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Geomodelling Trvel Time for Post Primary Schools Pupils in Awka Urban Area of Anambra State, Nigeria: Using Geographic Information System (GIS) Technique

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ABSTRACT

This study was carried to model and analyses the travel time within Awka urban area for post primary schools pupils and teachers using Geographic Information Systems (GIS) Techniques. The coordinates of each school was obtained using a hand-held global positioning system receiver and plotted on the base map. A geospatial database was created using data collected from schools through questionnaires, after which spatial and attribute queries were carried out. Travel time analysis was performed to ascertain the various time it would take a student coming from a particular location within the urban area to get to school either in a vehicle or on foot. The results showed that 54% of the schools in Awka urban area were located at areas with less traffic.

Keywords: Post Primary School, GIS, Travel Time, Spatial Database

1. INTRODUCTION

The post primary education also known as secondary school is the second stage of education. It follows elementary primary education and is sometimes followed by the university (tertiary) education. The formal education occurs during adolescence which starts within the ages of 11 and ends between the ages of 16 and 18years, although there are considerable from country to country, secondary education is usually 6years.The challenging problem induced by human population in recent years in awka urban area and environs has increased the pressure on road infrastructure by commuters. Students in the study area consider post primary school location accessibility via road infrastructures as a predetermination to choice of schools to attend because of the time travel considerations to and from school. Idhoko, Maduabuchukwu and Dere, (2021).
Geographic information systems (GIS) has been demonstrated as tool for the successful modeling of post primary schools and creating of spatial database of post primary schools, (Idhoko, Maduabuchukwu and Dere, 2021).

2.THE STUDY AREA

Awka is the capital of Anambra State, and lies between latitude 6.2220° N, and longitude 7.0821° E with an estimated population of 301,657 As of 2006 Nigerian census. The city is located in the center of the densely populated Igbo heartland in south east Nigeria. Awka is in the tropical rainforest zone of Nigeria and experiences two distinct seasons brought about by the two predominant winds that rule the area: the southwestern monsoon winds from the Atlantic Ocean and the northeastern dry winds from across the Sahara desert. The economy of Awka city revolves primarily around government since many state and federal institutions are located there. Awka hosts the State Governor's Lodge, State Assembly and State Ministries for Health, Education, Lands, and Water.

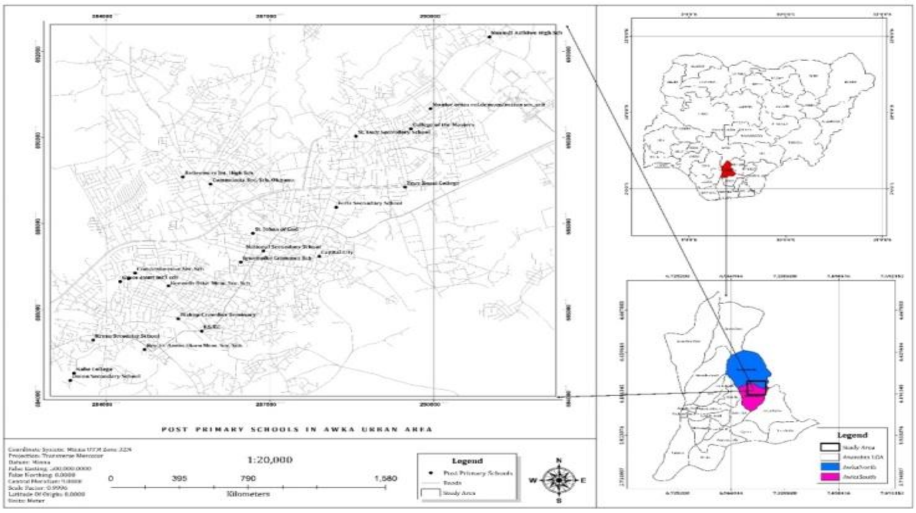


Figure 1: Showing Post Primary Schools in Awka Urban Area

3.REVIEWED LITERATURES

Idhoko et al (2021), study the distribution of post primary schools in awka urban using a geospatial modeling methodology. The study find out that about 75% of the post primary schools in awka urban area are day schools without boarding facilities.

Moses et al (2012), in their study carried out a spatial analysis on the educational facility situation of the sector to get a better understanding in order to evaluate the extent of the challenges faced. The purpose of their study was to illustrate how GIS can be used in addressing the educational planning problems through a case study of educational facilities in Busia County. The study involved inventory mapping of all the educational facilities in the County in the backdrop of existing road networks, analysis of the regional distribution of educational facilities, and evaluation of spatial accessibility to the facilities. Demographic data were used in demand analysis for various educational services within the county. Using the demand ratios such as school age population to primary schools,

Idowu (2012), in his research aimed at developing a GIS database for private and public secondary schools in his study area so as to enable effective and efficient planning and management of these schools. His research was achieved through identification of private and public secondary schools in the study area, mapping the secondary schools in the study area with some basic facilities, generating the attribute data of the public and private secondary schools and finally, creation of GIS database for schools. The attribute data was obtained through the administration of questionnaires to the schools; also a satellite image of the study area was obtained using Google earth to derive the base map through the digitizing process. The coordinates of each school were obtained using a hand-held GPS receiver to geo code the schools on the base map. Finally, a GIS database was created and the spatial and attribute data encoded and analysis was carried out using Arc GIS 9.2 software. The result therefore obtained from the database provides the users with a working environment for data management and also allows efficiency query of information needed for school management.

Fabiyi et al (2015), in their study examined the spatial distribution of post-primary education in Yewa South local government area, in the southwestern Nigeria. The locations of post-primary schools in the study area were captured through handheld Global Positioning systems (GPS) receivers and the spatial analyses were carried out in the GIS platform. The results showed a dispersed pattern for the overall assessment of spatial distribution in the areas. However, a clustered pattern was obtained for 9 electoral wards while a dispersed pattern was obtained in Ilaro ward (a relatively urban ward). According to the research, some students in the public post primary schools travel as much as 5 kilometers mostly on foot to school every working day. The paper concludes that spatial reengineering and reorganization of post-primary school is necessary in the study area if the access to educational facilities would be enhanced.

Alfred et al (2015), in their research aimed at developing a Geographic Information System (GIS) database for private and public secondary schools in their study area so as to enable effective and efficient planning and management of the schools. Their aim was achieved through identification of private and public secondary schools in the study area, mapping the secondary schools in the study area, with some basic facilities, generating the attribute data of the public and private secondary schools and finally, creating a Geographic Information System (GIS) database for schools. The attribute data were obtained from school's official records and personal interview with the school management. A topographical map of the study area was obtained in other to derive the base map through the digitizing process. The coordinates of each school were obtained using a hand-held Global Positioning System (GPS) receiver to georeference the schools on the base map. Finally, Geographic Information System (GIS) databases were created with the spatial and attribute data encoded. The analysis was carried out using ArcView 3.2a software. The result of the database provides the users with a sound working environment for data management and also allows for efficiency in querying of information needed for school management.

Asiyai (2012), in his study investigated school facilitates in public secondary schools in Delta State, Nigeria. The purpose of his study was to find out the state of the facilities, the types of maintenance carried out on the facilities by school administrators, the factors encouraging school facilities depreciation and the roles of school administrators in the management and maintenance of school facilities. The study employed the ex-post factor research design. A questionnaire was drafted which served as the instrument for data collection from 640 respondents selected through stratified sampling techniques from all the 358 public secondary schools in the state. The result of the findings revealed that school facilities in the schools are generally in a state of disrepair. The result further revealed that the maintenance carried out on school facilities was inadequate for majority of the facilities.

4.METHODOLOGY

This project was achieved using the Geospatial mapping techniques of (Idhoko et al 2016), however, the flowchart of the methodology was modified to reflect the various methods and steps which was employed to gather, analyze and produce the data required for this project. The flowchart of the methodology adopted in this study is shown below:

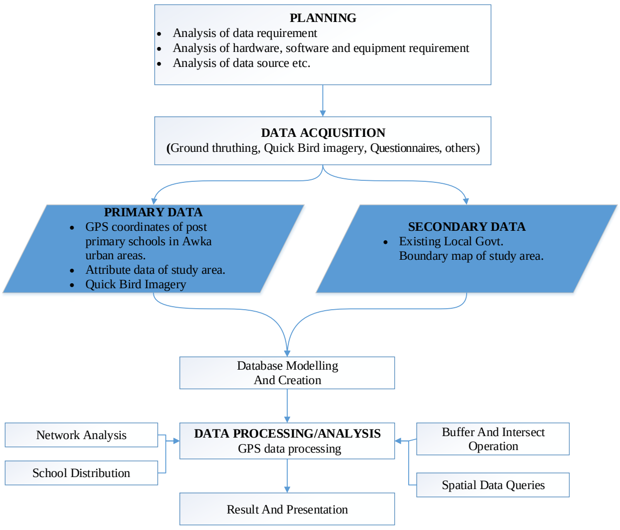


Figure 2: Flow chart of methodology

5. RESULTS PRESENTATION

The results obtained from the analysis performed in the spatial database using ArcMap 10.5 software are presented. The results of the database queries were presented in form of digital maps and graphic displays. Also results obtained from the GIS analysis such as the spatial queries, buffering and intersect operations, network analysis and spatial overlay performed on both the database and the map was present

5.1 Result of Traffic Index Analysis around Post Primary Schools in the Study Area

This analysis was performed to determine schools which fell within the roads with heavy, moderate and less traffic. The analysis shows that schools within areas with heavy traffic have high incidents of students coming late for classes compared to those with moderate and less Traffic.. The results of the analysis are shown (Figure 3 to.5). The buffer was conducted using a distance of 100 meters from the school to the road.

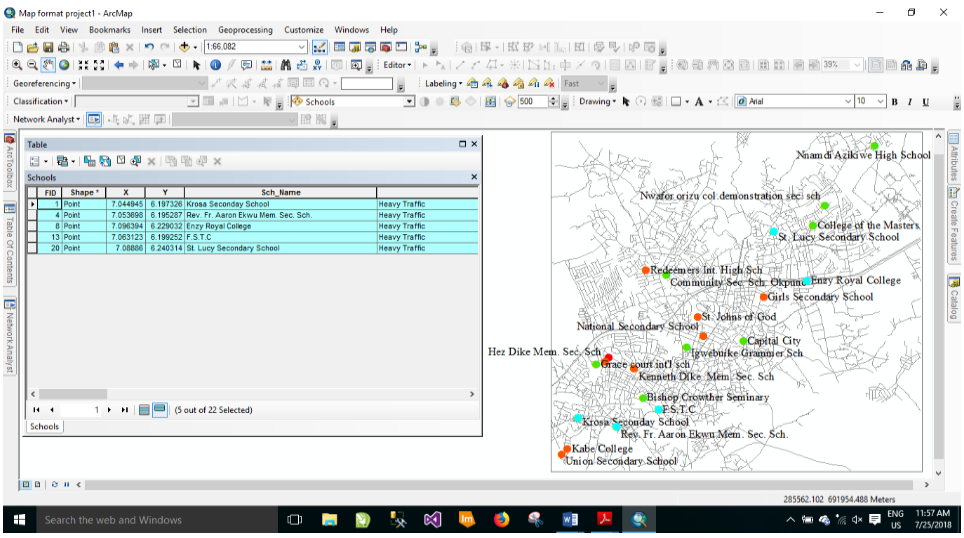


Figure 3. Result showing schools around areas of heavy traffic

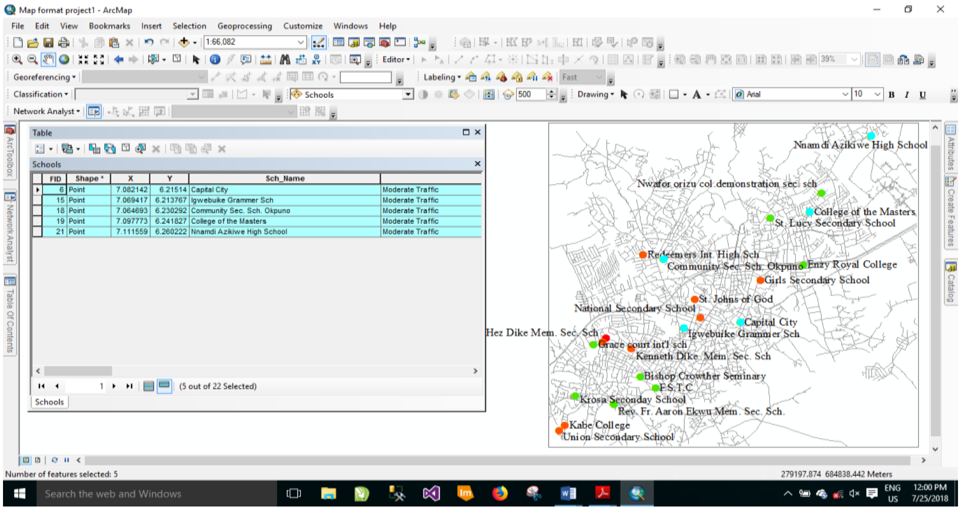


Figure 4.: Result showing schools around areas of moderate traffic

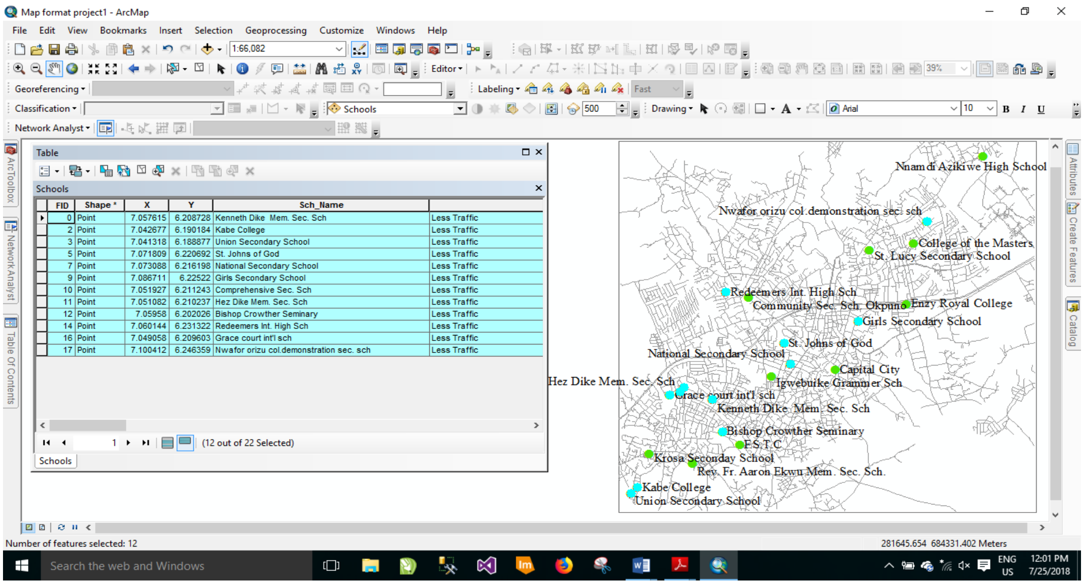


Figure 5. Result showing schools around areas of Less traffic

The result from the analysis as shown from the images above, shows that five (5) schools fall in areas with heavy traffic, five (5) in areas of moderate traffic and twelve (12) in areas with no or less traffic. This however implies that students in schools within areas with heavy traffic or moderate traffic are not safe. From the result, it can further be stated that 54% of the post primary schools in the study area are sited at areas with less traffic which means safety is assured for some of the students within the post primary schools in the study area

5.2 Result Travel time accessibility index

This analysis was performed to determine the time it would take a student living at a particular location to get to the facility which in this case is the school either on foot or a vehicle. In order to achieve this task, a calculation for time was made making reference to the speed as well as the distance/length of the road. Below shows the speed for major road, minor road and streets:

Major road = 80km/hr

Minor road = 60km/hr

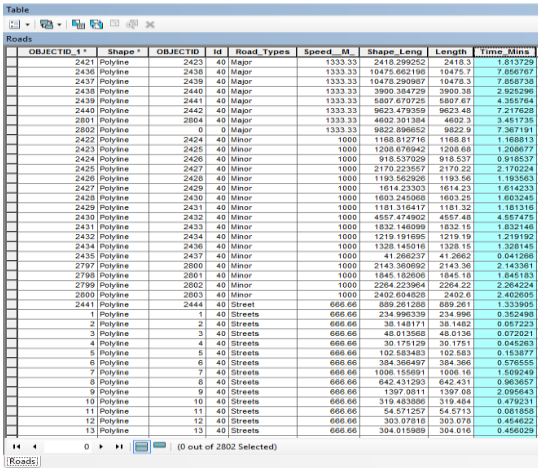
Streets = 40km/hr

The speed it would take for a student trekking on foot was calculated using the time it took to cover a distance of 100 meters on foot. Hence, the speed was computed thus:

Speed = $\frac{\textit{Distance}}{\textit{Time}}$

The time it took to cover a distance of 100 meters was 0.875 minutes. And so speed for trekking is given as 114.286m/min or 1.9047m/sec on foot.

The length of the roads were calculated using the calculator geometry tool and thus the time computed using the formula: Time = $\frac{\textit{length (distance)}}{\textit{Speed}}$. The figure below shows time calculated in minutes:



Table

Roads

OBJECTID_1 *	Shape *	OBJECTID	Id	Road_Types	Speed__M_	Shape_Leng	Length	Time_Mins
2421	Polyline	2423	40	Major	1333.33	2418.299252	2418.3	1.813729
2436	Polyline	2438	40	Major	1333.33	10475.662198	10475.7	7.856767
2437	Polyline	2439	40	Major	1333.33	10478.290987	10478.3	7.858738
2438	Polyline	2440	40	Major	1333.33	3900.384729	3900.38	2.925296
2439	Polyline	2441	40	Major	1333.33	5807.670725	5807.67	4.355764
2440	Polyline	2442	40	Major	1333.33	9623.479359	9623.48	7.217628
2801	Polyline	2804	40	Major	1333.33	4602.301384	4602.3	3.451735
2802	Polyline	0	0	Major	1333.33	9822.896652	9822.9	7.367191
2422	Polyline	2424	40	Minor	1000	1168.812716	1168.81	1.168813
2423	Polyline	2425	40	Minor	1000	1208.676942	1208.68	1.208677
2424	Polyline	2426	40	Minor	1000	918.537029	918.537	0.918537
2425	Polyline	2427	40	Minor	1000	2170.223557	2170.22	2.170224
2426	Polyline	2428	40	Minor	1000	1193.562926	1193.56	1.193563
2427	Polyline	2429	40	Minor	1000	1614.23303	1614.23	1.614233
2428	Polyline	2430	40	Minor	1000	1603.245068	1603.25	1.603245
2429	Polyline	2431	40	Minor	1000	1181.316417	1181.32	1.181316
2430	Polyline	2432	40	Minor	1000	4557.474902	4557.48	4.557475
2431	Polyline	2433	40	Minor	1000	1832.146099	1832.15	1.832146
2432	Polyline	2434	40	Minor	1000	1219.191695	1219.19	1.219192
2434	Polyline	2436	40	Minor	1000	1328.145016	1328.15	1.328145
2435	Polyline	2437	40	Minor	1000	41.266237	41.2662	0.041266
2797	Polyline	2800	40	Minor	1000	2143.360692	2143.36	2.143361
2798	Polyline	2801	40	Minor	1000	1845.182606	1845.18	1.845183
2799	Polyline	2802	40	Minor	1000	2264.223964	2264.22	2.264224
2800	Polyline	2803	40	Minor	1000	2402.604828	2402.6	2.402605
2441	Polyline	2444	40	Street	666.66	889.261288	889.261	1.333905
1	Polyline	1	40	Streets	666.66	234.996339	234.996	0.352498
2	Polyline	2	40	Streets	666.66	38.148171	38.1482	0.057223
3	Polyline	3	40	Streets	666.66	48.013568	48.0136	0.072021
4	Polyline	4	40	Streets	666.66	30.175129	30.1751	0.045263
5	Polyline	5	40	Streets	666.66	102.583483	102.583	0.153877
6	Polyline	6	40	Streets	666.66	384.366497	384.366	0.576555
7	Polyline	7	40	Streets	666.66	1006.155691	1006.16	1.509249
8	Polyline	8	40	Streets	666.66	642.431293	642.431	0.963657
9	Polyline	9	40	Streets	666.66	1397.0811	1397.08	2.095643
10	Polyline	10	40	Streets	666.66	319.483886	319.484	0.479231
11	Polyline	11	40	Streets	666.66	54.571257	54.5713	0.081858
12	Polyline	12	40	Streets	666.66	303.07818	303.078	0.454622
13	Polyline	13	40	Streets	666.66	304.015989	304.016	0.456029

0 (0 out of 2802 Selected)

Roads

Figure 6. Showing Calculated Time

The calculated time was then used for the travel time analysis, which involved the use of the network analyst tool. The analysis ran yielded the below result:

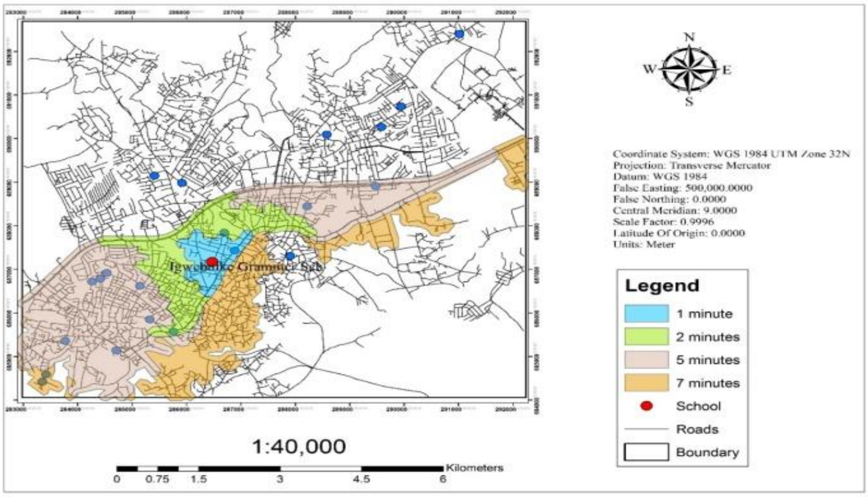


Figure 7 showing result of Travel Time Analysis

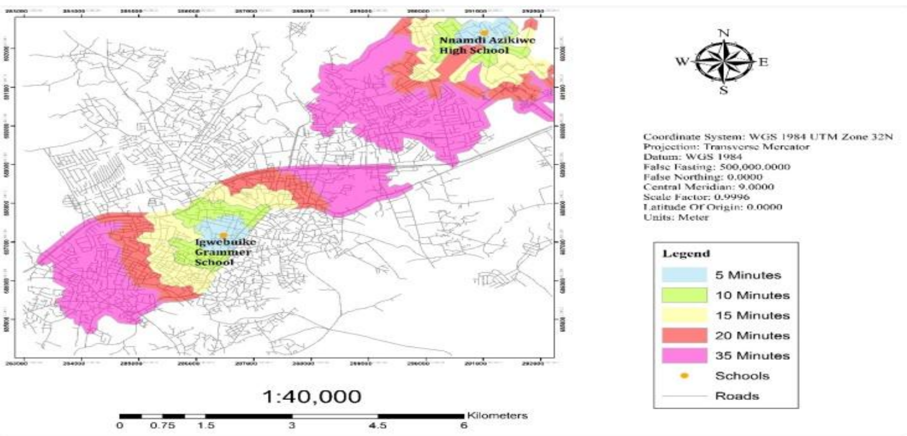


Figure 8: Showing result of Trekking Time Analysis

The result obtained in (figure 7), shows the time it would take a student coming from the highlighted region to Igwebuike grammar school. The result showed that it would take one (1) minute for a student around the blue polygon area to get to the school, two (2) minutes for a student around the green polygon area, five (5) minutes for a student around the light brown polygon area, and seven (7) minutes for a student around the orange polygon area. The result further showed that for igwebuikegrammer school, it would take a relatively short time for a students living around any of the highlighted location or region to get to the school.

The result obtained in (figure 8), shows the time it would take a student coming from the highlighted region to Igwebuikegrammer school and Nnamdi

Azikiwe high
school respectively on foot. The result showed that it would take five (5) minutes for a student around the blue polygon area to get to the school, ten (10) minutes for a student around the green polygon area, fifteen (15) minutes for a student around the yellow polygon area, twenty (20) minutes for a student around the red polygon area, and thirty-five (35) minutes for a student around the pink polygon to get to school while on foot. The result further showed that for igwebuikegrammer school and Nnamdi Azikiwe high school respectively, it would take a relatively short time for a student living around the blue, green and yellow region to get to school than students living around the red and pink region while trekking.

6.CONCLUSION

This Study has demonstrated that Geographic information System (GIS) tools can be used in the modeling and analyzing travel time for students in post primary schools in the study area. The study revealed that takes between 6 minutes to 35 minutes travel time for students trekking to school within the study area while it takes an average of 7 minutes travel time for most students to commute to post primary school locations in study area. The study also found out the challenge of students trekking to school locations far from their residential locations, get to school late for classes and lectures. This study has shown that GIS as a tool can be used to store, manipulate, and analyze data relating to post primary schools geospatial data. This study concludes that, in order to ascertain effective travel time to post primary school locations for students within the study area, the state government is needed to make policy formation on free transportation for students to and from post primary school locations in the study area. It is therefore recommended that the state government should intervene in improving road infrastructures within the study area.

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