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THE EFFECT OF VECTOR AND RASTER DATA MODELS ON ACADEMIC ACHIEVEMENT IN SOME ENVIRONMENTAL HEALTH CONCEPTS OF SENIOR SECONDARY SCHOOLS IN ZARIA METROPOLIS, NIGERIA

BY

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DECLARATION

We hereby declare that this project work titled" the effect of vector and raster data models on academic achievement in some environmental health concepts of senior secondary schools in Zaria metropolis" was written by us under the supervision of Dr. S.S. Obeka (Very Rev). The information gathered from the various literatures has been duly acknowledged by means of references.

Ibrahim Abdullahi	Priscilla Alfred	Bawa Talatu Datdani

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I am deeply grateful to Katsina State Scholarship Board and Dr. S.S Obeka (Very Rev) and mentors throughout our mentors throughout this research.

OPERATIONAL DEFINITION OF TERMS

So as not to misinterpret keywords, their definitions, relative to the project topic and operational terms would be stated below.

Vector data model: refers to data represented by collection of points, lines and polygons.

Raster data model: represents location and characteristics as cell matrixes that store numeric values.

Academic achievement: refers to the level of understanding and utilization of knowledge as well as the test scores of students.

Environmental health concepts: refers to terms in health and wellbeing in the environment e.g., malaria, typhoid and pollution.

Dependent variable:academic achievement in some environmental health concepts.

Independent variable: vector and raster data models.

Confidentiality: The participants would be guaranteed that the identifying information will not be made available to anyone who is not involved in the study and it will remain confidential for the purposes it is intended for.

Informed consent: The prospective research participants would be fully informed about the procedures involved in the research and would be asked to give their consent to participate.

Anonymity: The participants would remain anonymous throughout the study and even to the researchers themselves to guarantee privacy.

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ABSTRACT

This study focused on the effect of vector and raster data models on academic achievement in some environmental health concepts of senior secondary schools in Zaria metropolis. The study relates to a senior secondary school module delivered using traditional lectures and ICT based methods. The paper also examines the data for the presence of interaction effects between the GIS data models and socio-demographic characteristics. This is undertaken to identify whether or not sociodemographic characteristic differences influence the extent to which students benefit from the Vector and raster data modeling. The methodology that was employed in this study was systematic random sampling for students under traditional study mode and purposive sampling in identification of students under the GIS model usage study mode. The study recommends that critical factors such as institutional issue, management issue, pedagogical factors, technological issue, interface design issue, evaluation issue, and resource support issue and the factors within each issue have not yet been investigated with detail coverage. It further suggests that there is need to carry out detail research involving case studies based on survey questionnaires involving various learning institutions which will ultimately give a better understanding of impact of vector and raster data models within implementation process.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Education is a key factor for sustainable development (Chimombo 2005). The significance of education, especially in developing countries, is increasing because of progressing pressure to catch up with the developed world regarding, for example, global competitiveness (Hawkins

2002). Predictably, educational settings are different in developing countries than in developed countries, such as low quality of education and narrow possibilities in attending schools in rural areas because of far distances and high opportunity costs (Ibid 2005). Chimombo, 2005 opines that country-specific circumstances have to be improved regarding compulsory and free education to foster general access to education. In *Article 26 of the 1948 UN universal declaration of human rights* the right of obligatory and free education for everyone is already committed (UN Human Rights 1948).

Every year, more of the world's people become connected to the network, its bandwidth increases and its use becomes more integrated to all that happens in the globe. Accessibility to connectivity to this network has becomes key to opportunity, success and fulfillment for individuals. Nigeria has defined a national ICT policy with a view of creating an efficient, healthy and knowledge-based society. Just like the technology has changed the world, it is now changing the education environment.

A broad range of learning approaches exists already, for example, GIS based, blended learning (Maier, 2007), and distance learning which utilize information and communication technology (ICT). The use of ICT can benefit, for example, students in rural areas by having them attend classes as distance learners and motivating them to learn like the "Group Learning Sets" (GLS) initiative offers. Regarding this, the potential of vector and raster data models seems very assuring, but because of gaps between developed and developing countries knowledge transfer is not only difficult but also costly.

Identifying factors that affect academic achievement particularly in the area of health and healthcare concepts achievement, has been a long standing issue in educational research. Based on a wide consensus that health skills are increasingly necessary for the 21st century workforce

(Maier, 2007), strategies to improve health education achievement now focus more attention to diverse stakeholders than ever before. Owing to research efforts, several learning and demographic factors including taking instructions on geographic information systems (G.I.S) and modeling have been discovered as strong predictors that affects student academic achievement in health related concepts. However, there are other important potential factors that impact academic achievement of students in studies related to healthcare that have not been solidified in literature. Among these is the use of vector and raster data models in instruction in health related concepts of senior secondary school students. While computer technology has been incorporated into classrooms since the 1990s (baron, kemker, hames, and kalaydjian, 2003), few large scale studies have examined the effects of vector and raster data models on academic achievement in some environmental health concepts among secondary school students.

A data model organizes data elements and standardizes how the elements relate to one another. Since data elements document real life people, places and things and the events occurring between them, the data model represents reality. According to Hoberman (2009), the data model is a way finding tool which uses a set of symbols and texts to explain a subset of real information to communication improvement (enhancement). The geographic information systems note the data model as a mathematical construct for representing geographical objects or surfaces as data. The GIS has two types of data models: the vector and the raster data models.

In a raster data model, the entire area of the map is subdivided into a grid of tiny cells. A value is stored in each of the cells to represent the nature of whatever is present at the corresponding location on the ground (Hoberman, 2009). The raster data is thought of as a matrix of values. The use of this data model involves storing of map information as digital images, in which the cell values relates to the pixel colors of the image.

In vector data model, the features are recorded one by one with shape being defined by the numerical values of the pairs of XY coordinates.

A point is defined by a single pair of coordinate values

A line is defined by sequence of coordinate pairs of X and Y

An area is defined by points that move from beginning to end to form or make a complete enclosure.

The vector data models structure is thought of as a list of values (wiki, 2016)

Academic achievement in health concepts can be boosted in as much as appropriate use of the vector and raster data models are applied efficiently. This study will go a long way in providing statistical and theoretical data to aid the implementation of this method. This study chose secondary school health requirements because of its lack of research as potential factor of academic achievement.

1.2 Statement of the problem

This study aims at finding out the achievement levels of secondary school students in environmental health concepts and how the GIS data models would affect them. Though several other studies show that this is low in most northern Nigerian cities (including Zaria metropolis), this study shall set to find out if this is true and find out why. After this, the vector and raster data models will be applied and the academic achievement will be seen after the application to see the effect weather positive or negative.

The computer approach to instruction has shown promise and this suggests that the GIS models, vector and raster data models, being computer based would be efficient if applied appropriately. “The effect of vector and raster data models on academic achievement in some environmental health concepts of secondary schools students in Zaria metropolis, Nigeria” is the topic of the research.

The independent variables are the vector and the raster data models. The dependent variable is the academic achievement. The effect of the models would be shown elaborately after the data collected has been analyzed. This will show weather the effect is positive or negative. i.e., weather it increases or enhances academic achievement or reduces academic achievement of the students in the environmental health concepts.

Due to spatial constraints like distance and cost, the entire population would not be used for analysis or data collection. However, a sample will be selected from a particular secondary school from an area in this region (Zaria metropolis)

1.3 Objective of the study

This study is geared towards sourcing analyzing and providing information/data on the effects of vector and raster data models on academic achievement in some health concepts. This would show the nature of the effect. The general aim therefore is to establish the effects of vector and raster data models on academic achievement in health concepts.

The main objectives therefore are as follows:

1. To compare the results of those taught using the vector data model with those taught using the raster data model.
2. To compare the results of those taught using the vector data model with those taught using lecture method.
3. To compare the results of those taught using the raster data model with those taught using lecture method.

1.4 Null hypothesis

This research work attempts to know the effect of vector and raster data models on academic achievement in some environmental health concepts of senior secondary schools in Zaria metropolis. Nigeria.

The postulations to be tested thus include:

H1: There would be no significant difference between the mean score of students taught using vector data model and those taught raster data model.

H2: There would be no significant difference between the mean score of students taught with vector data model and those taught using lecture method.

H3: There would be no significant difference between the mean score of students taught with raster data model and those taught using lecture method.

1.5 Research questions

The research topic is “the effects of vector and raster data models on academic achievement in some environmental health concepts of senior secondary schools in Zaria metropolis”.

The following research questions are stated to guide the study.

1. What is the difference in the mean academic achievement score of students taught using vector data model and those taught using raster data model in the environmental health concepts taught to the senior secondary school students?
2. What is the difference in the mean academic achievement score of students taught using vector data model and those taught using lecture method in the environmental health concepts taught to the senior secondary school students?
3. What is the difference in the mean academic achievement score of students taught using raster data model and those taught using lecture method in the environmental health concepts taught to the senior secondary school students?

This will be answered using statistical methods during the research process through data analysis.

1.6 Significance of the study

Due to the developing trend in technology, and addressing the increasing difference between the developed countries that grow continuously in the use of technology and the developing countries, like Nigeria that use mostly, the traditional methods of instruction in health concepts, there continues to be the need for the use and promotion of adequate and qualitative models in education to improve the academic achievement of students in health and other aspects so as to fulfill the necessities.

The UN has even created a set of Millennium Development Goals (MDGs), which set a worldwide standard for combating poverty, hunger, disease, illiteracy, environmental degradation and discrimination against women." Surprisingly, it is estimated that a significant

amount of Nigerians will be inadequately and inappropriately instructed in computer assisted instruction by the year 2030. (Bashayi and Barau, 2013)

The student population in Zaria metropolis and Nigeria as a whole are no exception and have been stated to be primary targets in provision of technological and healthcare literacy for economic and health improvement for sustainable development (Nasir 2015). Currently, there appears to be no much study made on the effect of GIS modeling, specifically, vector and raster data models on academic achievement of students in Zaria metropolis. This study will therefore, if conducted appropriately, provide information and relevant data on the topic. It will also provide answers to questions already being asked, and provide measure to be taken in solving some, if not all of them. The study would also provide data, statistical and theoretical for ministries, teachers, parents, students and educationalists if sought. Other researchers willing to conduct further investigation on the topic would have a foundation for their study. Further analysis would show the amount or extent of resources to be expended on the implementation of the vector and raster data models on academics as a whole.

1.7 Assumptions

Health concepts in environmental conceptual terms might not have been taught to the population in this study. However, the introduction of the topic would not be seen as a constraint or hassle. Other criteria to be fulfilled before the research is concluded would not be seen as a constraint, as most stakeholders see positive technological and educational innovation as welcome developments.

1.8 Delimitations

This study is limited to the assessment of the effects of vector and raster data models on academic achievement in some environmental health concepts of senior secondary schools in Zaria metropolis. Zaria metropolis comprises of parts of Samaru, Congo, Tudun wada, and some parts of Sabon gari.

1.9 Limitations

The major limitations to this study might be time, distance and finance. It therefore would not go beyond its scope. Also, the study was conducted at a period that veered towards the end of the third term examinations in the secondary schools of the sample population. Hence, there was limited amount of time in conducting some of the activities.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter reviews various studies which have shown the inter-relationships among the measures of GIS, based and modeling which are computer related, pertinent to academic achievement. A more specific model will be developed for the present study.

Literatures relevant to the study are reviewed under the following sub-headings:

- The role of vector and raster data models on academic achievement
- Academic achievement
- Individual differences
- The data model
- Vector data model

- Vector Data Models Structures
- The raster data model
- Environmental health
- The Role of Prior Computer Skills on Performance in G.I.S Setup
- The Role of Socio-Demographic Characteristics on Academic Achievement
- Theoretical framework
- Constructivism Theory
- Facilitation Theory (The Humanist Approach)
- Conceptual framework
- Review of Empirical studies
- Implication of literature review for the present study

2.2 The role of vector and raster data models on academic achievement

Attitudes concerning computers, echoed by scholarly and academic reviews, range from neutral to positive. On one hand, it is noted that GIS strategies, as a computer related instruction, is at least as effective as traditional instructional strategies (Rosenberg, Grad and Matear, 2003), and that there are no major differences in academic achievement between the more traditional and more technology-oriented modes of instruction (Cavanaugh, 2001). On the other hand, many reviews go further, reflecting a principally positive attitude towards the impact of GIS based instruction (Mayer, 2003). The current piece sought to demystify G.I.S learning by concentrating on how specific factors (socio-demographic characteristics and prior computer skills) influence individual academic achievement.

GIS is one of the information system used to store, display, analyse, and manipulate data related to space. Recognizing the importance of GIS in geography education, several developed

countries around the world have taken innovative steps to incorporate GIS in primary and secondary geography curriculum. According to Bednarz (2004), United State was one of the first countries to use GIS in education. In 1990, United Kingdom introduced GIS in geography curriculum (Wiegand, 2007) and fully utilized to support teaching primary and secondary school students (Fargher & Rayner, 2012). In 1998, Singapore has also taken initiative steps to introduce GIS as an important teaching tool for teaching geography at the secondary school and junior college level. This was followed by Netherland 2003 and Turkey 2005 (Aladang, 2010).

In Nigeria, the use of GIS modeling, (the vector and raster data models), are being used in various fields. These included areas, such as engineering, environment, crime mapping, real estate land use, and politics. Most of the universities in Nigeria, namely, ABU (Ahmadu Bello University), Lagos state university, and Kaduna state University, are widely using GIS in their research and offering as major subject to students. However, GIS has not been embraced by Nigeria's education system and absence from the geography curriculum in primary and secondary school context (Habibah & Vasugiammai, 2010). Nevertheless, researchers continued to explore its potential (Abdul Hamid et al., 2006). Most of the research focused on the educational potential of GIS and the obstacles to its implementation (Mohd Faris, 2006). Thus, it has inspired researchers to undertake research on integrating the vector and raster data models as GIS techniques in teaching geography in the classroom. For instance, Vasugiammai (2005) has conducted studies of using GIS in local study and followed by Umah Devi (2008). Unfortunately, there is still a lapse in its implementation.

The rapid development of ICT has provided new ideas for teachers to utilize various ICT tools to enhance students' achievement. Several studies have also been carried out to examine the effectiveness of ICT tools on students' achievement (Shin, 2006; Marina, 2009; Miler &

Roberston, 2010; Park & Kim, 2011). The findings of these studies demonstrated that the utilization of ICT enhances students' achievement. The introduction of GIS in geography also provides alternative ICT tools to be used in teaching geography and concepts in health education to enhance students' achievement. And researchers began to evaluate the effectiveness of GIS in geography education. Jenner (2006) has reported that GIS teaching tools help students to engage in the more difficult task and enhance their achievement. Similar findings were also reported by Wiegard (2007). Researchers are now seeing the need to integrate the vector vand raster data models on the GIS into the educational system in secondary schools. Consequently, Aladang (2010) proposed that further research could be focused on underachieving students.

2.3 Academic achievement

Academic achievement represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, college, and university. School systems mostly define cognitive goals that either apply across multiple subject areas (e.g., critical thinking) or include the acquisition of knowledge and understanding in a specific intellectual domain (e.g., numeracy, literacy, science, history). Therefore, academic achievement should be considered to be a multifaceted construct that comprises different domains of learning (Linda and Ricarda,2014). Because the field of academic achievement is very wide-ranging and covers a broad variety of educational outcomes, the definition of academic achievement depends on the indicators used to measure it. Among the many criteria that indicate academic achievement, there are very general indicators such as procedural and declarative knowledge acquired in an educational system, more

curricular-based criteria such as grades or performance on an educational achievement test, and cumulative indicators of academic achievement such as educational degrees and certificates. All criteria have in common that they represent intellectual endeavors and thus, more or less, mirror the intellectual capacity of a person. In developed societies, academic achievement plays an important role in every person's life (Linda and Ricarda, 2014).

Academic achievement as measured by the GPA (grade point average) or by standardized assessments designed for selection purpose such as the SAT (Scholastic Assessment Test) determines whether a student will have the opportunity to continue his or her education (e.g., to attend a university). Therefore, academic achievement defines whether one can take part in higher education, and based on the educational degrees one attains, influences one's vocational career after education. Besides the relevance for an individual, academic achievement is of utmost importance for the wealth of a nation and its prosperity.

The strong association between a society's level of academic achievement and positive socioeconomic development is one reason for conducting international studies on academic achievement, such as PISA (Programme for International Student Assessment), administered by the OECD (Organisation for Economic Co-operation and Development). The results of these studies provide information about different indicators of a nation's academic achievement; such information is used to analyze the strengths and weaknesses of a nation's educational system and to guide educational policy decisions. Given the individual and societal importance of academic achievement, it is not surprising that academic achievement is the research focus of many scientists; for example, in psychology or educational disciplines. This article focuses on the explanation, determination, enhancement, and assessment of academic achievement as investigated by educational psychologists (Linda, 2014).

The exploration of academic achievement has led to numerous empirical studies and fundamental progress such as the development of the first intelligence test by Binet and Simon. Introductory textbooks such as Woolfolk 2007 provide theoretical and empirical insight into the determinants of academic achievement and its assessment. However, as academic achievement is a broad topic, several textbooks have focused mainly on selected aspects of academic achievement, such as enhancing academic achievement or specific predictors of academic achievement. A thorough, short, and informative overview of academic achievement is provided in Spinath 2012. Spinath 2012 emphasizes the importance of academic achievement with regard to different perspectives (such as for individuals and societies, as well as psychological and educational research).

Walberg 1986 is an early synthesis of existing research on the educational effects of the time but it still influences current research such as investigations of predictors of academic achievement in some of the large-scale academic achievement assessment studies (e.g., Programme for International Student Assessment, PISA). Walberg 1986 highlights the relevance of research syntheses (such as reviews and meta-analyses) as an initial point for the improvement of educational processes. A current work, Hattie 2009, provides an overview of the empirical findings on academic achievement by distinguishing between individual, home, and scholastic determinants of academic achievement according to theoretical assumptions. However, Spinath 2012 points out that it is more appropriate to speak of “predictors” instead of determinants of academic achievement because the mostly cross-sectional nature of the underlying research does not allow causal conclusions to be drawn.

Large-scale scholastic achievement assessments provide an overview of the current state of research on academic achievement, as these studies have investigated established predictors of

academic achievement on an international level. Furthermore, these studies, for the first time, have enabled nations to compare their educational systems with other nations and to evaluate them on this basis. However, it should be mentioned critically that this approach may, to some degree, overestimate the practical significance of differences between the countries. Moreover, the studies have increased the amount of attention paid to the role of family background and the educational system in the development of individual performance. The quality of teaching, in particular, has been emphasized as a predictor of student achievement. Altogether, there are valuable cross-sectional studies investigating many predictors of academic achievement. A further focus in educational research has been placed on tertiary educational research. Richardson, et al. 2012 subsumes the individual correlates of students' performance.

2.3.1 Individual differences

Individual differences in academic performance have been linked to differences in intelligence and personality. Students with higher mental ability as demonstrated by IQ tests and those who are higher in conscientiousness (linked to effort and achievement motivation) tend to achieve highly in academic settings. A recent meta-analysis suggested that mental curiosity (as measured by typical intellectual engagement) has an important influence on academic achievement in addition to intelligence and conscientiousness (Tomas, 2011)

Children's semi-structured home learning environment transitions into a more structured learning environment when children start first grade. Early academic achievement enhances later academic achievement.

Parent's academic socialization is a term describing the way parents influence students' academic achievement by shaping students' skills, behaviors and attitudes towards school. Parents

influence students through the environment and discourse parents have with their children. Academic socialization can be influenced by parents' socio-economic status. Highly educated parents tend to have more stimulating learning environments.

Another very important enhancer of academic achievement is the presence of physical activity. Studies have shown that physical activity can increase neural activity in the brain. Exercise specifically increases executive brain functions such as attention span and working memory.

2.4 The data model

An abstraction of real world which incorporates only those properties thought to be relevant to the application at hand: define specific group of entities and their attributes and the relationship between the entities. A data system is independent of a computer system (Association for Geographic Information). Any time one wishes to deal with geographic data, you must choose a data model by which to do it. The choice of the data model will yield benefits in terms of simplifying real world features enough to deal with them easily, but will also incur costs in terms of oversimplifying or misrepresenting different aspects.

A paper map is an example of an analog data model. It is a formalized framework that cartographers use to capture and represent information on a sheet of paper. The same sort of thing is also needed to capture and represent geographic data when the medium is digital rather than ink and paper. In a Geographic Information System, abstraction of realworld features must

therefore be formatted into a data model that defines how the computer will represent and manage the geographic information (geometry and attributes) (Bernhardsen, 1999).

2.4.1 Vector data model

There are three basic spatial data types used with GIS (points, lines, and areas):Points represent anything that can be described as a discrete x, y location**.** Lines represent anything having a length. Areas, or polygons, describe anything having boundaries**.** In this model, space is not quantized into discrete grid cells like the raster model.

Vector data models use points and their associated X, Y coordinate pairs to represent the vertices of spatial features, much as if they were being drawn on a map by hand (Aronoff 1989). The data attributes of these features are then stored in a separate database management system. The spatial information and the attribute information for these models are linked via a simple identification number that is given to each feature in a map.

Points are zero-dimensional objects that contain only a single coordinate pair. Points are typically used to model singular, discrete features such as buildings, wells, power poles, sample locations, and so forth. Points have only the property of location. Other types of point features include the node and the vertex. Specifically, a point is a stand-alone feature, while a node is a topological junction representing a common X, Y coordinate pair between intersecting lines and/or polygons. Vertices are defined as each bend along a line or polygon feature that is not the intersection of lines or polygons.

Points can be spatially linked to form more complex features. Lines are one-dimensional features composed of multiple, explicitly connected points. Lines are used to represent linear features

such as roads, streams, faults, boundaries, and so forth. Lines have the property of length. Lines that directly connect two nodes are sometimes referred to as chains, edges, segments, or arcs.

Polygons are two-dimensional features created by multiple lines that loop back to create a "closed" feature. In the case of polygons, the first coordinate pair (point) on the first line segment is the same as the last coordinate pair on the last line segment. Polygons are used to represent features such as city boundaries, geologic formations, lakes, soil associations, vegetation communities, and so forth. Polygons have the properties of area and perimeter. Polygons are also called areas.

2.4.1.1 Vector Data Models Structures

Vector data models can be structured many different ways. We will examine two of the more common data structures here. The simplest vector data structure is called the spaghetti data model (Dangermond 1982).

In the spaghetti model, each point, line, and/or polygon feature is represented as a string of X, Y coordinate pairs (or as a single X, Y coordinate pair in the case of a vector image with a single point) with no inherent structure. One could envision each line in this model to be a single strand of spaghetti that is formed into complex shapes by the addition of more and more strands of spaghetti. It is notable that in this model, any polygons that lie adjacent to each other must be made up of their own lines, or stands of spaghetti. In other words, each polygon must be uniquely defined by its own set of X, Y coordinate pairs, even if the adjacent polygons share the

exact same boundary information. This creates some redundancies within the data model and therefore reduces efficiency.

Despite the location designations associated with each line, or strand of spaghetti, spatial relationships are not explicitly encoded within the spaghetti model; rather, they are implied by their location. This results in a lack of topological information, which is problematic if the user attempts to make measurements or analysis. The computational requirements, therefore, are very steep if any advanced analytical techniques are employed on vector files structured thusly. Nevertheless, the simple structure of the spaghetti data model allows for efficient reproduction of maps and graphics as this topological information is unnecessary for plotting and printing.

In contrast to the spaghetti data model, the topological data model is characterized by the inclusion of topological information within the dataset, as the name implies. Topology is a set of rules that model the relationships between neighboring points, lines, and polygons and determines how they share geometry. For example, consider two adjacent polygons. In the spaghetti model, the shared boundary of two neighboring polygons is defined as two separate, identical lines. The inclusion of topology into the data model allows for a single line to represent this shared boundary with an explicit reference to denote which side of the line belongs with which polygon. Topology is also concerned with preserving spatial properties when the forms are bent, stretched, or placed under similar geometric transformations, which allows for more efficient projection and reprojection of map files.

Three basic topological precepts that are necessary to understand the topological data model are outlined here. First, connectivity describes the arc-node topology for the feature dataset. As discussed previously, nodes are more than simple points. In the topological data model, nodes

are the intersection points where two or more arcs meet. In addition, between each node pair is a line segment, sometimes called a link, which has its own identification number and references both its from-node and to-node. Therefore, the computer can determine that it is possible to move along arc 1 and turn onto arc 3, while it is not possible to move from arc 1 to arc 5, as they do not share a common node.

The second basic topological precept is area definition. Area definition states that an arc that connects to surround an area defines a polygon, also called polygon-arc topology. In the case of polygon-arc topology, arcs are used to construct polygons, and each arc is stored only once.

Contiguity, the third topological precept, is based on the concept that polygons that share a boundary are deemed adjacent. Specifically, polygon topology requires that all arcs in a polygon have a direction (a from-node and a to-node), which allows adjacency information to be determined.

2.4.2 The raster data model

The raster data model is widely used in applications ranging far beyond geographic information systems (GISs). Most likely, you are already very familiar with this data model if you have any experience with digital photographs. The ubiquitous JPEG, BMP, and TIFF file formats (among others) are based on the raster data model. Each of these uniquely colored pixels, when viewed as a whole, combines to form a coherent image.

The raster data model consists of rows and columns of equally sized pixels interconnected to form a planar surface. These pixels are used as building blocks for creating points, lines, areas, networks, and surfaces illustrate how a land parcel can be converted to a raster representation). Although pixels may be triangles, hexagons, or even octagons, square pixels represent the

simplest geometric form with which to work. Accordingly, the vast majority of available raster GIS data are built on the square pixel. These squares are typically reformed into rectangles of various dimensions if the data model is transformed from one projection to another (e.g., from State Plane coordinates to UTM [Universal Transverse Mercator] coordinates).

Because of the reliance on a uniform series of square pixels, the raster data model is referred to as a grid-based system. Typically, a single data value will be assigned to each grid locale. Each cell in a raster carries a single value, which represents the characteristic of the spatial phenomenon at a location denoted by its row and column. The data type for that cell value can be either integer or floating-point. Alternatively, the raster graphic can reference a database management system wherein open-ended attribute tables can be used to associate multiple data values to each pixel. The advance of computer technology has made this second methodology increasingly feasible as large datasets are no longer constrained by computer storage issues as they were previously.

Several methods exist for encoding raster data from scratch. Three of these models are Cell-by-cell raster encoding, run length raster encoding and quad tree raster encoding.

Cell-by-cell raster encoding. This minimally intensive method encodes a raster by creating records for each cell value by row and column. This method could be thought of as a large spreadsheet wherein each cell of the spreadsheet represents a pixel in the raster image. This method is also referred to as “exhaustive enumeration.”

Run-length raster encoding. This method encodes cell values in runs of similarly valued pixels and can result in a highly compressed image file. The run-length encoding method is useful in situations where large groups of neighboring pixels have similar values (e.g., discrete datasets

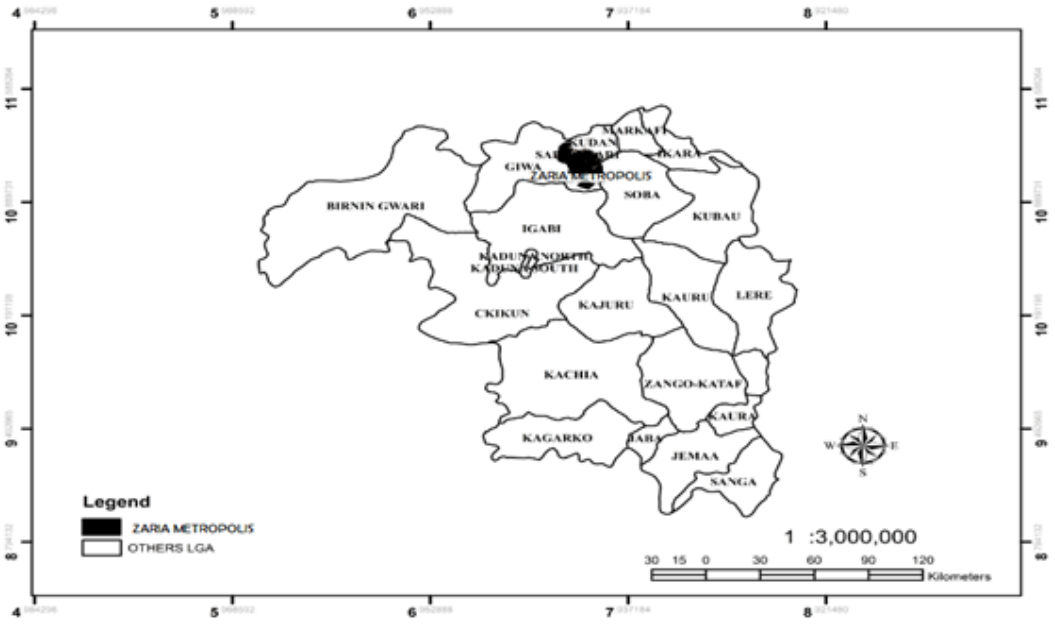
such as land use/land cover or habitat suitability) and is less useful where neighboring pixel values vary widely (e.g., continuous datasets such as elevation or sea-surface temperatures).

Quad-tree raster encoding. This method divides a raster into a hierarchy of quadrants that are subdivided based on similarly valued pixels. The division of the raster stops when a quadrant is made entirely from cells of the same value. A quadrant that cannot be subdivided is called a “leaf node.”

2.4 Geography of the study area

Location

Kaduna State, north central Nigeria, is politically classified as belonging to the now 'North - West' zone of the current six (6) Geo - political zones of Nigeria. It is populated by different ethnic groups.



MAP SHOWING ZARIA METROPOLIS

Geology and Relief

The bedrock geology is predominantly metamorphic rocks of the Nigerian Basement Complex. Although stream valley incisions and dissections of the high plains are evident in several areas, especially in the Zaria region, they are due more to anthropogenic influences and climatic factors than regional geologic instability.

Climate

The region experience a typical tropical continental climate with distinct seasonal regimes, oscillating between cool to hot dry and humid to wet. These two seasons reflect the influences of tropical continental and equatorial maritime airmasses which sweep over the entire country. The seasonality is pronounced with the cool to hot dry season being longer, than the rainy season.

Soils and Vegetation

Generally, the soils and vegetation are typical leached tropical ferruginous soils and savannah grassland with scattered trees and woody shrubs. The soils in the upland areas are rich in red clay and sand but poor in organic matter. However, soils within the "fadama" areas are richer in kaolinitic clay and organic matter, very heavy and poorly drained, characteristics of vertisols.

2.5 Environmental health

Environmental health problems are increasingly receiving glovbal attention. The health of entire nations may not only be affected by adverse environmental conditions, but by nutritional deficiencies that lead to morbidity and mortality. The type and extent of adverse health effects in a population depends on the potential for exposure to some environmental factors and pathogens as well as other environmental variables like industrialization, sanitation conditions and urbanization.

National and international comparisons between health status indicates can reveal the extent of any differences that exist, including dynamic changes in prevailing environmental conditions which may be helpful in characterizing the role of specific risk factors. Improvement in collection of environmental data and related to health can help to identify, control and eliminate many of the factors that are associated with Nigerian locales and by proper education to students from the secondary level of their education (Environmental health perspect 102:854-856, 1994). A large %age of deaths in nonindustrialized countries involves children who are younger than 5 years old. In Nigeria, the infant mortality rate has been estimated at 85 per 1000 live births, and the childhood mortality rate is 144 per 1000 children aged 1-4 years. Childbirth is related to marked mortality among Nigerian women. Data from rural areas in Nigeria indicate that infant mortality rates may reach 100 to 160 per 1000 live births. Economic stagnation has resulted in rapid urbanization in Nigeria, a rise in rent, and a lack of habitable dwellings. In the urban areas

of Nigeria, more than 87% of the population lives in single rooms or combinations of rooms, and only 5% occupy flats (Chukwuma, 2008) which are all usually shared or used as family units. Access to drinking water and sanitation facilities may be a problem, especially where there are proliferations of squatter settlements at city outskirts or within certain urban areas like Zaria. The International Drinking Water Supply and Sanitation Decade was launched at the UN General Assembly with the aim of making water and sanitation available to everyone.

Greater progress is evident in access to safe water than in sanitation services. Although access to both sanitation and water supply has improved in urban areas of certain countries, in others it has continually decreased. In most parts of Nigeria as well

as in other non industrialized countries, rural populations have very poor access to safe water and sanitation services. Pit and bucket latrines still predominate in Nigeria; 75% of urban households and 42% of rural households make use of pit latrines. About 52% of rural dwellers have no conventional toilets, so they use the bush or dunghills (Chukwuma, 2008).

Air water and land pollution, land degradation, mass wasting, refuse dumping, sanitation techniques, and forcasting amidst many other contemporary issues that are to be efficiently taught in schools especially at the secondary level so as to ensure adequate implementation of the measures put forward by environmentalists and other concerned groups or individuals (Ibukun, 2012).

2.6 The Role of Prior Computer Skills on Performance in G.I.S Setup

Some learners are better prepared than others to use ICT technologies to facilitate their educational progress; individual “readiness” seems to be a crucial factor in accounting for the success of GIS applications in education. Looker and Thiessen (2002), in their paper noted that digital divide for Canadian youth, remarked that access to, and experience with, computer

technology determines “computer competency”, and that this competency is generally associated with urban residents of higher economic status.

Levin and Arafeh (2002) remarked on the differences between students who are highly gifted in the internet usage and those who have had little opportunity to develop their experience with networking tools. Dewar and Whittington (2000) concluded that adult learners’ learning styles (as indicated by Myers-Briggs personality types) can predict the pattern of their participation in health topics related to the environment.

It is interesting to note however, that a key learning-style related factor may in fact be the student’s familiarity with the technology. A number of studies have shown that computing experience is a strong predictor of attitudes towards, and also use of, computers and the internet (Atkinson & Kydd, 1997). In effect, the student’s learning style may adapt and improve as familiarity with the GIS data models increases.

2.7 The Role of Socio-Demographic Characteristics on Academic Achievement

There have been numerous studies on the relationship between socio-demographic characteristics and academic performance. Some studies focused on specific socio-demographic Variables and GIS learners’ academic performance, characteristics or areas such as gender and learning styles (Blum, 1999; Shaw & Marlow, 1999; McLean & Morrison, 2000), ethnicity and learning styles (Jaju, Kwak&Zinkham, 2002), academic performance and learning styles in both Information Technology (IT) and non- Information Technology (non-IT) subject areas and in distance and contact courses (Aragon, Fowler, Allen, Armarego& Mackenzie, 2000; Papp, 2001; Johnson &Shaik, 2002; Neuhauser, 2002; Zywno&Waalen, 2002), level of educational attainment, number of children in the family, full-time work experience, family income level (Abdul-

Rahaman, 1994; Parker, 1994; Whittigton, 1997), age, marital status, employment status (Woodley & Parlett, 1983; Chacon-Duque,1985; Powell, Conway & Ross, 1990), number of hour employed per week, distance traveled to study centre, learners' previous educational level (Wang & Newlin, 2002).

2.8 Theoretical framework

The focus of this study is built upon the various learning styles theories of computer learning, and how learners gain knowledge differently. Facilitation theory and constructivist theory are two popular learning theory concepts which are used as a representation as a taxonomy for learning (Etmer & Newby, 1993). According Eccles (1999) developing a system of best practices built around these learning theories can assist teachers in encouraging improved student preparedness and instruction presented within an online learning environment of higher education.

2.9 Constructivism Theory

Constructivism is the theory that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When learners encounter something new, they reconcile it with previous knowledge and experience. They may change what they believe, or they may discard the new information as irrelevant. To be active creators of their knowledge however, they must be able to ask questions, explore and assess what they know. In the classroom, the constructivist view of learning means encouraging students to use active techniques such as experiments and real-world problem solving using authentic data if possible, and to create knowledge and reflect on their understanding.

Constructivism modifies the role of the teacher so that teachers help students to construct knowledge rather than reproduce a series of facts. The constructivist teacher provides tools such as problem-solving and inquiry-based learning activities like GIS based setup so that students can formulate and test their ideas, draw conclusions and inferences, and convey their knowledge in a collaborative learning environment. The teacher must understand the students' preexisting conceptions and guide the activities to address this knowledge and then build on it. Constructivist teachers encourage students to assess how the activity is helping them gain understanding.

Learners take the lead in self-regulated learning for the development of a total learning process that involves problem perception, adoption, and assessment of alternatives (Lee, 2004). Learners play the same roles that the producers do by organizing or re-organizing knowledge like a consumer, by selecting knowledge and using it practically (Thatcher& Pamela, 2000).

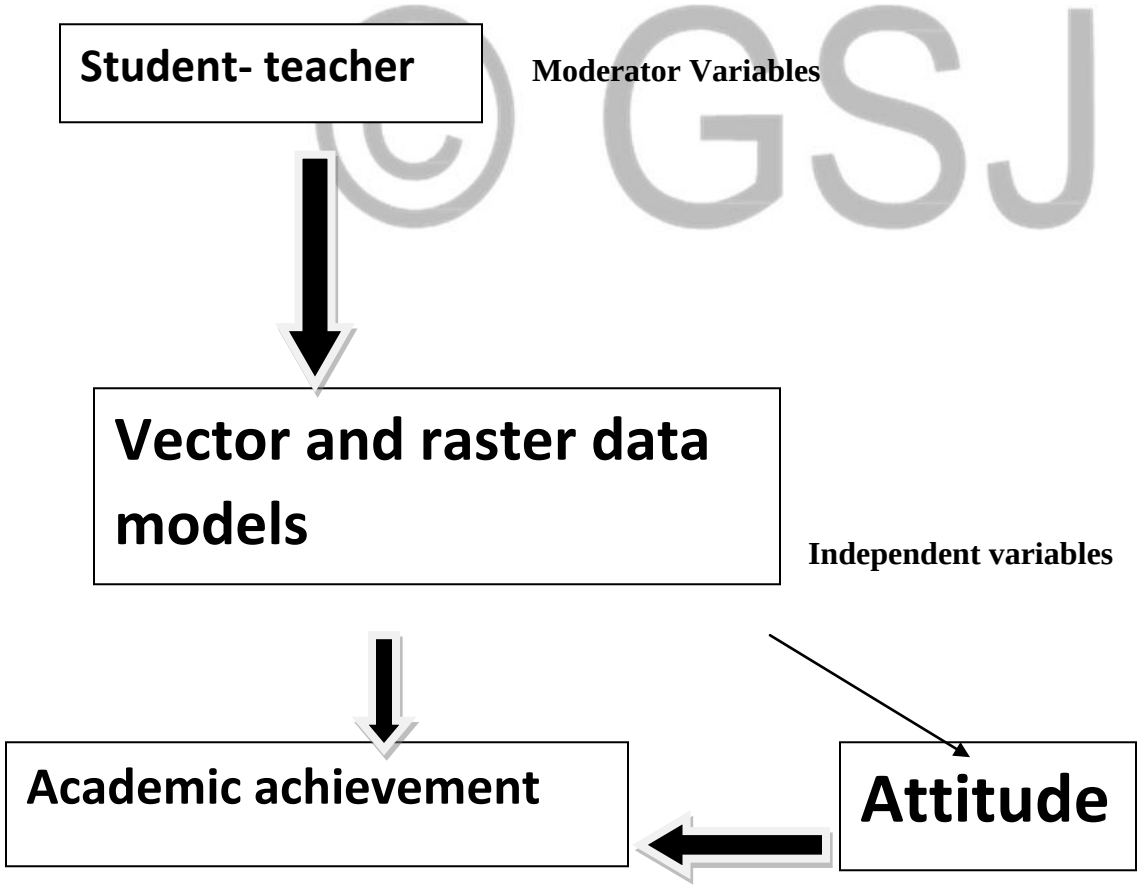
2.10 Facilitation Theory (The Humanist Approach)

Learning theory developed by Carl Rogers. One of the basic premises of this theory is that learning is possible because human beings have a "natural eagerness to learn" and they are responsible for and at the center of the learning process (person-centered learning). GIS based instruction is possible only because individuals signed up in it are self-driven and eager to learn despite their location in relation to learning institutions. The role of the teacher is to act as a facilitator- no amount of effort on the part of the teacher can guarantee success, unless the learner has a desire and predisposition to learn.

An interesting contribution of Rogers's Facilitation Theory is the notion that learning involves changing one's self-concept. Such changes may involve discovering one's strengths or weaknesses. Learners in the GIS setup have to perceive the possibility that there is in the system

for knowledge acquisition. A freshly perceived self-concept has a consolidating impact on learning in that it allows the learner to attack a target skill with confidence or with an adjusted 'updated' approach.

2.11 Conceptual framework



Dependent variableIntervening variable

Conceptual framework

Source: (Researchers, 2016)

The above conceptual framework will be used in this study. The independent variables are the vector and raster data models and how they influence academic achievement of individuals. Academic achievement is the dependent variable in this study, how does academic achievement vary based on the independent variables. Attitude which deals with the overall perception of the learner about learning style and hence influencing performance is the intervening variable. Regardless of the variance of the independent variables, the intervening variable's influence is constant. Teacher – student contact is the moderating variable that provides the interaction effect where it moderates the relations between the independent variables. Academic achievement in this setup can be influenced by varied variables either positively or negatively.

2.12 Review of Empirical studies

Chimombo, 2005 opines that country-specific circumstances have to be improved regarding compulsory and free education to foster general access to education. In *Article 26 of the 1948 UN universal declaration of human rights* the right of obligatory and free education for everyone is already committed (UN Human Rights 1948). While computer technology has been incorporated into classrooms since the 1990s (baron, kemker, hames, and kalaydjian, 2003), few

large scale studies have examined the effects of vector and raster data models on academic achievement in some environmental health concepts among secondary school students.

According to Hoberman (2009), the data model is a way finding tool which uses a set of symbols and texts to explain a subset of real information to communication improvement (enhancement).On one hand, it is noted that GIS strategies, as a computer related instruction, is at least as effective as traditional instructional strategies (Rosenberg, Grad and Matear, 2003), and that there are no major differences in academic achievement between the more traditional and more technology-oriented modes of instruction (Cavanaugh, 2001)

According to Bednarz (2004), United State was one of the first countries to use GIS in education. In 1990, United Kingdom introduced GIS in geography curriculum (Wiegand, 2007) and fully utilized to support teaching primary and secondary school students (Fargher & Rayner, 2012).The rapid development of ICT has provided new ideas for teachers to utilize various ICT tools to enhance students' achievement. Several studies have also been carried out to examine the effectiveness of ICT tools on students' achievement (Shin, 2006; Marina, 2009; Miler & Roberston, 2010; Park & Kim, 2011). The findings of these studies demonstrated that the utilization of ICT enhances students' achievement. The introduction of GIS in geography also provides alternative ICT tools to be used in teaching geography and concepts in health education to enhance students' achievement.Therefore, academic achievement should be considered to be a multifaceted construct that comprises different domains of learning (Linda and Ricarda,2014).The exploration of academic achievement has led to numerous empirical studies and fundamental progress such as the development of the first intelligence test by Binet and Simon. Introductory textbooks such as Woolfolk 2007 provide theoretical and empirical insight into the determinants of academic achievement and its assessment.

Vector data models can be structured many different ways. We will examine two of the more common data structures here. The simplest vector data structure is called the spaghetti data model (Dangermond 1982). The raster data model is widely used in applications ranging far beyond geographic information systems (GISs).

National and international comparisons between health status indicates can reveal the extent of any differences that exist, including dynamic changes in prevailing environmental conditions which may be helpful in characterizing the role of specific risk factors. Improvement in collection of environmental data and related to health can help to identify, control and eliminate many of the factors that are associated with Nigerian locales and by proper education to students from the secondary level of their education (Environmental health perspect 102:854-856, 1994).

Looker and Thiessen (2002), in their paper noted that digital divide for Canadian youth, remarked that access to, and experience with, computer technology determines "computer competency", and that this competency is generally associated with urban residents of higher economic status.

Levin and Arafeh (2002) remarked on the differences between students who are highly gifted in the internet usage and those who have had little opportunity to develop their experience with networking tools. Dewar and Whittington (2000) concluded that adult learners' learning styles (as indicated by Myers-Briggs personality types) can predict the pattern of their participation in health topics related to the environment.

Some studies focused on specific socio-demographic Variables and GIS learners' academic performance, characteristics or areas such as gender and learning styles (Blum, 1999; Shaw & Marlow, 1999; McLean & Morrison, 2000), ethnicity and learning styles (Jaju, Kwak&Zinkham,

2002), academic performance and learning styles in both Information Technology (IT) and non-Information Technology (non-IT) subject areas and in distance and contact courses (Aragon, Fowler, Allen, Armarego& Mackenzie, 2000; Papp, 2001

2.13 Implication of literature review for the present study

From the reviewed literature, even though the importance is evident, it can be deduced that there seems to be no research studies on the joint contributions of the various approaches' socio-demographic characteristics, vector and raster data models' variables to their academic performance. Whereas, researchers and theorists (Coldeway, 1986; Garrison, 1987; Kumar, 2001) have stressed the need for a comprehensive approach, taking into account all the experiences of GIS as well as the unique aspects of vector and raster data models environment. In addition, it has also been observed that little research has been devoted to exploring factors that predict the academic achievement in GIS modeling(Cookson, 1989) while those that even exist concentrated largely on demographic correlates as a component in their studies (Kumar, 2001).

Several studies have been carried out on academic performance especially on conventional students, but not much on GIS students within the Zaria educational system. The need to sever this ground so as to extend the frontier of knowledge in order to help improve the unimpressive GIS modeling academic achievement necessitates and serves as the motivating factor for undertaking the present piece of research so as to fill the existing important research gap (Calvert, 1986).

This study sought to establish whether the "Group Learning Sets" offer its beneficiaries ability to develop the associated concepts; does vector and raster data models help the students improve

their grades, skills, values, procedures and technology necessary to apply in their jobs. The study endeavored to answer the following questions, what role does prior computer skills play in improving student's performance: In so doing, the study sought to measure the ability of the students to use GIS tools such as, computers, and software for particular purposes. What is the role of sociodemographic characteristics on academic achievement? To measure the characteristics, the study sought to identify variables such as gender, age, and acceptance of the GIS models as may be informed by individual's learning activities.

2.14 Summary of literature review

Literatures reviewed in studies conducted relevant to the topic have highlighted that the inception of vector and raster data models which are both models under the Geographical Information System with a humanistic and facilitative approach, useable in several fields especially geography with emphasis on environmental health concepts in the present study. Also, the vector and raster models, academic achievement, GIS modeling, data systems, and environmental health concepts were discussed. The concepts of academic achievement with related concepts like motivation, teaching method and approaches, school environment, number of students, and some important sociodemographic characteristics were discussed. Previous research related to the effect of vector and raster data models on academic achievement in some environmental health concepts of senior secondary schools have also been reviewed.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methods that were used in the study. It explains the research design, the study population, sampling method and procedures, data collection procedures and instruments, data analysis, reporting and ethical issues.

This chapter would be discussed under the following headings:

- Research Design
- Population of the study
- Sampling and sampling procedures
- Instruments for data Collection
- Reliability of the instrument
- Validity of the instrument
- Procedure for data collection
- Procedure for data analysis

3.2 Research Design

The research design would be an analytical survey. Analytical surveys also referred to as diagnostic studies attempt to describe and explain *why* certain situations exist. In this approach two or more variables are usually examined to test research hypotheses. The results allow researchers to examine the interrelationships among variables and to draw explanatory inferences. In this study, the researchers sought the effect of vector and raster data models on

academic achievement in some environmental health concepts of senior secondary schools in Zaria metropolis, Nigeria.

The data to be collected for the research shall be form the selected secondary school in Zaria. The method of data collection in the research work would basically be the test scores result. There are three schools in this research. School A, B, and C. Each school has three groups. The experimental groups are two, the vector and raster taught groups, while the control group is the one taught using one of the conventional methods, the lecture method particularly.

3.2.1 Research design illustration

Group 1:EG1 → XVDM → OAM

Group 2:EG2 → XRDM → OAM

Group 3:CG → XLM → OAM

Key:

EG1: Experimental Group One

EG2: Experimental Group Two

CG: Control Group

XVDM: Treatment using Vector data model

XRDM: Treatment using Raster data model

XLM: No treatment taught using Lecture method

PTM: Performance test administration

3.3 Population of the study

In this study, the populations of interest are students from a senior secondary school in Zaria metropolis which has a computer laboratory for the required activity (3312). The preferred population would have ongoing studies in Geography, which therefore would help in establishing the effect during the study, of vector and raster data models on academic achievement in some environmental health concepts.

Table 3.1 Population of the study

SN	Name of schools	Male Students	Female students	Total
1	Govt. Girls Sec. Sch.	Nil	**268**	**268**
2	Govt. Day Sec. Sch. Bomo	**181**	**133**	**314**
3	Govt. Day Sec Sch. Kwangila	**177**	**140**	**317**
4	Govt. Sec. Sch. Chindit	**142**	**110**	**252**
5	Govt. Sec. Sch. Dogon Bauchi	**120**	**90**	**210**
6	Govt. Sec. Sch. Muchi	**167**	**251**	**418**
7	Gcc Muchia	**166**	**130**	**296**
8	Govt. Sec. Sch. Jama'a	**154**	**215**	**369**
9	Govt. Sec. Sch. Sakadadi	**163**	**112**	**275**
10	Govt. Sec. Sch.Bassawa	**172**	**108**	**280**
11	Govt. Sec. Sch. Aminu	**190**	**123**	**313**
Total		**1632**	**1680**	**3312**

Source: Kaduna state ministry of education inspectorate division Zaria (KSMEIDZ, 2015)

The above table shows the population distribution of the secondary schools in the study area.

3.4 Sampling and sampling procedures

The research would be conducted through a systematic random sampling procedure.This is a technique in which the researcher, based on his knowledge and understanding of the population, handpicks certain groups or individuals for their relevance to the subject of investigation (Aina 2001,) within the study location. The process would include about a hundred students from senior secondary section in lessons/subjects related to vector and raster data modeling (under the Geographical information systems) applicable to the relevant environmental concepts, to be interviewed. Questionnaires would be administered to the students from time to time within the period of study so as to depict mainly the sociodemographic characteristics while the results gathered in the laboratory/classroom activities through the performance test would be used mainly in the data analysis and presentation.

Table 3.2 Sample of the study

SN	Name of school	EG1	EG2	CG	Total
1	School A	10	10	10	30
2	School B	10	10	10	30
3	School C	10	10	10	30
Total		**30**	**30**	**30**	**90**

Source: Field Survey 2016

Key:

EG1: Experimental Group One

EG2: Experimental Group Two

CG: Control Group

School A: Govt. Sec. Sch. Bomo

School B: Govt. Sec Sch. Bassawa

School C: Govt. Sec Sch. Jama'a

3.5 Instruments for data Collection

The instrument of data collection in this study would be the performance test. The data in the performance test comprising of scores of the students in the activities relative to vector and raster data models in the environmental concepts.

A performance test is a test given to measure the outcome of variables after the course activity is implemented. A performance test is in some cases, preceded by a test prior to the experiment, which is the same test as the performance test. The performance test design allows the experimenter to test what effect, if any, the activities had by assessing the differences. If there are any differences, it is likely to be due to the nature or method of the course/subject implementation. The environmental health concepts are sanitation, waste management and pollution. The test would be administered using the six keys in the Blooms Taxonomy of Benjamin Bloom.

Table 3.3 Environmental health concepts to be taught using the vector and raster data models.

Concepts	**Knowledge** (16.6%)	**Comprehension** (16.6%)	**Application** (16.6%)	**Analysis** (16.6%)	**Synthesis** (16.6%)	**Evaluation** (16.6%)	**Total** (100%)
1. **Waste mgt.** (33.3%)	1	1	1	1	2	2	6
2. **Sanitation** (33.3%)	1	1	1	1	1	1	6
3. **Pollution** (33.3%)	1	1	1	1	1	1	6
Total	3	3	3	3	4	4	20

Source: Researchers, 2016.

3.6.1 Reliability of the instrument

According to Devellis (1991), as cited by Mugenda, (2004) reliability is the proportion of variance attributable to the time measurement of a variable and estimates the consistency of such measurement over time from a research instrument. It is a measure of the degree to which a research instrument would yield the same results or data after repeated trials. In this research, for the test items, the method used to establish the reliability of the performance test items was the Chronbach-Alpha method. This was done since the test item was not dichotomous in nature, but comprising of multiple choice questions. In order to ensure reliability, the performance test would be carefully administered. This will ensure internal consistency of the performance test. Also, in addition to face validity, cross checks would be made in the gathered data from the test scores to ensure the test-wise effect, thus, reliability.

3.6.2 Validity of the instrument

Validity establishes the relationship between the data and the variable or construct of interest. Its estimates how accurately the data obtained in a study represents a given variable or construct in the study Mugenda, (2004). To ensure accuracy of the data the researchers would make a pilot test and analyse the results and make corrections on the questions that are not clear.

Face validity and cross checks on the performance test would be made in the gathered data from the test scores. The researchers would visit the sampled student's to make them aware of the need of the study. This ensures validity of the data collected.

3.7 Procedure for data collection.

According to Miles and Huberman (1994) data analysis is an iterative process. Data analysis consists of three activities: Data reduction, Data display, and Conclusion drawing/verification".

Data reduction, this process is applied to qualitative data and focus remains on selection, simplification and transformation of data. In this continuous process the data is organized throughout the research to draw and finalize a conclusion (Miles and Huberman, 1994). In this research, the data will be reduced from critical elements in implementation of vector and raster data models on academic achievement in environmental health concepts.

3.8. Procedure for data analysis

The necessary data collected during the study will be checked and analyzed with relevant statistical methods simple enough to provide the required result. The research hypothesis will be tested using t-test at 0.05 signifance levels. The answering of the research question and hypothesis will be done using descriptive statistics which involve mean scores and standard deviations.

The response of the subjects was scored using the marking scheme. Each correct response scored one point with a maximum score of 15 marks. Analysis of data obtained from research would be done using qualitative, descriptive and inferential statistics and applied to all the research questions as well as proving of the hypothesis:

Research question 1:*What is the difference in the mean academic achievement score of students taught using vector data model and those taught using raster data model in the environmental health concepts taught to the senior secondary school students?*

This would be analyzed and answered qualitatively using descriptive statistics, measures of central tendency, particularly the mean, from the results of the academic achievement with comparison.

Research question 2:*What is the difference in the mean academic achievement score of students taught using vector data model and those taught using lecture method in the environmental health concepts taught to the senior secondary school students?*

Research question 3:*What is the difference in the mean academic achievement score of students taught using raster data model and those taught using lecture method in the environmental health concepts taught to the senior secondary school students?*

This would be analyzed and answered qualitatively using descriptive statistics, measures of central tendency, particularly the mean, from the results of the academic achievement with comparison.

Null hypothesis

The following Null hypothesis were formulated and tested at 0.05 significance level.

H1: There would be no significant difference between the mean score of students taught using vector data model and those taught raster data model.

This would be verified using t-test statistics at 0.05 level of significance using the test scores in the vector data model of the experimental group and that of those taught using the raster data model of the experimental group.

H2: There would be no significant difference between the mean score of students taught with vector data model and those taught using lecture method.

This would be verified using t-test statistics at 0.05 level of significance using the test scores in the vector data model of the experimental group and that of those taught using the lecture method of control group.

H3: There would be no significant difference between the mean score of students taught with raster data model and those taught using lecture method.

This would be verified using t-test statistics at 0.05 level of significance using the test scores in the raster data model of the experimental group and that of those taught using the lecture method of control group.

CHAPTER FOUR

4.0 DATA ANALYSIS AND PRESENTATION OF RESULTS

4.1 Introduction

This chapter discussed and analyze the data collected from the respondents to answer the research questions and hypothesis in chapter one. There are three research questions and three hypotheses in the study. The research was carried out on the effect of vector and raster data models on academic achievement in some environmental health concepts of senior secondary schools in Zaria metropolis, Nigeria. To achieve the objectives, performance tests were prepared for three groups. The experimental groups (of vector and raster data models) and the control group were taught using the methods and the test was administered to them after the lesson. The hypothesis was analysed using mean and mean deviation.

Summary as follows are the results of the data analysis, the discussion of the results:

4.2 Test of null hypothesis

4.2.1 Null hypothesis one

There would be no significant difference between the mean score of students taught using vector data model and those taught using the raster data model.

To test this hypothesis data was collected from the mean scores of **EG1** and **EG2**. The mean achievement of EG1 is 7.6 with a standard deviation of 5.69 while that of EG2 is 9.7 with a standard deviation of 4.42. There is significant difference of 2.1 with the **EG2** having a higher value. Hence the null hypothesis is therefore rejected. Thus there is a significant difference between the scores of the two groups.

Table 4.1: Mean score difference, standard deviation and Pearson moment correlation

Variables	N	Mean	S.D	T-Values	P	Remark
EG1	15	7.6	5.69			
				1.27	0.65	Significant
EG2	15	9.7	4.42			

Source: Field work (2016).

4.2.2 Null hypothesis two

There would be no significant difference between the mean score of students taught with vector data model and those taught using lecture method.

To test this hypothesis data was collected from the mean scores of **EG1** and **CG**. The mean achievement of EG1 is 7.6 with a standard deviation of 5.69 while that of CG is 7.3 with a standard deviation of 3.97. There is no significant difference (of 0.3) with the **EG1** having a

higher value. Hence the null hypothesis is therefore accepted. Thus there is no significant difference between the scores of the two groups.

Table 4.2: Mean score difference, standard deviation and pearson moment correlation differences of Experimental group one and Lecture Group.

Variables	N	Mean	S.D	T-Value	P	Remark
EG1	15	7.6	5.69			
				1.72	0.86	Significant
CG	15	7.3	3.97			

Source: Field work (2016).

4.2.3 Null hypothesis three

There would be no significant difference between the mean score of students taught with raster data model and those taught using lecture method.

To test this hypothesis data was collected from the mean scores of **EG2** and **CG**. The mean achievement of EG1 is 9.7 with a standard deviation of 4.42 while that of CG is 7.3 with a standard deviation of 3.97. There is significant difference of 2.4 with the **EG2** having a higher value. Hence the null hypothesis is therefore rejected. Thus there is a significant difference between the scores of the two groups.

Table 4.3: Mean score difference, standard deviation and pearson moment correlation differences of Experimental group two and Lecture Group.

Variables	N	Mean	S.D	T-Value	P	Remark
EG2	15	9.7	4.42			
				0.45	0.97	Significant
CG	15	7.3	3.97			

Source: Field work (2016).

4.3 Answering of research questions

The research questions would be answered with inference from the data collected in the performance tests administered, their scores and their analysis of qualitative statistics.

4.3.1 Research question one

What is the difference in the mean academic achievement score of students taught using vector data model and those taught using raster data model in the environmental health concepts taught to the senior secondary school students?

This was analyzed and answered qualitatively using descriptive statistics, measures of central tendency, particularly the mean, from the results of the academic achievement with comparison. There is significant difference between the two groups (difference of of 2.1). EG2 has higher score.

Table 4.4: Mean and Mean Deviation of Experimental group one and Experimental group two.

Variables	N	Mean	S.D
EG1	15	7.6	5.69
EG2	15	9.7	4.42

Source: Field work (2016).

4.3.2 Research question two

What is the difference in the mean academic achievement score of students taught using vector data model and those taught using lecture method in the environmental health concepts taught to the senior secondary school students?

This was analyzed and answered qualitatively using descriptive statistics, measures of central tendency, particularly the mean, from the results of the academic achievement with comparison. There is no significant difference between the two groups (difference of 0.3). EG1 has higher score.

Table 4.5: Mean and Mean Deviation of Experimental group one and Lecture Group.

Variables	N	Mean	S.D

EG1	15	7.6	5.69
CG	15	7.3	3.97

Source: Field work (2016).

4.3.3 Research question three

What is the difference in the mean academic achievement score of students taught using raster data model and those taught using lecture method in the environmental health concepts taught to the senior secondary school students?

This was analyzed and answered qualitatively using descriptive statistics, measures of central tendency, particularly the mean, from the results of the academic achievement with comparison. There is significant difference between the two groups (difference of of 2.4). EG2 has higher score.

Table 4.6: Mean and Mean Deviation of Experimental group two and Lecture Group.

Variables	N	Mean	S.D

EG2	15	9.7	4.42
CG	15	7.3	3.97

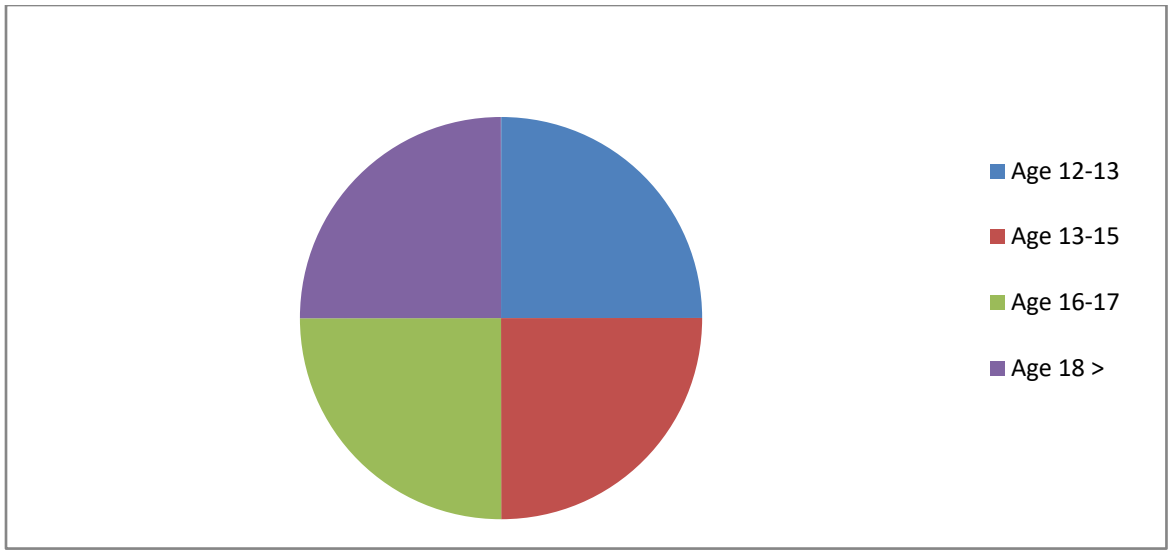
Source: Field work (2016).

4.4 Sociodemographic characteristics

This section presents the socio-demographic information of the respondents presented in bar graphs, charts and tables. The study found it crucial to ascertain the said information since it was deemed that such information was a clear indicator of factors that may influence one's academic achievement.

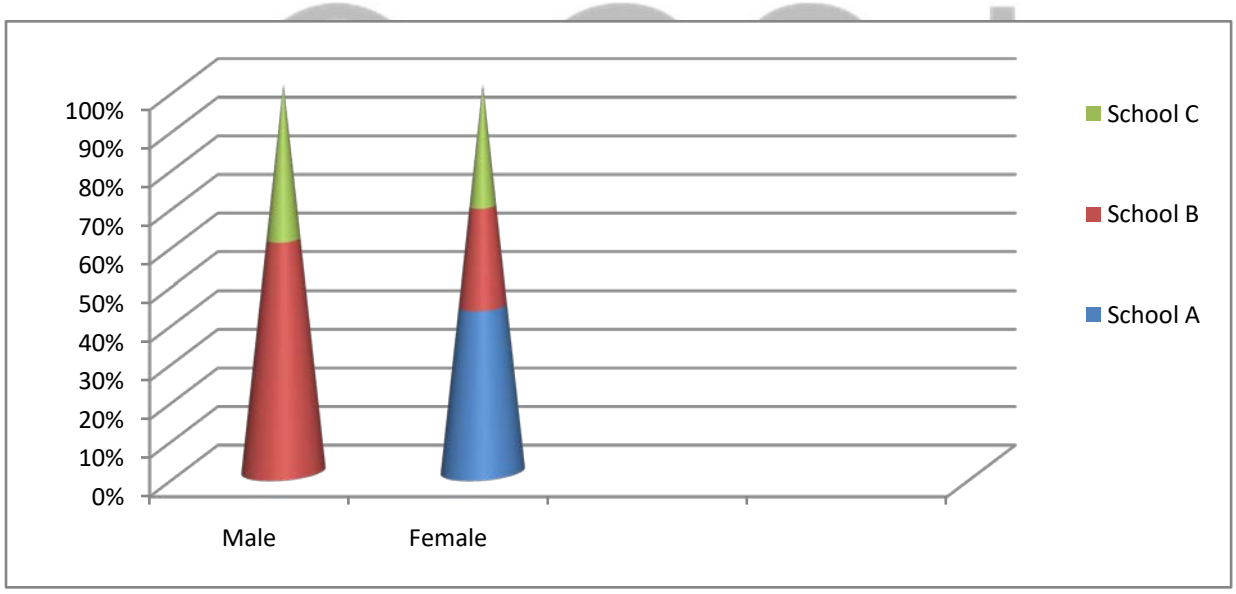
Figure 4.1 Pie chart and table showing average age.

AVERAGE AGE	FREQQUENCY
12-13	15
13-15	17
16-17	25
18 Above	33



Source: Field work (2016)

Figure 4.1 Charts showing sex of the respondents.



Source: Field work (2016)

4.5 Discussions

As gathered from the result of the research based on the various hypotheses, according to table 4.1, where we observed a mean achievement of EG1 is 7.6 with a standard deviation of 5.69 while that of EG2 is 9.7 with a standard deviation of 4.42. There is significant difference of 2.1 with the **EG2** having a higher value. Vector data model approach influences the performance of the students during the teaching procedure. Barth et al (1981) who equally stated that "activity method is used to supplement the normal learning process of listening, seeing, reading, hearing and writing. Which treat the production, selection and utilization of materials of instruction that do not depend solely on the printed word". This is in line with the observation made by the members of Science Teachers Association of Nigeria (STAN 1994) who observed that subjects taught by the use of lecture method only "the use of instructional material, couple with field activity in the teaching of geography is neglected, this has resulted to poor academic performance".

Similarly the result from table 4.2 observed the mean achievement of EG1 is 7.6 with a standard deviation of 5.69 while that of CG is 7.3 with a standard deviation of 3.97. There is no significant difference (of 0.3) with the **EG1** having a higher value. Whitehead (1975) believed that the teaching of geography will only be effective when he speaks on some measures on his own experiences and understanding and when those whom he teaches obtain some of their evidence at last hand from world outside school. Such as the use of out-door, activity method of teaching.

David (1976) observed that "since 1947 when the Ministry of Education issued circular 140, revoking the regulation which requires the consent of inspector for all Secular Introduction given

off the school premises the long experience belief that field work was essentials to learning in geography and could be practice without legal and formal difficulties.

Finally result from table 4.3 showed The mean achievement of EG1 is 9.7 with a standard deviation of 4.42 while that of CG is 7.3 with a standard deviation of 3.97. There is significant difference of 2.4 with the **EG2** having a higher value. Hence the null hypothesis is therefore rejected. Thus there is a significant difference between the scores of the two groups. This is in agreement with the findings of Musa etal (1998) argued that if students learn about a topic by learning from a teacher only, (i.e. via lecture method) the probability of recalling is less, than if the students both hear and have some visual and activity. Such that learning where visual aids are used is more paramount than without. Also, Baily (1974) who stated that it is designed to teach students about spatial relationship and it will provide opportunities for principles already known to be applied and tested.

4.6 Summary of the findings

Summarily, the results of the various hypotheses collected shows there is a positive significant difference in the use of activity method in the teaching and learning of geography at Secondary school level.

H1: On the academic achievement using vector data model and raster data model was of great significance.

H2: On the academic achievement using vector data model and lecture method was of great significance.

H3: Here however, on the academic achievement using raster data models and the lecture method does not show any significant difference. This is probably due to the use the complex nature of the method to their level of education. There is therefore no difference with the use of the raster data model and lecture method.

Since the result indicates significant difference emphasis and encouragement should be given to the use of activity method in the teaching of environmental health concepts. This will enhance the student's academic achievement in the environmental health concepts.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter summarizes the whole research process. A brief summary of the whole study is given. It also provides a summary of the main findings of the study, conclusions of the study, recommendations and suggestions for further research.

5.2 Discussion

From the recent analysis in chapter four, Table 4.1 shows a significant difference between **EG1** and **EG2**, nullifying the null hypothesis.

Table 4.2 shows a significant difference between **EG1** and **CG**, nullifying the null hypothesis.

Table 4.3 showing the performance of both boys and girls all in the experimental group, showed that there is no significant difference between **EG2** and **CG** . Thus accepting the null hypothesis, indicating that there is no difference in performance of the studentsusing the raster data model; contrary to the study of Clusesan (1977) who discovered in his study of comparative ability of boys and girls in integrated Science, observed that boys perform better than girls at secondary school level of education. The use of vector data model in teaching of environmental health concepts is effective and can be used at secondary school level of education.

5.3 Conclusion

As is always the case in every research work there is bound to be some constraints, the same thing implies to this result, there are a lot of bureaucratic bottle necks in the scope coverage of this research.

This research is limited to only an aspect of the activity method namely; the field work, aspects in computer experimentation. There were no field trips and/or excursion, due to financial set-back and constraints. The study also only included few schools in Zaria Metropolis. These therefore are not enough to give a wider generalization. Thus, for the research should be encouraged to cover other aspects of the field course and include more schools in other cities so as to broaden the scope of the study.

5.4 Recommendation

From the conclusion at the beginning of this chapter so far, we have observed a significant difference in of those taught using the vector data model and those taught using raster and lecture method. Also observed, is that there is no significant difference between the performances of students taught using the raster data model and the lecture method.

This research elicited and examined a number of extreme points of views about the impact of G.I.S on academic achievement. Although it was discovered that certain issues have not yet been properly addressed to G.I.S implementation processes, as the prime focus of the research was on prior computer skills, number of hours individual spend studying and socio-demographic characteristics.

The following are the recommendations of this study:

1. Critical factors such as institutional issue, management issue, pedagogical factors, technological issue, interface design issue, evaluation issue, and resource support issue and the factors within each issue have not yet been investigated with detail coverage.
2. The need to carry out detail research involving case studies based on survey questionnaires involving various learning institutions which will ultimately give a better understanding of impact of e-learning aspects within implementation process.
3. As the analysis of data gathered on a small sample, has shown that, there are still many issues that need to be closely considered before we can safely state that vector data model under G.I.S application have contributed to the enhancement of the performance of students at the S.S.S levels of our education system, irrespective of individual differences due to heredity and/or environment. It can be confidently said that there is still a long

way to go before we can make the whole world harvest the benefits from the progress of science and technology.

4. This research work should serve as a valuable material to the Ministry of education in planning for effective science instruction; most especially in geography studies this can be done by training science teachers towards the development of skills in different approaches for teaching methods that would affect the students learning positively.
5. It would be more helpful if more geography teachers are trained on the use of the raster data model of teaching, its application will give better meaning and positive attitude and interest in the learning of geography for students.

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PERFORMANCE TEST (I) WEEK ONE

Sanitation

Using the fictional map given to you, answer questions 1-5.

1. Which of the following, in the map is more suitable for refuse dumping?

A. Forest

B. Major road

C. School

D. Housing estate

E. Minor road

Environmental Management

Using the fictional map given to you, answer questions 1-5.

1. Where would best be suitable for afforestation?

2. Where is environmental management supposed to be taught?

A. Housing Estate

B. Forest

C. School

D. All of the above

3. Where is mosquito infestation most likely to occur due to lack of proper sanitation?

A. Major road
B. Forest
C. Minor Road
D. School
E. Housing Estate

4. Where on the map is drainage blockage likely to occur due to lack of proper sanitation?

A. Housing Estate
B. Minor Road
C. School
D. Forest
E. Major road

5. Where is environmental health most likely to be taught?

A. Major road
B. Forest
C. Minor Road
D. School
E. Housing Estate

Pollution

E. None of the above

3. Where is suitable for awareness on environmental management?

A. Major road
B. Forest
C. Minor Road
D. School
E. All of the above

4. Environmental management affects which of the following?

A. Housing Estate
B. Minor Road
C. School
D. Forest
E. All of the above.

5. All drainage should be directed towards?

A. Major road
B. Forest
C. Minor Road
D. School

Using the fictional map given to you, answer questions 1-5.

1.Where is air pollution likely to be highest?

A. Major road

B. Forest

C. Minor Road

D. School

E. Housing Estate

2. Where is environmental law monitoring most needed?

A. Major road

B. Forest

C. Minor Road

D. School

E. Housing Estate

3. Effect of pollution is highest on?

A. Major road

B. Forest

C. Minor Road

D. School

E. Housing Estate

4. Environmental laws should be monitored in?

A. Housing Estate

B. Minor Road

C. School

D. Forest

E. All of the above.

5. The most likely occurrence of land pollution would be from?

A. Major road

B. Forest

C. Minor Road

D. School

E. Housing Estate

PERFORMANCE TEST (II) WEEK TWO

Sanitation

Using the fictional map given to you, applying the vector data model, answer questions 1-5.

Environmental Management

Using the fictional map given to you,

applying the vector data model, answer questions 1-5.

1. Which of the following, in the map is more suitable for refuse dumping?

A. Line B
B. Polygon C
C. Line D
D. Point A

2.

A. Polygon E
B. Line D
C. Point A
D. Polygon C
E. Line B

3. Where is mosquito infestation most likely to occur due to lack of proper sanitation?

A. Line B
B. Polygon C
C. Line D
D. Point A
E. Polygon E

4. Where on the map is drainage blockage likely to occur due to lack of proper sanitation?

1. Where would best be suitable for afforestation?

A. Line B
B. Polygon C
C. Line D
D. Point A
E. Polygon E

2. Where is environmental management supposed to be taught?

A. Polygon E
B. Polygon C
C. Point A
D. All of the above
E. None of the above

3. Where is suitable for awareness on environmental managem

A. Line B
B. Polygon C
C. Line D
D. Point A
E. All of the above

4. Environmental management affects which of the following?

A. Polygon E

B. Line D

C. Point A

D. Polygon C

E. Line B

5. Where is environmental health most likely to be taught?

A. Line B

B. Polygon C

C. Line D

D. Point A

E. Polygon E

Pollution

Using the fictional map given to you, applying the vector data model, answer questions 1-5.

1.Where is air pollution likely to be highest?

A. Line B

B. Polygon C

C. Line D

D. Point A

E. Polygon E

2. Where is environmental law monitoring most needed?

A. Polygon E

B. Line D

C. Point A

D. Polygon C

E. All of the above.

5. All drainage should be directed towards?

A. Line B

B. Polygon C

C. Line D

D. Point A

A. Line B

B. Polygon C

C. Line D

D. Point A

E. Polygon E

3. Effect of pollution is highest on?

A. Line B

B. Polygon C

C. Line D

D. Point A

E. Polygon E

4. Environmental laws should be monitored in?

A. Polygon E

B. Line D

C. Point A

D. Polygon C

E. All of the above.

5. The most likely occurrence of land pollution would be from?

A. Line B

B. Polygon C

C. Line D

D. Point A

E. Polygon E

PERFORMANCE TEST (III) WEEK THREE

Sanitation

Using the fictional map given to you, applying the raster data model, answer questions 1-5.

1. Which of the following, in the map is more suitable for refuse dumping?

A. 1-3, 1-3
B. 1-3, 1-4
C. 4-3, 4-8
D. 1-7, 4
E. 3-5, 1-3

2. Which of the following is more suitable for waste incineration?

A. 1-3, 1-3
B. 1-3, 1-4
C. 4-3, 4-8
D. 1-7, 4
E. 3-5, 1-3

3. Where is mosquito infestation most likely to occur due to lack of proper sanitation?

A. 1-3, 1-3
B. 1-3, 1-4
C. 4-3, 4-8
D. 1-7, 4
E. 3-5, 1-3

4. Where on the map is drainage blockage likely to occur due to lack of proper sanitation?

Environmental Management

Using the fictional map given to you,

applying the raster data model, answer questions 1-5.

1. Where would best be suitable for afforestation?

A. 5-7, 1-8
B. 3-4, 4-5
C. 1-3, 1-3
D. 1-5,6
E. None of the above

2. Where is environmental management

supposed to be taught?

A. 5-7, 1-8
B. 3-4, 4-5
C. 1-3, 1-3
D. All of the above
E. None of the above

3. Where is suitable for awareness on environmentalm

A. 5-7, 1-8
B. 3-4, 4-5
C. 1-3, 1-3
D. All of the above
E. None of the above

A. 1-3, 1-3
B. 1-3, 1-4
C. 4-3, 4-8
D. 1-7, 4
E. 3-5, 1-3

5. Where is environmental health most likely to be taught?

A. 1-3, 1-3
B. 1-3, 1-4
C. 4-3, 4-8
D. 1-7, 4
E. 3-5, 1-3

4. Environmental management affects which of the following?

A. 5-7, 1-8
B. 3-4, 4-5
C. 1-3, 1-3
D. All of the above
E. None of the above

5. All drainage should be directed towards__

A. 5-7, 1-8
B. 3-4, 4-5
C. 1-3, 1-3
D. All of the above
E. None of the above

Pollution

Using the fictional map given to you, applying the raster data model, answer questions 1-5.

1. Where is air pollution likely to be highest?

A. 4-3, 4-8

B. 1-3, 1-3

C. 4-3, 4-8

D. All Of the above

E. None of the above

2. Where is environmental law monitoring most needed?

A. 1-3, 1-3,

B. 1-4, 1-4

C. 3-4, 3-3

D. 4-5, 5-4

E. 4-3, 4-8

3. Effect of pollution is highest on?

A. 4-3, 4-8

B. 1-4, 1-4

C. 4-5, 5-4

D. 1-3, 1-3

E. 1-3, 1-3

4. Environmental laws should be monitored in?

A. 4-3, 4-8

B. 1-4, 1-4

C. 4-5, 5-4

D. 1-3, 1-3

E. All of the above

5. The most likely occurrence of land pollution would be from?

A. 4-3, 4-8

B. 1-4, 1-4

C. 4-5, 5-4

D. 1-3, 1-3

E. 1-3, 1-3

LESSON PLAN WEEK 1 (RASTER DATA MODEL)

NAMEs	IBRAHIM ABDULLAHI PRISCILLA ALFRED BAWA TALATU DANTANI
REG. NUMBERS	U12DG1016 U12DG1017 U12DG1018
DEPARTMENT	Science education(geography section)
SCHOOL	
CLASS	SS 2
CLASS SIZE	
DATE	
AGE	
SUBJECT	GEOGRAPHY
TOPIC	ENVIRONMENTAL HEALTH CONCEPTS
SUB TOPIC	Sanitation
DURATION	40 Minutes
BEHAVIOURAL OBJECTIVES	At the end of the lesson, the students should be able to: 1. Define sanitation 2. State why sanitation is important 3. State the ways sanitation can be carried out.
INSTRUCTIONAL MATERIALS	Raster based Fictional map
PREVIOUS KNOWLEDGE	The students have been taught

	1. The concept of Environment 2. The concept of Health
INTRODUCTION	The teacher gives an overview of the previous lesson and links it with the present lesson.
PRESENTATION	The teacher present his lesson in the following steps: **STEP 1:** The teacher defines sanitation as measures to protect public health through proper solid waste disposal, sewage disposal, and cleanliness during food processing and preparation. **STEP 2:** The teacher lists and explains why sanitation is important, they include: 1. To maintain and enable positive health. 2. Reduction of insect infestation. 3. Raise standard of living. 4. Prevent frequent occurrence of diseases. **STEP 3:** The teacher lists and explains ways in which proper sanitation can be carried out. The ways include: 1. Clearing of rubbish heaps. 2. Clearing of gutters. 3. Appropriate refuse disposal.
EVALUATION	The teacher Evaluate the lesson by asking them the following questions. (Questions attached, MCQ)
SUMMARY	The teacher summarizes the lesson by stating the main points and answers questions from the students.

CONCLUSION	The teacher concludes the lesson by asking the students to read more on sanitation.

LESSON PLAN (RASTER DATA MODEL)

NAMEs	IBRAHIM ABDULLAHI PRISCILLA ALFRED BAWA TALATU DANTANI
REG. NUMBERS	U12DG1016 U12DG1017 U12DG1018
DEPARTMENT	Science education(geography section)
SCHOOL	
CLASS	SS 2
CLASS SIZE	

DATE	
AGE	
SUBJECT	GEOGRAPHY
TOPIC	ENVIRONMENTAL HEALTH CONCEPTS
SUB TOPIC	Pollution
DURATION	40 Minutes
BEHAVIOURAL OBJECTIVES	At the end of the lesson, the students should be able to: 1. Define Pollution 2. State the types of pollution 3. State the causes of pollution 4. State the ways pollution can be prevented.
INSTRUCTIONAL MATERIALS	Raster based Fictional map
PREVIOUS KNOWLEDGE	The students have been taught about 1. The concept of sanitation.
INTRODUCTION	The teacher gives an overview of the previous lesson and links it with the present lesson.
PRESENTATION	The teacher present his lesson in the following steps: **STEP1:** The teacher defines Pollution as contamination of Earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of ecosystems. **STEP 2:** The teacher lists and explains the types of pollution, they include: 1. Air pollution

	2. Water Pollution 3. Land Pollution 4. Noise Pollution **STEP3:** The teacher states and explains the causes of pollution. They include: 1. Industrial waste. 2. Inappropriate waste dumping. 3. CO2 from automobile. **STEP 4:** The teacher lists and explains ways in which pollution can be prevented. The ways include: 1. Clearing of rubbish heaps. 2. Appropriate refuse disposal. 3. Monitoring of environmental laws
EVALUATION	The teacher Evaluate the lesson by asking them the following questions. (Questions attached, MCQ)
SUMMARY	The teacher summarizes the lesson by stating the main points and answers questions from the students.
CONCLUSION	The teacher concludes the lesson by asking the students to read more on Pollution.

LESSON PLAN (LECTURE METHOD)

NAMEs	IBRAHIM ABDULLAHI PRISCILLA ALFRED BAWA TALATU DANTANI
REG. NUMBERS	U12DG1016 U12DG1017 U12DG1018
DEPARTMENT	Science education(geography section)
SCHOOL	
CLASS	SS 2
CLASS SIZE	
DATE	
AGE	
SUBJECT	GEOGRAPHY
TOPIC	ENVIRONMENTAL HEALTH CONCEPTS
SUB TOPIC	Environmental management
DURATION	40 Minutes
BEHAVIOURAL OBJECTIVES	At the end of the lesson, the students should be able to: 1. Define Environmental management

	2. State the reasons for Environmental management 3. State how Environmental management can be carried out.
INSTRUCTIONAL MATERIALS	Raster based Fictional map
PREVIOUS KNOWLEDGE	The students have been taught about 1. The concept of Pollution.
INTRODUCTION	The teacher gives an overview of the previous lesson and links it with the present lesson.
PRESENTATION	The teacher present his lesson in the following steps: **STEP1:** The teacher defines Environmental managementas the adoption of practices, acts and principles that increase the efficiency and safety of the environment and maintaining it on a longer run. **STEP 2:** The teacher State the reasons for Environmental management, they include: 1. For a healthy living condition 2. Improve standard of living 3. Reduce cost of reform and repairs of infrastructure 4. Sustainable development **STEP3:** The teacher states ways in which Environmental management can be carried out. They include: 1. Teaching the relevance in schools via inculcation 2. Provision of regulation and legislation 3. Creating awareness in the community 4. Provision of appropriate facilities for effective management
EVALUATION	The teacher Evaluate the lesson by asking them the following questions.

	(Questions attached, MCQ)
SUMMARY	The teacher summarizes the lesson by stating the main points and answers questions from the students.

NAMEs	IBRAHIM ABDULLAHI PRISCILLA ALFRED BAWA TALATU DANTANI

CONCLUSION	The teacher concludes the lesson by asking the students to read more on Environmental management.

LESSON PLAN WEEK II(LECTURE METHOD)

REG. NUMBERS	U12DG1016 U12DG1017 U12DG1018
DEPARTMENT	Science education(geography section)
SCHOOL	
CLASS	SS 2
CLASS SIZE	
DATE	
AGE	
SUBJECT	GEOGRAPHY
TOPIC	ENVIRONMENTAL HEALTH CONCEPTS
SUB TOPIC	Sanitation
DURATION	40 Minutes
BEHAVIOURAL OBJECTIVES	At the end of the lesson, the students should be able to: 1. Define sanitation 2. State why sanitation is important 3. State the ways sanitation can be carried out.
INSTRUCTIONAL MATERIALS	Fictional Map
PREVIOUS KNOWLEDGE	The students have been taught 1. The concept of Environment 2. The concept of Health
INTRODUCTION	The teacher gives an overview of the previous lesson and

	links it with the present lesson.
PRESENTATION	The teacher present his lesson in the following steps: **STEP 1:** The teacher defines sanitation as measures to protect public health through proper solid waste disposal, sewage disposal, and cleanliness during food processing and preparation. **STEP 2:** The teacher lists and explains why sanitation is important, they include: 1. To maintain and enable positive health. 2. Reduction of insect infestation. 3. Raise standard of living. 4. Prevent frequent occurrence of diseases. **STEP 3:** The teacher lists and explains ways in which proper sanitation can be carried out. The ways include: 1. Clearing of rubbish heaps. 2. Clearing of gutters. 3. Appropriate refuse disposal.
EVALUATION	The teacher Evaluate the lesson by asking them the following questions. (Questions attached, MCQ)
SUMMARY	The teacher summarizes the lesson by stating the main points and answers questions from the students.
CONCLUSION	The teacher concludes the lesson by asking the students to read more on sanitation.

LESSON PLAN WEEK 2

NAMEs	IBRAHIM ABDULLAHI PRISCILLA ALFRED BAWA TALATU DANTANI
REG. NUMBERS	U12DG1016 U12DG1017 U12DG1018
DEPARTMENT	Science education(geography section)
SCHOOL	
CLASS	SS 2
CLASS SIZE	
DATE	

AGE	
SUBJECT	GEOGRAPHY
TOPIC	ENVIRONMENTAL HEALTH CONCEPTS
SUB TOPIC	Pollution
DURATION	40 Minutes
BEHAVIOURAL OBJECTIVES	At the end of the lesson, the students should be able to: 1. Define Pollution 2. State the types of pollution 3. State the causes of pollution 4. State the ways pollution can be prevented.
INSTRUCTIONAL MATERIALS	Fictional Map
PREVIOUS KNOWLEDGE	The students have been taught about 1. The concept of sanitation.
INTRODUCTION	The teacher gives an overview of the previous lesson and links it with the present lesson.
PRESENTATION	The teacher present his lesson in the following steps: **STEP1:** The teacher defines Pollution as contamination of Earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of ecosystems. **STEP 2:** The teacher lists and explains the types of pollution, they include: 5. Air pollution 6. Water Pollution

	7. Land Pollution 8. Noise Pollution **STEP3:** The teacher states and explains the causes of pollution. They include: 4. Industrial waste. 5. Inappropriate waste dumping. 6. CO2 from automobile. **STEP 4:** The teacher lists and explains ways in which pollution can be prevented. The ways include: 1. Clearing of rubbish heaps. 2. Appropriate refuse disposal. 3. Monitoring of environmental laws
EVALUATION	The teacher Evaluate the lesson by asking them the following questions. (Questions attached, MCQ)
SUMMARY	The teacher summarizes the lesson by stating the main points and answers questions from the students.
CONCLUSION	The teacher concludes the lesson by asking the students to read more on Pollution.

LESSON PLAN WEEK 3

NAMEs	IBRAHIM ABDULLAHI PRISCILLA ALFRED BAWA TALATU DANTANI
REG. NUMBERS	U12DG1016 U12DG1017 U12DG1018
DEPARTMENT	Science education(geography section)
SCHOOL	
CLASS	SS 2
CLASS SIZE	
DATE	
AGE	
SUBJECT	GEOGRAPHY
TOPIC	ENVIRONMENTAL HEALTH CONCEPTS
SUB TOPIC	Environmental management
DURATION	40 Minutes
BEHAVIOURAL OBJECTIVES	At the end of the lesson, the students should be able to: 1. Define Environmental management 2. State the reasons for Environmental management 3. State how Environmental management can be carried out.
INSTRUCTIONAL MATERIALS	Fictional Map

PREVIOUS KNOWLEDGE	The students have been taught about 1. The concept of Pollution.
INTRODUCTION	The teacher gives an overview of the previous lesson and links it with the present lesson.
PRESENTATION	The teacher present his lesson in the following steps: **STEP1:** The teacher defines Environmental managementas the adoption of practices, acts and principles that increase the efficiency and safety of the environment and maintaining it on a longer run. **STEP 2:** The teacher State the reasons for Environmental management, they include: 5. For a healthy living condition 6. Improve standard of living 7. Reduce cost of reform and repairs of infrastructure 8. Sustainable development **STEP3:** The teacher states ways in which Environmental management can be carried out. They include: 5. Teaching the relevance in schools via inculcation 6. Provision of regulation and legislation 7. Creating awareness in the community 8. Provision of appropriate facilities for effective management
EVALUATION	The teacher Evaluate the lesson by asking them the following questions. (Questions attached, MCQ)
SUMMARY	The teacher summarizes the lesson by stating the main points and answers questions from the students.
CONCLUSION	The teacher concludes the lesson by asking the students to

	read more on Environmental management.

NAMEs	IBRAHIM ABDULLAHI PRISCILLA ALFRED BAWA TALATU DANTANI

LESSON PLAN WEEK III (VECTOR DATA MODEL)

REG. NUMBERS	U12DG1016 U12DG1017 U12DG1018
DEPARTMENT	Science education(geography section)
SCHOOL	
CLASS	SS 2
CLASS SIZE	
DATE	
AGE	
SUBJECT	GEOGRAPHY
TOPIC	ENVIRONMENTAL HEALTH CONCEPTS
SUB TOPIC	Sanitation
DURATION	40 Minutes
BEHAVIOURAL OBJECTIVES	At the end of the lesson, the students should be able to: 1. Define sanitation 2. State why sanitation is important 3. State the ways sanitation can be carried out.
INSTRUCTIONAL MATERIALS	Vector based fictional map
PREVIOUS KNOWLEDGE	The students have been taught 1. The concept of Environment 2. The concept of Health
INTRODUCTION	The teacher gives an overview of the previous lesson and

	links it with the present lesson.
PRESENTATION	The teacher present his lesson in the following steps: **STEP 1:** The teacher defines sanitation as measures to protect public health through proper solid waste disposal, sewage disposal, and cleanliness during food processing and preparation. **STEP 2:** The teacher lists and explains why sanitation is important, they include: 1. To maintain and enable positive health. 2. Reduction of insect infestation. 3. Raise standard of living. 4. Prevent frequent occurrence of diseases. **STEP 3:** The teacher lists and explains ways in which proper sanitation can be carried out. The ways include: 1. Clearing of rubbish heaps. 2. Clearing of gutters. 3. Appropriate refuse disposal.
EVALUATION	The teacher Evaluate the lesson by asking them the following questions. (Questions attached, MCQ)
SUMMARY	The teacher summarizes the lesson by stating the main points and answers questions from the students.
CONCLUSION	The teacher concludes the lesson by asking the students to read more on sanitation.

LESSON PLAN WEEK 2

NAMEs	IBRAHIM ABDULLAHI PRISCILLA ALFRED BAWA TALATU DANTANI
REG. NUMBERS	U12DG1016 U12DG1017 U12DG1018
DEPARTMENT	Science education(geography section)
SCHOOL	
CLASS	SS 2
CLASS SIZE	
DATE	

AGE	
SUBJECT	GEOGRAPHY
TOPIC	ENVIRONMENTAL HEALTH CONCEPTS
SUB TOPIC	Pollution
DURATION	40 Minutes
BEHAVIOURAL OBJECTIVES	At the end of the lesson, the students should be able to: 1. Define Pollution 2. State the types of pollution 3. State the causes of pollution 4. State the ways pollution can be prevented.
INSTRUCTIONAL MATERIALS	Vector based fictional map
PREVIOUS KNOWLEDGE	The students have been taught about 1. The concept of sanitation.
INTRODUCTION	The teacher gives an overview of the previous lesson and links it with the present lesson.
PRESENTATION	The teacher present his lesson in the following steps: **STEP1:** The teacher defines Pollution as contamination of Earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of ecosystems. **STEP 2:** The teacher lists and explains the types of pollution, they include: 9. Air pollution 10. Water Pollution

	11. Land Pollution 12. Noise Pollution **STEP3:** The teacher states and explains the causes of pollution. They include: 7. Industrial waste. 8. Inappropriate waste dumping. 9. CO2 from automobile. **STEP 4:** The teacher lists and explains ways in which pollution can be prevented. The ways include: 1. Clearing of rubbish heaps. 2. Appropriate refuse disposal. 3. Monitoring of environmental laws
EVALUATION	The teacher Evaluate the lesson by asking them the following questions. (Questions attached, MCQ)
SUMMARY	The teacher summarizes the lesson by stating the main points and answers questions from the students.
CONCLUSION	The teacher concludes the lesson by asking the students to read more on Pollution.

LESSON PLAN WEEK 3

NAMEs	IBRAHIM ABDULLAHI PRISCILLA ALFRED BAWA TALATU DANTANI
REG. NUMBERS	U12DG1016 U12DG1017 U12DG1018
DEPARTMENT	Science education(geography section)
SCHOOL	
CLASS	SS 2
CLASS SIZE	
DATE	
AGE	
SUBJECT	GEOGRAPHY
TOPIC	ENVIRONMENTAL HEALTH CONCEPTS
SUB TOPIC	Environmental management
DURATION	40 Minutes
BEHAVIOURAL OBJECTIVES	At the end of the lesson, the students should be able to: 1. Define Environmental management 2. State the reasons for Environmental management

	3. State how Environmental management can be carried out.
INSTRUCTIONAL MATERIALS	Vector based fictional map
PREVIOUS KNOWLEDGE	The students have been taught about 1. The concept of Pollution.
INTRODUCTION	The teacher gives an overview of the previous lesson and links it with the present lesson.
PRESENTATION	The teacher present his lesson in the following steps: **STEP1:** The teacher defines Environmental managementas the adoption of practices, acts and principles that increase the efficiency and safety of the environment and maintaining it on a longer run. **STEP 2:** The teacher State the reasons for Environmental management, they include: 9. For a healthy living condition 10. Improve standard of living 11. Reduce cost of reform and repairs of infrastructure 12. Sustainable development **STEP3:** The teacher states ways in which Environmental management can be carried out. They include: 9. Teaching the relevance in schools via inculcation 10. Provision of regulation and legislation 11. Creating awareness in the community 12. Provision of appropriate facilities for effective management
EVALUATION	The teacher Evaluate the lesson by asking them the following questions. (Questions attached, MCQ)

SUMMARY	The teacher summarizes the lesson by stating the main points and answers questions from the students.
CONCLUSION	The teacher concludes the lesson by asking the students to read more on Environmental management.

Marking scheme

1. A

2. A

3. C

4. B

5. D

6. A

7. B

8. C

9. E

10. B

11. E

12. C

13. A

14. B

15. B

STUDENT QUESTIONNAIRE

AHMADU BELLO UNIVERSITY, ZARIA

DEPARTMENT OF SCIENCE EDUCATION (GEOGRAPHY)

FACULTY OF EDUCATION

Dear Student,

Read the instructions carefully and tick appropriately. The information provided will be confidential.

Do not write your name on any part of this questionnaire.

SECTION 'A':

i. Name of School_____

ii. Class SS1[ ] , SS2[ ], SS3[ ]

iii. Age 12-13[ ] 14-15yrs [ ] 16-17yrs [ ] 18 and above [ ]

iv. Sex Male [ ] Female [ ]

v. School type, public[ ] Private[ ]

SECTION 'B'

1. Is the teaching method relevant to geography teaching in your school? A Agree [ ] B. Strongly agree [ ] C. Disagree [ ] D. Strongly disagree [ ]

2. Do you use the vector and raster data model for geography lesson in your school? A. Agree [ ]

B. Strongly agree [ ] C. Disagree [ ] D. Strongly disagree [ ]

3. Do you have a fully equipped computer laboratory in your school? A. Agree [ ]

B. Strongly agree [ ] C. Disagree [ ] D. Strongly disagree [ ]

4. The method of teaching is common to the students.

A. Agree [ ] B. Strongly agree [ ] C. Disagree [ ] D. Strongly disagree [ ]

5. Do you use the apply vector and raster data in environmental health concepts lessons in your school? A. Agree [ ] B. Strongly agree [ ] C. Disagree [ ] D. Strongly disagree [ ]

6. Is there any significant difference between the use of the vector and raster data models and conventional methods in teaching of the environmental health concepts in your school? A. Agree [ ]

B. Strongly agree [ ] C. Disagree [ ] D. Strongly disagree [ ]

7. Does the gender of students influence their performance when they taught using the vector and raster data models in your school? A. Agree [ ] B. Strongly agree [ ] C. Disagree [ ] D. Strongly disagree [ ]

8. Do the female students perform better than their male counterpart when taught using vector and raster data models? A. Agree [ ] B. Strongly agree [ ] C. Disagree [ ]

D. Strongly disagree [ ]

9. Do the male students perform better than their female counterpart when taught using vector and raster data models? A. Agree [ ] B. Strongly agree [ ] C. Disagree [ ]

D. Strongly disagree [ ]

10. Do the female and male students have the same level of performance when taught vector and raster data models? A. Agree [ ] B. Strongly agree [ ]

C. Disagree [ ] D. Strongly disagree [ ]

11. Do students do better when taught with vector data models explain more clearly compared to those taught using raster data models? A. Agree [ ] B. Strongly agree [ ] C. Disagree [ ] D. Strongly disagree [ ]