

Full Length Research Paper

Developing education-based management system using geo-spatial analysis for selected secondary schools in Ilorin West Local Government Area, Kwara State, Nigeria

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In Nigeria, management of education-based system is still subject to manual method in most of the public secondary schools. This study, however, develops Education Management Information System (EMIS) using Geographic Information System to provide accurate, relevant and up-to-date information on spatial basis. The study further identifies spatial related information that includes; staff strength, student enrollment, school status and location of secondary schools in Ilorin West Local Government Area, Ilorin, Kwara State. The primary data for this study were sourced through Global Positioning System (GPS) that identified the spatial reference points of the secondary schools, while the use of interview schedule was employed to ask basic questions from the principal officers in the secondary schools. Secondary data include administrative map and road map of Kwara State. Arcview 3.3 was used for data analysis, where all the attributes of the secondary schools were linked to the spatial data. Results show that; (i) GPS identified eighteen secondary schools concentrated at the core centre of the study area, (ii) 80% of the schools are situated very close to the roads, which is an indication of easy accessibility, (iii) school status ranged between boarding and day with overall staff strength ranging between 41 and 93, and total number of students ranging between 787 and 1982. The study concludes that Geographic Information System (GIS) is a sufficient tool for gathering and disseminating information at will. It is therefore recommended that regular updating of the GIS database through integration of education-based data will help in proper coordination of education sector and other related organization.

Key words: Geographic Information System (GIS), school, education, Global Positioning System (GPS).

INTRODUCTION

According to Osokoya (1984), the word education is derived from a Latin word "EDUCARE" meaning to bring

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up, to raise or elevate. Education becomes a gradual process of developing potentialities in the child. It includes every step taken by members of a society to impact values, ethics, skills and attitudes needed for the survival and growth of society and the younger generations who will take over the responsibility of sustaining the societal development.

Education, though diverse and complex, encompasses all disciplines concerned with acquisition of intellectual development. It also evaluates, analyzes and implements ideas as well as managing and finding solutions to problems involved in every aspect of human learning. This, undoubtedly, calls for an urgent need by all stakeholders to have free access to well organized, accurate, consistent and up-to-date source of information whenever and wherever required. More so, the imminent perceived danger of turning out half-backed graduates from our institutions, unprecedented examination malpractice, moral decadence, inadequate competent and capable man-power to man our economic sectors and lack of recognition of certificates obtained from our academic institutions, could be detrimental to the Nigeria education sector.

This study, however, aimed at developing Education Management Information System - EMIS using geo-spatial data. The focus stems from the realization that provision of accurate, relevant and timely information remains the life-wire of any institution-based system. This is more so found useful in a situation where planning, coordinating and controlling of numerous activities are still subject to the use of traditional and manual methods are still practiced in the management of public secondary schools in the study area.

It should be understood that access to information is vital to the development of any organization, especially when such information is being generated and managed using computer-based system. Geographic Information System (GIS) is a system of hardware, software, and procedures to facilitate the management, manipulation, analysis, modeling, planning and management of resources (NCGIA, 1991). This system provides accurate, consistent and up to date source of information which is capable of giving all authorized users easy access to relevant and timely resources. This will in a long way improves the management of the secondary schools in the study area and enhances staff productivity as well.

Study area

Ilorin, the Kwara State capital is located on latitude $8^{\circ} 32'N$ and longitude $4^{\circ}35'$ East. It has a forest area of about 1000 km^2 situated in the transition zone between the forest woodland of the South and the Savanna of the North in South Western of Nigeria (Figure 1). Based on

its location, Oyebanji (1978) referred to it as the “midland” of Nigeria and the “gateway” between Southern and Northern parts of Nigeria. In terms of its relative position, Ilorin could be accessed from any part of the country, especially through the Lagos-Kaduna express way. It has 500 km from Abuja – the capital territory of Nigeria, 306 km from Lagos and 600 km from Kaduna. Ilorin West Local Government Area (LGA) of Kwara State is located between latitude 50° East and longitude 8° North of the equator. It has an estimated land area of 54.25% of the entire city (Figures 1 and 2). The LGA was created in October, 1991 and serves as the headquarters of Ilorin emirate council.

Past and present educational system in the study area

According to Akanbi (1994), the government in conjunction with communities and religion groups made education at all levels what it is today in the State. Indigenous educational system was prevalent in this part of the country before the introduction of the Western Education system. The arrival of Islam and Christianity totally influenced the traditional system of education. Though, the early scholars of Islam from the core North had introduced major knowledge of the Quran that include the Hadith and the Sheriah as a prevalent mode of education since 1830.

In 1839, Ilorin had become a great centre of Islamic structure with a large number of Quranic learning institutions. The resultant effect of this was obvious on how some other people from other Yoruba lands imbibed the knowledge as well. However, the arrival of the British colony into Nigeria influenced the Christian to turn their attention towards education along the British model. The first secondary school in Kwara State, as part of Northern Nigeria, is the Ilorin Government Secondary School, which was established in 1915. This school started as higher elementary school that was referred to as the provincial secondary school. The feeder school for this higher elementary school was the Okesuna primary school in Ilorin. When the Northern Nigeria Regional Government became well established a province in the North introduced Government Provincial Secondary School, which is also known as Teachers' College.

The first Community Secondary School established in Kwara State was Offa Grammar School in 1943 followed by Oro Grammar School (1958) and Esie-Iludun Grammar School (1960); while the Christian missionaries built the Evangelical Church of West Africa (ECWA) in 1944 and equally established ECWA Girls Secondary School, Omu-Aran in 1948. Bishop Smith Memorial College in Ilorin was founded in 1957.

The first Islamic Missionary School in the state is Ansarul Islam Grammar School, Ijomu – Oro (1950)

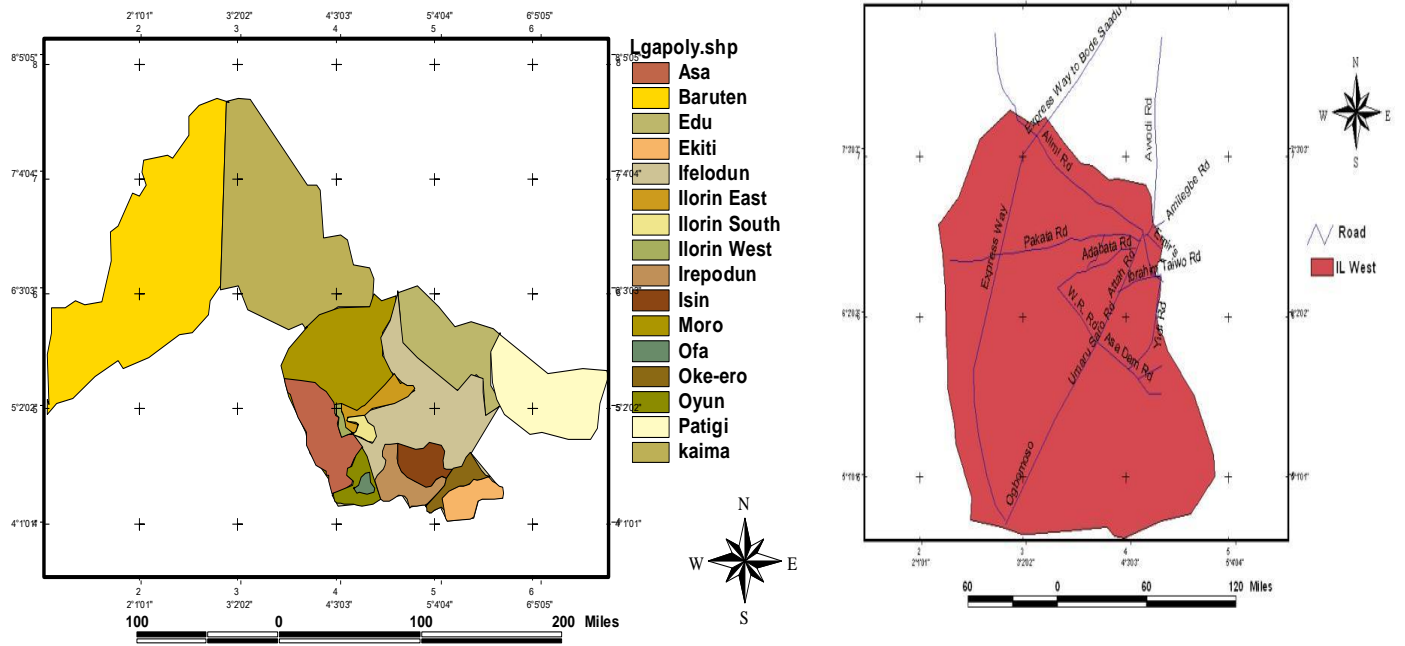


Figure 1. Map of Kwara State showing Ilorin West LGA.

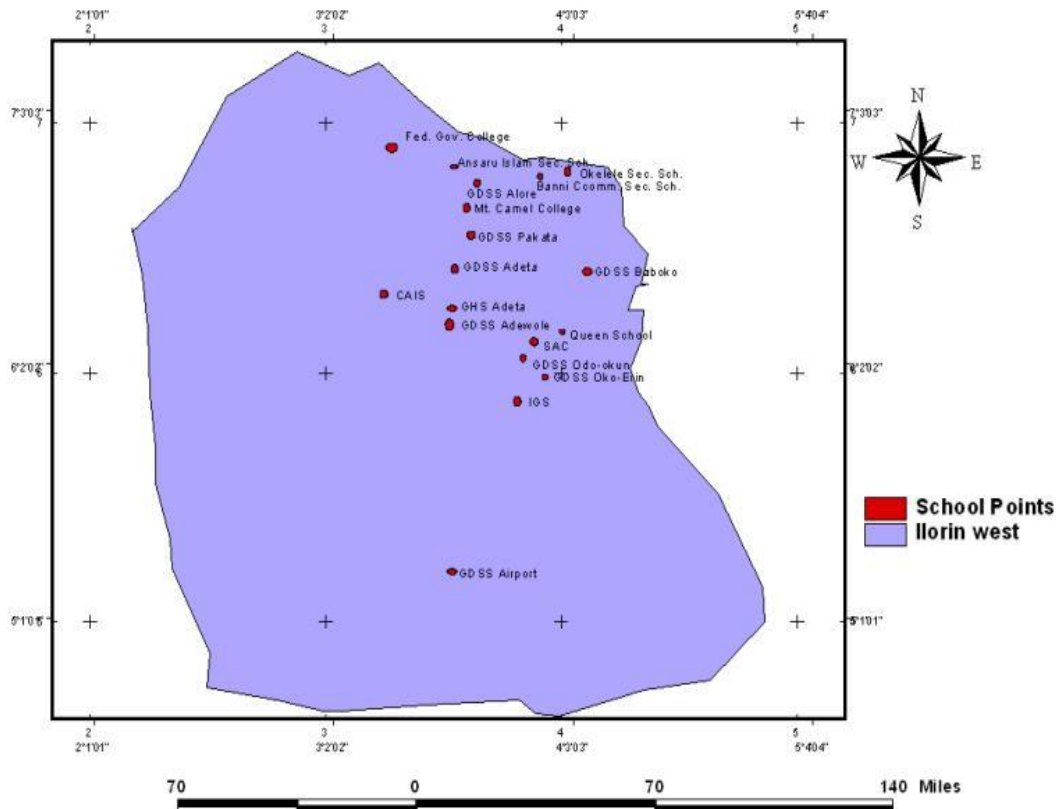


Figure 2. Point location of secondary school in Ilorin West Local Government.

followed by Ansarul Islam Secondary School, Ilorin (1971), Muslim Council College, Babaloma (1972), which were orchestrated through the establishment of Kwara State Teaching Service Commission in 1972 (Adesina, 1977). The Northern Nigeria regional government sited a Teacher College in Ilorin in 1953 and Queen Elizabeth Girls' Secondary School was established in 1956. After the Nigerian independence of 1960, several communities' secondary schools emerged between 1960 and 1979. In 1980 and 1990, communities and government collaborated in establishing a day secondary school system under the supervision of Kwara State Education Management Board (KWSEMB) that also managed primary education techniques in the state.

In 1990, Kwara State established unity secondary schools which operated a boarding system and also separated secondary schools tagged "science schools". The Unity Schools are on boarding basis while the science schools are expected to give room mostly for science students from junior secondary sections.

LITERATURE REVIEW

Education-based information system

According to the Centre for Educational Performance and Information at Michigan (CEPI, 2000), Educational Information System and Management (EISM) is referred to as a Data Warehouse System used by schools to submit data to the state and used for educational performance & information that will combine data storage and reporting. This will further serve as samples for all Michigan Educational Data. The data are organized into five core data sets that include, Simple Record, Student Data, Staff Data, Student Assessment Data, School Infrastructure Data, School Personnel Data and Financial Data with the school code master, directory of schools and general school information. As noted by Aepam (2003), (EISM) is a system of data collection, storage, retrieval, processing and dissemination of relevant information that specifically designed for use by the decision makers and administrators to plan and administer education Information System and management more efficiently and effectively.

Developing a sub-national, non-formal Education Management Information System could be a long journey task since most countries in the developing world are still lacking systems that can properly monitor the formal education. In response to this, efforts are on-going by the UNESCO (2008) to develop an easy-to-use methodology for setting-up-a non-formal education management information system (al-fe-mis). This system responds to the demand for a practical and internationally applicable approach to Non-Formal Education mapping, monitoring and evaluation which is adaptable to local contexts and

information needs.

Relevance of GIS in education system

Geographic Information System (GIS) provides a technology and method to analyze spatial data, or information about the earth. The earth's climate, natural hazard, population, geology, vegetation, soils, land use and other phenomena about the earth can be analyzed using computerized maps, aerial photographs, satellite imageries, database and graphics in a GIS, which helps in understanding patterns, linkages and trends about our planet.

Since the 1960s, GIS has quietly transformed decision-making through investigation in government and industry by bringing digital spatial data sets and geographic analysis to desktop computers. Geographic information science includes Geographical Information Systems as well as the discipline of geography (examining the patterns of the earth's people and physical environment), cartography (mapmaking), geology (the science of measuring and surveying the earth), and remote sensing (studying the earth from space).

GIS is integrated into education in three major ways at the elementary, secondary, and university levels. Firstly, teaching about GIS dominates at the community, college and university levels, where courses in methods and theory of GIS are taught in geography, engineering, business, environmental studies, geology and in other disciplines. Secondly, teaching of GIS is emphasized at the elementary and secondary levels, where GIS is used to teach concepts and skills in earth science, geography, chemistry, biological science, history and mathematics. GIS is used as essential research in all institutions of higher education in geography, demography, and geology. Students using GIS in their curriculum are studying phenomena from local to global scale. For example, students in Los Angeles map and analyze the ethnic make up of neighborhood city over time. Vermont middle school students used GIS technology as science journals and photographs to determine the origin and ecological relationship of a local pond to the community. Finally, North Carolina students used GIS to study the history and development of the African American community in their city.

The U.S. Labor Secretary's Commission on Achieving Necessary Skills is (SCANS) stated that the most effective way to teach skills is "in context" (U.S. Dept. of Labor 1991). Implementing GIS into the curriculum may encourage students to examine data from a variety of fields. Based on the publication of the Geography Education Standards Project (1994), Social Studies (National Research Council 1996) and technology (International Society for Technology in Education, 2000), educators nationwide have been progressing towards a

model of instruction that emphasize a hand on, interdisciplinary, research based learning experience.

Database design and creation

Odedare (2003) while observing the importance of a database system states that; a database allows for speedy retrieval; updating and compactness of data, data sharing is also achieved, drudgery is removed and orderly access and removal of unnecessary delay in the database. The advantages that accrue from having a centralizing control of the data as reason for using a database are: smooth data sharing, quick data retriever, reduction of data redundancy, security measure, avoidance of inconsistency maintenance of integrity. A database is described as a self-describing collection of integrated records that models the users’ reality. For GIS however, a special kind of database with spatial components is what is required and this is what is referred to as Spatial Database. The development of a spatial database is required in GIS for a wide range of reasons including reducing data duplication, ensuring data standardization and for efficient way of representing geographic data in the user’s perspectives.

Spatial database is the heart of any GIS operation that allows the system to meet up with the geographic information needs of planners, policy and decision makers. The information needs met by a well-designed spatial database helps in achieving reliable information storage and retrieval at will, up-to-date and well define functions of updating information, as well as the provision of analytical functions which allow (spatial) query and reality modeling or simulations.

MATERIALS AND METHODS

Both primary and secondary data were employed in this study. The primary data were sourced using Global Positioning System that identified the spatial reference points of the secondary schools. The coordinates were taken on the basis of geographic projection, which are degrees, minutes and seconds and hereafter converted into Universal Traverse Mercator (UTM) for easy manipulation by using a device referred to as geographic calculator. The use of interview schedule is part of researcher’s efforts through which basic questions that include staff strength, students’ enrollment, and school principal were asked from the principal officers in the secondary schools. Purposeful method of data collection was adopted to target the entire eighteen Secondary Schools in the study area.

Aside this, secondary data obtained include; administrative map and road map of Kwara State were as well used in this study. The map of Ilorin West Local Government Area was extracted and digitalized from the 1.50,000 topographical map of Kwara State (Ministry of Land and Survey, 2008). This was hand traced with a computer mouse to collect the coordinate of spatial features. An electronic scanning device was also used to convert map lines and points into digital map, which made it possible to specify their

Table 1a. Database showing School and Class Level

School	Class_Level
ANSAR ISLAM	JSS1-SS3
SAC	JSS1-SS3
MOUNT CAMEL	JSS1-SS3
GDSS ALORE	JSS1-SS3
IGS	JSS1-SS3
GHS ADETA	JSS1-SS3
CAIS ADETA/ADEWO	JSS1-SS3
GDSS ADEWOLE	JSS1-SS3
GGDSS PAKATA	JSS1-SS3
GDSS BABOKO	JSS1-SS3
GDSS ADETA	JSS1-SS3
QUEEN SCHOOL	JSS1-SS3
GDSS ODO OKUN	JSS1-SS3
GDSS AIRPORT	JSS1-SS3
GDSS OKO ERIN	JSS1-SS3
OKELELE SEC. SCH	JSS1-SS3
BANNI CSS	JSS1-SS3
FGC	JSS1-SS3

spatial relationships. The attributes of all the secondary schools were linked to the spatial data with Arcview 3.2a GIS software. Other related information such as location, road network, drainage were also linked together. The data were stored in a relational database, which consist of core data set (Secondary school points and unique ID) to which the associated spatial data (X, Y coordinate stored in tables that were prepared with Arc View 3.2a GIS software.

RESULTS

Identification of secondary schools location using global positioning system

Point locations of the selected secondary schools are presented in Figure 2. The Global Positioning System identified a total of eighteen schools in the study location. More importantly, it recognizes most of the schools being concentrated at the Northeastern part of Ilorin West Local Government Area. It is adequate to establish that only Government Day Secondary School was located closed to Federal Airport, Ilorin.

Geo-database of the existing schools in Ilorin West

The essence of GIS is to establish a link between the Geometric data and the attribute table. Table 1a indicates an existing database of the secondary school in the study location. This explains major features of the point location in terms of State, Country, City, Local Government Areas,

Table 1b. Database showing Students' Number, Staff Strength, School Principal and Status

NO_OF_STUD	NO_OF_ARMS	STAFF_STRE	PRINCIPAL_	SCHOOL_STA
1355	20	50		BOARDING
1233	12	55		DAY
1105	24	70	MR. AJAYI J.L.	BOARDING
1743	17	41	HAJIA FATENJO	DAY
1143	21	58		BOARDING
1016	16	47	MR. YAYA W.O.	DAY
954	13	29	ALH. NUHU A.A.	DAY
1095	10	93	ABDULKAREEM	DAY
1213	12	85	MRS. R.I. YEKINI	DAY
1983	36	76	K.I. OMOMEJI	DAY
1036	16	50		DAY
1583	14	83	HAJIA H.O. AYE	BOARDING
1597	17	71	A.W. JIMOH	DAY
787	13	48	ALH. A.A. SHEUN	DAY
1331	23	57	ALH. JATO M.F.	DAY
1144	15	52		DAY
1117	18	42	ALH. SULAIMON	DAY
1055	23	60		BOARDING

Name of School, Class level, Number of Student, Staff Strength, Principal's name and School Status. These information are essential in providing a spatial related answer to where and what exist in space? For instance, the descriptive analysis of the schools shows that all the identified schools' levels range between JSS1 to SS3. This implies that there is a complete cycle of education in all these schools.

It is clearly noted in Table 1b that Government Day Secondary School at Pakata area of Ilorin has the highest number of students. The total of one thousand, nine hundred and eighty three (1,983) students was recorded in this school with equivalent seventy-six staff population. This also forms the highest record among the Day Schools in the study area. The closest populated school is Queen School, which has total number of one thousand, five hundred and ninety-seven (1597) students with seventy-one staff.

This study generally revealed 80% concentration of secondary schools at the core centre of the study area and induced by the available roads, which forms the basis for school choice among the students (Figure 2). The school status is ranged between boarding and day with overall staff strength ranging between 41 and 93, and total number of students between 787 and 1, 982.

Overlay analysis

This aspect of the study was carried out through various

overlay processes. Figure 3 depicts superimposition of road network of the study area and the point location of the Secondary Schools. Equally, the available rivers in the study area were overlaid on the point locations of the secondary schools. Apart from the accessibility impact, the overlay operation also indicates the best route that could lead to school location. Students in most cases prefer taking a short route to school.

For instance, Table 2 indicates the secondary roads and their joint locations. It is pertinent to understand that some of the roads link to different schools. For example, Alimi Road leads to Okelele Secondary School and Adeta Government High School. This scenario creates advantage for student and the staff to arrive at school through their choice of route.

Spatial searches/queries

Under this operation, different specific clarifications of the database components were made through the process of spatial query. This results in a point on the map were queried. Once points are in GIS format, they can be analyzed and displayed in several ways (Matt, 2005; Armstrong et al., 1993; Bruno, 1996; Caro et al., 2004; Yıldırım et al., 2004; Pearce, 2000; Jensen, 2002; Schlosser, 1998; Zuppo and Fonseca, 1994). For instance, two definite queries were carried out in this work to demonstrate the capability of GIS Software (Arcview) employed. The spatial searches focused on

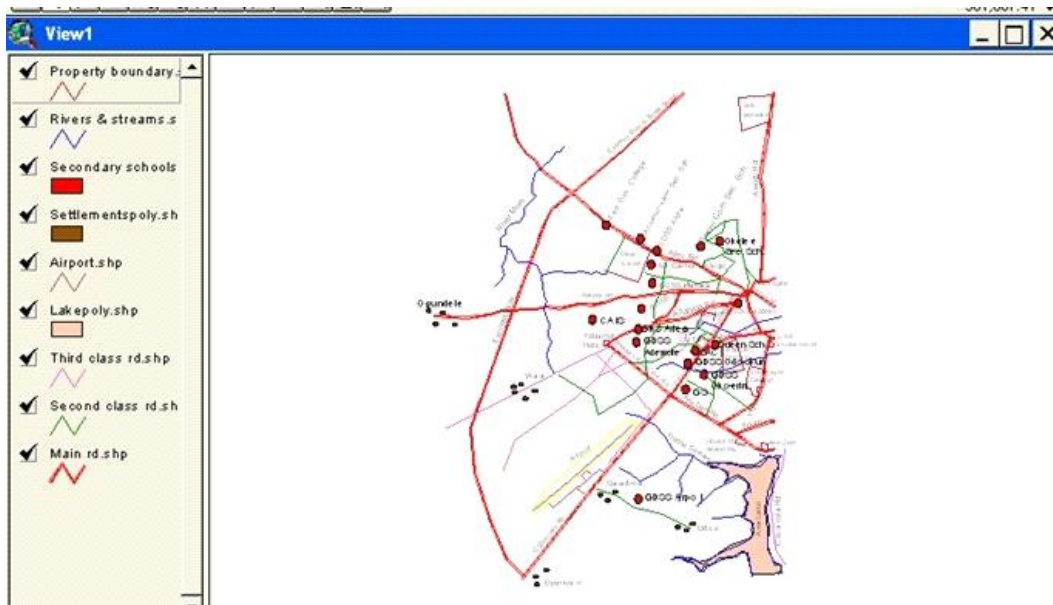


Figure 3. Overlay of Road Network and Drainage on School Point Maps.

Table 2. Attribute table of secondary roads that links school locations

Shape	ID 0	ID 1
PolyLine	Secondary Road	Alimi Rd - Okelele Sec. School
PolyLine	Secondary Road	Okelele Junction
PolyLine	Secondary Road	Alimi Rd.- Oloje Estate
PolyLine	Secondary Road	Emir's Palace - Okelele Sec. Sch
PolyLine	Secondary Road	Amilegbe-Okelele
PolyLine	Secondary Road	Pataka Rd.- Alimi Rd.
PolyLine	Secondary Road	Alimi Rd. Oloje Estate
PolyLine	Secondary Road	Alimi Rd.- GHS Adeta
PolyLine	Secondary Road	Western Rd-SAC
PolyLine	Secondary Road	UITH-SAC
PolyLine	Secondary Road	Abdul Azeez Ata Rd- GHS Adeta
PolyLine	Secondary Road	Ibrahim T. Rd - Abdul Azeez A Rd.
PolyLine	Secondary Road	Ibrahim T. Rd - Asa Dam Rd
PolyLine	Secondary Road	GGDSS Odo Okun- Yidi Rd
PolyLine	Secondary Road	Umaru S Rd - IGS
PolyLine	Secondary Road	W.R Rd. - Wara Settlement
PolyLine	Secondary Road	Airport Rd - Odore Settlement

quantity search and status search. All these were possible mainly because of available information on the attribute tables and the existing links with the geometric information.

Quantity search

This aspect of the geographic query allows for specific

search to be made directly on the map. Here, the verifier would access both the spatial and attribute data by checking on a point in Figure 4. The secondary schools that have the Staff Strength (SS) above 49 are queried while the points representing such schools turned yellow. The result of the query is displayed on Table 3 where 13 schools out of 18 schools were found in this category. The 21 to 49 SS indicates the minimum SS identified in the study area, however, 50 to 93 was tagged as

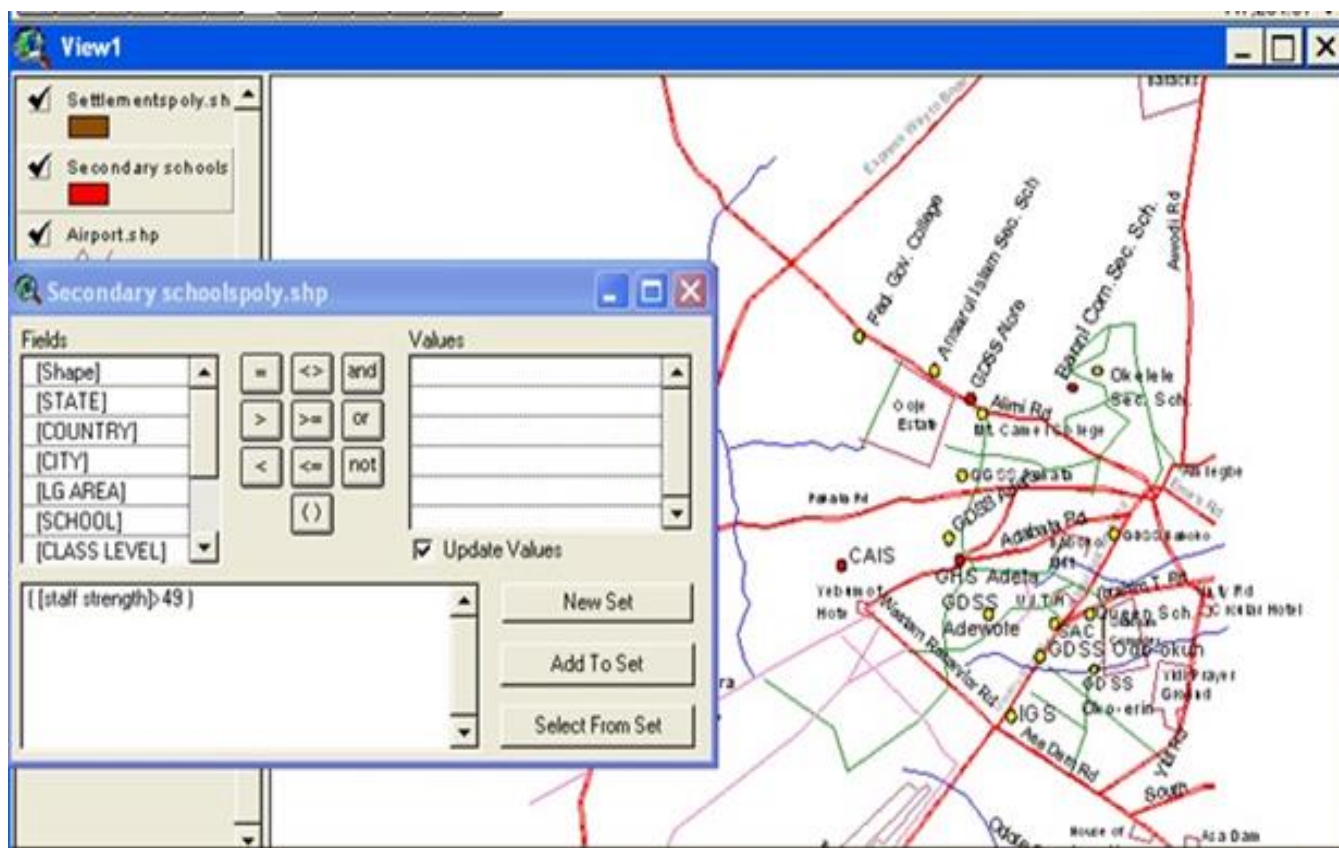


Figure 4. Staff strength above 49 is displayed.

Table 3. Result of query showing secondary schools with maximum staff strength.

School	Class level	No. of student	No. of arms	Staff strength	Principals' name	School status
ANSAR ISLAM	JS1-SS3	1355	20	50	-	Boarding
SAC	JS1-SS3	1233	12	55	-	Day
MOUNT CAMEL	JS1-SS3	1105	24	70	MR. AJAYI J.L	Boarding
GDSS ALORE	JS1-SS3	1743	17	41	HAJIA FATENI	Day
IGS	JS1-SS3	1163	21	58	-	Boarding
GHS ADETA	JS1-SS3	1016	16	47	MR. YAHYA W. O	Day
CAIS ADETAZ/ADEWOLE	JS1-SS3	954	13	29	ALH. NUNU A.A	Day
GDSS ADEWOLE	JS1-SS3	1035	10	53	ALH. ABDUKAREEM	Day
GGDSS PAKATA	JS1-SS3	1213	12	65	MRS. R.I YEKANI	Day
GDSS BAABOKO	JS1-SS3	1982	36	76	K.I OMOMEJI	Day
GDSS ADETA	JS1-SS3	1036	16	50	MR. YAHYA W.O	Day
QUEEN SCHOOL	JS1-SS3	1583	14	83	HAJIA H. O. AYE	Boarding
GDSS ODO OKUN	JS1-SS3	1597	17	71	A.W. JIMOH	Day
GDSS AIRPORT	JS1-SS3	787	13	48	ALH. A.A. SHEHU	Day
GDSS OKO ERIN	JS1-SS3	1331	23	57	ALH. JATO M.F	Day
OKELE SEC. SCH	JS1-SS3	1144	15	52	-	Day
BANNI CSS	JS1-SS3	1117	18	42	ALH. SULAMON. Y	Day
FGC	JS1-SS3	1055	23	60	-	Boarding

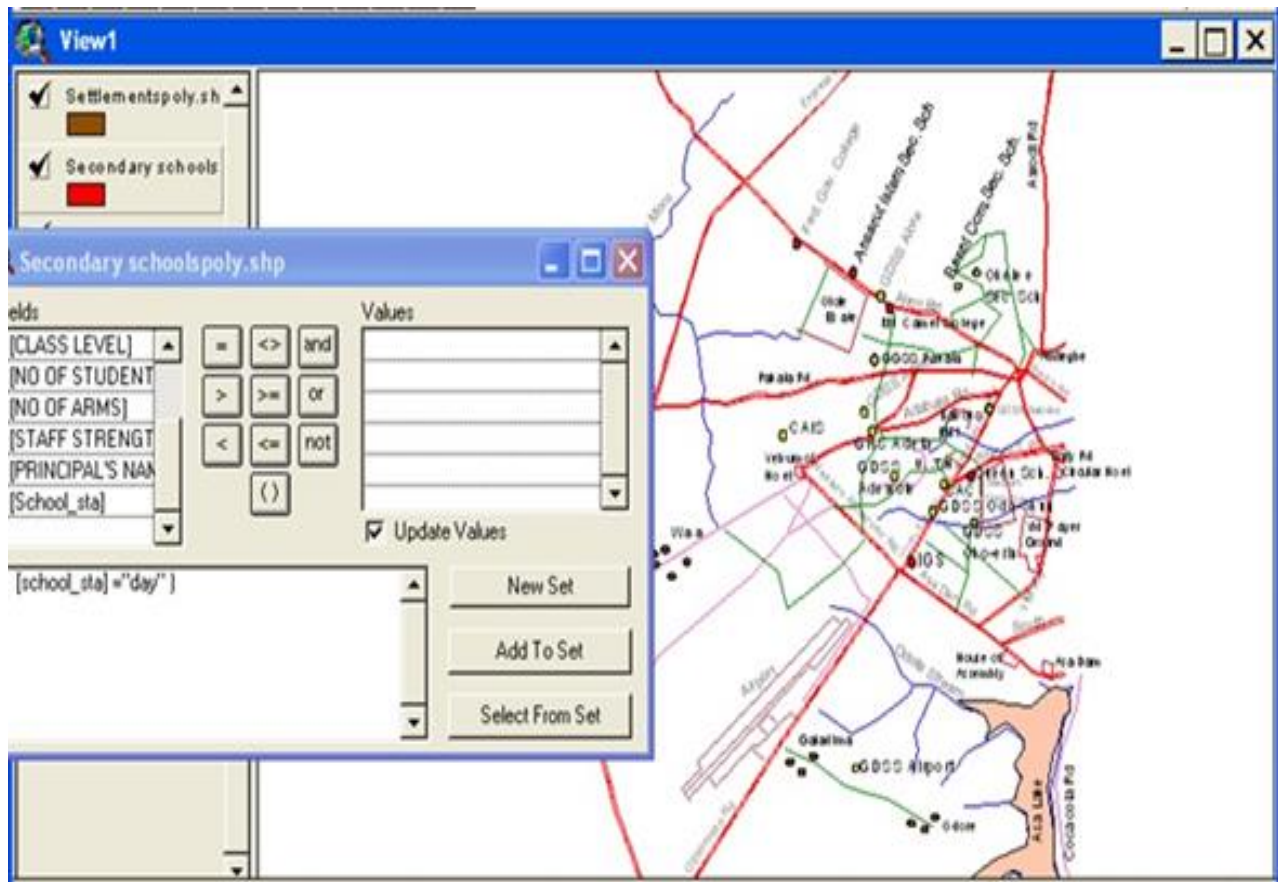


Figure 5. Queried school status.

maximum SS. This information suggests that student can consider SS in relation to Student population when attempting an enrollment in such school.

Status search

This option finds an object of a definite school status to a given point. The category of Secondary Schools that are Day Schools (DSs) were queried and turned yellow (Figure 5). It was observed that only 5 schools run boarding system.

The analysis depicts 13 DSs in this study area in Table 4. This means, most schools in the study area are majorly run on daily system- where student returns to their home from school on daily basis.

This gives a choice on type of school to attend to students based on their education preference. It is apparent to note that most of these DSs are linked to public schools established by the Government and exclusively run from Junior secondary 1 to Senior secondary 3.

Conclusion

The application of computerized systems ensures a speedy and timely provision of relevant information and for decision making on education matters. This study has developed education-based management system using geo-spatial analysis for selected secondary schools in Ilorin West Local Government Area, Kwara State, Nigeria.

Results show that; accessibility, staff strength, and system of operation in terms of boarding and day school, public or private school majorly formed a guide to choice of school by the students. Based on these findings, it is recommended that secondary schools be encouraged to adopt the Database Management System to assist in policy making, planning and carrying out developmental projects as a crucial tool for a productive system of education.

Conflict of Interests

The authors have not declared any conflicts of interests.

Table 4. Result of query showing school status.

School	Class level	No. of student	No. of arms	Staff strength	Principals' name	School status
ANSAR ISLAM	JS1-SS3	1355	20	50	-	Boarding
SAC	JS1-SS3	1233	12	55	-	Day
MOUNT CAMEL	JS1-SS3	1105	24	70	MR. AJAYI J.L	Boarding
GDSS ALORE	JS1-SS3	1743	17	41	HAJIA FATENI	Day
IGS	JS1-SS3	1163	21	58	-	Boarding
GHS ADETA	JS1-SS3	1016	16	47	MR. YAHYA W. O	Day
CAIS ADETAZ/ADEWOLE	JS1-SS3	954	13	29	ALH. NUNU A.A	Day
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GDSS ODO OKUN	JS1-SS3	1597	17	71	A.W. JIMOH	Day
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GDSS OKO ERIN	JS1-SS3	1331	23	57	ALH. JATO M.F	Day
OKELE SEC. SCH	JS1-SS3	1144	15	52	-	Day
BANNI CSS	JS1-SS3	1117	18	42	ALH. SULAMON. Y	Day
FGC	JS1-SS3	1055	23	60	-	Boarding

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