievement, retention and interest.

### 1.3 Aim and Objectives of the Study

The aim of this study was to investigate the effects of animation and concept mapping visualization on achievements, retention and interest in Geography among secondary school students, Abuja. The objective of the study were to:

1. determined the effects of animation, concept mapping visualization and conventional method on students' achievement in weather concepts;
2. Find out the influence of gender on students' achievement when taught weather concepts using animation;
3. find out the influence of gender on students' achievement when taught weather concepts using concept maps visualization;

4. examine students' retention when taught weather concepts using animation, concept mapping visualization and conventional method;
5. investigate the influence of gender on students' retention when taught weather concepts using animation;
6. investigate the influence of gender on students' retention when taught weather concepts using concept maps visualization;
7. determine the difference in the interest inventory scores of students when taught weather concepts using animation and concept maps visualization;
8. find out the influence of gender on the interest inventory scores of students when taught weather concepts using animation; and
9. determine the influence of gender on the interest inventory scores of students when taught weather concepts using concept maps visualization.

## 1.4 Research Questions

The following research questions were answered in the study:

1. What are the effects of animation, concept mapping visualization and conventional method on students' achievement in weather concepts?
2. What is the influence of gender on students' achievement when taught weather concepts using animation?
3. What is the influence of gender on students' achievement when taught weather concepts using concept maps visualization?
4. What are the differences in the students' retention score when taught weather concepts using animation, concept mapping visualization and conventional method?
5. What is the influence of gender on students' retention scores when taught weather concepts using animation?

6. What is the influence of gender on students' retention when taught weather concepts using concept maps visualization?
7. What is the difference in the interest inventory scores of students when taught weather concepts using animation and concept maps visualization?
8. How does gender influence the interest inventory scores of students when taught weather concepts using animation?
9. How does gender influence the interest inventory scores of students when taught weather concepts using concept maps visualization?

## 1.5 Research Hypotheses

The following null hypotheses were formulated and was tested at 0.05 level of significance:

$HO_1$: There is no significant difference in the mean achievement scores of students taught weather concepts using animation, concept map visualization and lecture method.

$HO_2$: There is no significant difference in the mean achievement scores of male and female students taught weather concepts using animation.

$Ho_3$ There is no significant difference in the mean achievement scores of male and female students taught weather concept using concept maps visualization.

$Ho_4$: There is no significant difference in the mean retention scores of students taught weather concept using animation, concept maps visualization and lecture method.

$Ho_5$: There is no significant difference in the mean retention scores of male and female students taught weather concepts using animation.

$Ho_6$: There is no significant difference in the mean retention scores of students' taught weather concept using concept maps visualization.

$Ho_7$: There is no significant difference in the mean interest inventory scores of students taught weather concepts using animation and concept maps visualization.

$Ho_8$: There is no significant difference in the mean interest inventory scores of male and female students taught weather concepts using animation.

$Ho_9$: There is no significant difference in the mean interest inventory scores of male and female students taught weather concepts using concept maps visualization.

## 1.6 Significance of the Study

This study examined the effect of animation and concept map visualization teaching strategy on secondary school Geography students' academic achievement, retention, and interest of weather concepts.

The result of this research may have both practical and theoretical significance to the following groups; students, teachers, Principals/Educational administrators, The Association of Nigerian Geographers, Textbook Publishers and Media Outlets, Non-Governmental Organizations (NGO's), Government, Researchers, Educational Technologist, Educational Resource Centers, Government, amongst others.

In the theoretical significance, it is assumed that the findings of this study might buttress the cognitive load theory (intrinsic load), which is the number of information elements the user requires to grasp in working memory spontaneously to understand the information. If the students' achievement, retention and interest is positively affected as a result of the application of animation and concept map visualization, mental load theory will be achieved. Chang *et al*. (2016) emphasized that the use of audiovisual presentation of subject contents to the learners through the use of computer technologies such as animation and concept maps.

To the students, the findings will be of significance to them because they will be able to visualize and conceptualize concepts such as weather concepts. This they will do by visualizing the elements/factors of weather as they play important role in their life especially weather forecasting. The students might be the most benefitting group of people because the constructivist theory of learning stresses that the learners should be provided with a ladder but then the learners must climb the ladder by themselves. Based on this fact, the learners might be able to actively engage themselves in learning and building their own knowledge structures by investigating and discovering since learning is through animation and concept maps which is student- centered and participatory. The use of animated concept map strategies, might also make learning real, concrete, and develop the students in practicing the basics geography skills and learning at their pace and time. The development and construction of animation and concept maps can make students develop interest in geography and creative skills in manipulating computers and construction of concept maps on their own.

The teachers at all levels of our institutions might be able to appreciate and adapt the most favorable and slow cost demanding teaching strategies and use them for the classroom instruction to promote and enhance active involvement of students and above all providing opportunities for learner to construct maps in their minds on difficult concepts. The training of the teacher by the researcher may acquaint the teachers of the paradigm shift from teacher- centered approach to student- centered approach of learning. More so, teachers of geography will be more resourceful in making use of innovative media in instructional delivery which may lead to students' achievement, retention and interest.

Educational administrators and Principals of schools are the custodians of knowledge in their institutions. They might find the outcome of this study very useful in creating

awareness on the need of conducting animation and concept maps visualization studies. This will consequently reduce complaints of insufficient teaching materials for teaching geography and the limitations associated with using laboratories in teaching weather related concepts.

It is hoped that this study might provide the learning skills of observation, recording, analysis, and reporting of geography phenomena that are likely to be developed among students. This has a philosophical background of intuitivist and objectivist students who place a significant role of observation in driving scientific knowledge. This will enable provision of meaningful learning and develop conceptual growth in the minds of students when taught weather concept using animation and concept maps teaching strategy. It is also hoped that engaging students into lesson might development their interest in Geography.

The association of Nigerian Geographers (ANG) might use the result of finding of this study to improve teaching of geography at all levels thereby organizing workshops, seminars, and conferences on utilization of animation and concept maps teaching strategy among teachers especially at secondary school level.

Textbook publishers and media outlets (print and electronic) may find the study useful to design activities that involves the use of animation and concept maps teaching strategy instruction to aid meaningful learning among students.

Non- governmental organizations (NGOs) might see the relevance of this research and be able to provide assistance to the schools by retraining teachers on the use of animation and concept maps, purchase of packages and other instructional materials to promote learning in schools and consequently the problem of poor performance might be reduced.

The result that will be yielded from this study will assist the FCT government, FCT Secondary Education Board (FME), Technical Schools Board (TSB) to plan policies that will make the study of geography compulsory right from primary school through secondary to tertiary levels. This will help in achieving scientific and technological advancement.

To the curriculum planners, the study might keep the developers of curriculum abreast with the current pedagogical instructional needs of the learners which includes knowledge acquisition through scientific and technological tools

Researchers may hopefully use the outcome of the study to replicate it in the other study areas, improve on it or adapt it for similar studies and also add more information to the existing literature. The study might hopefully extend the frontier of learning for further researchers on the teaching and learning of weather concepts at senior secondary school.

Textbook publishers and media outlets (print and electronic) may find the study useful to design activities that involve the use of animation and concept maps visualization teaching strategy instruction to aid meaningful learning among students.

The association of Nigerian Geographers (ANG) might hopefully use the result of findings of this study to improve teaching of geography at secondary school thereby organizing workshops, seminars and conference on utilization of animation and concept maps teaching strategies among teachers at secondary school level.

The government can inculcate the findings in curriculum development at various levels.

## 1.7 Scope of the Study

This study examined the effect of animation and concept map visualization on achievement, retention and interest in Geography among secondary school students in Wuse, Abuja. The study was only conducted on secondary school 11(SS 11) students

because the topic to be treated fell in their syllabus. The topic that was treated is the concept of weather because it has been reported to be difficult and abstract as reported by WAEC and NECO. The variables of the study are independent variable which is animation and concept map visualization while the dependent variables are achievement, retention and interest while the moderating variable is gender. The study will last for about 8 weeks.

## 1.8 Basic Assumptions of the Study

The present study is based on the assumptions that:

1. Animation and concept maps have not been used as teaching strategy for weather concept of Geography.
2. Geography students were exposed to weather concept before the study.
3. Students in the study area exhibit similar Retention and Interest ability.
4. The classroom atmosphere will be conducive for teaching and learning
5. Gender may not have any significant effect on academic achievement of students.

   In the light of the above assumptions, researcher was optimistic that if these were adequately taken care of, learning achievement, retention and interest may be guaranteed to a reasonable level.

## 1.9 Operational Definition of Terms

The following terms have been operationally defined as used in this study:

**Visualization:** Visualization refers to our ability to create pictures in our heads based on text we read or words we hear. It is one of many skills that makes reading comprehension possible. Students who visualize as they read not only have a richer reading experience but can recall what they have read for longer periods of time.

**Animated media package:** Instructional strategy in teaching experimental group that implies application of computer software package plus flash cards in instructional process.

**Animation:** It is a way of developing a motion picture using a series of drawings, computer graphics, and photographs of objects.

**Concept Maps**: A concept map is a visual organization and representation of knowledge. It shows concepts and ideas and the relationships among them.

**Academic Achievement**: outcome from a positive learning. This is the exhibition of knowledge attains by students in the school subject usually designed by test scores or by marks assigned by teachers.

**Retention:** This is the ability of students to remember material learned (weather concepts) after a given period. It is knowledge left in memory after forgetfulness.

**Interest:** The term *interest* can describe two distinct (though often co-occurring) experiences: an individual's momentary experience of being captivated by an object as well as more lasting feelings that the object is enjoyable and worth further exploration.

**Geography**: Subject of earth and space study. It is the study of the physical features of the earth and its atmosphere, and of human activity as it affects and is affected by these, including the distribution of population and resources and political and economic activities.

**Gender:** Feminine / Masculine characteristics. The concept of gender also includes the expectations held about the characteristics, aptitudes and likely behaviours of both women and men (femininity and masculinity).

**Control Group;** Group of students taught weather concepts using lecture method only.

**Experimental Group:** Group of students taught weather concepts using animation and concept map strategies.

**Lecture method:** Instructional strategy in teaching control group that involves verbal presentation of ideas, concept, and generalization of facts.

**Weather concepts:** Concepts or topic used in teaching experimental and control group and constructs of weather.

# CHAPTER TWO

# 2.0 LITERATURE REVIEW

## 2.1 Conceptual Framework

### 2.1.1 Concept of Geography

Geography as an academic subject centers on the evolution and organization of earths feature and process. In other word, it is the study of man and his environmental features. It also focuses on locations, space relations, and changes of physical phenomena on the earth‘s surface. It is about how, why, and where human and natural activities occur and how they are interconnected spatially (Aderogba, 2012).

### 2.1.2 Scope of Geography

Scope is the range covered by an activity or subject. According to Nigerian Education Research and Development Council (NERDC 2008), major scope and subdivisions of geography are: Physical geography, Mathematical Geography, Biogeography and Human geography. Even though, Strahler and Strahler, (2006) organized these subfields into two broad realms of human geography and physical geography. Human components of geography according to researchers (Strahler & Strahler, 2006; Atere, 2006; Obioma, 2008; Abdulkarim, 2010) focus on the socio-economic, population and settlement, patterns of locations. Physical geography examines patterns of the natural processes occurring at the Earth‘s surface that provides the natural setting for human activities namely, the study of climate, landforms, Coastal inland and marine waters, vegetation, risks and hazard and soils. In line with this, the NERDC (2008) categorized the scope of geography at senior secondary school level into seven themes (Local Geography, the earth and the solar system, Environment and its resources, Regional Geography of Nigeria, Map reading and Interpretation, Economic and Human Geography and Introductory Geographic Information System). In SS I level, students were exposed to all

the seven themes. However, the themes reduced to six at SS II level, and to five at SS III level. At all the levels, 18 weather concepts were embedded as Environment and its resources theme. The West African Examinations Council and National Examinations Council (2013) detailed the scope of geography at the secondary school levels into physical, human, regional, and practical geography to facilitate students' assessment. The scope of geography globally was described as eclectic in nature. That is to say Geography is inter disciplinary characteristics, branches out to other disciplines such as Biology – (Biogeography), Physics (Geophysics), Medicine (Medical geography), Economics – (Economic Geography), Politics - (Political Geography) Agricultural Science (Agricultural Geography), Computer Information Science (Geography Information Science) among others. These characteristics of geography make it a dynamic subject of study according to Atere (2006).

However, Boehim (2000) and Aderogba (2012), stated that geography provides trained students with a wide career opportunity. For instance, a geographer who study Cartography and Geographic Information System will be a Cartographer for Federal Government (agencies such as Defense Mapping Agency, US Geographical Survey or Environmental Protection Agency or Private Sector (e.g. Environmental System Research Institute, Integral or Bentley); Map Liberian, GIS specialist for Planners, land developers, estate agencies, local government, remote sensing analyst, Surveyor. Physical Geographer can work on weather forecaster; outdoor guide; coastal zone manager; hydrologist; soil conservation/agricultural extension agent. Environmental Studies offered environmental geographer an opportunity to become an environmental manager; forestry technician; park ranger; hazardous waste planner among others. According to Rilwani *et al.* (2014), the strength of geography as a subject in the senior secondary school lies in the background training and opportunity it can provide to students who want to

pursue different types of professions, among which are careers in self-employment, professional establishments, paid employment in government and industries and specialized professions. This study therefore focuses on weather concept of senior secondary school geography. The concept was embedded under Environment and its resources theme of geography that can be found at SSI, SS II and SS III level. However, SS II level were used for this research.

### 2.1.3 Objectives of teaching geography in schools

The objectives of teaching geography at secondary school level were derived from national educational aims and objectives of the Federal Government of Nigeria (FGN, 2004). The National Aims and Objectives of Education in Nigeria are: The inculcation of National consciousness and National unity. The inculcation of the right type of values and attitudes for the survival of the individual and the Nigerian society. The training of the mind in the understanding of the world around us. The acquisition of appropriate skills, abilities, and competences both mental and physical as equipment for the individual to live in and contribute to the development of his society. According to Atere (2006) the objectives of teaching geography was linked to what geography can contribute to realizing the aims secondary education in Nigeria in the following areas:

a. Providing students with a sound knowledge of their immediate environment.
b. Developing students' ability to comprehend and explain natural phenomena.
c. Inculcating students' useful skills and outlooks that will enable them to make useful contribution to their community and their country.
d. Enable the students appreciate problems of other peoples and in fact, to show empathy to them.
e. Develop in students the critical thinking ability, accuracy and objectivity for proper and logical investigation.

f. Foster in students a sense of responsibility toward their own society.

g. Develop in students a comprehension of the spatial relationship and various features on the surface of the earth.

h. Enable students comprehend the habitation of man within his environment. In line with the National Policy of Education (FGN, 2004) and the broad objectives of teaching geography, the West African Examination Council as one of the examination bodies at secondary school level in Nigeria further clarifies these aims and objectives of teaching geography at Secondary School level:

    i. Understand the concept of different characters and the spatial relationship of the features on the earth surface.

    ii. Understand the concept of man-environment relation, that is, to examine and explain the interaction of man with his physical and cultural environment.

    iii. Acquire the basic knowledge of the nature and function of physical and human environments and understanding of their inter-relationships on the resulting issues.

    iv. Organize and formulate principles according to acquired geographical concepts and apply these principles to interpret and analyze spatial problems in the immediate and wide environment.

    v. Develop skills and techniques for accurate, orderly, and objective geographical investigations to be carried out both in the classrooms and in the environment (Aderogba, 2012).

In accordance with the National Policy on Education (FGN, 2008), geography as a Senior School subject should therefore help the Nigerian Senior Secondary School students to: (a) Understand the concepts of differential character and the spatial relationships of the

surface features of the earth. (b) Understanding the concept of man-environment relations (i.e. to examine the life of man within his physical and cultural environments and to explain their interactions). (c) Appreciate and develop a sense of responsibility towards one own society and an intelligent interest in the formulation of national goals and policies, especially as they influence the different resources and regions of the area. (d) Develop sympathetic understanding of the people of other lands, based upon the recognition that they may have different assemblies of resources, different goals and different problems from the people of their home area. (e) Organize and formulate principles according to acquired geographic concepts, which they can use to analyze and interpret spatial problems in their immediate and wider environments. (f) To develop skills and techniques for accurate, orderly objective geographical investigations to be carried out both in the classroom and in the immediate environment.

Going by the above, Atere, (2006) and Aderogba, (2012) stated what geography as a subject could contribute towards the realization of national aims and objectives as follows: a. Teaching Geography exposes students to know more about the immediate environment and the globe at large; appreciate their environment and even realize the need for the judicious conservation of these resources which is akin to the second national educational aims (inculcation of the right type of values and attitude). b. Through the teaching of geography, students could acquire certain essential skills such as the art of close observation of natural phenomena, accuracy in the recording and analysis of the collected data, and logical and critical thinking. These skills equip the students for meaningful contribution to the development of their society, and these are in consonance with the fourth national educational aim. c. The objectives of geography teaching also prepare the students toward the inculcation of the national consciousness and national unity, which is the first national educational aim. Based on the objectives of geography

teaching, this study developed four objectives and examined the impact of animated-media instructional strategy on the academic achievement, interest, and retention in weather concept of senior secondary school geography.

### 2.1.4 Secondary school geography curriculum

The National Policy on Education (2004) considers Education as an instrument for change and development. In order to make it possible for education to fulfill that fundamental role, there is the need to design, plan and implement relevant and related curricula for the school subjects in Educational system of Nigeria. It is that need that spurs the Nigerian Educational Research Council to sponsor the Senior Secondary School Geography Curriculum Planning/Writing workshop between 9th and 19th January 1985 at the Durbar Hotel, Badagry Express Road, Lagos, Nigeria, at the instance of the Federal Government (Atere, 2006). The Geography Curriculum package that has been developed for the Senior Secondary School Geography programme has many special features. Such features have been designed and built into the curriculum in order to make the teaching and learning of Senior Secondary School Geography a more challenging, appealing, stimulating, relevant and rewarding experience. Some of the special features of this curriculum package, as observed by Atere (2006), and NERDC, (2008) are the following: (a) The provision of a geography programme that is based on the choice of suitable and relevant themes; units, content, teaching method, students' activities, teaching aids and evaluation; (b) The reduction in the scope and content coverage of the subject matter of Senior Secondary School Geography, without losing the high quality required at that level. (c) The provision of a wide range of experience for students in the use of the concept centered approach to learning, problem-solving and activity-based techniques for the acquisition of basic geographic knowledge and skills; (d) The inclusion of innovative elements into the syllabus, through the emphasis placed on practical geography throughout the 3-years

course and the introduction of geographic principles, concepts and skills that are relevant to current trends in the discipline and useful for solving environmental problems; among others. Obioma (2008), explained that following the Federal Government reform in education and the need to attain the Millennium Development Goals (MDGs) and the critical targets of the National Economic Empowerment and Development Strategies (NEEDS), which includes: value orientation, poverty eradication, job creation, wealth generation and using education to empower the people, it has become imperative that the existing curricula for senior secondary school should be reviewed and realigned to fit the reform programme.

The NCE at its meeting in Ibadan in December 2005 directed the NERDC to carry out this assignment. In response to the above developments, a Highly Level Policy Committee on Curricula Development (HLPC), made up of critical stakeholders and chaired by NERDC, took the initiative to provide the guidelines of restructuring the curriculum. The committee held a meeting of experts and workshops between January 2007 and March 2008. The meeting resulted in the production of current geography curriculum module composed of 52 contents to be covered within a total period of nine (9) terms (NERDC, 2008). Obioma (2008), added that since the curriculum reflects the total experiences to which all students must be exposed, the contents, performance objectives, activities for both teachers and students, teaching and learning materials and evaluation guide are provided. The prescriptions represent the minimum content to be taught in the schools in order to achieve the objectives of the new senior secondary programme. The teachers are encouraged to enrich the contents with relevant materials and information from their immediate environment, but adapting the curriculum to their needs and aspirations. In compliance with the above, all the topics/ themes of geography in the new senior secondary school curriculum were provided with the contents,

performance objectives, activities for teachers and students, teaching and learning materials and evaluation guide (NERDC, 2008). The curriculum content has provided insight on the kinds of skills to identify measure and test during treatment of subjects. Thus, this study used curriculum content of senior secondary geography curriculum and formed the bases of lesson plan of animated-concept map visualization instructional strategy and lecture method in relation to academic achievement, retention, and interest in weather concepts.

### 2.1.5 Weather concept in geography

Weather is the condition of a place over a short period. Ajayi (2003) defined weather as the condition of the atmosphere at any particular time or over a certain period as shown by various methodology phenomena, including atmospheric pressure, temperature, humidity, rainfall, wind speed and direction and cloudiness. However, Iweana (2006) opined that weather is the condition of the lower atmosphere of a place over a short period, which is always very brief as changes regularly. It could be sunny, rainy or cloudy. It is the state of the atmosphere in relation to variations in temperature, rainfall, humidity, wind, simple cloud cover and other meteorological conditions. Abdulkarim (2010), distinguished the concept of weather from climate. While the later was regarded as the atmospheric condition of a place over a long period, the former refers to the average weather condition of a place over a long period usually about or over 30 years. This phenomenon is governed by latitude, position relative to continents and ocean as well as the local geographical conditions. This involves the systematic observation, recovery and processing of the climatic elements. Weather of a place can best be understood through its element. Researchers ascertain that weather instruments that can be observed and recorded include temperature, rainfall, atmospheric pressure, wind, humidity, sunshine, and clouds. Temperature, as observed by Ajayi (2003) and Iwena, (2008), is an important

element of weather. It is defined as a measure of the level of sensible heat of matter, whether it is gaseous (air), liquid (water) or solid (rock or dry soil). The sun is the sole source of energy on the earth's surface. The energy, which exists in form of heat and light, is called solar radiation. The heat produced warm up the air in the atmosphere and force it to move up and down in different directions. The temperature of the atmosphere varies greatly on the earth surface (Ajayi, 2003). The temperature is highest at the ground level and a decrease with increasing altitude is identified as the normal lapse rate which usually about 6.50C for every 1000 meters' ascent above sea level. However, Strahler and Strahler (2006), observed that the temperature affects the cloth we wear, cost of food, plant selection, and animals that make up the biological landscape of the region. Geographical weathering and soil formation processes are dependent on temperature over the long term. Rainfall and other forms of precipitation are other concepts of weather. Strahler and Strahler (2006) defined rainfall as the amount of water in liquid or solid form from the atmosphere on to the earth surface, lakes or oceans. It is formed when moist air is cooled, causing water vapor to form liquid droplets or solid ice particles. Ajayi (2003), observed that rainfall as an important form of precipitation, which result from the cooling of saturated air in the lower atmosphere. Atmospheric pressure is the weight of the volume of air that extends from the ground surface to the outermost layers of the atmosphere (Ajayi, 2003). In addition, Obeka (2010), observed that numerous measurements of air pressure are used for weather analysis in identifying troughs of high-pressure systems

#### 2.1.5.1 Instruments for measuring weather elements

Instruments for measuring weather elements to include: Rain gauge; Wind Vane; Anemometer; Barometer; Hygrometer; and Thermometers, Sundial among others (Ajayi, 2003; Oladipo, 2009; Obeka, 2010; Abdulkarim, 2010; Hafield, 2012). Rain gauge is used in measuring rainfall and consists of a metal container, metal jar or glass bottle and metal

funnel (Ajayi, 2003). Obeka (2009) ascertained that rain gauge is an instrument used to measure the amount of liquid precipitation over set of periods. The researcher posited that most rain gauges' record precipitation in millimeters, inches or centimeters either manually or automated. Ajayi, (2003) observed that rain gauge function better when kept in an open space far from buildings and trees or shelter. This enables the instrument to collect rain water directly and ensures that no water drops from roof or trees enter the funnel after rain stopped. With daily examination, it is kept in good condition for effective recording. It is sunk into ground such that 30 centimeters of it is above the ground level where the need arises. Wind Vane and Anemometer are instruments for measuring wind direction and speed respectively. Wind vane work by moving to minimize air resistance. Wind vane consists of freely rotating arrow pointing to the direction of wind movement.

Wind speed is measured using anemometer. It consists of three or four cups attached to the ends of the horizontal spaces mounted on a higher vertical spindle. Obeka (2009) observed that in primitive situation where these instruments are not available; finger technique were used to test the direction of wind. This is attained by wetting the finger and raising it upwards. The coolest side of the finger is the direction from where wind is blowing. Hygrometer is used for measuring humidity. It consists of wet and dry bulb thermometer. Thermometer on the other hand measures temperature of a place. It is a narrow glass tubes contains mercury or alcohol. Strahler and Strahler (2006) reported that temperature is measured in degrees Celsius ($^{o}$C) or Fahrenheit ($^{o}$F). Two types of thermometers noted by researchers are maximum thermometer (which measures the highest temperature attained during the day) and minimum thermometer (which records the lowest temperature reached during the day).

Thermometers are kept in Stevenson screen, designed to protect it from direct sun and rains and to attain correct recordings at a period. (Ajayi, 2003; Strahler & Strahler, 2006;

Obeka 2009; Abdulkarim, 2010). In geography, scholars (Strahler & Strahler, 2006, Aderogba, 2011; Abdulkarim, 2010) observed that the teaching of weather is an essential component that develops the skills of observation, measurement, recording, experimenting and making influences of geographic data among students. This involved the use of measuring instruments such as rain gauge, thermometers, and barometers among others. This study investigated the effects of the use of animated concept map visualization instructional strategy on academic achievement, retention and interest of geography students in weather concepts.

### 2.1.6 Methods of teaching geography

The concept of teaching method refers to the ways, approaches, procedures, and kinds of activities that teachers and students engage in the interactive process with a view to inducing, inspiring, and facilitating learning for accomplishing a set of instructional objectives. According to Okam (2009), method include utilisation of appropriately selected curriculum materials, content and learning experiences, motivational strategies, an application of learning theories and a demonstration of a knowledge of developmental psychology or other aspects of educational psychology in the teaching learning process. Researchers (Amosun, 2008; Joshi, 2008; Okam, 2009, Usman, 2010, Obeka, 2010, Lawal, 2007: Aderogba, 2012) opined that there have been varieties of methods and techniques for teaching sciences. Most of these are in use and each of them provides something useful and worthwhile to a capable and enthusiastic teacher. None of these methods are error proof; because they have limitations. These methods include: (i) Lecture method (Brown, 2011; Usman, 2010, Maikano, 2007; Okam, 2009); (ii) Project method (Atere, 2006; Okam, 2009); (iii) Inquiry Method (Mansaray, 2012; Obeka 2010, Olajide, 2009); (iv) Discussion Method (Ibrahim 2018; Atere, 2006; Okam, 2009); (v) Simulation method (Atere, 2006; Obeka 2009); (vi). Fieldtrip method (Omolade, 2004;

Atere, 2006; Busari, 2009); (vii) Laboratory activity method 29 (Maikano, 2007; Olajide, 2009; Aderogba, 2011; Usman, 2012); and (vii) Animation method (Mayer, 2002; Tayo, 2012; Lin, 2011; Brown, 2011; Aksoy, 2013). This study used the animation and lecture methods to guide in testing the subjects.

#### *2.1.6.1 Animation method*

Animation is a way of developing a motion picture using a series of drawings, computer graphics, and photographs of objects. It is a technique of photographing successive drawings or positions of puppets or models to create an illusion of movement when the film is shown as a sequence. Pilling (2007) define animation as created performance," that is carefully worded to establish validity and secure resources for an animation program or class. According to Mayer and Moreno (2002), animation refers to a simulated motion picture depicting movement of drawn (or simulated) objects or moving something that cannot move by itself. Schnotz and Bannert (2003), describes animation as the rapid succession of pictures indicating a series of slides, appearance and disappearance of iconic element continually. In educational terms, animation is a technique of visualization. Sánchez *et al.* (2010) describe educational animations as animations produced for the specific purpose of fostering learning. The popularity of using animations to help students understand and remember information has greatly increased since the advent of powerful graphics-oriented computers. This technology allows animations to be produced much more easily and cheaply than in former years.

Previously, traditional animation required specialized labor-intensive techniques that were both time-consuming and expensive. In contrast, software is now available that makes it possible for individual educators to author their own animations without the need for specialist expertise. Teachers are no longer limited to relying on static graphics but can readily convert them into educational animations. According to Thomas and Israel

(2014), animation teaching is a device that has the features of both audio and visual representations that are used in the teaching/learning process for effective dissemination of knowledge. Thus, animation teaching enhances learning of service subject. Lin (2011) ascertained that animation has been used in various discipline to deliver instructional material that is hard to present alone using static visuals or that contains content that is highly abstract or invisible to human eyes. Thus, in computer based instructional environment, animation is typically used due to its inherent characteristic that facilitates the teaching and learning processes.

According to Aksoy (2013), animation has three characteristics, namely; the picture; display of movements and Simulation. Animation corresponds to the context of the topics, otherwise it becomes distracting, and the intended objectives of using it defeated. The study therefore centers on concept map animations as the rapid display of sequence of pictures on computer screen that has the potential to provide feedbacks in students' achievement, interest and retention in learning. Animation history draws back to 1880s. The first animation films date back as early as 1910 when cartoon shorts began showing in theatres. Since then, numerous animation films have been released expanding into more complex films that require a breadth of different from the previous cartoons to motion animations. Algilasi (2010), maintain that most of the first films were French and released in America. The Warner Brothers produced some of the most notable motion pictures of the 20th century.

The continuous development of technological inventions allowed animators to excel in this field. Hoban and Nielsen (2010) observed that the worldwide explosion in personal digital technologies offers increasing opportunities for students in primary or secondary schools to create their own digital media. Waldrip *et al.* (2006), has attributed this exponential growth in personal digital technologies with a growing body of research

which suggests that getting students to create a multimodal representation of a science concept is a good way to enhance learning. A representation is a sign that stands for something else and can be expressed using different modes — by text, photographs, sketches, voice, numbers, graphs or models. It is through developing a sign and thinking about its meaning that students develop a better understanding of what it is meant to be representing. Importantly, research (Hoban & Nielsen, 2010) has shown that constructing a representation helps students to make meaning of a science concept and this is often preferential to students copying an expert generated representation from a textbook, which is a common practice in classrooms. Rieber (2001), posited that animations assist students to understand abstract and invisible processes and can improve students' learning motivation.

David and Dan (2002), asserted that a successful animation syllabus is interdisciplinary, and encourages students to develop effective skills and practice interactive activities. Wu and Shah (2004), observed the neglect of determining the impact of animation to students' mind, thus understanding the information of the animation may differ, and it depends on the sex and the spatial visualization understanding ability. Use of animations has been strongly encouraged as an innovative, constructivist and students-centered alternative to the traditional learning approaches in many countries. Studies from many countries have demonstrated positive effects, which the use of different and innovative methodologies and visualization technologies may have to students' understanding of central scientific concepts. For instance, in Estonia animations have been shown to be beneficial in science lessons (Soika, 2007).

The use of activating and innovative learning technologies in Estonia is also encouraged by the new national curricula for basic school and gymnasium. In these official documents, learning is emphasized as a process during which a student actively constructs

personal knowledge in continuous interaction with his/her social environment. David and Dan (2002), study the instructional effectiveness of using animations to teach learning objectives in an undergraduate operating systems course. Statistical analysis using a paired t-test indicates inclusion of animations in an undergraduate operating systems course yielded significant overall student achievement gains as measured by pretest and posttest scores. Many instructors in computer science today are reluctant to design and include animation and visualizations as teaching tools due to time constraints and doubts about their benefits.

In Germany, Hoffler and Leutner (2007), studies the effect of instructional animation versus static pictures. The meta-analysis revealed that animation is superior over static picture presentation. In Malaysia, Rahmat, (2010) indicated that computer animation learning courseware had given a positive impact on student performance in visual art education subject. In China, Hwang *et al.* (2012), have demonstrated that the use of animations as supplementary learning material of physiology content in four academic years is effective in improving learner academic achievement. Here in Nigeria, Owolabi and Abiola (2014) ascertain that there is a significant difference in the performance of science students exposed to cartoon animation than their counter part exposed to lecture method only. The difference is in favor of students exposed to treatment.

### *2.1.6.2 Classification of animation technique*

There are three main types of animation techniques: Traditional animation, Stop motion and Computer animation (Mayer, 2002; O'Day, 2007; Rahmat, 2010; Awad, 2013). 1. Traditional Animation: Films produced this way are originally drawn on paper. Each frame slightly differs from the one before it to create the illusion of motion. The drawings are photocopied into transparent acetate sheets called cells, and are filled in with paints of assigned colors or tones. Therefore, this technique is often referred to as paper/ cell

technique. This method first appeared in the 20th century. By the 21st century, photographed or scanned frames replaced hand drawing film frames. 2. Stop Motion: Animators physically manipulate actual objects and photographing them one frame of film at a time to create the illusion of movement.

There are many different types of stop-motion animation including puppet animation, clay animation, cutout animation, graphic animation, etc. 3. Computer Animation: Computer animation creates the illusion of movement through a succession of computer-generated still images. This digitally created animation encompasses a variety of techniques including 2D animation and 3D animation. This animation takes less time than previous traditional animation. Computer animation holds a great potential as a tool for creating multimedia instructional environments. Instructors can use computer animation to demonstrate learning materials visually as they want and they can control every aspect of the animation. According to Mayer's Cognitive Theory, the computer is a system for delivering information to students. The instructor's role is to present information, as words or pictures, or both, and the learner role is to receive the information. Adding pictures, such as animation, should deepen the meaning of the presented information and give it a physical translation. In this study, computer animation called animated concept map visualization instructional strategy will be used as treatment to experimental group. The animation involves power point projection of the animated software of weather concepts.

#### *2.1.6.3 Animated concept map instructional strategy*

Concept map instructional strategy is presentation of a network diagram in which nodes and links are sequentially added or modified. Concept map is a knowledge representation medium that shows a mode- link diagram changing over time. It may be implemented as a series of slides or frames ordered so that the first slide shows a blank map and the last slide shows a computer map. Animated concept map is the application of animation,

either computer or video, to add a temporal component to concept. It involves the application of computer software package in instructional process. It represents some aspects of reality that one is unable to present directly to the learners, because it presents image, sound and action.

According to Nsofor and Ala (2013) any instructional process that evokes the involvement of as many of the human sensory organs tends to facilitate the permanency of learning. In animated concept map instructional environments, students are exposed to material in a verbal as well as a pictorial form. In this study, the researcher adapted animation and concept map instructional strategies of weather concept as instructional strategy for teaching experimental group. The animation was developed by the researcher with the aid of: Microsoft office power point; Adobe flash files (soft files); and; GIF animated images: internet downloaded meteorological instruments. These components were embedded into the Microsoft document to form a single animation package. Adobe flash files (soft files) were imported into the power point using computer software named adobe acrobat. GIF animated images were developed using computer software called Graphic Image Processing software (GIMP). Adobe flash software is used to independently play all soft files.

#### *2.1.6.4 Advantages of using animation in teaching*

Morison and Tversky (2001) posits that animation with graphic convey spatial information better than text alone because they represent space with space. Morison and Tversky (2001) uphold that animations have five functions; namely; connection; attention gaining: motivation; presentation; and clarification. Stith (2004) positioned that these animations provide a meaningful way of communicating dynamic, complex sequences of physical events effectively better than graphs. Additional advantages of animation were reported by Agina, (2003) to include; 1. Skill and Ability Improvement; the interactive

animation takes less time to teach students complex concepts and facilitate faster learning of difficult topics. Using an interactive animation solves the problem of the imagination-skill in education and training. 2. Interactivity: This is a mutual action between the learner, learning system, and learning materials. Students learn faster and develop positive attitudes toward it. When using audio and video techniques are employed, the interaction gets motivating to students. 3. Engagement: Interactive learning with live-action animation, simulation, video, audio, graphics, feedback, expert advice, and questions and answers maintain students' interest and reinforce skills.

Through continual practice, learning is absorbed and integrated into daily performance. 4. Motivation: Since animation is an inspired and interactive way for flexible education and training, students will be more motivated to learn 5. Immediate Feedback: Students get an immediate feedback from the animation system, which will enhance their skills and abilities. 6. Animation programs are noted for their flexibility and practicality. They aid students through attracting and holding their attention. Animation aims to reduce students' time in learning, more practical and task-oriented. It leads to greater long – term memory retention (O'Day, 2016).

According to Ainsworth (2008), affective account of learning with animations suggests that, learners may often report increase in satisfaction and motivation. Ling (2011), states that animation has been used in various disciplines to deliver instructional material that is heard to present alone using static visuals or that contains content that is highly abstract to human eyes. Animation provides feedback in various forms that may be both entertaining and motivating to learn stringing for the correct response. Aksoy (2013), maintains that computer animation technique enables higher academic achievement in comparison to traditional teaching methods. Riaza and Halimah, (2010) reported that

students perform better in recall scores when animation and narration were used in teaching.

#### *2.1.6.5 Disadvantage of using animation in teaching*

Despite the benefit of animation teaching, researchers maintain that it has some hindrances. For example, Morrison and Tversky, (2001), states that although animated graphics uses motion to show change over time presenting information about change over time with animated graphics, which did not enhance learning beyond presenting motion graphics. Agina (2003), supported that animation has the following disadvantages: 1. some information of real-life learning is lost in the animation processes. 2. Computer animation programs function better during sessions than in the translation of a course of study. 3. Animation programs cannot be adapted to take into account different student levels and consideration within a group or class. 4. Animation programs requires special equipment for a quality presentation. 5. Animation programs cannot depict actuality like videos. The researcher concludes that the use of animation programme as a process for creating interactive learning environment helps students with visual tendencies to understand and maintain the learnt material. Al-Khalifa (2005), comments that, there appears to be difficulty in determining whether animation is more effective than verbal/pictorial representation or vice versa. Ainswort, (2008), is of the view that, an analysis of motor and perceptual consequence of learning with animations shows that while they make dynamic information explicit, it should reduce the amount of cognitive effort required, to team about the dynamic system. They also introduce significant problems for perceptual processing and memory because of their transcend nature. Therefore, Animated-Media package involving computer (Microsoft power point), cartoons, flash cards, and animated weather concepts software will be used as a treatment in this study.

### 2.1.7 Lecture method

Lecture method involve verbal presentation of ideas, concept, and generalization of facts. The method is one of the science teaching instructional strategies that encourages rote learning and regurgitation of information without necessarily aiding understanding and this does not enhance academic achievement as observed by researchers (James, 2000; Bichi, 2002; Usman, 2010; and Maikano 2007). Lecture method is also referred to as expository method because it is teacher-dominated and learner‘s passive method (Atere, 2006). In using this method, the teacher talks while the students listen (Maikano, 2007). Lecture method is also known as talk-and-chalk method in a situation when the teacher decides to write the summary of the points she/he has taught on the board (Joshi, 2008). In lecture method, the teacher delivers pre-planned lesson to the students with little or no instructional aids in lecture method. (Okam, 2009). Lecturing, as a method, is used largely to build up basic theoretical knowledge, which must be acquired by the students before he/she is able to display practical skills and undertake practical tasks in the laboratory. It is highly valued in a situation where the number of students, who are benefiting from it is quite large and, in a situation, where there is inadequate number of competent and qualified teachers coupled with the insufficient instructional materials, lecture method with note taking technique may be more effective than any other methods. In fact, in teaching geography, lecture method will be more effective in a very large class situation in which the teacher combines the method with the effective use of instructional materials, questioning technique and other appropriate strategies that can be employed based on the classroom situation, (Atere, 2006; Okam, 2009). Joshi (2008) ascertained that lecture method serves four basic purposes, namely; (i) motivating students to learn; (ii) Clarifying students ‘problems during lessons; (iii) Reviewing classroom work in order to improve students ‘mastery of the subject; and (iv) to expand ideas, knowledge or

information in order to engender interests and mastery amongst students. In general, the approach becomes effective if the purpose is clearly understood.

Okam (2009), reflects that the lecture method is used in achieving the following designs in teaching: Provision of some relevant background materials and information which bear on a topic or lesson, for introducing a new different topic, Summarizing and recapitulating certain generalizations, for providing supplementary information beyond what textbooks have to offer, for explaining certain theoretical principles or points which cannot be easily demonstrated. Explaining demonstrations that have been executed. Researchers (such as Mansaray, 2012; Joshi, 2008; Okam, 2009; Atadoga & Lakpini, 2013) have identified some merits and demerits of lecture method in teaching-learning processes as follows: The lecture method is useful in imparting factual information in an efficient manner to convey facts, concepts and principles to students who have difficulty reading their texts. It is easy and convenient for the lecturer to deliver his prepared lectures without hustles of practical demonstration; also, the lecturer hardly considers the possibility of students' participation. Good lecture can motivate, inspire, and instigates a student towards creative thinking and helps to get thinking patterns of students to be more focused. The method is convenient and suitable for carrying out a number of academic activities and responsibilities during certain occasions. Some of these activities include: (i) introducing a topic (ii) summarizing a subject-matter; (iii) giving instruction before performing any laboratory experiments; (iv) explaining complicated and difficult experiments; (v) giving historical accounts of scientific events, scientific discoveries and inventions; (vi) describing the lives of great scientists, their achievements and contributions to science.

Lecture method is associated with the following shortcomings: There is no provision for activities in the method as students are reduced to the status of passive listeners. This implies limited development of scientific attitude and training. It does not take care of

observation, experimentation, drawing inferences as there are no opportunities for students to engage in practical experiences. It does not provide immediate mechanisms for ascertaining students' level of understanding and mastery of what is being taught. It does not cater for individual needs of students. The standard lecture format may not be the most effective way to promote thinking and develop attitudes, but changes to lecture techniques may help to overcome such limitations. Selecting appropriate lecture techniques is also one-way to help lecturers become more effective. As such, there remains considerable scope to explore the use of technology in enhancing the delivery of, and ultimately, the learning outcomes of a lecture. This study used lecture method as an instructional strategy for teaching the control group.

### 2.1.8 Concept mapping instruction strategy

Concept maps are diagram that show the relationship between concepts. They are graphical tools that designers, engineers, technical writers and others use to organize and structure knowledge (Hussin, 2012). Alberto and Novak see concept maps as graphical tools for organizing and representing knowledge. They include concepts, concepts usually enclosed in circles or boxes of some type and relationships between concepts. They are made up of two key components "concept" and "linking words", also known as "linking phrases". The linking words are used to join two or more concepts thereby forming propositions.

Novak (2010) based on Ausubel's (2000) work, defined "concept" as a perceived regularity or pattern in events or objects, or records of events or objects, designated by a label. According to Novak *et al.* (2010) concept maps provide a graphic representation of a person's structural knowledge or conceptual understanding of a particular topic. Concept maps can be used as a tool to visualize and measure the depth, breadth and organization of person's knowledge. Concept maps are similar to spider web which

consist of nodes that are connected by links to create diagrams that illustrate relationships among key ideas that represent information. The links between various nodes show that the concepts are conceptually and logically related within the concept map. It has been noted that when constructing or designing a concept map, the major idea should be on the relationships among the concepts. Hence the combination of two connected by a linking line and labelled by a linking word creates a proposition, which is the smallest linguistic unit that carries meaning (Ausubel, 2000).

#### *2.1.8.1 Nature and scope of concept maps*

Various researchers have defined concept mapping as a tool for the propagation and enhancement of learning and teaching. In the opinion of Okeke and Okafor, (2007), concept mapping signifies a pedagogical strategy and meta- cognitive tool based on Ausubel-Novak-Gowin theory of meaningful learning, this theory is based on the fact that meaningful learning is a process in which knowledge is linked or associated with relevant concepts which are already known to the learning. Ezenwa (2009) opined that concept maps are representation of meaning, and they are meta- cognitive strategies which serve to help students organize their cognitive framework into more powerful integrated pattern. According to her, the instructional strategy employed by the teacher plays an important role in concept acquisition and meaningful learning. Wang (2007) sees concept mapping as capable being used to organize classroom teaching in order to achieve a three dimensional objectives of teaching and helps teachers to understand students' knowledge structure, assess students' development and promote their self – reflection and to grasp the knowledge structure entirely and form the strategy of cognition and meta cognition.

Ezenwa (2009) believe that concept mapping establishes efficiency in the strategy of enhancing learning, improving retention and reasoning and reading comprehension amongst others in the basic area of science, it aids planning of lesson and improve the

educational standard. Dunsworth and Atkinson (2007) argued that it puts concepts into perspective, analyse relationships and prioritize information, and such information will indeed be retained longer. They demonstrated that concept maps are schematic diagrams which use words to show the relationship of one concept to another. It is a graphical representation where nodes (points or vertices) represent concept and links (lines) stand for the relationship between concepts which may be categorized and the concept may show temporal or causal relationship between concepts.

Concept mapping has to do with the technique for visualizing the relationship among different concepts; it is a programmed way for representing relationships between ideas, images, or words. Each word or Phrase is connected to another and linked back to the original idea, word or phrase, as the concept maps are away to develop logical thinking and study skills by exposing connections in such a way that students can see how singular ideas could form a large whole.it is used in the evaluation of science curriculum and instructional activities for promoting understanding and positive learner attitudes towards science. Animated concept mapping helps students to fully and graphically represent what they are learning. Teachers may find it easy to also monitor the kinds of instruction through which students are taught.

In general, concept mapping is done for a number of reasons: to assess the level of understanding: to aid learning through the blending new and old knowledge; to communicate difficult ideas and impressions; ton a complex structure generates ideas and to design a complex structure (web sites, hypermedia, long text, etc). Ogunkunle, (2004) noted that concept maps can be useful as a tool for conceptual development of hypermedia, navigational structures within hypermedia application, and interfaces for the indexing and retrieval of hypermedia objects. Writing on the essence of concepts maps

further, Ezenwa (2009) stated that concept mapping is student centered for meaningful learning.

The quest for the efficacy of concept mapping strategy in bringing about meaningful learning and enhanced achievement in science was discussed in different perspectives. Students who showed evidence of meaningful learning tend to construct best hierarchically organized concept maps. This was found to be true with biology, chemistry and physics students. Concept maps reveals quality and quantity of concept propositional networks held by students before and after instruction. It helps students take charge of their own meaning making. Concept mapping as an instruction strategy has also been shown as useful tool for making students of different abilities especially the lower achievers lean meaningfully. Concept mapping strategy has also proven to be useful and effective for the cognitive and affective gains. Research results supports the efficiency of using concept mapping strategy as a veritable tool in the science classroom for enhancing meaningful learning, reasoning ability, long term retention of knowledge, interest, enhanced attitude and reading comprehension, identification of misconception and for any gender. All research results presented positive effects on students' learning using concept mapping.

Findings on the use of concept mapping in the past decade or two in Nigeria and overseas, in different science subjects with various difficult science concept (topics) in public schools and university environment using secondary and university students have converged in supporting that the strategy is potent in bringing about meaningful learning and improved performance. It obvious that concept mapping plays central role in the students' achievement, retention and interest for meaningful learning. One interesting thing about concept mapping is that students were carried out in public schools in Nigeria

where facilities were minimal and students-teacher ratio high and study was for a limited period, yet the results continue to be promising.

Concept mapping strategy can therefore be said to be a very powerful tool for promoting students' meaningful learning. Teachers often show concept maps as visual reference during lesson; has been used to develop curriculum and used as excellent activity for revision at the end of instruction; it has been used as a study strategy as it provides a concise , well organized overview of a topic; it is a good starter activity to explore or elicit students' understanding; it enables students to appreciate the inter relationship among concepts and sub concepts; it helps students recognize and modify faulty knowledge structure used to identify misconceptions. These views agreed with the position of Rule to this effect, drawing a concept maps may be compared to participating in a brainstorming session as a tool of creativity, and that though a concept map may be produced by one person who is the original owner, the idea may infect others and thus become shared. It can play the role of communication tool used by people to discuss concepts and the relationships between the concepts. Equally, concept mapping is used extensively to improve language ability and competence, enhance knowledge acquisition, transmit ideas regardless of its intellectual roots, and facilitates creation of shared vision and understanding within an organization and creating new and integrative knowledge into an organizational resource.

#### *2.1.8.2 Characteristics of concept maps*

Concept maps were developed in 1972 in course of Novak's research program at Cornell University where he sought to follow and understand changes in children's knowledge of science (Novak & Mosunda, 2011). During the course of the research effort, it became clear that concept maps were useful not only to represent the change in children's understanding of a topic, but they were also an excellent tool for the participating graduate

students to express their courses. Now concept mapping is used all over the world as a means to represent a person's knowledge about a domain of knowledge, by users of all ages and in all domains of knowledge. Concept maps have specific characteristics that distinguish them from other knowledge representation tools. It is not every graph with text in its nodes is a concept map, and the literature or web are full of diagram that are wrongly depicted as concept maps. The key characteristics of concept maps:

#### *2.1.8.2.1 Propositional Structure*

Concept maps express explicitly the most relevant relationships between a set of concepts. This relationship is depicted by means of linking phrases forming propositions. A concept map consists of a graphical representation of a set propositions about a topic. Each concept consists of a minimum number of words needed to express the object or event, and linking words are also as concise as possible and usually include a verb. There is no predefined list of linking words. Numerous linking words are available that can be used.

Propositions should not be confused with prepositions, which are a grammatical for such as "to", "by", "above", "of" among others.

#### *2.1.8.2.2* **Hierarchical Structure**

There is hierarchy of concept within any domain of knowledge where the most general concepts are at the top of the hierarchy and the more specific, less general concept are arranged hierarchically below. Concept maps tends to be read from the top, progressing down towards the bottom.

#### *2.1.8.2.3 Focus Question*

A great way to delineate the context for a concept map is to define a focus question that is a question that clearly specifies the problem or challenge the concept map should help to resolve.

#### *2.1.8.2.4 Cross – links*

These are relationships or links between concepts in different segments or domain of the concept map. Cross-links help us to see how a concept in one domain of knowledge represented on the map is related to a concept in another domain shown on the map.

### *2.1.8.3 Components of networks in concept mapping*

Various components are used when teaching and applying concept mapping. Concept maps are generally represented in a well-defined manner and order, with members arranged in parts in the concept maps according to pre- determined ranking. The most important general concepts are usually showcased at the top, the specifics, examples, images and other describers are placed underneath. The networks are drawn, consisting of connecting nodes usually enclosed in boxes, but can also be represented in circles, points or other suitable figures. Each node represents various concepts (Chei-Cheng, 2008). Nodes are connected by links or lines, which represent a particular relationship between two concepts. Both nodes and links are labelled. Links could be non- directional or unidirectional, the non- directional links shows no arrow, and unidirectional links has an arrow at one level while the bidirectional has an arrow at both end, (Mintze, 2000). In demonstrating relationship of concepts, linking words, phrases and symbols are used to show the connectivity between concepts. Cross- links refers to long connections, which consist of connecting lines, with linking words, phrases, and symbols between concepts in different themes of concept map. These links help to identify how various domain are related.

### *2.1.8.4 Types of concept maps*

There are four major types of concept recognized by experts who have researched extensively; **Spider / central concept Maps:** here, the main topic is placed in the center of the map and related themes are linked to it or around it depicting series of interconnectivities. It is shaped like a spider with its many legs radiating from the central body. This map is developed when only one concept is being used.

Advantages: spider/ central concept maps are easy to configure, all data is organized around a unified theme and it is easy to read.

Disadvantages: this map is difficult to show relationships without making the map messy and easy to read, it does not allow for integration of all data and the relationships among data.

#### *2.1.8.4.1 Hierarchical/chronological concept maps*

This type of map has a design which the most important concept is placed at the top rather than the center as the case of spider concept maps, the more specific or less important, but related topics are placed below it. The main theme radiates vertically downwards in descending order of importance, significance or magnitude, thus giving a comprehensive explanation of the concept or theme in question.

Advantages: the maps follow a definite pattern; the most general data is located at the top and moves to the most specific and it is also easy to read.

Disadvantages: the maps may show no interrelationship between data and it does not allow for critical thinking and thus limited problem solving.

#### *2.1.8.4.2 Flow chart/ linear fashion concept maps*

This type represents a kind of sequence in a linear format, ranking or order. It has a diverse usage such as in business and organization in analyzing the steps involved in completing task (Areu, 2008).

Advantages: the maps are easy to read and the information is organized in a logical, ordered fashion.

Disadvantages; the maps contain very minimal data noted on concept map, lack of critical thinking and clinical reasoning skills used and it is usually incomplete.

#### *2.1.8.4.3 Systems map- inputs/outputs concept maps*

Advantages: the map is complete, it includes all data on the map and shows many relationships between the data, the maps use critical thinking skills along with problem solving skills. It links theory and practice very well.

Disadvantages: it is sometimes difficult to read due to the number of relationships noted and it takes more time to complete.

### *2.1.8.5 Procedures for the construction of concept map*

The core elements of concept map are proposition, which consist of two or more concepts connected to each other to form a hierarchical branching and dendrite structure that represent the organization of knowledge in long term memory. The basic assumptions of concept maps are that interrelatedness'' is an essential property of knowledge, and that understanding '' can be represented through a rich set of relations among important concept in a discipline. The map is composed of concepts labels, each enclosed in a box or oval, a series of labelled linking lines, an inclusive, general to specific organization.

**Brainstorming phase:** Pick a topic, from your memory which one can jog by going through notes and related course material, identify facts, terms, and ideas that one thinks are in anyway related or associated with the topic make a list of these items and print them neatly on small post- notes, one per note, in very brief form, that is a single word or short phrase. In this brain storming process, write down everything that anybody in the group thinks is important and avoid how important the item is. Your objective here is to generate the largest possible list you can. Before the group completes this step, they may have more than 50 items.

**Organizing phase;** spread out the concept (post-it-note) on a flat surface so that all can be read easily and, together, create groups and sub- groups of related items. Try to group items to emphasize hierarchies. Identify items that represent those higher categories and add them. Feel free to rearrange items and introduce new items that may have been omitted initially. Some concept will fall into multiple groupings. This will be important later.

**Layout Phase:** on a large sheet of paper, try to come up with an arrangement (layout) that best represent your collective understanding of the interrelationships and connections among groupings. Feel free to rearrange things at any time during this phase. Use a consistent hierarchy in which the most important concepts are in the center or at the top. Within sub- grouping, place closely related items near to each other. Think in terms of connecting the items in a simple sentence that shows the relationship between them. Do not expect layout to be like that of other groups. It may be advisable to meet outside of class to work on this assignment and plan for its completion.

**Linking Phase:** use lines with arrows to connect and show the relationship between connected items. Write a word or short phrase by each arrow to specify the relationship. Many arrows can originate or terminate on particularly important concepts.

**Finalizing the Concept Map**: after your group has agreed on an arrangement of items that conveys your understanding, then convert the concept map into a permanent form that others can view and discuss. Be creative in a constructive way through the use of colors, fonts, shapes, border thickness, among others to communicate group's understanding. Give your concept map a title. When constructing the final concept map on a computer, try using power point. In reviewing concept map consider; accuracy and thoroughness, organization, appearance and creativity. Reiber, (2001) recommended that learners employ five to six steps when they create concept or network maps. Researchers such as; Akapir (2005) suggested that a period of direct instruction is necessary before a learner can successfully employ this process.

### *2.1.8.6 Global application of concept maps*

Concept mapping involves the use of maps in teaching as a strategy to provide meaningful learning in all the educational settings by providing a vivid structure and detailed organization during the process by which learners gain knowledge. However, this does not completely replace or substitute the traditional system of instruction. It only provides a conduit for better learning, broad discussions, and more effective advancement within those environments (Reiser, (2001). Teacher as instructors use concept maps to assess knowledge gained by their students. The tradition employed by the students in constructing concept maps determine their level and quality of learning have been found to be more effective in showing how well students understand important concept recently learned. Researchers in the education department, University of California, teachers and other educators found concept mapping as an easy to use effective method of evaluating

the progress of their learners (William, 2009). The strategies have also been found to be more conducive to the quantity and quality of material learned based on long term memory (Okeke 2007). More than forty years of research, development and application has resulted in the inclusion of concept mapping in many businesses and organizations, large and small, throughout the world.

In United States of America, concepts Systems Incorporation is one of the leading companies that provide computer software and consulting services in the area of concept mapping. A new business might use concept mapping to identify its employee's knowledge base. Lawyers use concept maps to illustrate arguments on both sides of complex issues. Educators use concept maps to help students learn new materials, retain historic materials, and integrate the two together (Liu, 2009). Problem solvers use concept maps to better understand and diagnose problems.

#### *2.1.8.7 Benefits of concept mapping instruction in learning*

Concept mapping serves various purposes during instructional and learning processes which includes: helping students to brainstorm and generate new ideas, encouraging students to unravel new concepts and propositions that connect or link them, thus allowing the students to vividly communicate ideas, views, facts, thoughts, and information. Concept mapping instruction strategies assist students to integrate new concepts with older concepts, it enables students to gain insight knowledge of any topic and evaluate the information (Ezenwa, 2009).

#### *2.1.8.8 Concept maps in education*

When concept maps are designed and generated correctly, they become powerful weapon for the students to attain high level of cognitive performance. It also serves as a veritable tool in evaluating the extent to which the learner has achieved the stated behavioral

outcomes of a lesson by educators. Students who are able to develop their own concept maps tend to use words and this help them identify incorrect ideas and concepts, educators based on this, are able to see what students do not understand; providing an accurate, objective way to evaluate areas in which the students do not grasp full (Sirkimaa, 2001).

#### *2.1.8.9 Uses and benefits of concept maps in teaching and learning teaching*

Concept maps are used in illustrating relationship between different processes and compartments, it helps in connecting concepts with examples. Concept maps are used in documenting existing knowledge on topics which can be built on or changed in the learning process, it is used identifying gaps in knowledge and in constructing argument. It helps in identifying connected aspect in complex problem.

##### *2.1.8.9.1 Learning*

Concept maps are developed by an individual or group and organized in a way that makes sense to them- promoting a sense of ownership- important to motivation. It connects prior knowledge to new learning and highlights gaps in knowledge making it easier for learners to know what they do not know and need to know. Concept maps focuses on details while retaining.

Given the benefits of concept mapping instructional strategy and its overwhelming evidence from research works, it would be right to say that the most effective and potent way of raising the standard of performance is through the use of concept mapping strategy (Ezenwa, 2009)

### 2.1.9 Academic achievement in geography education

Academic achievements in geography is the extent to which a student has attained their short or long-term educational goals. It is the exhibition of knowledge attain or skills developed by students in the subject usually designed by test scores assigned by teachers.

It is an indication of the types of learning and its environment in a teaching and learning process.

According to Aydın and Coşkun (2011) the scores in examinations and the passing notes in class usually determine the achievements of the students about the course (geography). It can also be in the final year examinations conducted by examination bodies such as WAEC, NECO and NEBTEB (Aderogba, 2012). WAEC as an examination body have outlined some weaknesses resulting to poor achievement of students in the final year geography examination. For instance, in Nov/Dec 2012, Geography Paper 1 question number three dealt with aspect of weather and climate. Report on this question revealed that many of those who attempted it could not correctly plot the combined temperature and rainfall graph for the station; quite a good number of the candidates could not correctly calculate the annual rainfall; and that many of the candidates could not correctly deduce that the rainfall and temperature distribution shown in the station represented that of the Tropical Continental Climate. In addition, majority could not correctly indicate the instruments of measuring pressure, humidity, and rainfall. Some of the candidates could not describe the effects of climate on agriculture temperature is measured using thermometer. The situation was the same in 2015 where majority of students who sat and attempt for November/December, 2015 geography paper question number 1B, could not properly explained the factors affecting weather and climate. Such factors include; cloud cover and humidity; insulation; planetary wind; ocean current; latitude and altitude among others. 42 researchers (Sabitu & Nuradeen, 2010; Aderogba, 2012; Rilwani *et al.*, 2014) have identified several factors influencing students 'academic achievement in geography as a course of study including class size, laboratories, instructional strategies, textbooks, guidance and counseling services, academic and professional qualification of

teachers, teachers‘ attributes, students‘ attributes, peer groups, parental and home background, and school environment among others.

According to Sabitu and Nuradeen (2010) the success of any teaching and learning process, which invariably influences students ‘academic achievement depends on how effective and efficient the teachers are. Teacher knowledge plays a significant role in classrooms, as it can affect teachers ‘choice of appropriate strategies during the teaching process. Akintade (2011) stated that, it is very important that a secondary school geography teacher should be academically articulate in his area of specialization. Zarei and Sharifabad (2012) observed that teachers can be different from each other based on the experience they have attained during teaching. Rilwani *et al.* (2014) suggest that effective teaching is a significant predictor of students ‘academic achievement; therefore, effective teachers should produce students of higher academic achievement. According to Ofoegbu, (2004), poor academic achievement of students in Nigeria has been linked to poor teachers ‘performance in terms of accomplishing the teaching task, negative attitude to work and poor teaching habits, which have been attributed to instructional strategy.

### 2.1.10 Academic achievement and gender in science education

Academic achievement as a variable in students’ learning has been a matter of concerned in the present-day research. Busari, (2009) defines academic achievement as the level of performance in the subject as exhibited by an individual. According to Ogundukun and Adeyemo (2010) academic achievement is the exhibition of knowledge attain or skills developed by students in the school subject usually designed by test scores or by marks assigned by teachers which can be low or high. Atadoga and Onaolapo (2008), states that, instructional strategies adopted by teachers at all levels of education in imparting knowledge and skills to the learners are determined by teachers’ abilities, topic to be taught, learners age, available resources and available space. Thus, Poopola (2010),

ascertained that, academic achievement is a function of a sopped various factors such as method of teaching, teachers' qualifications, child's home background, school environment, attitude, interest among others.

Ogundokun and Adeyomi (2010) added that, academic achievement (low) is related to the decline in the availability of teaching resources in the school. The concept of gender in teaching and learning process has attracted the attention of many psychologist, biologists, and researchers as a result of which a lot of literatures exist on different aspects of the concepts (Bichi, 2002). Research question number four of this study focuses on academic achievement of male and female students in weather concept. This necessitates the researcher to review some relevant literatures on gender and academic achievement in science education. A considerable amount of researches has focused on gender differences in school learning (Nsofor, 2014). Male show more positive attitudes toward science than females (Prokop *et al.*, 2007). Moreover, a careful consideration of the statistics of contribution of gender in Science Technology and Mathematics (STM) in Nigeria reveals that the participation of women is significantly low (Olagunji & Abiona, 2008). Evidences have supported this view in almost every science and technological based organization. Some studies have found gender disparity in the use of instructional methods on students' achievement in favor of male, (Mari, 2010; Bichi, 2002; Usman, 2007; Obeka, 2013). Others have found none (Haruna, 2011; Maikano, 2007; Mari 2010; Usman, 2010). Studies have also revealed that, the application of instructional treatment on a mixed gender school population improves the academic achievement of students at the same time yield to different responses or results (Nsofor, 2014).

Alpha (2007), in a research on Gender Disparity on Achievement in Mathematics of Senior Secondary School, opined that performance of males is higher than that of females. In support of this, Usman (2012), compared the relationship between students'

performance and their Academic Achievement in Biology using NISTEP mode of teaching reveals that senior secondary male biology students perform well in any rigorous work than their female counterpart. In a similar vein Obeka (2009), conducts a research on EPODEWALAD and Power Simulation games of geographic and environmental education. Findings of the study, among others, revealed that gender is a significant factor in students' achievement. On the contrary, study conducted by Mari (2010) on understanding of science process and its relationship to achievement in integrated science‖ argued that females perform better than males in integrated science. Bichi (2002) work on Effects of Gender on Historically Enriched Curriculum on Academic Achievement in Evolution Concept Using Senior Secondary Biology Students. The finding revealed disparity among gender in support of girls.

Maikano (2007) find no significant difference in the academic achievement between male and female students taught ecological concepts the outdoor laboratory instructional strategy. Mari (2010), supports this assertion in his study on entry qualification and performance. The result shows that male and female students admitted with the same entry qualification have no difference in their performance. In addition, Usman (2010) opines that outdoor laboratory method enhances academic achievement of students in spite of their gender. The causes of disparity between male and female student as observed by Novak (2010) is the characteristic nature of teachers who were more friendly with boys than girls. Usman (2010), added that is the ways science is being taught in the classroom that cause the disparity between male and female students. American Psychological Association, (APA, 2010) suggests that social and cultural factors perceived or actual performance difference, can also be responsible for this disparity. In a study titled Effects of Constructivist Teaching Strategy on Gender in Learning of Addition and Subtraction Skills at Primary School Level ‖conducted by Kajuru and Ado

(2012), establish that, innovative teaching strategies with integrated resource materials enhance academic achievement of students. In similar vein, Obeka (2013), studies the effects of innovative teaching strategies with integrated resource materials on academic achievement for access and quality environmental education. A sample of 85 students was selected using intact classes in two senior secondary schools in Otukpo educational zone Benue state, Nigeria. The study employs quasi experiment, test, and posttest design. Four hypotheses raised were analyzed using t-test. The result of this study further shows that using lecture method with integrated standard and improvised instructional material, influence academic achievement consequently, this helps the students to collaborate in a practical rather than passive manner, which has positive effect on students 'academic achievement. Academic achievement and gender are variables in this study for determining whether Animated concept maps is gender stereotype or not. Hence, two instructional strategies were used to determine their impacts on the academic achievement of male and female senior secondary geography students.

### 2.1.11 Students' retention ability in science

Teaching Retention as a variable in this study is the ability to remember things, task, or material learned (for example, weather concepts) previously. It is the endurance of behaviors, which have been learned, or acquired when the behavior is not being utilized. Bichi (2002), sees retention as the ability to retain and later recall information or knowledge gained after learning. Mukherjee (2002), maintains that retention has to do with the ability of human beings to reproduce past learning. Every individual shows some degree of mastery to reproduce his past learning or experience. For this to happen, three stages of human behavior have to be considered, viz- (a). There must be some initial learning experience, (b) there must be an intervening period during which individual stores the learned materials and experience, and (c) there is the final stage of reproduction

of the initially learned materials or experience. Aggarwal (2008), regards the term retention as the process of relegation of the past experience in the sub-conscious mind of the individual in the form of mental experience. In similar vein, Suleiman (2011), defines retention as the ability of one to remember what he has learned in the later time, it takes place when learning is coded in to memory. It is one of the four main elements of memory (others are learning, recall, and recognition).

However, Mangal (2010), reports that these four elements have been replaced by three distinct stages (encoding, storage and retrieval). The storage stage is concerned with the power of retention of encoded information. Educational psychologists have used retention as one of the criteria for distinguishing between short term and immediate memory (Ladan *et al.*, 2009). The initial stage of memory process is learning. If there is no sufficient intelligence for learning, there can be no retention. Mangal (2010), ascertained that in immediate memory, the retention time is less than one second while in short term memory the period of retention can be extended to quite a longer duration as a result of the proper efforts and rehearsal by students. Retention of learned materials, as a variable in students 'learning can be measured. Aggarwal (2008), identifies four methods of measuring retention. These are: Recall or reproduction; Relearning or saving method (this involve calculating the number of trials taken to learn materials in the beginning and note down the savings of trials relearning it after some lapse of time); Recognition; and; Reconstruction. A good memory and retention lead to meaningful learning leading to production of a series of changes within our entire cognitive structure, modifying existing concepts, and forming new linkages between concepts According to Bichi (2002), permanent and meaningful learning is the target of our educational endeavor. Understanding and retention are the products of meaningful learning when teaching is effective and meaningful to the students. Thus, appropriate coding of incoming

information provides the index that may be consulted; so that retention takes place without elaborate search, ability retains and consequently remembers what we have experienced, or what we have in the memory (Adeyemo, 2010).

Several factors influence retention. For example, Blair *et al.* (2008), states that anything that aid learning should improve retention while things that lead to confusion, or interference among learning materials decrease the speed and efficiency of learning and accelerates forgetting. Interference may exist in several forms such as retroactive inhibition, or emotional inhibition. Retroactive inhibition occurs when things are learned, the result of that learning usually occurs after a passage time. In the intervening period, many other things are learned. This interpolated learning interferes with the memory of the original materials and the interference is known as retroactive inhibition (Suleiman, 2011). Paul (1999) as cited in Suleiman (2011), ascertained that retention is base model for which the meaningful stimuli are processed by the brain at a deep level. This model is attributed to the long-time memory (retention) which is based on our ability to process semantic knowledge deeply by associating recall items. Retention constitutes learning and recall.

Mangal, (2011) ascertained that retention of learned material could be improved through: 1. Being free from excessive anxiety, fear and other emotional factors which tend to block memory. 2. Developed self-confidence and never think that you would not be able to recall something 3. Association of ideas, connection, and systematic thinking are very helpful in the task of recall. 4. Never strain self for too long to recall something. Method of learning or sending is the easiest way to measure retention. Sometimes after several years have gone, we cannot recall single line of materials learned early, yet we attempt to memorize it again, we find it comes back rapidly as before (Ladan *et al.* 2009). Memory is a process involved in the retention of material. A mechanism in which an individual

stores information for a short period of time (short-term memory). Long-term memory is the permanent repository of information acquired from the world around us. Retention is an aspect of long-term memory, which has a seemingly limitless capacity to store information with little or no decay and requires little, if any, rehearsal (Mangal, 2011).

However, Mukherjee (2002), states that, in order to improve learning retention, the following factors has to be considered: 1. Since individuals differ in their ability to retained learned materials over a period of time, the teaching methods ought to be different and varied to meet the need of everybody in the learning situation. 2. During teaching, various forms of group labeling, closure among others should be employed.3. Attempts should be made to create situation for proactive and retroactive facilitations, and to minimize their effects on inference, by suitable planning of curricular and sequence of the lessons. 4. There should be provision and time for recapitulation and revision of the learned materials during each lesson, and in each week, students should be encouraged to improve on their study habits, note taking, recording and reading. 5. Care should be taken in the transmission of information by providing for gaps or pauses, and using a language of highest redundancy. 6. Spaced practice instead of massed practice should be encouraged to enhanced retention of the learned materials; in the same way, students would benefit from part and whole learning of the text than trying to memorize the text by the whole method only, should be encouraged. 7. Since understanding plays a vital role in one's ability to recall at a later stage, emphasis should be given on understanding than learning by rote or repetitive drill of the same material. Blair *et al.* (2008), conducted an experiment on the effect of traditional learning method in teaching two sections of an undergraduate course on the retention.

The researchers discovered that those students taught using inquiry method had better retention ability than those taught with traditional lecture method. Based on studies in

other disciplines showing the value of a proper narrative, O'Day (2006), in his study animated cell biology: a quick and easy method for making effective high-quality teaching animations‖ posited that group viewing the graphic with a legend obtained a much higher mean retention grade (80.6%) compared with those who viewed the graphic lacking a legend (58.1%). Viewing the figure with a legend also led to slightly higher initial marks than the respective un-narrated animation (75.0%). These suggestive data support the widely held view that animations enhance the pedagogical value of visually presented information.

Aggarwal (2008), stated that, one of the important aims of school instruction is to encourage the students to acquire and to retain the knowledge imparted in school for future use in school life and in meeting out of school life problems of the present and future, hence it is very essential to take proper steps to enable students retain and recall easily. In addition, many researchers have also investigated and defined several variables that affect knowledge retention. Obeka (2010), added that, they include the type and content of tasks to be learned, amount of original learning, instructional strategy used and length of retention interval. It is not uncommon for geography students to learn material, take examination, and forget the material there after. This study will have incorporated the use of animated concept map instructional strategy in teaching for experimental group, lecture method for control group, and observe their impacts on students 'retention ability.

### 2.1.12 Interest as a factor in teaching

Interests are topics which students are curious and spend more time exploring. It is a feeling of curiosity or concerned about subject that makes the attention turn towards it. It also the focused interaction between an individual and an object which may be class of objects ideas among others that results in an enduring affective disposition towards the

object (Corno, 2012; Lin, 2011). Obeka (2010) views interest as the course of certain actions which acts as drive or motivations that propels people to act in certain ways and as the effect of an activity from which a child is learn to pay attention as the lesson goes on if he or she is interested in the particular lesson and the - method of learning. It is a type of attitude which share in some characteristics of cognitive, affective and psycho or components. Aggarwal (2008), defines interest as a feeling that prompts us to spontaneous activity. It is a motivating force that impels us to attend to a person, a thing, or an activity as well as effective experience that has been stimulated by the activity itself. According to the researchers, once interest is aroused in studies, games, literature and good conduct, the child will consider no sacrifice and effort too great to attain proficiency. Thus, interest can be the cause of activity and the result of participation in activity.

Mangal (2010), observed that interest is the key factor and driving force that help us in paying attention as well as remaining engaged in our so attended activities. It is a great motivating force and reservoir of one‘s inner potential, capable of molding and sharpening one‘s behavior and personality make-up in a particular field. Interests are not permanent and fixed; they changed as a result of maturation, learning and other internal as well as environmental conditions and factors. Hussin *et al.* (2000), asserts that many theorists and researchers have found that it is important to recognize the consent of maturation and interest not as single entity but as multi-factional one. The researchers also believes that teachers are able to drive the students to learn the language and to sustain students‘ interest in the language, learnt, if they can provide activities that are: Interrelated between in-class and out of class language activities; communicative game type integrative (Shirt/small, action transform larger activities); Pleasant state and non-threatening; Enthusiastic; Group-based; Meaningful or relevant; Challenging. These activities help promote self-confidence experiences of success learning satisfaction and

good relationships among students and between teachers and students. Obeka (2009), observes that, in spite of zeal, determination and sincere interest, students 'interest and ability can be clambered by the use of ineffective teaching method such as the traditional lecture.

Other factors affecting interest in learning as pointed by Aggarwal (2008), and Mangal (2010) are; personal factors (socio-economic status, students' mental health and development, his age, sex, child 'ideals, motives and wishes); environmental factors (education and training, cultural status, opportunities to the child for exploring interests). Interest is a critical cognitive and affective motivational variable that guides attention, facilitates learning in different content areas and for students of all ages, and develops through experiences (Reninger & Hidi, 2011). Interest of the learner can be measured. Researchers (such as Aggarwal, 2008; Mangal, 2010; Reninger & Hidi, 2011) have identified variety of methods by which interest can be measured. However, the overwhelming literatures coined to the use of; interest inventories; Kuder's preference record; Stewart and Brainard's specific interest inventories; Cleeton's Vocational Interest Inventories; and; Strong's Vocational Interest Blank. Relevance of interest in learning can never be a dispute.

Aggarwal (2008), in his study on effect of resource materials types on achievement retention observed no significant influence on gender interest. Result of studies on EPODEWALAD and Power Simulation Games of Geographical and Environmental Education by Obeka (2009), shows that, students taught using EPODEWALAD simulation displayed greater interest in the environmental concept of geography than lecture group. Interest as well as close attention is essential for useful learning and memorization. A person who has no interest in what he learns will not give due attention to it and consequently will not be able to learn it. This care should be taken to create the

necessary interest in the material by making its purpose clear and linking it with one ‘s natural instincts and urges. All the factors causing distraction should be reduced to a minimum so that all attention can be paid to the material at home (Mangal, 2011). In this study, interest is considered as a variable to be measured in experimental and control groups. Animated concept map instructional strategy and lecture method will be used in determining whether or not the strategies can enhance interest of students on weather concept of geography.

## 2.2 Theoretical Framework

### 2.2.1 Constructivist theory of learning, Piaget

The fundamental principles of educational psychology are that instructors cannot simply give learners knowledge, but the learners must construct the knowledge is their own schema (Che-Hung *et al.* 2010). The instructor can only facilitate the process by transferring knowledge in the ways that make information put across meaningfully and genuinely to the learners, by exposing the students to opportunities to discover or apply ideas themselves, and acquainting them of the need to consciously use their own strategies for learning. The instructor provides the rung for the students that will lead to higher understanding, yet the learners themselves must climb these rungs. Animation and concept mapping strategies are based on the constructivist theory of knowledge. A theory of learning based on the idea that students construct knowledge in their own minds while the teacher acting as the facilitator is called constructivist theory of learning (Piaget, 2011). The basis of the constructivist theory is the notion that students must individually discover and transform complex information, ideas if they are to build their own (Aiyede, 2016; Omolade, 2002).

The theory always observes the learners in terms of consistently looking out for new knowledge against the old procedures and then re-analyzing the rule when they no longer

work. In this theory, the learner is the main actor in the learning process and thus often regarded as student – centered instruction hence, the learner is always an active participant in the instructional mode. The teacher is the guide just as the magnetic bearing guide the navigator while the students discover their own meaning (Gall *et al.,* 2007). The premise is that knowledge is actively constructed by the learner on the ground of construct already available to him or her. Traditional theory of knowledge view knowledge as the learners' representation of things and events in themselves, as they ought to exist in the real world. This means that which exist already before the learners' cognitive activity, (Oladipo, 2009). The psychological theories of Piaget and Brunner have lent support to this view. Gana (2013) noted that knowledge results from the manipulation of real objects (realia) that is noticing the conflicts that exist between one's schemas of thinking as human cognitive constructs required for adoption. He pioneered the development of "critical spirit" through give and take in group learning or cooperative learning situation where knowledge is being shared among the peers. His genetic epistemology supports the importance of social learning in children noting that action is a result of inbuilt impulse (inert) during which sensory motor period (Pollock *et al.,* 2002).

Piaget is of the view that it is only when necessary authorities are lazed or soften that adults' open way for children to develop minds that facilitate the thinking independently and creatively which leads to the development of moral feelings and convictions that take into cognizance that the best motivator of all involved (Piaget, 2011). Moreno (2007) believed that the teacher-student relationship is characterized by symbiotic relationship in which the teacher reciprocates to the students the respect by exposing them to possibility of regulating their behavior voluntarily. In 1936, Piaget opined a radical concept that the knower and the environment could not be separated in the development radical thinking processes (Piaget, 2011). He also added that the acquisition of knowledge

is a social endeavor. He further emphasized that knowledge results in continuous stages of understanding which involves the learner with the information and people creating and harnessing which consequently lead to transfer from one stage to another, characterized by new schemas which were absent before the subject's mind in the outside world. Knowledge acquisition is a social endeavor. According to Piaget, there are four universal stages which begins at birth to about two years, the other stages called the pre-operational stage starts from two-seven years and the third, the concrete-operational stage from seven-eleven years and finally the formal operational stage – eleven – adult. The constructivist view is similar to what Piaget, (2011) described as the theory of equilibrium of learning, Gagne (2017) realized the importance of relating unfamiliar to the familiar in order to attain meaningful learning when he possessed certain prerequisite of knowledge. Blair *et al.* (2008) also stressed the importance of prior knowledge to learning. The philosophy behind individual's construction of meaning from prior experiences is labelled as "constructivism," concept mapping takes it root from this theory of learning. Wallace and Mintze (2000) combined all the ideas about constructivism to produce a model called "Generative learning Model." This model shows how learners construct meaning from old experiences by incorporating construct into the old. The model shows that:

i. The learner's memory store interacts with sensory input from the environment and from which some selected and others ignored
ii. The new situation requires the learner to generate a link between it and relevant parts of his memory store.
iii. The learner retrieves information from memory store, which is used to construct meaning from new experience
iv. The new construct is tested against the store experience

v. The new construct may now be incorporated into memory either in whole, modified, constructed or re-interpreted.

The implication of this model of learning to the teacher is that it points to the fact that before school age, children already hold conceptions about the physical world. The more the teacher knows about these pre-conceptions, the better for the enhancement of meaningful learning.

For the construction of knowledge to progress, Bastruk (2005) opined that cognitive conflict and contradictions must be encountered. Cognitive changes and learning take place when a scheme, instead of producing the expected result, leads to perturbations which in turn lead to accommodation that creates new equilibrium (Glasersfeld, 2011). There is no way therefore to undermine the role of cognitive conflict in teaching and learning. The mind always tries to attain equilibrium; new concepts are linked to the existing structures. The mind always tries to attain equilibrium and with any disturbances, gaps are created; as it craves for equilibrium, new concepts are linked to the existing structures. This is meaningfully learning of different subjects. It is obvious that the current trend in research all over the world is the use of computer facilities, animations and resources to enhance students learning, this may be the reason why Mahoney, (2005) opined that many exercises that depart from traditional method are now readily accessible on the web, even though teachers do not use these facilities. They further showed that the interactive approaches to lecturing significantly enhances learning.

#### *2.2.1.1 Origin of educational theory of concept maps*

Concept maps were developed in the course of research program which aimed at understanding the changes in children knowledge of science. This program is solely based on the learning psychology theory of Ausubel 2008. The basic idea or focus in his

cognitive psychology is that learning takes place by assimilation of new concepts and proposition into existing concept.

#### *2.2.1.2 Meaningful Learning requires three conditions*

1. The materials to be learned must be conceptually clear, vivid and presorted with language and examples relatable to the learner's prior knowledge.
2. The learner must possess relevant prior knowledge.
3. The learner must choose to learn meaningfully.

In learning, the human memory is not a single "vessel" to be filled, but rather a complex set of interrelated memory systems.

### 2.2.2 Bruner's theory of cognitive learning

Bruner's theory states; "To perceive is to categorize, to conceptualize is to learn to form categories, to make decisions is to categorize". He maintained that people interpret words in terms of similarities and differences and suggested a coding system in which people have a hierarchical arrangement of related categories. Each successively higher level of categories becomes more specific. The major variable in his theory of learning is the coding system into which learners organize this coding system. He believes that the system facilities transfer of knowledge; enhance retention and increase problem solving and motivation. He also advocated the discovery-oriented learning method in schools which he believed helped students discover the relationship between categories.

### 2.2.3 David Ausubel's theory of subsumption

This is also referred to as Assimilation theory or Theory of Advanced organization. The theory focuses on how individuals acquire and learn large chunk of information through visual means or text material. The theoretical framework for this study is based on the cognitive learning theory. Concept mapping is grounded in Ausubel's Assimilation

Theory. (Ausubel, 2008). Assimilation theory posits that new knowledge can be learned most effectively by relating it to previously existing knowledge. Concept Maps may be viewed as a methodological tool of assimilation theory that displays fundamental elements of the theory such as subsumption, integrative reconciliation and progressive differentiation. Concept Maps allow for the representation of non-hierarchical relationships or cross-links, as well as other types of non-hierarchical arrangements. Over the past decades, Ausubel (2008) has been concerned with the problem of how meaningful verbal learning and retention can be facilitated through the use of extrinsic organizing devices that modify the learner's cognitive structure. He stressed that if existing cognitive structure is clear, stable, and suitably organized, it facilitates the learning and retention of new subject matter. However, if it is unstable, ambiguous, disorganized, or chaotically organized, it inhibits learning and retention. In order to describe the importance of classification in learning and retention and the strategy for deliberately manipulating cognitive structure so as to enhance proactive facilitation and to minimize proactive interference, Ausubel (2008) coined the phrase "advance organizer" this involves the use of appropriately relevant inclusive introductory materials that are maximally clear and stable in a learning situation. These organizers are normally introduced in advance of the learning material itself and are used to establish a meaningful learning set.

The advance organizers help the learner to recognize the elements of new learning materials and it can be meaningfully learned by relating them to specifically relevant aspects of existing cognitive structures. The rationale for using organizer is based primarily on the importance of having relevant and otherwise appropriately established ideas already available in cognitive structure. It is also to make logical meaningful new ideas, potentially meaningful and to give them stable anchorage. The organizer functions to bridge the gap between what the learners already know and what he needs to know

before he can meaningfully learn the task at hand. It is to provide ideational scaffolding for the stable incorporation and retention of the more detailed and differentiated material that follows. This is the basis of this research study. The concept maps were introduced in advance of the learning materials to facilitate the establishment of meaningful learning set.

The central propositions in Ausubel's cognitive assimilation (subsumption) theory, Ausubel, (2008) the main basis for concept mapping, are:

1. Concepts derive their meanings through their inter-connections with other concepts; and
2. Meaningful learning occurs when fresh knowledge is consciously anchored to relevant concepts in the Cognitive structure of the learner.

According to Wandersee (2010), concept mapping relates directly to such theoretical principles as prior knowledge, subsumption, progressive differentiation, cognitive bridging and integrative reconciliation. This theory involves the learner linking new specialized concepts to more generalized, more inclusive concepts in the learner's existing structure of Knowledge (schema). The result of subsumption is that the Schema of the learner becomes progressively more differentiated leading to assimilation of newer information. This theory, therefore, asserts that cognitive structure is hierarchically organized and more inclusive, broad concepts are super-ordinate to less inclusive and more specific concepts. Furthermore, concepts in the learner's cognitive structure undergo progressive differentiation in which greater inclusiveness and specificity of concepts are discerned, resulting in recognition of more prepositional linkages with other related concepts (Cana *et al.,* 2003).

A student may not remember a name he learnt previously but when the bearer of the name is physically present, he may recall. Cana *et al.* (2003) are in agreement with the above explanation. They identified the roles that instructional strategy can play in learning and teaching of subjects. This situation mostly applied to factual knowledge where recognition is much more difficult to recall. The theory stipulates that an experience gained in one situation may be incompatible in another situation because of the absence of vital clues.

### 2.2.4 Ausubel's assimilation theory

Concept Maps have a strong foothold in psychological and epistemological foundations, based on Ausubel's Assimilation theory (Ausubel, 2008) and Novak's theory of Learning which explains that people learn new things by using their current knowledge and to a greater or lesser degree, seeking ways to integrate new knowledge and related knowledge already known. When learning is done meaningfully, there is integration of new concepts into our cognitive knowledge structure which takes place through linking of the new knowledge to concepts already understood (Novak, 2001). It is therefore a graphical representation relationship between concepts in our cognitive structure.

#### *2.2.4.1 Concept mapping as a meta-cognitive instructional strategy*

This is based on Ausubel, Novak and Gowin's theory of meaningful learning (Ausubel, 2010). This relate directly to such theoretical principles as prior knowledge, subsumption and progressive differentiation, cognitive bridging and integrative reconciliation. It is based on the psychological theory in science education which is designed to assist learners "Learn how to learn" science. In designing a concept map on a particular piece of scientific knowledge or experience requires the ability of the mapper to locate and relate its salient concept to a general, super ordinate concept.

Meta-knowledge and meta-learning are both teaching strategies that empower a learner to take control of his/her own learning in a highly meaningful fashion Novak (2010) and Chei-Chang (2008), Meta – knowledge is defined to be the knowledge that scales with the very nature of knowledge and knowing, while meta-learning is seen to be the learning that deals with the nature of learning, or learning about meaningful learning (Novak and Gowin, 2010).

## 2.3 Review of Related Empirical Studies

This heading highlights some of the empirical studies conducted on effects of animation and concept map teaching strategies on achievement, retention and interest of concepts taught in Mathematics and supporting these studies with related empirical researches in other subject areas both within and outside Nigeria. It attempts to provide in summary, the researcher's purposes, methods and the findings of individuals or collaborative researches.

Aremu and Abiodun (2010), work on the use of animation and lecture method on academic achievement of Nigerian secondary school students. The moderating effect of mental ability and gender were also investigated in the study. The study sample covers 180 SS II biology students who were selected using simple random sampling technique from two Federal Government Schools in Southern Nigeria. The pre-test-post-test, control group, quasi experimental design with 2x2x2 factorial matrix was adopted for the study. Students in experimental group were taught using animated package developed by the researchers as computer animation. While students in control group were taught using lecture method. The 59 result of this study shows that there is significant mean effect of treatment on students' achievement in biology. The computer animation was effective in improving students, academic achievement than lecture method.

The study reviewed is related to this study in terms of the use animation and academic achievement in secondary schools. The studies are also related in terms of design of the study, instrument for data collection and method of data analysis. Though, the two studies differ in terms of concept map visualization, area of the study, population and sampling.

Neuman *et al.* (2011), worked on evaluating computer-based simulations, multimedia and animations that help integrate blended learning with lectures in first year statistics. The course is a university year one statistics course mainly for students studying psychology. The topics includes basic research approaches; descriptive statistics (graphical and numerical); correlation; z-scores; probability; sampling distributions; and hypothesis testing for one sample and/or two samples using the z-test, t-test, and their nonparametric equivalents. The course was taught over one semester that comprised of 13 weeks of teaching using 2-hour for lectures per-week accompanied by 1-hour tutorial. The tutorial classes incorporated small group exercises and computer-based exercises in which the SPSS statistical package was taught. The course had a website that used the Blackboard LMS, from which students could access resources. Approximately 200 students were enrolled. The technology used includes multimedia, computer-based simulations, animations, and statistical software. Interviews were conducted on a stratified random sample of 38 students in a first-year statistics course. The animated package was a graphic file in GIF format and was integrated into the PowerPoint slides. The results show three 61 global effects on student learning and engagement: shows the practical application of statistics, helped with understanding statistics, and addressed negative attitudes towards statistics. It also shows a graphical representation of a confidence interval of the mean moving along the x-axis of a normal distribution Lin (2011), undertook a study on facilitating learning from animated instructional package. 582 undergraduate students enrolled in an eastern university in the United State participates in the study. A 2 x 3

factorial design were used. Analysis of data involves the use of mean, standard deviation, and analysis of variance. Result of finding shows that students who received animated visual treatment scored significantly higher on all criteria posttest than those who received the static visual treatment consistently, for both phases of analysis.

The study reviewed is related to this study in terms of the use of animation for teaching and learning. The studies are also related in terms of instrument for data collection and method of data analysis. Though, the two studies differ in terms of concept map visualization, retention, interest, design of the study, area of the study, population and sampling.

Tayo (2012), studied the effect of Animated Agricultural Package on attitude and performance of Students in south-west area using JSS III students in Ilesa west local government area of Osun state. He used 100 JSS III students as a sample of the study. The animated packages were developed locally based on the topics on crop rotation and design in modules using macromedia flash B.G and Microsoft power point 2007. Two research instruments (ASAT and SATASAQ) were used for data collection. Descriptive (mean and standard deviation) and inferential (f-test) statistics were used in the analysis. The result shows that: Students attitude towards agricultural science was enhanced with the use of the animated instructional package (f = 4.398, p table 1.98, w = 100, X = 23. 92, 90.66, SD (4.73, 6.43), DF = 98) over the lecture method. Retention has a link with academic achievement (Bichi, 2002; O'Day, 2016). O‘Day (2007) in his study, the Value of Animations in Biology Teaching; a study of long – term memory retention involving 393 students of Biology. Animations from three different sources were used each with different parameters. The result analysis involving mean, standard deviation, and t-test shows that animations provide a valuable way to communicate dynamic, complex sequences of Biological events more effectively than text in a static graphic. Students

prefer having animations in view of reading the textbook. In addition, animations lead to greater long – term memory retention that simple graphics. Interest as a variable in science education has been found to be one of the strong catalysts of teaching and learning.

The study reviewed is related to this study in terms of the use of animation for teaching and learning but the two studies differ in terms of concept map visualization, achievement, retention, interest, design of the study, area of the study, population, sampling, method of data collection and method of data analysis.

Damole *et al.* (2011) investigated the effect of concept mapping instructional strategy on the achievement of students in biology. The adopted quasi-experimental design, specifically non-randomized control group pre-test and post-test deign was used for the study. Two separate intact classed were used and categorized into experimental and control groups. One hundred and thirty-seven (137) students were captured for the study. The sample size consisted of fifty-eight (58) males and seventy-nine (79) females. Biology Achievement Test (BAT) consisting of twenty (20) items questions and 5-item essay questions were used for data collection. Experimental group was taught with concept maps while the control group with conventional lecture method. The data obtained was analyzed using of Covariance (ANCOVA). Results obtained showed that students exposed to concept mapping techniques showed a significant difference in the achievement of students. The experimental groups did better than the control groups in the post-test for both male and female categories.

The study reviewed is related to this study in terms of the use of concept mapping instructional strategy on the achievement of students. The two studies are also related in terms of design of the study, method of data collection and method of data analysis.

Though, the two studies differ in terms of the use of animation in teaching and learning, retention, interest, area of the study, population and sampling.

Udeani and Okafor (2012) investigated the comparative effectiveness of the expository and concept mapping instructional strategy of presenting secondary school biology concepts to slow learners. The study covered all the senior secondary three biology students of Community Secondary School, Ede Oballa, Nsukka in Enugu State. One hundred and thirty-one (131) slow learners were captured for the study based on their past promotion and terminal examinations, teachers' observation ratings and comments and students' inter-ratings.

The slow learners were observed in their respective biology class for two weeks. They were then categorized on gender difference and 124 of were shared equally into male and female (M=62/F=62) to ensure equal representation of the subjects in the study. Instrument for data collection was a thirty multiple (30) choice items. Two treatment conditions were used concept mapping and expository method of instruction. The concept of photosynthesis was taught for two weeks. Analysis of post-test scores indicated that the group taught with animated concept mapping instructional strategy performed significantly better than their expository group counterparts, the female slow learners taught with the animated concept mapping instructional strategy performed – significantly better than their male counterparts taught by the same method

Ezenwa (2009) investigated the linkage between students reading comprehension and teaching strategies in learning selected chemistry concepts. The population comprised of 246 students in Niger State Students were categorized into two groups and one group was taught with concept mapping strategy and the other with guided discovery strategy. Two groups were taught the concepts of acids, bases and salts, 50 items reading comprehension

test based on practical application of acid, bases and salts was administered to the students. It was revealed that the students taught reading comprehension did significantly well than those taught through guided discovery method.

In Ezenwa (2009) investigated the effects of concept mapping teaching strategy and guided discovery method on students' performance in chemistry in some selected senior secondary school student in Niger State. The study used 246 students of Chemistry randomly selected from senior secondary one in Niger State. Instrument for data collection was drawn from past WAEC question papers and called Chemistry Concept Achievement Test (CCAT) made up of items. Pre-test post-test control group design was used for the study. The experimental group was taught via concept mapping strategy while the control group was taught with guided discovery. The study revealed that the experimental group taught using concept mapping significantly did better on the chemistry concept achievement test, and also retained more chemistry knowledge than the control group taught with guided discovery method.

The study reviewed is related to this study in terms of the use of concept mapping teaching strategy on teaching and learning in secondary schools. The two studies are also related in terms of design of the study, method of data collection and method of data analysis. Though, the two studies differ in terms of the use of animation in teaching and learning, students' achievement, retention, interest, area of the study, population and sampling.

Gambari *et al.* (2014) determined the effect of concept mapping and guided discovery method on the variables of gender and different levels achievers. The sample size comprised of 150 students drawn randomly from selected co-educational schools in Minna Metropolis. The instrument consisted of 50 items on the concept of particulate nature of matter. The two groups were taught with two modes and at the end were given

a post-test. The result showed that the lower achievers' group was able to successfully utilize the concept mapping for better performance than the average and higher achievers.

Ezenwa (2009) investigated the effect of exposure of concept mapping strategy and guided discovery method on the attitudes of students to chemistry learning. The study was a descriptive research. The data was collected through the administration of questionnaire comprising of 40 items. The instrument was Likert-type questionnaire using four scales.

It revealed that exposure to concept mapping instruction positively and significantly enhanced students' attitude towards chemistry learning. There was also a correlation of attitude to chemistry and academic performance with a significant correlation of 0.62.

Dantani *et al.* (2013) investigated the effects of two modes of concept mapping instructional strategies on secondary school students' retention level in mathematics in Niger State, Nigeria. The research design adopted for the study was pre-test post-test randomized group. Two hundred and four (204) SSI students in six (6) randomly selected co-educational secondary schools in Niger State formed the target population of the study. The control group was taught with spider mode of concept map while the experimental was taught with hierarchy mode of concept map. Instrument for data collection was Algebra Retention Test.

One-way analysis of variance (ANOVA) was used to analyze the data obtained. The result obtained showed that there was no significant difference in the retention level of experimental group and control group, and that spider and hierarchy modes of concept mapping instructional strategies are not gender bias at retention level.

The study reviewed is related to this study in terms of the use of concept mapping on teaching and learning in secondary schools' students' retention. The two studies are also

related in terms of design of the study, method of data collection and method of data analysis. Though, the two studies differ in terms of the use of animation in teaching and learning, students' achievement, interest, area of the study, population and sampling.

Other researches includes: Edmondson (2000) Awofolaju (2006), Alice (2007), Eze (2008) and Wushishi (2001) conducted research studies on the effects of concept mapping instruction on students' achievement and retention in various subjects and found out that the experimental group exposed mapping instruction did better than the control group target with traditional lecture method.

Animation method as an important tool for science education was further supported by studies (for example, Hoffler & Leutner 2007; Tayo, 2012; Thomas & Israel, 2014), who proves that animated images transform abstract idea into concrete images, thus improving the student 's achievement, understanding, and attention.

Danmole (2018), study on animated demonstration versus written instructions for learning procedural tasks in university of Machingan. Twenty-eight students and staff form the sample of the study involving 2 x 2 7 x 3 mixed factorial design. F – test analysis was carried out and result shows that animated demonstration appears to have advantage over text in improving academic performance of students. This study is in university and did not considered the impact of animation on retention and interest, hence the gap to fill in the present study.

Lee (2019), carry out a study on the evaluation of animations as student aids in learning computer algorithms with a sample of 22 participants formed. Two hypotheses were tested using one – way analysis of variance 2 x 2 factorial design were also used. The result of finding shows a reliable main effect for animation, f (1, 84) = 3.98 P = 0.049, MSE = 2.24. Thus, the benefits conferred by animation centers on encouraging students

to make and test protection as the two have indistinguishable effects on post – test performance of students. Lee (2019), compares two classes of 30 students in which one was taught using a traditional note taking approach and a calculator and the other was taught using hands on activities and statistical animated software on a computer. During a subsequent interview, the technology rich approach was reported to reduce boredom, be better at relating statistics to research and problem solving, and make statistics more concrete. In the same vein, Sanger, (2000), states that, the chemistry animation research has demonstrated that computer animation supported education has a positive effect on students' conceptual under-standing of chemical processes.

The study reviewed is related to this study in terms of the use of animation in teaching and learning but the two studies differ in terms of the use of concept mapping in teaching and learning, students' achievement, retention, interest, area of the study, population and sampling.

Morrison and Tversky (2001) study of the ineffectiveness of animation in instruction among Stanford University Students. One hypothesis was raised and tested using t-test. Result of finding shows that graphics were more effective than text in some cases, especially for participants with low spatial ability, but animation did not further increase effectiveness.

Weiss *et al.* (2002), in a study principle for using Animation in Computer Based Instruction; Theoretical Heuristics for Effective Instruction‖ suggests that, the inherent purposes of animation are cosmetic, attention gaining, motivation, presentation and clarification functions. Thus, the use of animation, as a presentation strategy is particularly helpful when presenting highly abstract or dynamic process. Saulawa (2006), employs a similar hand on activity approach to Lee (2019), but combines it with a

computer (animated) software package designed to enhance learning. Observations of five students and an examination of the dialogue between them and their instructor indicates that this approach facilitate the learning of statistical concepts. One limitation, as noted by the author, was that the study took place outside the natural classroom setting. Stith (2004) ‘s study on use of animation in teaching cell biology, compared the correct responses to specific questions by groups viewing the apoptosis animation versus students who did not. Stith's data suggests that questions involving rote memory did not benefit from the animation, but those involving dynamic processes did benefit.

Kajuru and Ado (2012), ascertained that, there have been several school-based action research studies in Australia using animation to promote students’ literacy skills. One project, Clay Animation in the Primary Classroom, was conducted at Hawthorndene Primary School and investigated the use of clay animation as a teaching and learning approach to enhance outcomes for disengaged and underachieving students. Titles of the fictional QuickTime movies produced include a ―Zoo Trip, ―Snakes‖, ―Hamburger‖ and ―Elephant Sandwich. The study concluded that, ―clay animation as a teaching and learning tool is an exciting, time consuming, challenging, motivational process, and above all, a lot of fun. It can impact in a positive way on learning, group skills and teamwork, self esteem, confidence and leadership skills‖. Murray, *et al.,* (2005), conduct clay animation task, which is Student Centered Curriculum among Multi-literacy and Disengaged Students at Tintinara Area School to assist year 4-6 boys to improve their literacy skills. The boys created a sequence of representations by writing stories with a selected theme, designing them with a storyboard, constructing clay figures and backdrop scenes, using digital photography and then completed written evaluations. In the study, the targeted group of boys became aware of the importance of planning and structuring their narratives, which suggested the need for more explicit teaching of narrative structure

so that children could enhance their stories. Feng *et al.* (2006), in meta – analytical research on the effectiveness of animation in facilitating multi-level learning (factorial knowledge, comprehension and application) summarized the findings of 34 published experimental studies that involved 13, 514 participants. Conclusion among the 34 studies reported positive effects of animation in promoting learning. The overall mean weighted average effect size was d+ = 0. 313, with 95% confident interval (CI) being 0.277 to 0.349. This average-group recovery animation improved 58 multi-level-learning achievement at a rate of 62% as compared with 50% in the students in the static graphics groups.

Hoffler and Leutner (2007), investigates a Similar Meta - analysis of 26 primary students yielding 26 pair – wise companions of dynamic and static visualizations reveal medium sized overall advantages of instructional animations over static pictures. The mean weighted effect size on learning outcome (d = 0.37 (95%, CI 0.215 – 0.49). moderator analysis indicates even more substantial effect sizes when the animation is representational rather than deviational (d = 0.40, 95% CI 0.26 – 053), when the animation is highly realistic e.g video-based (d = 0.76 95%, CT 0.39 – 1 .13). This, animation appear to be better than their reputation. Ruffini (2009), states that, the use of animations is more effective than static sequential images for teaching dynamic events. Animations when design properly can attract and maintain interest in a presentation.

Sánchez *et al.* (2010), made a study on the importance of animation as a visual method in learning chemistry. The study objective was to examined differences in students 'motivation and learning outcomes resulting from two different teaching methods. The study used two groups. For the first group visual material was presented in traditional paper form. For the second group the material was presented via the computer animation. The sample population consists of 41 students from gymnasium final grade, who had

designed concept maps before. The animation and knowledge tests were represented in the module learning environment, which was familiar for the students from previous lessons.

The study took place in two days, so the number of students varies: 29 students creates concept maps before and after the studying process, but they all answered to the knowledge tests. Similar materials were created for those who studied from paper-based instruction and for those who followed the animation. In both cases, the material contained identical information (as a text or as a voice), figure of process and pictures of the topic. Students studied individually from the materials; the main multimedia principles while the animations created were followed. The animation explained invisible processes of micro stage. It was interactive- students had the ability to use control tabs. The animation was two- dimensional and did not use many different colors, high speed and molecule models in the animation. The animation contains voice explanation; the most were accentuated textually. Excessive effects (fast moving, incoming, contrasting colors etc) were not used. Their findings revealed that: a) The results of knowledge tests were similar to both groups (there were no significant differences, which would depend on the studying method) b) Students, who had studied from the animation, represented the structure of the figure (which was in the animation and paper based instruction); they create less links with concepts than before the studying process; c) Students, who had studied from the paper-based instruction, had created more propositions and all of them had created different structured concept maps. In that study, the structure of the concept maps (created propositions) and the number of the propositions depends on the individual studying method.

The study reviewed is related to this study in terms of the use of animation in teaching and learning but the two studies differ in terms of the use of concept mapping in teaching

and learning, students' achievement, retention, interest, area of the study, population and sampling.

Chei-Chang (2008) examined whether concept mapping can be used to help students to improve their learning achievement and interest. One hundred and twenty-four students from two classes were captured in advanced accounting course in 2002 at the school of management of a university in Taiwan. One class of 62 students was randomly selected. Adopting a concept mapping strategy can significantly improve students' learning achievement compared to using a traditional expository teaching method. Secondly, most of the students were satisfied with using concept-mapping in an advanced accounting course. It was indicated that concept mapping can help them to understand, integrate and clarify accounting concepts and also enhance their interest in learning accounting. They also thought that concept mapping could be usefully used in other curriculum areas.

The study reviewed is related to this study in terms of the use of concept mapping instructional strategy on students' achievement and interest but the two studies differ in terms of the use of animation in teaching and learning, retention, area of the study, population and sampling.

Che-Hung *et al.* (2010) examined whether teachers' activities lead to adjustment, revision and reorganization of students understanding via concept mapping teaching strategy. Based on the conceptual, the researcher adopted five stage teaching model which included orientation, elicitation, restructure, application and review for the course design. The students received eighteen weeks course training and the students were asked to map their understanding of the concepts at the beginning and at the end of the course. Qualitative data were also collected from in- depth interviews. The purpose of the study was to determine whether teachers' activities lead to the adjustment, revision and reorganization

of students' understanding via a concept mapping teaching strategy. The study found that student already had prior concept about the course even before the course started and some of the running and revision of these concept is obtained through the help of the teaching activities.

Nekang and Agwagah (2010) investigated the effect of concept mapping on two groups of form five students' achievement and interest in elementary probability. It also seeks to find out the effects of concept mapping on the achievement of male and female students in probability. The study investigated the effect of concept mapping on achievement and interest of male and female students in probability on two groups of final year students. Seventeen (17) item Achievement Test in Elementary Probability (ATEP) and a thirteen (13) ten-item Probability/and Statistics Inventory (ATEP) were administered on 154 students before and after teaching. The participants were randomly selected from two schools in Bui Division, in the North Region of Cameroon. The study lasted for two weeks. Data collected were analyzed using means and standard deviations to answer the three research questions and a 2x2 analysis of covariance (ANCOVA) was used to test the hypotheses stated. The results showed that concept mapping enhances students' achievement and interest in probability and statistics in Bui Division in Cameroon.

The study reviewed is related to this study in terms of the use of concept mapping instructional strategy on students' achievement and interest but the two studies differ in terms of the use of animation in teaching and learning, retention, area of the study, population and sampling.

A summary of other researches past and present includes; Novak and Gowin (2010), Chang *et al.* (2002); Budd (2004); Blair, *et al.* (2008); Freeman *et al.* (2015); Harpaz *et al.* (2014); Vanides *et al.* (2005) they all conducted research on the effects of concept

maps on students' achievement and retention in various subject areas and in different localities and observed that concept maps are veritable tools in enhancing learning among students.

Gender is one of the cardinal factors interacting with the achievement, a lot of researches have been conducted but unresolved as to the cause of the disparity (Nusbaum, 2000), some researchers observed in the course of their studies that males have higher achievement than the female counterparts amongst previous researchers are; Okeke (2007); Novak and Mosunda (2011) and Danmole (2018) others found out that the opposite is the case (females performing better than males) such findings includes studies by Kelly (2011) in (Damole *et al.* 2011). The non-significant difference between the two sexes was observed by researchers such as; (Okeke, 2007; Nusbaun 2000; Gambari, 2004; Ash 2005; Ezenwa 2009), amongst others noted that there was no significant difference between males and female students exposed to CAIP. It is therefore beneficial to investigate whether gender of students involved in using animations would have an effect on achievement and retention. Gender is a very vital moderating factor in any research, because it involves the use of computers and science subject (biology) these two areas are usually stereotypes of male domains (Novak, 2010). Gender as reported by various studies could be factor when computers are used for instruction. The assumptions are always that since boys are more pre disposed to the use of technology they may benefit more from the integration technology and learning. Contrarily girls may be limited in their learning when is involves technology (Unmeh, 2013).

## 2.4 Summary of Literature Reviewed

The literatures reviewed were categorized into conceptual, theoretical and empirical frameworks including genders as variable. Historical perspective of the main theme reviewed the historical foundations of the independent variables of the study which

includes; history of constructivism, computer animation, concepts mapping and conventional method of instruction. Under the conceptual framework dwelled on the theories of constructivism, computer animation and concept mapping instructional strategies. Empirical studies on the two variables, reviewed related literatures conducted by researchers within and outside the country. This was done in order to buttress the in-depth researches conducted recently on the variables investigated by the researcher. Based on the reviewed studies, it was observed that animation and concept maps studies on academic interest, achievement and retention has been widely researched, but the comparative effects of the three independent variables has not been given priority in the trends of research.

Previous and recent studies carried out on the integration of animation have indicated positive effects on learning, reduction in cognitive load in learning task due to the use of animations; the potential for increased learning when there is a need for external visualization and when content depends on motion; and opportunities for classification of complex information (Liu, 2004; Akpinar *et al.* 2008; Ogundokun and Adeyomi, 2010).

Several literatures (Aggarwal, 2008; Obeka, 2009; Mangal, 2010; Renninger and Hiddi, 2011) were reviewed on how interest can be generated as well as its measurement. Thus, in the present study, animated-media instructional strategy on weather concept developed using Adobe flash files (soft files), and Internet downloaded meteorological instrument embedded into the Microsoft document to form a single animation package to be used with Microsoft office power point (2007). The developed package was used as a treatment for experimental group and its impacts was observed on academic achievement, interest and retention in weather concept among senior secondary school students of Wuse education Zone, Abuja, Nigeria.

**Implication of Literature Reviewed on the Present Study**

From the studies reviewed, researchers such as Okam (2009), Usman (2010), Aderogba (2012), Obeka (2013) Atadoga and Lakpini (2013) and Thomas and Israel (2014) have identified that instructional strategy employed by teachers in teaching sciences significantly affect the level of students' academic achievement. In geography, several hindrances to effective learning arise and students tend to have low interest and retention in the subject. For instance, Abdulkarim (2010) and Aderogba (2012) observed the hindrances to students' academic achievement and retention in geography as limitation or insufficient instructional facilities, meteorological station, and laboratories for teaching geography in school.

Consequently, these generate low academic achievement among students. In order to address the problem, several innovative instructional methods have been found in the review. One of such methods is teaching using animation which is found to be superior over some methods of teaching sciences.

From the review, most of the study with animation method was conducted in countries like Japan, China, Malaysia, and southeastern Nigeria among others. In addition, the review revealed that the studies conducted were mostly in Biology, Statistic, Chemistry, Physics, Computer science, and Languages and at all level of education. A similar study was conducted in Geography in senior secondary school of Katsina state, Nigeria and on the concepts of weather to examine the impact of animated-media instructional strategy on academic achievement, retention, and interest at this level (Alice, 2007). The literatures reviewed have pointed out that study on animation instructional strategy have been conducted on variables such as performance and attitude of students in tertiary institutions. Most of these studies were in biology, physics, chemistry, and mathematics; none exists in the field of geography, specifically weather concepts. Similar study was

conducted using secondary school students on the impact of animation and concept map instructional strategy in relation to academic achievement, retention, and interest in weather concept of geography. The literatures reviewed have helped in ascertaining countries of the world that are using animated-media instructional strategy and concept maps in teaching. Countries notable in this research are; China, USA, UK, Australia, Malaysia, and Germany, a gap to fill in Nigeria.

Also, previous research findings and current studies have shown that animations serve several purposes in terms of instructions such as attracting and directing attention; representing purposes in terms of instructions such as; attracting and attention; representing domain knowledge about dynamic processes, explanation of complex phenomena and communication of dynamic complex sequences of biological events more effectively (Park, 2008; Stith 2004 and O'Day, 2006) According to Akpinar *et al.* (2008) the use of animation and concept map may also accelerate conceptual understanding by enhancing the formation of dynamic mental models of the phenomenon been studies.

This study was conducted in Wuse Education zone of Abuja, Nigeria. The study intends to determining the effect of animation and concept map visualization instructional strategy on academic achievement, retention, and interest in weather concept. Therefore, the researcher developed a computer animation and concept maps instruction package to determine the effects on achievement, retention and interest, also the determination of gender influence on the two dependent variables of the study.

# CHAPTER THREE

## 3.0 RESEARCH METHODOLOGY

### 3.1 Research Design

The research design used in this study was the quasi-experimental design. A pre-test, post-test, non-equivalent, non-randomized experimental and control group research design. Quasi-experimental design can be used when it is not possible for the researcher to randomize the subjects and assign them to treatment groups without disrupting the academic programmes of the schools involved in the study (Gall *et al.* 2007). The study used three groups; experimental group I, II, and control group. Experimental Groups are groups exposed to experimental treatment ($X_1$ and $X_2$). That is, teaching using animation and concept map visualization instructional strategy. While, control group was taught using lecture method ($X_0$ that is no treatment). There were two levels of independent variables namely; animation and concept map visualization, three levels of dependent variables which are; achievement, retention, and interest, and two levels of gender (male and female) which is the moderating variable. The research design layout is shown in Table 3.1:

**Table 3.1: Research Design Layout**

| Group | Pretest | Treatment | Achievement | Retention |
|---|---|---|---|---|
| EXP1 | $O_1$ | $X_1$ | $O_2$ | $O_3$ |
| EXP2 | $O_4$ | $X_2$ | $O_5$ | $O_6$ |
| CONTR | $O_7$ | $X_0$ | $O_8$ | $O_9$ |

Where:

$O_1, O_4, O_7$: Observation of pretest scores for the experimental and control,
$O_2, O_5, O_8$: Observation of achievement scores for the experimental and control,
$O_3, O_6, O_9$: Observation of retention scores for the experimental and control,

## 3.2 Population of the Study

The population for this study covered all senior secondary schools (SS II) students offering geography in Wuse education zone, with population of 303 Senior Secondary School year II students in the study area. From this figure, 158 were male while 145 were female of average age of 16 years plus from the selected senior Secondary Schools (SS II) offering geography in Wuse education zone. The demographic distribution of the target population is shown in Table 3.2.

**Table 3.2 Demographic Distribution of the Target Population by School and Gender**

| S/No | Names of schools | Male | Female | Total |
|---|---|---|---|---|
| 1 | Ladela Schools, Wuse 2, Abuja. | 09 | 18 | 27 |
| 2 | Olumawu Schools, Wuse 2, Abuja. | 16 | 36 | 52 |
| 3 | Raberto Schools, Wuse 2, Abuja. | 28 | 13 | 21 |
| 4 | Lightway Academy, Wuse 2, Abuja. | 34 | 20 | 54 |
| 5 | Premier International School, Wuse 2, Abuja. | 48 | 50 | 98 |

**Source:** Class Teacher Attendance Register (2019/2020 Session)

## 3.3 Sample and Sampling Technique

A sample of 120 SS II Geography students was used for this study. The sampling technique adopted for this study was multistage sampling technique. This technique uses more than one sampling method to arrive at the final sample for the study. Three co-educational schools were purposively selected for the study because they have well equipped Geography laboratory, qualified teachers who have taught Geography for at least five years and because they have both gender since gender is one for the variables considered in this study. The purposively selected schools were randomly assigned to

experimental groups one, two and control groups using simple random sampling technique. Intact class of SSII students were used as the respondents in this study because they had adequate exposure to Geography. The sample size distribution for the study is shown in table 3.3

**Table 3.3: Sample Size for the Students**

| Name of schools | Male | Female | Total |
|---|---|---|---|
| 1. Olumawu schools, Wuse 2 | 16 | 36 | **52** |
| 2. Ladela schools, Wuse 2 | 09 | 18 | **27** |
| 3. Raberto Schools, Wuse 2, Abuja. | 28 | 13 | 41 |
| **Total** | **53** | **67** | **120** |

**Source:** Class Teacher Attendance Register (2019/2020 Session)

### 3.4 Research Instruments

Five research instruments were developed by the researcher and used for the study. The instruments include:

1. Animated weather visualization Video Instructional Package
2. Weather Concept Mapping Chart.
3. Visualization and Weather Concept Map Interest Questionnaire
4. Weather Concept Achievement Test (WCAT).
5. Lesson plan

### 3.5 Development of Research Instruments

#### 3.5.1 Weather concept achievement test (WCAT)

This instrument is a 60 items achievement test developed by the researcher to determine the achievement and retention of students in weather concept. The instrument was developed from the weather concepts of senior secondary school geography curriculum. The WCAT item consists of 60 objectives (multiple type) test items each with four

alternatives (A-D) and 10 true or false questions. The item took into consideration the educational taxonomy of Bloom to ensure equal distribution of the items over the units. The table of specification for the Weather Concept Achievement Test (WCAT) is shown in Table 3.4

**Table 3.4: Specification for WCAT Construction**

| Topics | Kn | Co | Ap | Total |
|---|---|---|---|---|
| Topic A | 4 | 3 | 2 | **9** |
| Topic B | 5 | 4 | 4 | **13** |
| Topic C | 5 | 4 | 2 | **11** |
| Topic D | 5 | 3 | 3 | **11** |
| **Total** | **25** | **19** | **16** | **60** |

Key: Kn = Knowledge, Co = Comprehension, Ap = Application

### 3.5.2 Visualization and Weather Concept Interest Questionnaire (VWCIQ).

The Visualization and Weather Concept Interest Questionnaire (VWCIQ) is a 26 items interest inventory questionnaire developed by the researcher to determine the interest of students between and after treatment on weather concept of Geography. The items were developed using the Likert scale 5- point rating scale involving; Strongly agreed (S.A); Agreed (A); Undecided (U); Disagreed (D); and; Strongly disagreed (S.D). Each option carries weight in the order of priority from five to one in positive interest responses and from 1-5 in negative interest responses. The students were asked to freely indicate their interest on weather concepts by simply ticking one of the five options that suit their interest. From the item, maximum score is 130, minimum score was 26 and the average score is 78. A score of 78 and above signified positive interest and thus acceptance region. A score below 78 indicated no interest towards weather concept and therefore rejection

region. Detailed Weather Concept Interest Questionnaire (WCIQ) items developed by the researcher was be presented in appendix.

### 3.5.3 Concept map chart

The concept map was constructed following the procedures suggested by Novak (2010), that is organizing concepts, linking existing concepts to other relevant concepts, arranging the concepts hierarchically and labelling the linkages between the concepts.

The concept maps were based on phases; organization phase which includes the identification of facts, terms, and ideas that are associated with the concept on a spread sheet so that it can be read with ease, the arrangement phase; the facts and terms will be arranged collectively based on the interrelationships and connections among the groupings. Linking phase; an array of lines or arrows head will be used to connect or link the items, terms and facts together and finally the labelling.

### 3.5.4 Animated concept map visualization video

This was developed by the researcher using Microsoft office and Anime Studio. Different elements of weather were captured over time according to seasons.

## 3.6 Validation of Research Instruments

Concept maps developed by the researcher were validated by one expert in the Department of Educational Technology, Federal University of Technology, Minna and two Geography teachers who are teachers in the pool of secondary schools of study. This is to ensure proper construction of the maps, hierarchical presentation of facts, proper linking of facts, labels, clarity of lines among others.

The weather concept Achievement Test was developed by the researcher based on table of specification in relation to cognitive domain level. The questions and marking schemes

were subjected to face and content validity**.** Two experts and Senior lecturers in the Department of Science Education, Federal University of Technology, Minna, Niger State and two experts in geography (meteorologist / climatologists), a language education specialist and a Geography teacher at secondary school validated the instrument. The validation entails checking the items against the topic and content of the lesson. WCAT validation ensured that the content of the test adequately covers the curriculum or syllabus and the experts also suggested modification on the structure of the items, organization, choice of appropriate alternatives for the multiple-choice questions, clarity of the questions, and language level of the items. The report will be presented as the appendix in this work. The experts examined whether the items are clear to avoid ambiguity, appropriate for the level of the students under study, check for possible errors in the instruments and suggest corrections.

### 3.6.1 Validity of the animated video instructional package (AVIP)

The (AVIP) relevant to the weather concept maps was equally validated by one expert in Department of Educational Technology, Federal University of Technology Minna, Niger State. The expert examined the face and the content validity of the instrument using criteria which are: the simplicity of the format and its suitability for the level of students; the appropriateness of the graphics and text; the sharpness, clarity, and easy accessibility of the instrument; the subject matter covered, accuracy and logical presentation; verification of the content to determine the degree and component of the topic to be covered; and then the time provided to watch the video.

### 3.6.2 Validity of visualization and weather concept interest questionnaire (VWCIQ)

Visualization and Weather Concept Interest Questionnaire (VWCIQ), was equally validated by experts in the Department of Educational Technology and Science Education including Educational psychology, guidance and counsellor. The expert examined the face and the content validity of the instrument using criteria which are: the simplicity of the format and its suitability for the level of students; the appropriateness of the graphics and text; the sharpness, clarity, and easy accessibility of the instrument.

## 3.7 Reliability of the Research Instruments

To determine the reliability of the study, a pilot test was conducted with a group of 30 students in one Senior Secondary School that did not form the study sample, to determine the reliability of the instruments. The school selected for this purpose is similar to those of the main study in term of location, ownership and status levels and was randomly selected. Test re-test method was adopted for this purpose. Both WCAT and VWCIQ was administered during pilot study. WCAT was administered to these students at the beginning of the first week (test) and collected back for scoring. After an interval of two weeks, the same instrument was re-administered to the same group of students (re-test). Tuckman (2015), who proposed the minimum interval of two or more weeks between first and second administration, recommended the use of two weeks interval.

The results of the two tests were compared and correlated. Reliability coefficient of 0.87 was obtained using Pearson Product Moment Correlation (PPMC) method with the aid of SPSS Package. From the result obtained, it shows that the instruments are reliable. While that of the Questionnaire was 0.75 using Cronbach alpha formula respectively.

## 3.8 Method of Data Collection

One week before the experiment, the researcher visited the selected schools with the letter of introduction obtained from the HOD Education Technology Department, Federal University of Technology, Minna in order to obtain official permission from the school management, cooperation from staff especially that teaching geography and the subject teachers were sought. After permission was granted, on the second week, the administration of WCAT and VWCIQ commenced in order to determine the previous knowledge, interest, and the equivalent level of both the control and experimental groups. After this, treatment of the packages commenced. This treatment lasted from the second week to the fifth week during which the experimental groups were exposed to the video package while the control group was taught using lecture method. The post-test was administered in the sixth week and lasted for a week. All data collection lasted for one week.

## 3.9 Method of Data Analysis

The procedure for data analysis was determined by the type of data and the nature of hypothesis to be tested. The data collected was analyzed using descriptive of mean and standard deviation and inferential statistics of ANCOVA and t-test respectively. Mean and standard deviation was used to answer the research questions while ANCOVA was used to test the hypotheses using the Statistical Package for Social Sciences (SPSS) version 20. The significance of the statistical analyses was ascertained at 0.05 alpha level of significance.

# CHAPTER FOUR

## 4.0 RESULTS AND DISCUSSION

### 4.1 Research Questions

**Research Question One:** What are the effects of animation, concept mapping visualization and conventional method on students' achievement in weather concepts?

To answer research question one, mean and standard deviation was used to analyse the pretest and post test scores of students as shown in Table 4.1.1

**Table 4.1.1: Mean and Standard Deviation of Pre-test and Post-test Scores of Students taught Weather Concepts using Animation, Concept Map Visualization and Lecture Method**

| Group | N | Pretest | | Posttest | |
|---|---|---|---|---|---|
| | | **Mean** | **SD** | **Mean** | **SD** |
| **Exp Grp I** | **52** | 14.04 | 2.505 | 36.58 | 4.016 |
| **Exp Grp II** | **27** | 13.89 | 2.65 | 35.78 | 5.066 |
| **Control** | 41 | 13.37 | 3.399 | 34.00 | 6.152 |

Table 4.1.1 shows that at pre-test, the mean achievement scores of the students in the experimental and control groups were 14.04, 13.89 and 13.37 with standard deviations of 2.505, 2.65and 3.399 respectively. There were differences in the variability of their scores judging from the gap in their standard deviations. However, at post-test, the treatment groups had mean achievement scores of 36.58, 35.78 and 34.00 and standard deviations of 4.01, 5.07 and 6.15 for experimental and control groups respectively. This result indicates that the experimental group achieved higher than the control group. In effect, using animation and concept map visualization proved superior to the lecture method in enhancing students' achievement. To ascertain whether the observed differences is significant, hypothesis one is tested at 0.05 level of significance in Table 4.2.2.

**Research Question Two:** What is the influence gender on students' achievement when taught weather concepts using animation?

To answer research question two, mean and standard deviation was used to analyse the pretest and post test scores of students as shown in Table 4.1.2

**Table 4.1.2: Mean and Standard Deviation of Pre-test and Post-test Scores of Male and Female Students taught Weather Concept using Animation.**

| | | Pre-test | | Posttest | | |
|---|---|---|---|---|---|---|
| **Gender** | **N** | **Mean** | **SD** | **Mean** | **SD** | **Mean Gain** |
| Male | 16 | 14.16 | 2.266 | 37.18 | 3.786 | 23.16 |
| Female | 36 | 14.12 | 2.614 | 35.41 | 4.083 | 21.2 |

Table 4.1.2 shows the Mean and Standard Deviation of Pre-test and Post-test Scores of male and female students taught weather concepts with the use of Animation package. Male students had achievement mean score of 14.16 with a standard deviation of 2.26 at the pre-test while their female counterparts had achievement mean score of 14.12 with a standard deviation of 2.61. Mean gain scores of 23.16 and 21.20 for the male and female students respectively indicates that male students achieved higher than their female counterparts. Whether the difference in the mean achievement scores is significant is shown in Table 4.2.3.

**Research Question Three:** What is the influence gender on students' achievement when taught weather concepts using concept maps visualization?

To answer research question three, mean and standard deviation was used to analyse the pretest and post test scores of students as shown in Table 4.1.3.

**Table 4.1.3: Mean and Standard Deviation of Pre-test and Post-test Scores of Students taught Weather Concepts with the use of Concept Map Visualization.**

| Gender | N | Pre-test | | Posttest | | |
|---|---|---|---|---|---|---|
| | | **Mean** | **SD** | **Mean** | **SD** | **Mean Gain** |
| **Male** | 09 | 14.16 | 2.266 | 38.17 | 3.786 | 24.03 |
| **Female** | 18 | 14.12 | 2.614 | 34.51 | 4.083 | 20.39 |

Table 4.1.3 shows the Mean and Standard Deviation of Pre-test and Post-test Scores of male and female students taught with the use of concept map package. Male students had achievement mean score of 14.16 with a standard deviation of 2.266 at the pre-test and a mean achievement score of 38,17 with a standard deviation of 3.786 at post-test while their female counterparts had achievement mean score of 14.12 with a standard deviation of 2.614 at pretest and a mean achievement score of 34.51 with a standard deviation of 4.083 at posttest. Mean gain scores of 24.03 and 20.39 for the male and female students respectively indicate that male students achieved higher than their female counterparts. Whether the difference in the mean achievement scores is significant is shown in Table 4.2.4

**Research Question Four:** What are the differences in the students' retention score when taught weather concepts using animation, concept mapping visualization and conventional method.

To answer research question four, mean and standard deviation was adopted and used to analyse the retention scores of students as shown in Table 4.1.4

**Table 4.1.4: Mean and Standard Deviation of Post-test and Retention Scores of Students taught Weather Concepts using Animation, Concept Map Visualization and Lecture Method.**

| Group | N | Posttest | | Retention | | Mean Difference |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| **Exp Grp I** | 52 | 36.58 | 4.016 | 22.22 | 6.320 | 14.36 |
| **Exp Grp II** | 21 | 35.78 | 5.066 | 23.62 | 6.168 | 12.16 |
| **Control Grp** | 28 | 34.00 | 6.152 | 21.18 | 5.786 | 12.28 |

Table 4.1.4 shows the mean and standard deviation of posttest and retention scores of students taught using animation, concept map visualization and conventional method. The table reveals that at posttest the mean retention scores of the students in the experimental group I, II and control groups were 36.58, 35.78 and 34.00 with standard deviations of 4.016, 5.066 and 6.152 respectively. There are differences in the variability of their scores judging from the gap in their standard deviations. However, at retention-test, the treatment groups had mean scores of 22.22, 23.62 and 21.18 with standard deviations of 6.320, 6.168 and 5.786 for both experimental and control groups respectively. In addition, the experimental group one, two and control groups had a mean difference of 14.36, 12.16 and 12.28. This result indicates that the experimental group one had the highest retention. In effect, using animation proved to enhance students' retention more. To ascertain whether the observed difference is significant, hypothesis 4 is tested at 0.05 level of significance in Table 4.2.5.

**Research Question Five:** what is the influence of gender on students' mean retention scores when taught weather concepts using animation?

To answer research question five, mean and standard was use to analyse male and female students' retention score as shown in Table 4.1.5.

**Table 4.1.5: Mean and Standard Deviation of Post-test and Retention Scores of Students taught Weather with the use of Animation**

| Gender | N | Posttest | | Retention | | Mean |
|---|---|---|---|---|---|---|
| | | **Mean** | **SD** | **Mean** | **SD** | **Difference** |
| **Male** | 16 | 37.18 | 3.786 | 28.64 | 4.904 | 8.54 |
| **Female** | 36 | 35.41 | 4.083 | 26.74 | 3.949 | 8.67 |

Table 4.1.5 shows the Mean and Standard Deviation of Post-test and retention scores of male and female students taught with the use of Animation package. Male students had mean score of 37.18 with a standard deviation of 3.786 at the posttest while their female counterparts had mean score of 35.41with a standard deviation of 4.083. Mean gain scores of 8.54 and 8.67 for the male and female students respectively indicates that male students achieved higher than their female counterparts. Whether the difference in the mean retention scores is significant is shown in Table 4.2.6.

**Research Question Six:** Will gender influence students' retention when taught weather concepts using concept maps visualization?

To answer research question six, mean and standard were used to analyse male and female students' retention score as shown in Table 4.1.6

**Table 4.1.6: Mean and Standard Deviation of Post-test and Retention Scores of Male and Female Students taught Weather Concepts using Concept Map Visualization**

| Group | N | Posttest | | Retention | |
|---|---|---|---|---|---|
| | | **Mean** | **SD** | **Mean** | **SD** |
| Male | 09 | 34.00 | 6.152 | 21.23 | 6.320 |
| Female | 18 | 36.58 | 4.016 | 22.16 | 6.168 |

Table 4.6 shows that the posttest scores of male and female students taught weather concepts using concept map visualization are 34.00 and 36.58 respectively with standard deviations of 6.152 and 4.016 respectively. There were differences in the variability of

their scores judging from the gap in their standard deviations. However, at retention-test, the male and female students have mean scores of 21.23 and 22.16 with standard deviations of 6.320 and 6.168 respectively. This result indicates that the female retained more than their male counterparts. In effect, using concept map visualization proved to enhancing students' retention. To ascertain whether the observed differences is significant, hypothesis 6 is tested at 0.05 level of significance in Table 4.2.7

**Research Question Seven:** What is the difference in the interest inventory scores of students when taught weather concepts using animation and concept maps visualization? To answer research question seven, mean and standard deviation were used to analyse interest inventory scores of students when taught weather concepts using animation and concept maps visualization as shown in Table 4.1.7

**Table 4.1.7: Mean and Standard Deviation on Interest Inventory responses of Students taught Weather Concepts using Animation and Concept Map Visualization**

| Group | N | Mean | SD |
|---|---|---|---|
| Exp Grp I | 52 | 30.56 | 4.509 |
| Exp Grp II | 27 | 26.92 | 3.575 |

Table 4.1.7 shows the mean and standard deviation of mean of interest inventory scores of students when taught weather concepts using animation and concept maps visualization. The result indicated that there was difference in the mean response of experimental groups one and two with a mean score of 30.56, 26.92 and standard deviation of 4.509, 3.575 respectively. To determine if the difference in mean is significant, a corresponding hypothesis is tested and presented in table 4.2.8

**Research Question Eight:** What is the influence of gender on the interest inventory scores of students when taught weather concepts using animation?

To answer research question eight, mean and standard deviation of inventory responses of male and female students is shown in Table 4.1.8

**Table 4.1.8: Mean and Standard Deviation on Inventory responses of Male and Female Students taught Weather using Animation**

| Group | N | Mean | SD |
|---|---|---|---|
| Male | 36 | 26.64 | 3.424 |
| Female | 16 | 27.20 | 3.783 |

Table 4.1.8 shows the mean and standard deviation of male and female students' inventory responses. The result indicated that there was difference in the mean response of male and female students with a mean score of 26.64 and standard deviation of 3.424 for male and mean score of 27.20 with standard deviation of 3.783 for female. To determine if the difference in mean is significant, a corresponding hypothesis was tested and presented in Table 4.2.9.

**Research Question Nine:** What is the influence of gender on the interest inventory scores of students when taught weather concepts using concept maps visualization?

To answer research question nine, mean and standard deviation was used to analyse the inventory responses of male and female students as shown in Table 4.1.9

**Table 4.1.9: Mean and Standard Deviation on Inventory responses of Male and Female Students taught Weather using Concept Map Visualization.**

| Group | N | $\bar{x}$ | SD |
|---|---|---|---|
| Male | 36 | 25.42 | 3.424 |
| Female | 16 | 28.58 | 3.783 |

Table 4.1.9 shows the mean and standard deviation of male and female students. The result indicated that there was difference in the mean response of male and female students with a mean score of 25.42 and standard deviation of 3.424 for male and mean

score of 28.58 with standard deviation of 3.783 for female. To determine if the difference in mean is significant, a corresponding hypothesis is tested and presented in Table 4.2.10

## 4.2 Hypotheses Testing

### 4.2.1 Pretest Analysis

Weather Achievement Test (WAT) was used as a pretest to determine the academic equivalence of students taught weather concept in experimental and control groups. Pretest data for the groups were analyzed using one-way Analysis of Variance. The results of the analysis are presented in Table 4.2.1.

**Table 4.2.1: ANOVA Analysis of the Pretest scores of Experimental and Control Groups**

| Sources of Variation | Sum of Square | df | Mean Square | F-Cal | p-Value |
|---|---|---|---|---|---|
| Between groups | 148.338 | 2 | 74.169 | | |
| Within Group | 2368.253 | 117 | 20.241 | 3.664* | 0.029 |
| Total | 2516.592 | 119 | | | |

*Significant at P< 0.05

Table 4.2.1 shows the ANOVA comparison of pretest scores of experimental and control groups. An examination of the Table shows a significant difference between the Experimental and Control groups ($F = 3.664$, $p = 0.018$). This implies that the groups are not equivalent before treatment was administered. Hence, Analysis of Covariance (ANCOVA) was used to compare the posttest score of the groups and determine whether significant difference existed when covariate effect (pretest) is controlled.

### 4.2.2 Hypotheses Testing

**$HO_1$:** There is no significant difference in the mean achievement scores of students taught Weather concepts using animation, concept map visualization and lecture method.

To test this hypothesis, ANCOVA was used to analysed the achievement scores of students taught using animation, concept map visualization and conventional method as shown in Table 4.2.2.

**Table 4.2.2a: Analysis of Covariance of Posttest Scores of Experimental Groups One, Two and Control Groups**

| Source | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 221.912[a] | 2 | 110.956 | 4.952 | .010 |
| Intercept | 2779.816 | 1 | 2779.816 | 124.070 | .000 |
| Covariate (Pretest) | 103.895 | 1 | 103.895 | 4.637 | .034 |
| Main Effect (Treatment) | 93.109 | 1 | 93.109 | 4.156 | .045 |
| Error | 1702.797 | 76 | 22.405 | | |
| Total | 102588.000 | 79 | | | |
| Corrected Total | 1924.709 | 78 | | | |

*: Significant at 0.05 level

Table 4.2.2 shows the ANCOVA result of the comparison of posttest score of students in experimental group one, two and the control groups. An examination of the Table shows a significant main effect ( p = 0.045). On the basis of this, hypothesis one was rejected. Therefore, the achievement scores of students taught weather concept using animation, concept map visualization and control methods differed significantly and do, hypothesis one was rejected. To determine the location of the significant difference between the three groups, Scheffe's post hoc test was conducted on the data. The result is shown in Table 4.2.2b.

**Table 4.2.2b: Scheffe's Post Hoc Analysis of the Groups Mean Scores**

| Sources of Variation | Mean Scores | Exp I | Exp II | Control |
|---|---|---|---|---|
| Experimental I | 40.12 | | *0.000 | *0.000 |
| Experimental II | 37.10 | *0.000 | | *0.000 |
| Control | 21.90 | *0.000 | *0.000 | |

* The mean difference is significant at the 0.05 level.

The data in Table 4.2.2b indicates that there was significant difference in the posttest mean scores of students exposed to animation (X=40.12) and those exposed to concept map visualization (X=37.10) in favour of experimental I (animation). It also indicates that significant difference exists in the posttest scores of students exposed to concept map visualization (X = 37.10) and those exposed to conventional method (21.90) in favour of experiment group II (concept map visualization).Also, significant differences was established in the posttest scores of students exposed to animation(X=40.20) and those exposed to control group (X=21.90) in favour of experimental group one.

**$HO_2$:** There is no significant difference in the mean achievement scores of male and female students taught Weather using animation package.

To test hypothesis two, the mean achievement scores of male and female students in experimental group one was computed and analyzed using t-test as presented in Table 4.2.3

**Table 4.2.3: t-test Analysis of Achievement Score of Male and Female Students in Experimental Group One**

| Group | N | Mean | SD | df | T | P |
|---|---|---|---|---|---|---|
| Male | 16 | 14.16 | 2.27 | | | |
| | | | | 50 | 0.179* | 0.947 |
| Female | 36 | 14.12 | 2.61 | | | |

*: Significant at 0.05 level

Table 4.2.3 shows the t-test comparison of pretest score of male and female Weather students in experimental group. An examination of the Table shows that there is no significant difference between the two groups (t (52) = 0.179, p = 0.947). Hence hypothesis two was retained.

**$HO_3$:** There is no significant difference in the mean achievement scores of male and female students taught Weather using concept map visualization.

To test hypothesis three, the mean achievement scores of male and female students in experimental group two was computed and analyzed using t-test as presented in Table 4.2.4

**Table 4.2.4: t-test Analysis of Mean Achievement Scores of Male and Female Student in Experimental Group Two**

| Group | N | Mean | SD | Df | T | P |
|---|---|---|---|---|---|---|
| Male | 09 | 37.18 | 3.789 | | | |
| | | | | 25 | 1.964* | 0.054 |
| Female | 18 | 35.41 | 4.083 | | | |

*: Significant at $p \leq 0.05$

Table 4.2.4 shows the mean achievement score of male and female students taught with the use of Animation. Although Male Biology students (M =19.91, SD = 7.223) scoring lower than Female Biology students (M = 19.56, SD = 5.719) with t(52) = 1.964, p = 0.783 (p > 0.05), the p-value indicate that there was no significant difference in the score between male and female. Hence, the null hypothesis is retained.

**$HO_4$:** There is no significant difference in the mean retention score of students taught Weather using the animation package, concept map visualization and conventional method.

To test hypothesis four, Analysis of Covariance (ANCOVA) was used to compare the retention score of the three groups and determine whether significant difference exist when covariate effect (posttest) is controlled. The result is presented in Table 4.2.5

**Table 4.2.5: Analysis of Covariance of Retention Scores of Experimental groups One, Two and Control Groups Using Concept Map Visualization**

| Source | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 124.945[a] | 2 | 62.473 | 1.773 | .179 |
| Intercept | 971.881 | 1 | 971.881 | 27.577 | .000 |
| POSTTEST | 64.069 | 1 | 64.069 | 1.818 | .183 |
| GROUP | 87.780 | 1 | 87.780 | 2.491 | .120 |
| Error | 2044.071 | 58 | 35.243 | | |
| Total | 37835.000 | 61 | | | |
| Corrected Total | 2169.016 | 60 | | | |

*: Significant at 0.05 level

Table 4.2.5 shows the ANCOVA result of the comparison of retention score of students in experimental groups one, two and control groups. An examination of the Table shows a significant main effect (F = 2.491, p = 0.120). On the basis of this, hypothesis four was retained. The result revealed that there is no significant difference between the mean retention score of students taught Weather using animation package, concepts maps and those taught with lecture method when covariate effect (posttest) was controlled.

**$HO_5$:** There is no significant difference in the mean retention scores of male and female students taught Weather using animation package.

To test hypothesis five, t-test was used to analyse the retention scores of students in experimental group one as shown in Table 4.2.6

**Table 4.2.6: t-test Analysis of the Retention Scores of Male and Female taught Weather Concept using animation package**

| Group | N | Mean | SD | Df | T | P |
|---|---|---|---|---|---|---|
| Male | 36 | 28.64 | 4.904 | | | |
| | | | | 50 | 1.916* | 0.059 |
| Female | 16 | 26.74 | 3.949 | | | |

*: Significant at $p \leq 0.05$

Table 4.2.6 shows the mean retention score of male and female students taught with the use of Animation. The Male Weather students (M =28.64, SD = 4.904) scoring higher than Female Weather students (M = 26.74, SD = 3.949) with t (52) = 1.916, p = 0.059 (p > 0.05), the p-value indicate that there was no significant difference in the score between male and female. Hence, the null hypothesis is retained.

**HO**$_6$: There is no significant difference in the mean retention of scores of students' taught weather concept using concept maps visualization.

To test hypothesis six, t-test was used to analyse the male and female retention scores of students in experimental group two which is shown in Table 4.2.6

**Table 4.2.7: t-test Analysis of the Retention Scores of Male and Female Students taught Weather Concepts using Concept Map Visualization**

| Group | N | Mean | SD | df | T | P |
|---|---|---|---|---|---|---|
| Male | 28 | 36.04 | 3.453 | | | |
| | | | | 39 | 1.854* | 0.065 |
| Female | 13 | 33.20 | 3.153 | | | |

*: Significant at $p \leq 0.05$

Table 4.2.6 shows the mean achievement score of male and female students taught with the use of concept maps. Although Male students (M =36.04, SD = 3.453) scoring higher than Female students (M = 33.20, SD = 3.153) with (41) = 1.854, p = 0.065 (p > 0.05),

the p-value indicate that there was no significant difference in the score between male and female. Hence, the null hypothesis is retained.

**$HO_7$:** There is no significant difference in the mean interest inventory scores of students taught weather concepts using animation and concept map visualization.

To test hypothesis seven, t-test was used to analyse the inventory scores of students in both experimental groups one and two as shown in Table 4.2.8

**Table 4.2.8: t-test Analysis of the Interest Inventory Scores of Experimental Groups One and Two**

| Group | N | Mean | SD | df | T | P |
|---|---|---|---|---|---|---|
| Experimental | 52 | 26.92 | 4.904 | | | |
| | | | | 77 | 3.365* | 0.001 |
| Control | 27 | 30.56 | 3.575 | | | |

*: Significant at $p \leq 0.05$

Table 4.2.8 shows the mean interest inventory score of experimental and control group. Experimental group (M =26.92, SD = 4.904) scoring lower than the control group (M = 30.575, SD = 3.575) with $t(79) = 3.365$, $p = 0.001$ ($p < 0.05$), the p-value indicate that there was significant difference in the score between Experimental and control group. Hence, the null hypothesis was rejected.

**$HO_8$:** There is no significant difference in the mean interest inventory scores of male and female students taught Weather using Animation.

To test hypothesis eight, t-test was used to analyse the inventory scores of students in experimental group one as shown in Table 4.2.9

**Table 4.2.9: t-test Analysis of the Mean Interest Inventory Scores of Male and Female taught Weather Concepts using Animation**

| Group | N | Mean | SD | df | t-cal | P-value |
|---|---|---|---|---|---|---|
| Male | 36 | 27.11 | 3.492 | | | |
| | | | | 50 | 0.336* | 0.015 |
| Female | 16 | 29.56 | 4.807 | | | |

*: Significant at $p \leq 0.05$

Table 4.2.9 shows the mean interest inventory response score of male and female. Male (M=27.11, SD = 3.492) scoring lower than the female (M = 29.56, SD = 4.807) with t (52) = 0.336, p = 0.015 (p < 0.05), the p-value indicate that there was significant difference in the score between male and female. Hence, the null hypothesis was rejected.

**$HO_9$:** There is no significant difference in the mean interest inventory scores of male and female students taught weather using concept maps.

To test hypothesis nine, t-test was used to analyse the inventory scores of male and female students in experimental group two as shown in Table 4.2.10

**Table 4.2.10: t-test Analysis of the Mean Interest Inventory Scores of Male and Female taught Weather Concepts using Concept Map Visualization**

| Group | N | Mean | SD | Df | t-cal | P-value |
|---|---|---|---|---|---|---|
| Male | 28 | 24.80 | 3.492 | | | |
| | | | | 39 | 1.182* | 0.008 |
| Female | 13 | 27.81 | 4.807 | | | |

*: Significant at $p \leq 0.05$

Table 4.2.18 shows the mean interest inventory score of male and female. Male (M =24.80, SD = 3.492) scoring lower than the female (M = 27.81, SD = 4.807) with t (61) = 1.182, p = 0.008 (p < 0.05), the p-value indicate that there was significant difference in the score between male and female. Hence, the null hypothesis was rejected.

## 4.3 Summary of the Findings

From the data collected, computed, analyzed and interpreted in this study, the findings are summarized as follow:

1. There is no significant difference in the mean achievement scores of students taught Weather concepts using animation, concept map visualization and lecture method. Students taught with Animation and concept map visualization perform better than those taught with lecture methods.
2. There is no significant difference in the mean achievement scores of male and female students taught Weather using animation package. Both male and female Students taught with Animation achieved alike.
3. What is the influence gender on students' achievement when taught weather concepts using concept maps visualization. Both male and female students achieved alike.
4. What are the differences in the students' retention score when taught weather concepts using animation, concept mapping visualization and conventional method. All students taught using animation package and concept map visualization retained concepts taught well
5. There is no significant difference in the mean retention scores of male and female students taught Weather using animation package. Both male and female students retained concepts taught well.
6. There is no significant difference in the mean retention of scores of students' taught weather concept using concept maps visualization. Both male and female students retained concepts taught well.

7. There is no significant difference in the mean interest inventory scores of students taught weather concepts using animation and concept map visualization in favour of experimental group one.
8. There is no significant difference in the mean interest inventory scores of male and female students taught Weather using Animation. The female students have more interest in the concepts taught than their male counterparts.
9. There is no significant difference in the mean interest inventory scores of male and female students taught weather using concept maps. The female students have more interest in the concepts taught using concept map visualization than their male counterparts.

## 4.4 Discussion of Findings

Findings of this study on the difference in mean achievement scores of students taught weather concepts using animation and lecture method indicated that the experimental group achieved higher than the control group. In effect, using animation proved superior to the conventional lecture method in enhancing students' achievement. This finding is in line with the earlier findings of Danmole and Femi-Adeoye (2004), Aremu and Abiodun (2010), and Neumann *et al.* (2011), who found out that students taught weather with animation perform better than those taught with lecture method. Moreover, since the finding from this study revealed that experimental group achieved higher than the control group, the study further investigates if the differences in the Weather achievement test between the experimental and control group is significant or not.

Hypothesis one finds out if there is significant difference between the mean achievement scores of students taught weather concepts using animation package and lecture method. The result shows a significant difference between the two groups ($t(79) = 2.531$, $p = 0.018$). The result revealed that there is significant difference between the mean

achievement score of students taught weather using animation and those taught with lecture method when covariate effect (pre-test) was controlled. This finding is in line with the earlier findings of Femi-Adeoye (2004), Aremu and Abiodun (2010); Neumann *et al.* (2011), who found out that students taught Weather with animation perform better than those taught with conventional method. The students taught with animation performed better than those taught with conventional method because they can feel and see what they are taught with the aid of instructional materials and can complement their learning with their textbooks.

Finding that emanated from this study on the difference in mean retention scores of students taught weather concepts using animation package and lecture method. The result indicates that the experimental group achieved higher than the control group. In effect, using animation proved superior to the conventional lecture method in enhancing students' retention. This finding is in line with the earlier findings of Ezenwa (2009); Chang *et al.* (2002); Budd (2004); Freeman *et al.* (2015); Harpaz, *et al.* (2014); Vanides *et al.* (2005) who found out that students taught weather with animation retained more knowledge than the control group taught with lecture method. Since the finding from this study revealed that experimental group achieved higher than the control group, the study further investigates if the differences in the Weather retention test between the experimental and control group for significance.

Hypothesis two finds out if there was significant difference in the mean retention score of students taught weather using the animation package and that taught using lecture method. The result shows that experimental group had the highest mean gain scores of 12.96 while the control group had mean gain scores of 14.78. Results revealed that animation improved the retention of students in Weather better than lecture method. This finding is in agreement with the earlier findings of Freeman *et al.* (2015); Harpaz, *et al.*

(2014) who found out that students taught weather with animation retained more knowledge than the control group taught with lecture method. The students taught with concept mapping retained better than those taught with conventional method because hearing is not as good as seeing. This study contradicts the earlier finding of Dantani, Kure and Usman (2013) who found out that there was no significant difference in the retention level of experimental group and control group.

Finding of this study on the difference in the mean achievement scores of male and female students taught Weather using animation. The result indicates that the male students had achievement mean score of 14.16 with a standard deviation of 2.266 at the pre-test while their female counterparts had achievement mean score of 14.12 with a standard deviation of 2.614. The result indicates that male students achieved higher than their female counterparts. This finding is in line with the earlier findings of Novak (2001) and Danmole (2018) who found out that male students have higher achievement than their female counterparts. This study contradicts the earlier findings of Damole *et al.* (2004). Moreover, since the finding from this study revealed that the male students achieved higher than their female counterparts, the study further investigates if the differences in the achievement test between the two groups are significant or not.

Hypothesis three finds out if there is significant difference in the mean achievement scores of male and female students taught weather using animation package. The result indicated that there was no significant difference in the score between male and female students which indicated that animation is equivalent in improving the achievement of both male and female weather students. This study is in line with the earlier finding of Nusbaun 2000; Gambari, (2004) who found out that there was no significant difference between males and female students exposed to animation. There was no significant in the

achievement score of both male and female students because the two group were exposed to the same treatment.

Finding of this study on difference in the mean retention scores of male and female students taught weather using animation show that male students retained higher than their female counterparts. This study is not in line with the earlier finding of Dantani *et al.* (2013) who found out that there was no significant difference in the retention level of experimental group and control group. Since the finding from this study revealed that the male students achieved higher than their female counterparts, the study further investigates if the differences in the achievement test between the two groups are significant or not.

Hypothesis four finds out if there is any significant difference in the mean retention scores of male and female students taught Weather using Animation package. The male group had the highest mean gain scores of 8.54 while the female group had mean gain scores of 8.67. Results of the statistical analyses of the retention score of the male and female Weather students revealed that concept map animation is equivalent in improving the retention of both male and female Weather students. This study is not in line with the earlier finding of Dantani *et al.* (2013) who found out that there was no significant difference in the retention level of experimental group and control group. This study contradicts the earlier finding of Udeani and Okafor (2012) who found out that the female learners taught with the animation taught by the same method. The assumptions are always that since males are more pre disposed to the use of technology they may benefit more from the integration technology and learning. Contrarily females may be limited in their learning when is involves technology.

Finding of this study on difference in the mean interest inventory scores of student taught weather using Animation and lecture revealed that there was difference in the mean response of control and experimental group with a mean score of 30.56 and standard deviation of 4.409 for control group and mean score of 26.92 with standard deviation of 3.575 for experimental group.

Hypothesis five finds out if there is any significant difference in the mean interest inventory scores of students taught using animation and conventional method. The result indicated that the experimental group (M =26.92, SD = 4.904) score lower than the control group (M = 30.575, SD = 3.575) with t (79) = 3.365, p = 0.001 ($p < 0.05$), the p-value indicate that there was significant difference in the score between experimental and control group. This study was not in line with earlier finding of Nekang and Agwagah (2010); Hoffler and Leutner (2007) who found out that concept mapping enhances students' interest in learning.

Finding emanated from this study on the difference in the mean interest inventory scores of male and female students taught weather using animation revealed that there was difference in the mean response of male and female students with a mean score of 26.64 and standard deviation of 3.424 for male and mean score of 27.20 with standard deviation of 3.783 for female. To determine if the difference in mean is significant, a corresponding hypothesis was tested.

The findings from Hypothesis six finds out if there is any significant difference in the mean interest inventory scores of male and female students taught weather using animation. The result show that the mean interest inventory score of male and female. Male (M =27.11, SD = 3.492) scoring lower than the female (M = 29.56, SD = 4.807)

with t (52) = 0.336, p= 0.015 ($p < 0.05$), the p-value indicate that there was significant difference in the score between male and female students taught with animation.

Finding emanated from this study on the difference in mean achievement scores of students taught weather concepts using concept maps and lecture method. The result indicates that the experimental group achieved higher than the control group. In effect, using concept map proved superior to the conventional lecture method in enhancing students' performance. This finding is in line with the earlier findings of Freeman *et al.* (2015); Harpaz *et al.* (2014) who found out that students taught weather with concept map than the control group taught with lecture method. Since the finding from this study revealed that experimental group achieved higher than the control group, the study further investigates if the differences in the Weather achievement test between the experimental and control group is significant or not.

Hypothesis seven finds out if there is significant difference in the mean achievement score of students taught weather using the concept maps and that taught using lecture method. The result shows that experimental group had the highest mean gain scores. This study agrees with the earlier finding of Danmole (2018); Danmole and Femi-Adeoye (2004) who investigated the effect of concept mapping instructional strategy on the achievement of students and found out that there was no significant difference in the performance level of experimental group and control group.

Finding from this study on the difference in mean retention scores of students taught weather concepts using concept map and lecture method. The result indicates that the experimental group achieved higher than the control group. In effect, using concept maps proved superior to the lecture method in enhancing students' retention. This finding is in line with the earlier findings of Udeani and Okafor (2012); Edmondson (2000) Awofolaju

(2006); Aiyede (2016); Eze (2008); Wushishi (2001) who found out that students taught weather with concept map visualization retained more knowledge than the control group taught with lecture method. Since the finding from this study revealed that experimental group achieved higher than the control group, the study further investigates if the differences in the Weather retention test between the experimental and control group is significant or not.

Hypothesis eight finds out if there is no significant difference in the mean retention score of students taught weather using the concept maps and those taught using lecture method. Result showed that. The result revealed that there is no significant difference between the mean retention score of students taught weather using concepts maps and those taught with lecture method when covariate effect (posttest) was controlled. This study contradicts the earlier finding of Dantani *et al.* (2013) who found out that there was significant difference in the retention level of experimental group and control group.

Finding that emanated from this study on the difference in the mean interest inventory scores of male and female students taught weather using concept map revealed that there was difference in the mean response of male and female students. The result show that the mean interest inventory score of females is higher than that of their male counterpart and that there was significant difference in the score between male and female students taught with concept maps. This result is in agreement with Novak *et al.* (2010) and Danmole (2018) who found out that the females have higher mean interest inventory score than males. However, Dantani *et al.* (2013) found out that the opposite was the case.

Hypothesis nine finds out if there is any significant difference in the mean interest inventory scores of male and female students taught Weather using concept maps. The result showed that there was significant difference in the mean interest inventory scores

of male and female students taught Weather concepts. This finding contradict the findings of Nusbaun, (2000); Ezenwa (2009); Alio *et al.*, (2000), who noted that there was no significant difference between males and female students exposed to treatment like concept map.

# CHAPTER FIVE

## 5.0 CONCLUSION AND RECOMMENDATIONS

### 5.1 Conclusion

Findings of this study has revealed that students taught with animation and concept mapping visualization perform better than those taught with lecture methods and there is significant difference between mean achievement score of students taught with animation and concept map visualization. There is gender difference in the achievement mean score of male and female students. The male students achieved higher than their female counterparts. The study revealed further that the students taught with animation and concept map visualization retained more knowledge than the control group taught with lecture method. There is gender difference in the retention mean score of male and female students. The male students retained higher than their female counterparts. Furthermore, the study revealed that there was difference in the mean response of students taught with animation and concept map visualization and those taught with lecture method. There is gender difference in the interest mean score of male and female students. The female students have more interest than their male counterparts when taught with animation and concept maps. The use of animation and concept maps visualization when it is well tailored would in no doubt improve the teaching and learning process.

### 5.2 Recommendations

Based on the findings that emanated from this study, the following recommendation were made:

i. Teachers in secondary school should be encouraged by the school administrators and management to adopt the use of animation and concept map and other

instructional packages to complement their teaching. This will enhance their teaching methods and provide them with supplementary materials for teaching.

ii. Government and education board should make provision for continuous sensitizations, trainings and workshops for teachers in secondary schools. This will further encourage them to engage in the use of technology for teaching.

iii. Government and school administrators should make provision for infrastructure that support the learners through the use of technology, this will encourage and enable learners to communicate with each other and give them opportunity to share and access different teaching materials that can aid their learning.

iv. Curriculum developer may incorporate this strategy in curriculum guidelines for achievement of intended learning outcomes and content development for meaningful and higher order learning.

v. Concept map and animation is an emerging teaching and learning strategy. Pre-service and in-service teacher education programs ought to incorporate it in the curriculum to prepare teachers with respect to its philosophical background, theoretical base and practical usage.

## 5.3 Limitations of the Study

The following are the limitations of this study:

1. This study was limited to only senior secondary school two (SSSII) students in Wuse education zone in Abuja. This limitation precludes the finding of this study from been generalized.
2. Other students aside from Geography students were not selected as part of the sample for this study. Selection of sample was limited to students in senior secondary school two offering Weather in Wuse education zone in Abuja.

## 5.4 Contributions to Knowledge

The study has added to the pool of knowledge in the following ways:

1. It has succeeded in finding out the importance of animation and concept maps an effective teaching-learning strategy which would help in promoting different teaching- learning styles that can foster the performance of students.
2. Animation and concept maps could be effectively used to bridge the gap of teaching and learning process between teachers and students in the process of teaching and learning.
3. The study contributed to the existing literatures and provided a platform for further researches on animation and concept mapping learning style.

## 5.5 Suggestions for Further Studies

For further researches in this area, the following suggestions should be considered;

1. This study was carried out on weather for senior secondary school students and proved animation and concept maps visualization as a beneficial teaching learning strategy for cognitive development of students. It is suggested to conduct such research studies for other level and subjects.
2. The results of this study revealed that animation and concept map is found to be more beneficial for male than female students. Hence a qualitative or quantitative research is recommended for the exploration of those variables that affect learning patterns of male and female students.
3. In this study a class were taken as experimental groups. The students in each class belong to mixed ability levels. It is suggested that research may be conducted to find out the effect of animation and concept mapping on students with different ability levels.

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## APPENDICES

### Appendix A

### Cognitive Processes for Retention and Transfer

## Remembering

**Recognizing – l**ocating knowledge in long – term memory that is consistent with presented material.

**Recalling** – retrieving relevant knowledge from long- term memory to a certain category, example, concept or principle.

## Understanding

**Interpreting** – converting information from one form of representation to another.

**Exemplifying** – finding a specific example or instance of a general concept or principle.

**Classifying** – determining that something, for example, a particular instance or example belongs to a certain category, for example, concept or principle.

**Summarizing** – producing a short statement that represents presented information or abstracts a general theme.

**Inferring** – drawing a logical conclusion from presented information.

**Comparing** – detecting similarities and differences between two or more objects, events, ideas, problems, or situations.

## Applying

**Executing**- applying a procedure to a familiar task.

**Implementing** – applying one or more procedures to an unfamiliar task.

**Analyzing**

Differentiating – discriminating relevant from irrelevant parts or important from unimportant parts of presented materials.

**Organizing** – determining how elements fit or function within a structure.

**Attributing** – determining the point of view, biases, values, or intent underlying presented material.

## Evaluating

**Checking** – detecting inconsistencies or fallacies within a process or product, determining whether a process or product has internal consistency, or detecting the effectiveness of a procedure as it is implemented.

**Critiquing** – detecting inconsistencies between a product or operation and some external criteria, determining whether a product has external consistency, or judging the appropriateness of a procedure for a given problem

## Creating

**Generating** – inventing alternative hypotheses based on criteria.

**Planning** – devising a method of accomplishing some task.

**Producing** – inventing a product.

Table 1: cognitive processes for retention and transfer (source: Mayer, 2002).

## APPENDIX B

### TABLE OF SPECIFICATION FOR WCAT CONSTRUCTION

| S/N | Content | Weight (%) | Kn. (30) | Co. (21) | Ap. (17) | An. (11) | Sy. (11) | Ev. (10) | Total (100) |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | Definition of weather. | **(15)** | **3** | **2** | **1** | **1** | **1** | **1** | **9** |
| **2.** | Elements of weather and units of measurement. | **(22)** | **4** | **3** | **3** | **1** | **1** | **1** | **13** |
| **3.** | Instrument in measuring weather elements. | **(18)** | **3** | **3** | **1** | **1** | **2** | **1** | **11** |
| **4.** | Simple observation, recording, and reporting of weather data. | **(27)** | **4** | **3** | **3** | **2** | **2** | **2** | **16** |
| **5.** | Relevance of weather elements to physical and human activities | **(18)** | **4** | **2** | **2** | **1** | **1** | **1** | **11** |
| | **Total** | **100** | **18** | **13** | **10** | **7** | **7** | **6** | **60** |

KEY: **Kn.=Knowledge, Co.=Comprehension; Ap.=Application; An.=Analysis; Sy; Synthesis; Ev= Evaluation.** Sou**rce: (Adopted from Sambo, (2008) &Obeka, (2011)**

## APPENDIX C

## WEATHER CONCEPT ACHIEVEMENT TEST (WCAT)

**SECTION A: BIODATA**

**Name of School…….**

**Class…….....**

**Identification No…….....**

**Gender: Male [ ] Female [ ]**

**SECTION B: ITEMS ON WEATHER CONCEPT ACHIEVEMENT TEST (WCAT)**

**Instruction**

Please read the following instructions carefully before you answer the questions..

1. Write your school name, class and identification number provided for the examination in the space provided in the answer sheet.

2. Read each question carefully before answering it. If you find a question difficult, go on to the other questions and finish them first.

3. Shade only one letter for each answer in the objective questions.

4. If you change your mind on any answer, completely erase the first shading.

**NOW ATTEMPT THE FOLLOWING QUESTIONS BY CIRCLING THE CORRECT ANSWER**

1. The condition of lower atmosphere of a place over a short period of time is called…….

(a) Climate (b) weather (c) temperature (d) latitude

2. The major difference between weather and climate is that weather…… (a) Rain is constant for a long time (b) Change from day to day(c) Never changes throughout (d) Changes after 35 years.

3.……Is the chief source of atmospheric heat. (a) Cloud (b) Moon (c) Sun (d) Stars.

**From the following statement, indicate the nature of weather of the day.**

4. If I rest under a tree or air condition, the weather of the day is…….

(a) Snowy (b) cold (c) rainy (d) Sunny

5. I cannot take bath at 6am because the weather of the day is still…..

(a) Sunny (b) Rainy (c) Cold (d) Windy

6. I have to use an umbrella from The researcher hostel/house to geography laboratory; the weather of the day is …..(a) Hot (b) cold (c) rainy (d) windy

7. Gases that exert weights on the earth atmosphere are called……

(a) Air temperature (b) wind (c) rainfall (d) Air pressure

8. The following weather concept can be measured except……. (a) Air temperature (b) Relative humidity (c) Cloud cover (d)Air pressure

9. Amount of water or in the atmosphere is called……. (a) Humidity (b) pressure (c) temperature (d) rainfall

10. What is Wind? (a) stable air (b) directional air (c) air in motion (d) unmovable air

11. When temperature decreases with height, it is called……. (a) Continentality effect (b) ocean current (c) latitude (d) normal lapse rate

12. A place where weather conditions are measured is called……..….. (a) meteorological station (b) radio station (c) television station (d) home station.

13. Hygrometer is an instrument used in measuring which of the following element? (a) Atmospheric pressure (b) Relative humidity (c) insulation (d) temperature

14. The wet bulb thermometer always shows……. than the dry bulb thermometer (a) high reading (b) long reading (c) Lower reading (d) moderate reading

15. Wind direction is measured by an instrument called…….

(a) Wind velocity (b) Wind vane (c) Wind anemometer (d) Wind ammeter

16. Air is said to be saturated when it is 100%. Under which condition?

(a) if the wet bulb indicates a lower reading

(b) if the dry bulb indicates a higher reading

(c) if there is no difference between the reading of wet bulb an dry bulb

(d) if there is high difference between the reading of wet bulb and dry bulb

17. Anemometer is used to measure……

(a) Wind direction (b) Wind size (c) wind speed (d) wind color

18. A reading of 790mm is regarded as…

(a) low pressure (b) moderate pressure (c) absolute pressure(d) high pressure

19. Pressure is measure in unit of force called…

(a) millibars (b) Fahrenheit (c) degree centigrade (d) millimeter

20. The temperature of a place is measured by an instrument called _____

(a) Rain gauge (b) Barometer (c) Anemometer (d) Thermometer

21. Thermometer works on the principle that alcohol expand when … and contract when …

a) cooled, heated (b) saturated, heated (c) heated, cooled (d) saturated, evaporated

22. To get accurate records thermometers are kept in a standard shelter called Stevenson screen to protect them from the effect of _____

(a) Radiant heat of the sun and rain (b) wind blows (c) trees and shade (d) collecting accurate data

**Use the following data to answer question 23 – 27**

| Month | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp (oC) | 40 | 30 | 21 | 25 | 10 | 40 | 48 | 30 | 25 | 30 | 20 | 15 |

23. The month with the highest temperature is (a). December (b). July (c). June (d). May

24. The month with the lowest temperature is (a). December (b). July (c). June (d). May

25. The total annual temperature is ___(a). 331oc (b). 334oc (c). 27.8oc (d). 10oc

26. The annual range of temperature is__. (a). 331oc (b). 334oc (c). 38oc (d). 10oc

27. The mean annual temperature is_____(a). 27.8oc (b). 334oc (c). 331oc (d). 10oc

28. An SS II student measured soil temperature and found his result to be 16oc. He was asked to report this finding in degree Fahrenheit. What is his new temperature?

(a) 70.8of (b) 50.8of (c) 60.8of (d) 80of

29. Convert 50of to a temperature in degree centigrade…(a) 5oc (b) 10oc (c) 20oc(d) 50oc

30. The freezing point or the lowest point for centigrade scale is always 0oc while Fahrenheit is.....(a), 45of (b) 10of (c) 0of (d) 32of

31. Wind vane is made up of two parts. One part is the _____ on the top, which is free to move with the prevailing wind.....(a) Frame (b) arrow (c) mercury (d) distilled water

32. The vane or arrow point to the direction from which _____ so that wind is named from the direction it blows.

(a) Wind is blowing (b) sun is raising (c) water is falling (d) wind is stationary

33. Wind vane is located in...so that buildings/trees do not defect the wind direction.(a)A wind position(b)grazing position (c)a covered position (d)an exposed position

34. Anemometer consists of three or four _____ attached to the ends of horizontal spaces mounted on a high vertical spindle.

(a) Spherical cups (b) semi circular cups (c) square cups (d) rectangular cups

35. The higher the _____ of the wind, the greater the speed of the cups and vice versa.
(a) Direction (b) speed (c) amount (d) colour
36. Rainfall includes other form of precipitation is measured by an instrument called….
(a) rain gauge (b) nanometer (c) millibars (d) Stevenson screen

**Use the following data to answer question 37 – 40**

| Month | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall (mm) | 10 | 80 | 20 | 120 | 130 | 150 | 200 | 210 | 190 | 18 | 17 | 9 |

37. What is the month with the lowest rainfall? (a). December (b). July (c). June (d). May
38. What is the month with the highest rainfall? (a). December (b). July (c). August (d). May
39. What is the annual range of rainfall? (a). 64mm (b).80mm (c).10mm (d). 201mm
40. What is the mean annual rainfall? (a). 96mm (b). 17mm (c). 160mm (d). 16.66mm
41. If Temperature is measured in oC or oF, rainfall in cm and mm, pressure in millibars, what is the unit of measuring relative humidity?
(a) Ratio (b) percentage (c) centimeter (d) kilogram
42. In Morning hours, the standard time for fully measurement of weather element is ____
(a) 10:00 am (b) 7:00pm (c) 12:00pm (d) 8:00pm
43. If measurement is to be taken in the afternoon, it is normally done by _____
(a) 2:00pm (b) 3:00pm (c) 4:00pm (d) 5:00pm
44. For the evening measurements, the standard time is normally ____ (local time)
(a) 5:00pm (b) 6:00pm (c) 7:00pm (d) 8:00pm

**Use the following information to answer question 45-60**

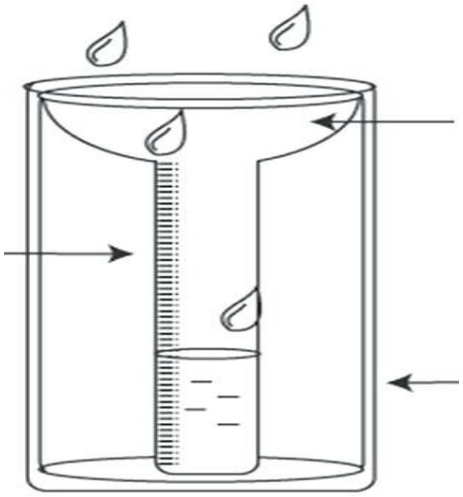


**Fig A**


**Fig B**

45. Identify the instrument named figure A.

(a) Anemometer (b) Hygrometer (c) Wind vane (d) Rain gauge

46. The instrument labelled fig A is used in measuring _____

(a) Temperature (b) Rainfall (c) Pressure (d) Humidity

47. The part labelled I in fig A is called

(a) jar or glass bottle (b) Stevenson screen (c) measuring cylinder (d) funnel

48. The metal funnel that leads to glass bottle enclosed within a copper cylinder connected to an inner container where the water is collected is labelled as …(a) I (b) II (c) III (d) IV

49. The distance between ground labelled and funnel top is given as _____

(a) 20cm (b) 30cm (c) 40cm (d) 30m

50. Identify the instrument labelled figure B.

(a) Rain gauge (b) Wind vane (c) Anemometer (d) Barometer

## APPENDIX D

## WEATHER CONCEPTS INTEREST QUESTIONNAIRE (W.C.I.Q.)

Dear Respondent,

Below is a list of items designated by a master 's student to examine the degree of students' interest in weather concepts of Senior Secondary School Geography. You are requested to freely rate yourself to indicate the extent to which the questionnaire items are interesting to you or not. Be informed that information provided will be used strictly for this research only and will be treated with outmost confidentiality.

Please take note of the following keys to guide your responses:

S.A……Strongly Agree

A……Agree

U……Undecided

D……Disagree

S.D…….Strongly Disagree

Thank You.

**SECTION A: BIODATA**

Name of School……..

Class……..

Gender: Male [ ] Female [ ]

Age……..

Serial Number……

**SECTION B: ITEMS ON WEATHER CONCEPT INTEREST QUESTIONNAIRE (WCIQ)**

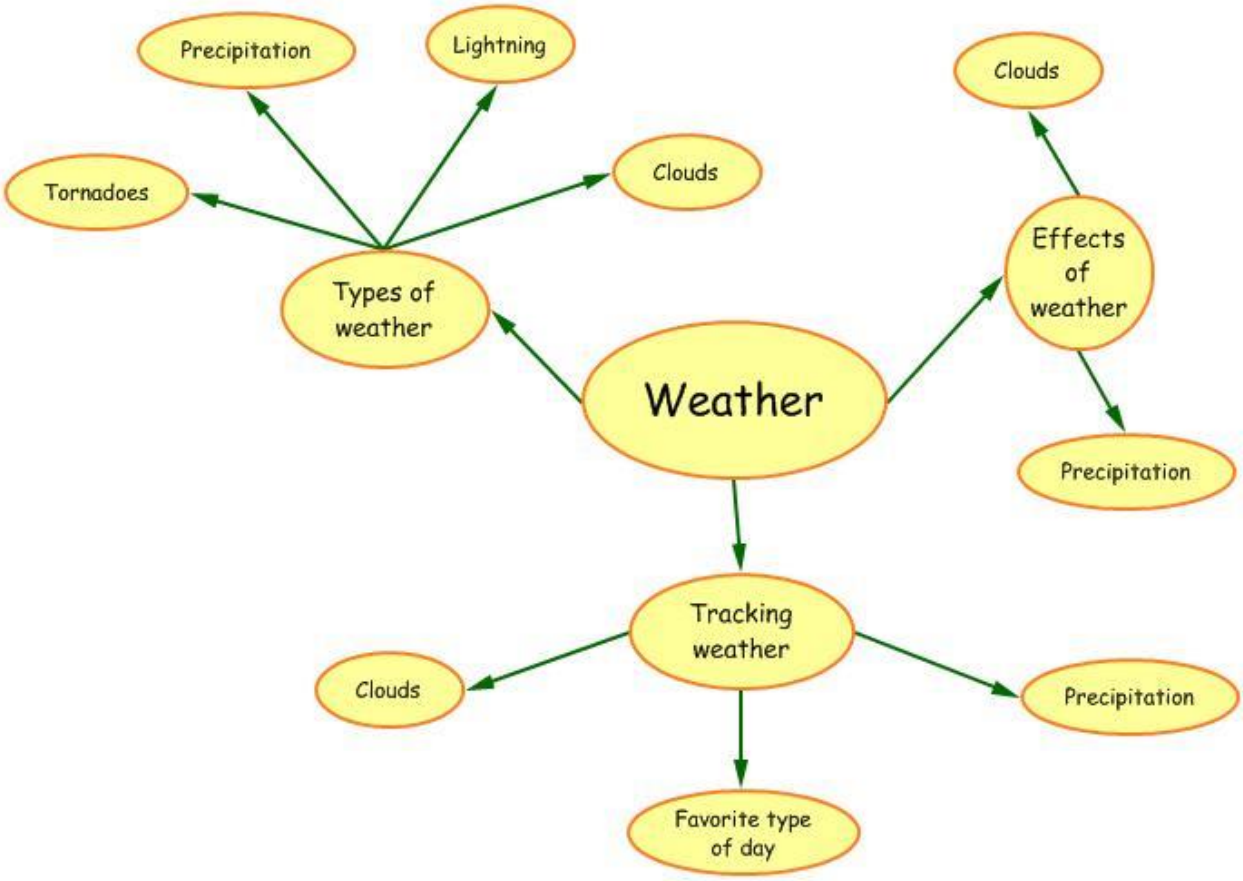
Please mark (v) in the appropriately column of your choice.

| S/N | ITEM | S.A | A | U | D | S.D |
|---|---|---|---|---|---|---|
| 1 | I am interested in listening to The researcher teachers teaching weather | | | | | |
| 2 | I don't like listening to daily weather report of radio and television services. | | | | | |
| 3 | I always enjoy reading newspapers and documents on weather. | | | | | |
| 4 | I am not interested in discussing the effects of weather elements on humans | | | | | |
| 5 | Weather forecast in media are faulty; therefore, I don't trust it | | | | | |

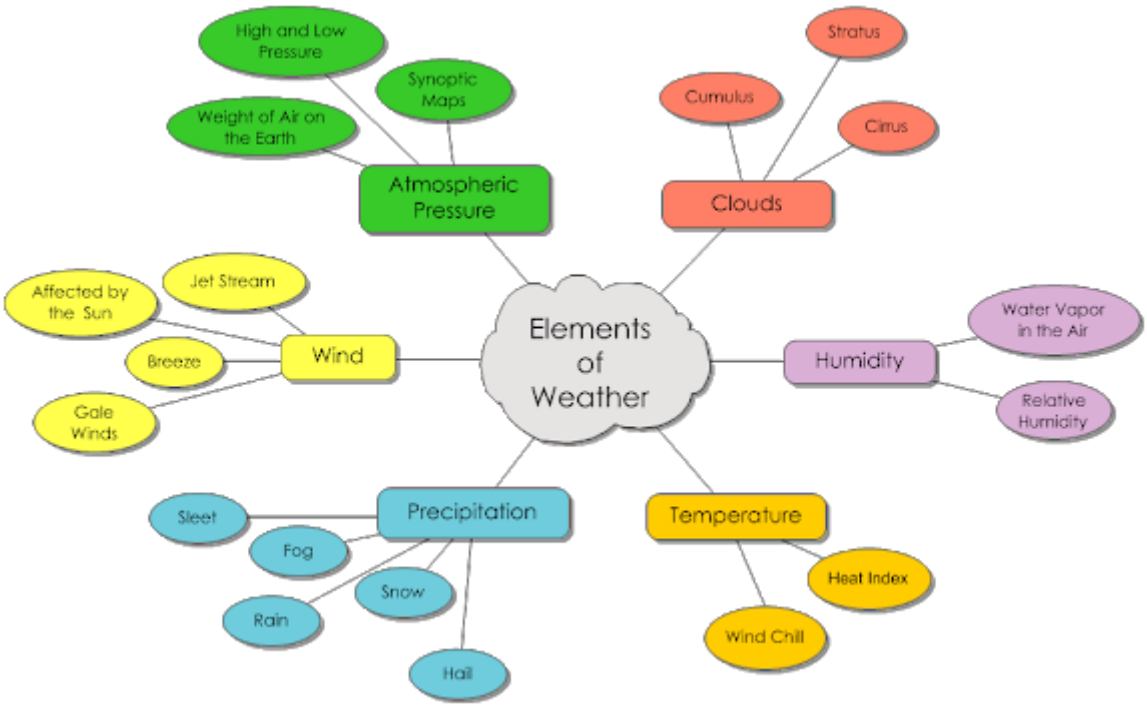
| | |
|---|---|
| 6 | I like telling The researcher parent the relevance of weather on health, agriculture production and environment, schools and club |
| 7 | I will not study weather courses in the University |
| 8 | Studying weather concepts is difficult to me |
| 9 | It is waste of time to listen to weather related broadcast on media |
| 10 | Due to The researcher exposure to weather, I carefully choose the type of cloths wear. |

## APPENDIX E

Weather concept Map Visualization



Elements of Weather Concept Map



## APPENDIX F

LESSON PLAN FOR EXPERIMENTAL GROUP

LESSON 1

Week: One

Class: SS II

Sex: Males and Females

Average age: 17 years

Methodology: Animation and Concept Map Visualization Strategy

Subject: Geography

Topic: The concept of weather, climate and their associate terminologies

Behavioral objectives: By the end of the lesson, students should be able to:

1. Define the terms ―weather and climate.
2. Differentiate between weather and climate.
3. State an example of weather and climate conditions
4. Explain at least two terminologies associated with weather and climate
5. Develop interest in weather concept

**Previous knowledge**: Students are aware of some changes that naturally occurred in the environment such as season, day, night, rainy day, etc.

**Instructional material:** Computer, projector, and animated package of weather.

**Introduction:** The teacher introduces the lesson by telling students a short story on weather and climate and ask the following questions which are meant to provoke meaningful thoughts from the students in terms of the previous and relevant knowledge they acquire in relation to the topic ―weather and climate:

1. What two major changes do you normally observed within 24 hours of the day?
   Expected answer: appearance of sun make day, when sun set night comes.
2. Why is that in a particular period of a year one must wear tick cloth?
   Expected answer: cold nature of the season. E.tc.

**Presentation:** The teacher presents her lesson based on the following steps:

**Step 1:** The teacher will paste her animated chart showing different condition of weather and allow students to carefully observe the animation and comment on the features observed.

**Step 2:** The teacher interacts with students and explains that the features observed are some conditions of the day in the atmosphere. Some of these features changed within short period of time and the phenomena are termed "weather". However, the same phenomena may extent over a long period of time. We called this "climate".

**Step 3:** The teacher then projects the definition of weather and climate using power point. Weather is the condition of lower atmosphere of a place over a short period of time.

Climate is the average condition of lower atmosphere of a place over a long period of time.

Differences between weather and climate: the teacher groups students and distributes two different animated flash cards for them to observed the differences between weather and climate. Each group should appoint a leader to explain group 's finding. The teacher, after deliberations of the groups, interacts with the class to show differences between weather and climate.

Terminologies associated with weather concepts: the teacher uses power point to show and explain to students on some terminologies associated with weather concepts. Some of the terminologies includes: Snowy, cold, windy, rainy, land and sea breeze, environmental lapse rate e.tc.

**student's Activity:** The teacher asks students to use the information provided in the animated flash cards and form their animation in their exercise books with some explanations on the animated weather formed.

**Evaluation:** The teacher evaluates his lesson by asking students some questions based on the lesson treated.

Example: -

What is weather?

What is climate?

What is the difference between weather and climate? List the terms associated with weather concept.

**Conclusion:** The teacher concludes the lesson by summarizing the entire lesson, explains some areas of difficulties observed during evaluation and allow students to make their own note on the concepts taught.

LESSON 2

Week: Two
Class: SS 11
Sex: Males and females
Average age: 17 years
Methodology: Animation and Concept Map strategy
Subject: Geography
Topic: Elements of weather and their units of measurement.

**Behavioral objectives:** By the end of the lesson, students should be able to:

Explain the terms weather element.

State at least three weather elements.

Explain each weather element State the unit of measuring each weather element

Develop interest in weather elements

**Previous Knowledge:** Students have previously learnt about the definition of weather and climate as well as some terminologies associated with weather concept.

**Instructional Materials:** Computer, projector and Animated package of weather element.

**Introduction:** The teacher introduces the lesson by asking students some questions based on their previous lesson.

Example:

What is the difference between weather and climate?

What is environmental lapse rate?

**Presentation:** The teacher presents her lesson based on the following steps:

**Step 1:** The teacher pastes animated chart showing different element of weather and allow students to carefully observe the animation and comment on the features observed.

**Step 2:** The teacher interacts with students and explains that the features observed are some elements that we observed and measured about conditions of the day in the lower atmosphere. Such phenomena observe in relation to weather.

**Step 3:** The teacher then projects the list of elements of weather as follows: Elements of Weather: Rainfall, Temperature, Wind, Atmospheric pressure, Relative humidity, Cloud cover, Sunshine e.t.c. The teacher explains to student on each element using power point projection of animated-media instructional strategy.

Example: Rainfall- refers to the rain of the earth ‘s surface from the atmosphere. Temperature: Is the degree of hotness or coldness of a place. Wind: Wind is the air in motion characterized by speed and direction. Atmospheric pressure: This refers to the weight of air over time. Relative humidity: Humidity is the measure of the dampness of the atmosphere due to water in the gaseous state and which varies from place to place at different times of the day. e.t.c. Units used in explaining weather elements: Element Unit of measurement Rainfall- millimeters

(mm). Temperature- Degree centigrade (o c), Degree Fahrenheit (o f), Wind- cardinal points, Atmospheric pressure- millibars.

**Students 'activity:** The teacher asks students to use the experience of the lesson and observed the following: Temperature of the day at 12:30 pm and 12:30 am. Time and direction of Sun rise on three different days Wind direction and speed at 10:05 am on two different days.

**Evaluation:** The teacher evaluates her lesson by asking students some questions based on the lesson treated. Example: What is weather element? List 3 weather elements. What is the unit of measuring temperature?

**Conclusion:** The teacher concludes her lesson by summarizing the entire lesson, explain some areas of difficulties observed during evaluation and allow students to make their own note on the concepts taught.

LESSON 3

| | |
|---|---|
| Week: | Three |
| Class: | SS II |
| Sex: | Males and Females |
| Average age: | 17 years |
| Methodology: | Animated-media instructional strategy |
| Subject: | Geography |

Topic: instrument in measuring weather elements and precautions for using each instrument.

**Behavioral objectives:** By the end of the lesson, students should be able to:

1. State the instruments for measuring weather elements.

2. Match each instrument with its corresponding element and unit 3. State the precautions for using each instrument 4. Develop interest in weather instruments

**Previous lesson**: Students have previously learnt about Elements of weather and their units of measurement.

**Instructional materials:** Animated chart showing weather instruments, animated meteorological station computer, projector and animated package of weather instrument.

**Introduction-** The teacher introduces the lesson by asking students some questions based on their previous lesson. Example: What is weather element? What are weather elements? What is the unit of measuring temperature?

**Presentation:** The teacher presents her lesson based on the following steps:

**Step 1**: The teacher pastes animated chart showing different instruments of weather and allow students to carefully observe the animation and comment on the features observed. The teacher interacts with students and explains that the features observed are some instruments used in measuring weather elements. They are kept in meteorological station. Some of these instruments (e.g. thermometer) can be kept in Stevenson screen.

**Step 2:** The teacher then projects the animated metrological station together with the list of weather instruments as follows: Instruments used in measuring Elements of Weather :1. Rain gauge, 2. Thermometer, 3. Wind vane, 4. Anemometer, 5. Hygrometer, 6. Barometer, 7. Sunshine recorder, Etc.

**The Step 3:** teacher explains to student on each instrument using power point projection of animated-media instructional strategy. Example:

1. Rain gauge: This is an instrument used in measuring Precipitation or rain of the earth ‘s surface from the atmosphere. 2. Thermometer: this is used in measuring temperature (Is the degree of hotness or coldness of a place)

3. Wind vane: is an instrument for measuring Wind direction

4. Anemometer: is an instrument for measuring Wind speed

5. Barometer: is an instrument for measuring Atmospheric pressure or the weight of air over time.

6. Hygrometer: is an instrument for measuring Relative humidity which is the measure of the dampness of the atmosphere due to water in the air.

**Students 'activity:** gaseous state and which varies from place to place at different times of the day. e.t.c.

**Precautions used with weather instruments.** The teacher project animated weather instrument and show precautions for keeping each instrument. Example: To get accurate records thermometers are kept in a standard shelter called Stevenson screen to protect them from the effect of Radiant heat of the sun and rain. Rain gauge: The distance between ground labeled and funnel top. The metal funnel that leads to glass bottle enclosed within a copper cylinder connected to an inner container where the water is collected. The teacher guide students on how to match instruments, elements and their Correspondence units of measurement using animation. Element Instruments Unit of measurement 1. Rainfall- Rain gauge mm 2. Temperature- Thermometer o c or o f. 3. Wind direction- Wind vane, cardinal points 4. Atmospheric pressure- Barometer millibers 5. Relative humidity Hygrometer % etc. The teacher asks students to use the animated weather instruments and draw the following in their work sheets: 1. Rain gauge 2. thermometer 3. Wind vane. 4. anemometer 5. hygrometer 6. Barometer.

**Evaluation:** The teacher evaluates his lesson by asking students some questions based on the lesson treated. Example: 1. State the instruments for measuring weather elements. 2. What is rain gauge used for? 3. State the precautions for keeping thermometer.

**Conclusion:** The teacher concludes her lesson by summarizing the entire lesson, explain some areas of difficulties observed during evaluation and allow students to make their own note on the concepts taught.

LESSON: 4

| | |
|---|---|
| WEEK: | Four |
| Class: | SS II |
| Sex: | Males and Females |
| Average age: | 17 years |
| Methodology: | Animated-media instructional strategy |
| Subject: | Geography |

Topic: Observing, recording analysis, interpretation, and reporting of weather data (temperature, rainfall, and wind).

**Behavioral objectives:** By the end of the lesson, students should be able to: Describe procedures for observing and recording weather elements temperature, rainfall and wind). Convert temperature from degrees to Fahrenheit. Describe the procedure of interpretation and reporting temperature, rainfall and wind. Develop interest in Observing, recording analysis, interpretation and reporting of weather data.

**Previous knowledge**: Students have previously learnt about instruments used in measuring weather elements.

**Instructional materials:** Animated Chart showing weather data (temperature, rainfall and wind), computer, projector, rainfall and temperature data.

**Introduction:** The teacher introduces the lesson by asking students some questions based on their previous lesson. Example: - What is meteorological station? - What are the elements for measuring weather data? - What is Stevenson screen? E.tc.

**Presentation**: The teacher presents her lesson based on the following steps:

**Step 1**: The teacher displays animated chart on the board and explain to students on technique of observing weather elements on: Rainfall, Temperature, Wind (finger method) Etc. The teacher guide students on how to create weather data (rainfall and temperature). Example:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall Data Month | J | F | M | A | M | J | J | A | S | O | N | D |
| Rainfall (mm) | 10 | 80 | 20 | 120 | 130 | 150 | 200 | 210 | 190 | 18 | 17 | 9 |
| Temperature Data Month | J | F | M | A | M | J | J | A | S | O | N | D |
| Temp .C | 40 | 30 | 21 | 25 | 10 | 40 | 48 | 30 | 25 | 30 | 20 | 15 |

The teacher explains to students on Interpretation and reporting weather data. Example: Conversion of temperature scale. Daily rainfall and temperature. Monthly rainfall and temperature. Mean annual rainfall and temperature. Diurnal temperature. Local times for observing weather elements e.t.c. The teacher asks students to formulate three data each on rainfall and temperature and use it to interprets the differences in the three different sets of data formed.

**Evaluation:** The teacher evaluates her lesson by asking students some questions based on the lesson treated.

Example: A student observed and measured temperature of the year and obtained the following information: 12, 14, 17, 23, 65, 45, 68, 10, 53, 12, 90, 43,56. From the result obtained, what is: The month with the highest temperature? The month with the lowest temperature? The total annual temperature? The annual range of temperature? The mean annual temperature? An SS II student measured soil temperature and found his result to be 16o c. He was asked to report this finding in degree Fahrenheit. What is his new reading?

**Conclusion:** The teacher concludes her lesson by highlighting some areas of difficulties observed during evaluation and allows students to make their own note on the concepts taught.

LESSON PLAN FOR CONTROL GROUP

| | |
|---|---|
| LESSON | 1 |
| Week: | One |
| Class: | SS II |
| Sex: | Males and Females |
| Average age: | 17 years |
| Methodology: | Lecture method |
| Subject: | Geography |

Topic: The concept of weather, climate and their associate terminologies

Behavioral objectives: By the end of the lesson, students should be able to: Define the terms ―weather and climate‖. Differentiate between weather and climate. State an example of weather and climate conditions. Explain at least two terminologies associated with weather and climate. Develop interest in weather concept.

**Previous lesson:** Students are aware of some changes that naturally occurred in the environment such as season, day, night etc.

**Instructional materials:** Chalk and chalk board.

Introduction: The teacher introduces the lesson by explaining the objectives of the lesson to students and asks them some questions in relation to their past experience with weather. Example: Expected question1: What two major changes do you normally observed within 24 hours of the day? Expected answer: appearance of sun make day, when sun set night comes. Expected question 2: Why is that in a particular period of a year one must wear tick cloth? Expected answer: cold nature of the season. E.tc.

**Presentation:** The teacher presents her lesson based on the following steps:

**Step 1:** The teacher defines weather and climate while students listen. Example: 1. Weather is the condition of lower atmosphere of a place over a short period of time. Climate is the average condition of lower atmosphere of a place over a long period of time.

**Step 2:** Differences between weather and climate. Example: Weather can change within a short period while climate deals with average condition of atmosphere for a very long period of time say 35 years. E.t.c

**Step 3:** Terminologies associated with weather concepts: the teacher explains to students on some terminologies associated with weather concepts. Some of the terminologies includes: Snowy, cold, windy, rainy; Land and see breeze; Environmental lapse rate e.t.c.

Students ‘activities: The teacher ask students to relate their experiences on environmental lapse rate using previous experiences of trees and mountains climbing

**Evaluation:** The teacher evaluates his lesson by asking students some questions based on the lesson treated. Example: What is weather? What is climate? What is the difference between weather and climate? List the terms associated with weather concept. E.t.c

**Conclusion.** The teacher concludes her lesson by summarizing the entire lesson, explain some areas of difficulties observed during evaluation and allow students to make their own note on the concepts taught.

LESSON 2

Week: Two
Class: SS II
Sex: Males and Females
Average age: 17 years ±
Methodology: Lecture method
Subject: Geography
Topic: Elements of weather and their units of measurement **Behavioral objectives:** By the end of the lesson, students should be able to: Explain the terms weather element. State at least three weather elements. Explain each weather element State the unit of measuring each weather element Develop interest in weather elements.

**Previous lesson:** Students have previously learnt about the definition of weather and climate as well as some terminologies associated with weather concept.

**Instructional materials:** Introduction Chart showing definition of weather element, chalk and chalk board.

Introduction: The teacher introduces the lesson by asking students some questions based on their previous lesson. Example: What is the difference between weather and climate? What is environmental lapse rate? E.tc.

**Presentation:** The teacher presents his lesson based on the following steps:

**Step 1:** The teacher explains to students on the objective of the lesson. This is followed by explaining the term elements of weather. Example: These are certain things that we observed and measured about conditions of the day in the lower atmosphere. Such phenomena observe in relation to weather are terms as elements of weather.

**Step 2:** The teacher lists the element of weather as follows: Elements of Weather: Rainfall, Temperature, Wind, Atmospheric pressure, Relative humidity, Cloud cover, Sunshine, Etc.

**Step 3** The teacher explains to student on each element.

Example:

Rainfall: Precipitation refers to the rain of the earth‘s surface from the atmosphere Temperature: Is the degree of hotness or coldness of a place Wind:

Wind is the air in motion characterized by speed and direction Atmospheric pressure: This refers to the weight of air over time. Relative humidity: Humidity is the measure of the dampness of the atmosphere due to water in the gaseous state and which varies from place to place at different times of the day. e.t.c units used in explaining weather elements: Element Unit of measurement Rainfall millimeters (mm), Temperature Degree centigrade (o c), Degree Fahrenheit (o f) Wind cardinal points Atmospheric pressure millibers Relative humidity percentage etc

Students‘ activities: The teacher ask students to distinguish between elements, units and instruments for weather with examples.

**Evaluation:** The teacher evaluates his lesson by asking students some questions based on the lesson treated. Example: What is weather element? What are weather elements? What is the unit of measuring temperature?

**Conclusion:** The teacher concludes her lesson by summarizing the entire lesson, explain to the students on major areas of difficulties observed in evaluation

LESSON 3

| | |
|---|---|
| Week: | Three |
| Class: | SS II |
| Sex: | Males and Females |
| Average age: | 17 years |
| Methodology: | Lecture method |
| Subject: | Geography |

Topic: instrument in measuring weather elements and precautions for using each instrument.

**Behavioral objectives:** By the end of the lesson, students should be able to: State the instruments for measuring weather elements. Match each instrument with its corresponding element and unit State the precautions for using each instrument Develop interest in weather instruments.

**Previous lesson:** Students have previously learnt about Elements of weather and their units of measurement.

**Instructional materials:** Chart showing weather instruments, chalk and chalk board.

**Introduction:** The teacher introduces the lesson by asking students some questions based on their previous lesson. Example: What is weather element? What are weather elements? What is the unit of measuring temperature? E.tc.

Presentation: The teacher presents her lesson based on the following steps:

**Step 1:** The teacher paste chart showing different instruments of weather and explains that the features observed are some instruments used in measuring weather elements. They are kept in meteorological station. Some of these instruments (e.g. thermometer) can be kept in Stevenson screen. Some of these instruments (e.g. thermometer) can be kept in Stevenson screen.

**Step 2:** The teacher lists the instruments of weather while students listen. Example: Instruments used in measuring Elements of Weather are: Rain gauge, thermometer, Wind vane, anemometer, hygrometer, barometer, Sunshine recorder.

**Step 3:** The teacher explains to student on each instrument. Example: Rain gauge: This is an instrument used in measuring Precipitation or rain of the earth ‘s surface from the atmosphere. Thermometer: this is used in measuring temperature (Is the degree of hotness or coldness of a place) Wind vane: is an instrument for measuring Wind direction Anemometer: is an instrument for measuring Wind speed Barometer: is an instrument for measuring Atmospheric pressure or the weight of air over time. Hygrometer: is an instrument for measuring Relative humidity which is the measure of the dampness of the atmosphere due to water in the gaseous state and which varies from place to place at different times of the day. e.t.c.

**Step 4**: Precautions used with weather instruments. The teacher project animated weather instrument and show precautions for keeping each instrument. Example: To get accurate records thermometers are kept in a standard shelter called Stevenson screen to protect them from the effect of Radiant heat of the sun and

rain. Rain gauge: The distance between ground labeled and funnel top. The metal funnel that leads to glass bottle enclosed within a copper cylinder connected to an inner container where the water is collected.

**Step 5**: The teacher explains to students on how to match instruments, elements and their correspondence units of measurement. Example:

| Element Instruments | Unit of measurement |
|---|---|
| Rainfall …… | mm |
| Temperature…… | Thermometer |
| Wind direction … | cardinal points … Barometer .. millibers |
| Relative humidity …….. | Hygrometer. Etc |

Students‘ activities: The teacher allow students to ask questions based on the lesson treated.

**Evaluation:** The teacher evaluates his lesson by asking students some questions based on the lesson treated. Example: State the instruments for measuring weather elements. What is rain gauge used for? State the precautions for keeping thermometer

**Conclusion.** The teacher concludes her lesson by summarizing the entire lesson, explain some areas of difficulties observed during evaluation and allow students to make their own note on the concepts taught.

LESSON 4

Week: Four
Class: SS II
Sex: Males and Females
Average age: 17 years
Methodology: Lecture method
Subject Geography: Topic Observing, recording analysis, interpretation and reporting of weather data (temperature, rainfall and wind).

**Behavioral objectives:** By the end of the lesson, students should be able to: Describe procedures for observing and recording weather elements temperature, rainfall and wind). Convert temperature from degrees to Fahrenheit Describe the procedure of interpretation and reporting temperature, rainfall and wind. Develop interest in Observing, recording analysis, interpretation and reporting of weather data.

Previous Knowledge: Students have previously learnt about instruments used in measuring weather elements.

**Instructional materials:** Chart showing weather data (temperature, rainfall and wind), chalk and chalk board.

**Introduction:** The teacher introduces the lesson by asking students some questions based on their previous lesson. Example: What is meteorological station? What are the elements for measuring weather data? What is Stevenson screen? E.tc.

Presentation: The teacher presents her lesson based on the following steps:

**Step** 1: Display chart on the board and explain to students on technique of observing weather elements on: Rainfall; Temperature; Wind (finger method), e.t.c.

The teacher asks students to perform some practical involving temperature and rainfall in their exercise books weather data (rainfall and temperature). Example: Rainfall data Month J F M A M J J A S O N D

Rainfall (mm) 10 80 20 120 130 150 200 210 190 18 17 9 Temperature data Month J F M A M J J A S O N D

Temp ( oC) 40 30 21 25 10 40 48 30 25 30 20 15

**Step 2:** The teacher explains to students on Interpretation and reporting weather data. Example: Conversion of temperature scale. Daily rainfall and temperature. Monthly rainfall and temperature. Mean annual rainfall and temperature. Diurnal temperature. Local times for observing weather elements e.t.c.

**Students‘ activities:** The teacher ask students to perform some practical involving temperature and rainfall in their exercise books

**Evaluation:** The teacher evaluates her lesson by asking students some questions based on the lesson treated. Example: A student observed and measured temperature of the year and obtained the following information: 12, 14, 17, 23, 65, 45, 68, 10, 53, 12, 90, 43,56. From the result obtained, what is: The month with the highest temperature? The month with the lowest temperature? The total

annual temperature? The annual range of temperature? The mean annual temperature? An SS II student measured soil temperature and found his result to be 16o c. He was asked to report this finding in degree Fahrenheit. What is his new temperature?

**Conclusion:** The teacher concludes her lesson by highlighting some areas of difficulties observed during evaluation and allows students to make their own note on the concepts taught.