

## Knowledge of Geographic Information System (GIS) and Possibility of Teaching GIS in Secondary Schools, Kano State, Nigeria

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### ABSTRACT

The aim of this research work is to find out how GIS knowledge could be taught in secondary schools by student teachers. However, descriptive research design where both quantitative and qualitative data were used to describe the phenomena in question. On the other hand, the research population includes all geography student teachers in three Universities situated in Kano State and one-degree awarding institution. However, twenty student teachers were selected from four institution each without considering the population of each institution. Equally, convenient sampling technique was adopted in distribution the questionnaire. Questionnaire was used as method of data collection and data were analysed using thematic approach. Simple statistics such as percentage was used for data analysis and interpretation of result was done using table, charts, etc. Some of the findings are GIS course is not core in all three universities, only in one degree awarding institution (which is compulsory). Most of the student teachers can only teach definition of GIS, importance of GIS, data in GIS and some can only teach raster and vector. Some of the recommendations made include GIS laboratory should be provided, infrastructural facilities should be furnished.

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### Keywords:

GIS, geography teacher, secondary school

### INTRODUCTION

Geography is about understanding places and people and how people interact with the place. It is about understanding spatial distributions of earth phenomena and relationship between physical environment and human activity over the space as well as its impact to the environment. The discipline (geography) is so interested on the question "why people do what they do where they do it." The tradition philosophical inquiry into the natural world is what leads to the development of geography, and this continues to date. The philosophy of geography emanates from the fact that physical and human phenomena are spatially distributed over the earth's surface. The outcome of a trained geographer is a geographically informed person, who sees meaning in the arrangement of things in space; who also sees relations between people, places and environment; who uses geographical skills; and who applies spatial and ecological perspectives to life situations (Yusuf, 2008). However, all these that have been mentioned could comprehensively be achieved through GIS knowledge and skills.

Use of computer in teaching and learning in our schools is of paramount importance in this global age and students' geographic ignorance or geographic illiteracy as it is commonly called (Dobson, 2008) can be reduced to the barest level. Quiz after quiz has shown that kids today don't know where any place is, talk less of the geography of the place. The capacity of computer today as a teaching material and in storing, updating and analysing geographic data is becoming more relevant to geography teachers. Geography is a living subject that embraces changes from time to time. Since after the end of World War II, geography like other disciplines, has experienced the explosion of knowledge brought on by the new tools of modern technology for the acquisition and manipulation of data (Yusuf, 2008).

The process of manipulating geographical data in a digital form through a computer is commonly known as Geographic Information System (GIS). GIS refers to the science of using GIS software and GIS techniques to represent, analyze and predict spatial relationships. There are several GIS computer software. These include: Idrisi, ILWIS, Arc View, Arc Info, Arc GIS, Erdas Imagine and ER mapper (Yusuf, 2008). Therefore, the research is aimed at investigating the knowledge and application of GIS among the trained geography teachers for the benefit of secondary schools. However, the aim of this research work is to find out how knowledge of GIS could be taught in secondary schools by student-teachers graduated from all university in Kano State and one degree awarding institution.

#### *Relevance of GIS in Teaching and Learning at Secondary School*

Secondary school is one of the lower foundations where all other field of human endeavour get it source. Student must have a basic certificate or prerequisite before he undergoes into a course in higher education of learning. This character is obvious to many courses of study in a higher level of learning Geography has no

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exception. Such Geography is a science of synthesis which seeks to understand the character of a place in terms of total integration of the various phenomena which characterize a place as well as the interrelationships between places which take its source from social studies of lower level of education (Adeyemo, 2010). The same with other science specialized in one particular set of phenomena such as plants, rocks, economic or political behaviour and others. Through geography students study people, crops, customs, minerals, soils and other things as well as complex interrelationship that give a place its character. It study place whether in form of a region, country, state, town, city village or any other form of a place (Mohammed, 2014; Abubakar, et.al, 2023).

In view of the above mentioned, geography teacher need to be skilful and resourceful since his field deals with a lot of thing in the society. Therefore, GIS as a tool can serve geographer the electronic tools to show a range of data on a place and help students to understand changing patterns in both the natural and human landscape. With increasing free and commercial applications of electronic mapping software and GPS gadgets, students are becoming more aware of the potential of this area. Working with computer makes students of lower level to develop more interest in their subject area as learning can never take place without interest (Denga, 2003). GIS technique makes students to pay serious attention to the subject matter and the ability to have self-motive as well as carry out independent work and decision making even in the absent of the teacher. Thus, GIS in secondary school curriculum may encourage students to examine data from a variety of fields (Kerski, 2003). Geography is the subject that deals with the location of phenomena mostly represented on map, a great tool that can be used to describe the position of an event. However, maps are used to visualize geospatial distribution of the place or the attributes of objects or phenomena located on Earth and help users to have better understanding of geospatial relationships. Information on distances, directions, area sizes, patterns and relations can be understood and quantified using maps, (Kraak, and Ormeling 2010). However, GIS application is very much relevant to a geographer as stated by Reddy (2008) in the following points.

- I. Making existing maps more at a quicker pace.
- II. Making existing maps at a cheaper rate.
- III. Making existing maps for specific user needs.
- IV. Making existing map production possible in situations where skilled staffs are unavailable.
- V. To allow experimentation with different graphical representations of the same data.
- VI. To facilitate map making and updating when the data are already in digital form.
- VII. To facilitate analysis of data that demand interaction between statistical analysis and mapping.
- VIII. To minimize the use of the printed map as a data store and thereby to minimize the effects of classification and generalization on the quality of the data.
- IX. To create maps like the 3-D type.
- X. To create maps in which selection and generalization procedures are explicitly defined and consistently executed.

Therefore, from the above listed points GIS technology equipped teacher with multiple ways to handle a geographic data which can be of advantage in teaching and learning process. GIS is used as a tool to collect regional data and produce thematic maps. The students are expected to learn the basics of GIS, understand the potentials of different GIS applications, and to be able to process, interpret and visualize geographical data with Geographical Information Systems. All these depend largely upon on the GIS knowledge acquired. However, teaching involves representation and communication in various forms between teacher and learner, thus Harvey (2005) opines that many of our representations and communications about things and events around us, in history, even in the future, rely on geography and cartography ( the science that has been replaced by GIS). Maps and geographic information are now essential to know how the real world is.

#### *Professional Geography Teacher*

The multi-disciplinary approach in geography aims at teaching graduates to appreciate the diversity and unity of human environmental system. The many places and interpretations of physical and human environment make geographers to be cognizant and innovative. Specifically modern geography is an all-encompassing discipline that seeks to understand the world and all of its human and natural complexities. The integrated problems and prospects allow the appraisal of issues; keep abreast with the issue of environment, sustainability and resource use and conservation, especially in the modern era of globalization and technological change (Yusuf, 2008). Therefore, Professional geography teacher should be good at explaining things and how something works, or how something happened. Kizlik (2010) opines that

explaining content to students comfortably is an essential skill for teachers, regardless of the degree or grade level, so for teaching to be comfortable there is need for teaching materials that enhance easy understanding of the learners in which GIS skills is among. At the same vein (Birman *et al.* 2000, Hawley & Valli 1999) stated that a basic qualification, whatever the case, is the acquisition of an extended body of knowledge which contributes to the way the teacher performs his practice. Teachers are required to know what they are teaching because understanding of subject matter by a teacher implies that the teachers is able to grasp the main points and teach them to the learners, and to correct any misconceptions of knowledge, and all this revolves around the teachers understanding of the subject matter (Kamamia *et al.*, 2014). However, Geography teacher also, must be a product of teacher training programme. Thus, he is expected to learn the techniques, which any good teacher must possess in teaching Geography (Kabuga, 2004). Geography aims to inspire students to understand the man environment relationships and development. In fact a geographer should be a very good planner as he examines the origin, distribution and arrangement of all elements of the earth surface. Yusuf (2008) stated that the practical skills acquired in geography; like map reading, cartography, GIS and field are designed work to make geographer an excellent interpreter of environment and society, which is vital for planning and development of the entire human society.

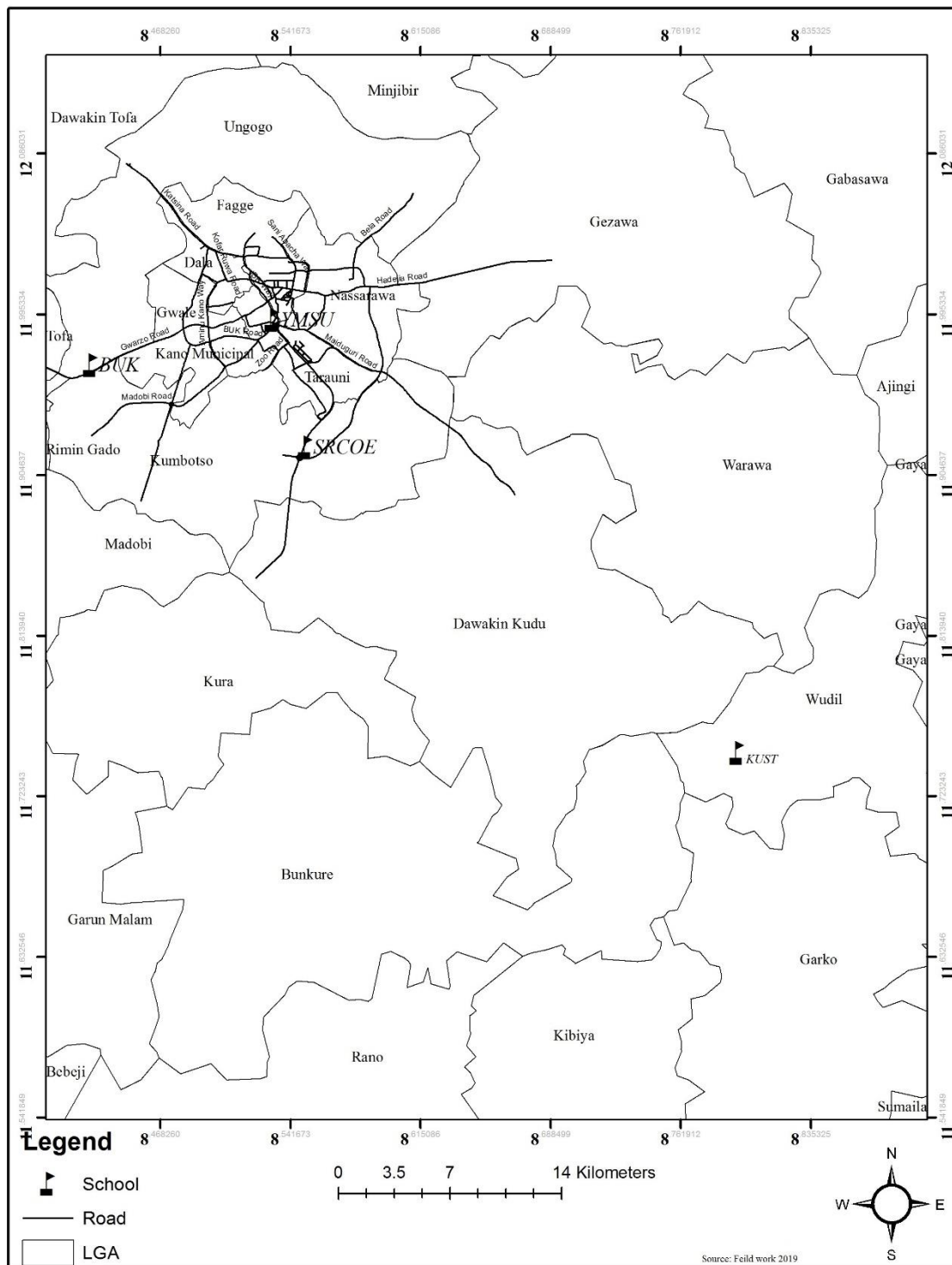
Therefore, one of the professional quality of a teacher is a thorough mastery of what is expected from him, and GIS is now part of the Geography syllabus of secondary schools breakdown to be taught at SS one, SS two and SS three respectively.

However, GIS technology gives room for teachers to take students outside the four corner of the classroom to various locations without been in contact to the location.

#### **Materials and Methods**

This research work utilizes descriptive research design where both quantitative and qualitative data were used to describe the phenomena in question. On the other hand, the research population includes all geography student-teachers in three Universities situated in Kano State (Bayero University, Kano University of Science and Technology as well as Maitama Sule University, Kano) and one degree awarding institution (Sa'adatu Rimi College of Education) (Figure 1). However, twenty student-teachers were selected from four institution each without considering the population of each institution. That is to say non-proportional sampling is used in selecting twenty participants from each institutions. Equally, convenient sampling technique was adopted in distribution the questionnaire.

Questionnaire was used as instrument for data collection which was distributed to eighty student-teachers and all eight questionnaires were retrieved without missing. Data were analysed using thematic approach; where sameness responses were merged together and use simple statistics such as percentage, etc while for interpretation table, charts, etc were used.



**Figure 1. Sampled School**

### Results and Discussion

Thematic analysis is adopted for this research work; this gives the researchers chance to merge institutions those offer GIS as compulsory course and those is elective to them and those which is neither elective nor compulsory to them.

Geography student teachers at KUST, Kano do not offer GIS as either elective or compulsory. Therefore, any student-teacher finished KUST must go for training in GIS. This is because GIS is one of the topic taught in secondary school nowadays. GIS is enshrining in NERDC National Curriculum for Geography 2007 (page 39–42, 63 and 74). A qualified teacher teaches at basic level of education and secondary school like those have

degree in education with teaching subject is expected to teach. But here those expected to teach at secondary schools do not have skills of some topics. This will reap half-baked teacher that produce quack students.

At SRCOE, all student teacher take GIS as compulsory course and the result is as follow

You cannot give out what you do not have.

Respond to the first question, which says that “have you ever undergone into GIS class or training school?” Yes\_\_\_ No\_\_\_. Out of twenty student teachers 16 responded that they attended at Bayero University, Kano while the remaining 20% responded that the never attended any GIS class whether at the university level or outside.

However, the result of MSU is almost the same with that of BUK where 13 students offer GIS course as elective out of 20 respondents. On the other hand, all student teachers at SRCOE offer GIS as compulsory course. This is the best idea to train a student with contemporary techniques a discipline required. This also helps the student teachers while teaching at secondary school during teaching-practice or while be employed.

The second question states “What GIS software were you able to use in your geographical work?”

The figure 2below shows different responses from two universities and one degree awarding institution. All the three institutions trained their student on ArcGIS with 2, 12 and 10 respondents at BUK, MSU and SRCOE respectively. Similarly, 8, 4 and 5 respondents were trained on ArcMap at BUK, MSU and SRCOE respectively. ERDAS is only taught at MSU, Saga GIS, Map Server as well as Map Information Professional were taught at BUK alone. Two student teachers misplaced DEM as software. QGIS Aand ArcGIS are the major software trained students with at SRCOE, ArcGIS and QGIS are the most frequent software student been exposed to at MSU. While for BUK ArcMap and Arcview are major software trained learners with. This indicates that the student teachers have been exposed to different GIS Software, whichis basic for learner to grasp.

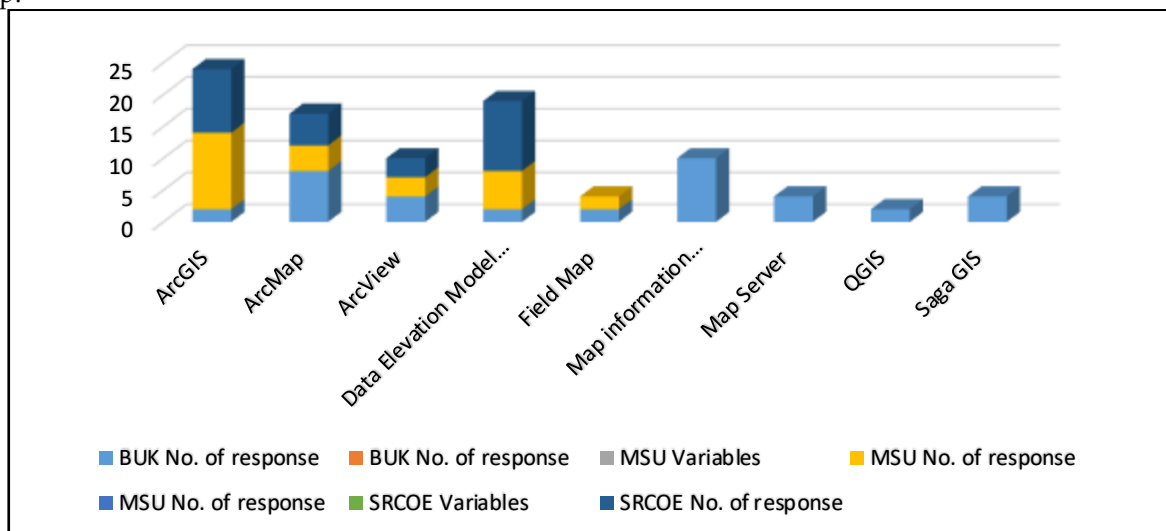


Fig. 2: Software student-teachers were exposed during class or training (Source: Fieldwork, 2019)

Table 1 shows the topic student-teachers can teach at secondary schools.

Table 1. Variables of secondary schools

BUK			YMSU			SRCOE	
Variables	Number responses	of	Variables	Number of responses	Variables	Number responses	of
Data in GIS	6		Definition of GIS	13	Definition of GIS	9	
Importance of data	2		Application of GIS	10	Application of GIS	8	
Definition of GIS	12		Vector	2	Vector	1	
Importance of GIS	8		Raster	2	Raster	1	
GIS Communication	6		Geographic data	4	Data in GIS	5	

Source: Fieldwork, 2019

Table 1 above indicates that almost all three institutions their students can teach ‘what is GIS’, followed by applications of GIS to the development of a nation. Nevertheless, not a single student in MSU can teach

importance of data in GIS based on the response. Equally, at BUK, the result indicates that the student teachers can teach neither raster nor vector. This vector and raster is the basic geographic data. Apart from these differences, all the topics can be taught by the respondent at all the three higher institutions.

### **Conclusion**

Based on the findings, it is discovered that most of student-teachers when employed could not teach GIS at secondary level. This is because all the universities situated in Kano State (both federal and state owned) GIS is not core course. Only in one degree awarding institution where GIS is core course. However, this GIS is a topic teach at secondary school for almost four to six weeks. For that the course should be core. Additionally, it is revealed that student-teachers were exposed to different software while training.

### **Recommendation**

The issue of funding which should not be left for the government alone as such there is the need for community participation in the funding of education especially in the following areas: School infrastructures should be furnished and in abundant. This include geographic instrument such as projector, internet, weather station, etc which can arouse the attention of learners to heed attention upon. This also can make a student to be curious on all what is new to him. GIS laboratory: nowadays GIS is taught in both primary (under Basic Science) and Secondary level. A teacher must learn and practice, so that he can be able to teach wherever he goes. GIS software, computer systems and its accessories should be provided by either government or donation from Non-governmental agencies. Qualified personnel should taught this course at universities and institution awarding degree. A lecturer who studied GIS at masters' degree level at least with teaching qualification. Practical aspect should be emphasis on this course. Reliable power supply: solar power, generator or constant electricity should be at hand so that whenever need arise, the activities will start without hesitation. Equally, GIS course should be compulsory course at university to B.Sc. Ed. Students so that they can teach during their teaching practice or while be employed after graduation.

### **Declarations**

#### **Conflict of Interest**

No potential conflicts of interest were disclosed by the author(s) with respect to the research, authorship, or publication of this article.

#### **Ethics Approval**

The formal ethics approval was granted by the Social and Human Sciences Research and Publication Ethics Committee of Aliko Dangote University of Science and Technology. We conducted the study in accordance with the Helsinki Declaration in 1975.

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#### **Research and Publication Ethics Statement**

The study was approved by the research team's university ethics committee of the Aliko Dangote University of Science and Technology. Hereby, we as the authors consciously assure that for the manuscript "Knowledge of Geograhic Information System (GIS) and Possibility of Teaching GIS in Secondary Schools, Kano State, Nigeria " the following is fulfilled:

- This material is the authors' own original work, which has not been previously published elsewhere.
- The paper reflects the authors' own research and analysis in a truthful and complete manner.
- The results are appropriately placed in the context of prior and existing research.
- All sources used are properly disclosed.

#### **Contribution Rates of Authors to the Article**

The authors provide equal contribution to this work.

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