Application of Geospatial Information System to Assess the Effectiveness of the MDG Target in Amac Metropolis-Abuja, Nigeria

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Abstract: This study aims to assess the effectiveness of the MDG target as it concerns, the state of education in Abuja Municipal Area Council (AMAC) metropolis-Nigeria. One of the educational challenges faced in developing countries is how to know which school to send children to. This is mainly due to lack of detailed information as to, what school offers, what type of education, and at what fee. But with Geospatial Information Systems (GIS) providing information about primary and secondary schools, Millennium Development Goals’ (MDGs’) vision of literacy for 15-24 year olds will be achieved. The development of geospatial database information system of primary and secondary schools for Garki and Wuse districts, Abuja, was embarked upon to provide timely, consistent and accurate information to decision makers for use in achieving this particular target of the Millennium Development Goals (MDGs). The delay in achievement of this target is not because governments in developing countries aren’t putting maximum effort, but because these governments are choosing to put the cart before the horse. Sustainable literacy level cannot be achieved without an effective framework charged with the collection, storage, query, analysis and management of the relevant data. What is needed is a system that provides government with data about all educational facilities within required proximity and determines availability of the required facilities. GIS is that decision making technology, which integrates ‘spatially referenced data’ with a problem solving environment. The method employed was to acquire both spatial and attribute data of every primary and secondary school in Garki and Wuse districts. The spatially referenced database was created using Microsoft Access 2007 and ArcGIS 9.2 software. The database was queried and the results of the queries analyzed. The results showed that 60% of the schools didn’t have access to Internet. Twenty-one (21) percent had no library. Sixty-three (63) percent of schools were also found to lack Elementary Science Laboratory as stipulated in the National Policy on Education. It was also observed that, the closest distance between public schools to Area 1 and Wuse Central bus-stops, are 0.769 and 1.15 m, respectively.

Key words: GIS and planning, MDG, quality education and assessment, referenced database

INTRODUCTION

Education is a basic human right, and is indispensable for the realization of other human rights as a means for accessing broader social, economic, political and cultural benefits. Because it is transformative and empowering, education contributes to building more just societies through reducing poverty and inequalities, enhancing acceptance of diversity, and promoting respect for the rule of law. No society has ever achieved significant human development for its citizens without substantial and steady investment in education. The severe decline of the oil market in the early eighties, combined with the Structural Adjustment Programme (SAP), led to drastic reductions in spending on education. The results are, unpaid teacher salaries, degradation of education facilities at all levels and strikes in universities and schools. The end result is declining literacy rates in the country.

Several studies have been carried out on the poor state of education in Nigeria because they help not only in creating awareness, but also serves as instrument for economic empowerment and development of sustainable economy.

According to the available records, school mapping originated in France in I 963 (Caillods, 1983; Galabawa et al., 2002; Govinda, 1999). School Mapping (SM) is a normative approach to the micro planning of school locations. SM is also used to investigate and ensure the efficient and equitable distribution of resources within and between school systems when large scale reform or significant expansion of an educational system takes place (Caillods, 1983).

Igbuzor (2006) aptly captured in the National Empowerment Development Strategy as follows:

"The delivery of education in Nigeria has suffered from years of neglect, compounded by inadequate attention to policy frameworks within the sector. The national literacy rate is currently 57%. Some 49% of the teaching force is unqualified. There are
In identifying areas within the metropolis that lack schools. Such assistance is a cost effective approach to improving and monitoring the distribution of schools. This increasing the likelihood that ensuing strategies will be more pertinent.

- More flexible assistance can be provided in prospective planning at multiple levels or units of analysis: national, regional, provincial/district, and local.

To this list the following might be added for consideration (Hite and Hite, 2004):

- Expanded “holistic” representation and exploration of the contexts of schooling through the direct and dynamic use of multiple sources of influential data such as those found in census, transportation, utilities, health care, land use, and agricultural databases which are otherwise very difficult to include in education planning and management.
- Increased public appeal and utility.
- Extensive control of scale of complexity: extensive flexibility in how much data are displayed or explored at a given time, with changes in unit of analysis virtually immediate.
- Dynamic ability to facilitate “what if” analysis, exploratory inquiry, and creation of planning and management “scenarios”.

The main use for GIS is, as in most other fields, for the easy visualization of data. GIS is good at displaying data once manipulated and allowing the identification of patterns, but its wider implementation is hampered by the usual personnel and financial constraints common in many parts of the public sector (Wikipedia, 2009).

The word GIS has wider application; especially land based location references of object phenomena in space. It has a stronger relationship for geographical location in space (Wikipedia, 2009).

Significance of study: The poor state of education system in Abuja and Nigeria at large is mainly because of the low status of teaching as a profession in the country (Ejieh, 2009). It is common knowledge that, candidates for teacher education are the generally academically weak students, who do not aspire to more prestigious professions (Akinpelu, 1972; Fadipe, 1992).

When considering GIS in micro planning, an obvious question is whether GIS is simply a better, more precise and flexible spatial analysis tool for representing schools and their physical, social and geo-political contexts or whether GIS provides a different way to understand and plan those contexts geo spatially?

The challenge of this study is to assist local authority in identifying areas within the metropolis that lack schools. Such assistance is a cost effective approach to improve and monitor the distribution of schools. This
would involve collection of up-to-date school data within the metropolis. Such data will consist of spatial database showing location of every school within the metropolis, as well as attribute data showing details of school capabilities.

Because GIS helps in projecting tabular data onto maps, this will not boost monitoring of schools. It will attract government support, thereby enhancing development in the country.

**Study area:** The study area is roughly defined by UTM - 32 coordinates 330000.00E, 1006000.00N; 339000.00E, 1006000.00N; 339000.00E, 998000.00N; 330000.00E, 998000.00N. It covers Garki and Wuse districts of Abuja Municipal Area council (AMAC) with areas 1, 2, 3, 7, 8, 10, 11 and Garki II in Garki district and zones 1, 2, 3, 4, 5, 6, 7 and Wuse II in Wuse district.

**METHODOLOGY**

This study was carried out in 2010 by first acquiring from the Office of the Abuja Geographic Information System (AGIS), a digital map of the study area (AMAC metropolis, Abuja - Nigeria) in AutoCAD format. Questionnaires were issued to every school in order to acquire facility information. A geodatabase was created using Microsoft Access 2007 and ArcGIS 9.2 software. The location of each school was used to determine general spatial distribution of schools within the metropolis.

A comprehensive list of schools in the districts was collated from the Department for Policy Implementation (DPI) Education Secretariat Abuja, for private schools are as follow:

- Local Education Authority (LEA)
- Wuse Zone 5 for schools owned by Abuja Municipal Area Council (AMAC), as well as Universal Basic Education (UBE)
- Area 2 Garki Abuja for UBE Schools

In addition to the above list, a street by street search was conducted, in order to have a full cover of the schools.

Data collected include: Name of the school, Address, Tuition fee, Classes, Availability of Laboratories/Internet facilities. Certain principles guided the database design process. The first principle is that duplicate information (also called redundant data) was avoided in order not to introduce errors and inconsistencies in the database. The second principle is that the correctness and completeness of information is important. If the database contains incorrect information, any report that pulls information from the database will also contain incorrect information. As a result, any decision made that is based on these reports will then be misinformed.

The database design involved gathering all of the types of information desired to be recorded in the database, such as Name/Address of school, System of study, Average number of pupils/students per class room, Internet/Laboratory access, Tuition fees. Information items were divided into major entities or subjects, such as Brochure, Directory, Facilities and Clubs. Each subject then becomes a table. The database was designed such that the positional data is well organized. It also provides for adequate linking, retrieval, updating of data.

Tables were created by dividing the collected data into subject-based tables to minimize redundant data. The primary key for each table is specified. This is a unique identifier for each entry which distinguishes each point. The tables were created in Microsoft Access.

Data for the database was entered in Microsoft Access and saved in data base four (dbfIV) format which is recognizable and acceptable to the ArcCatalog extension of ArcGIS. ArcCatalog allows the user to easily access and manage geographic data that is stored in folders on local disks or relational databases that are available on the user's network. Data can be copied, moved, deleted, and quickly viewed before it is added to a map. The data and the digital map were stored in the ArcCatalog extension.

The digital map for the project was saved in AutoCAD’s drawing exchange format (dxf), a format that is compatible to ArcGIS. The map was opened in the ArcMap extension where it was discovered that the entire layout was digitized in one layer. The map had to undergo another round of digitization in ArcGIS in order to create layers for the features on the features (major roads and minor roads) and the tables held in the ArcCatalog extension were added, using the add XY, Command at the tools menu. There were three tables, one for private schools, one for public schools and one for missionary schools.

The system can be updated to reflect changes in any school information such as tuition fees etc, as well as appending more attributes in ArcGIS interface by an authorized ArcGIS application user.

The query was carried out using the query builder. The query builder tool is accessed by clicking on selection authorized ArcGIS application user.

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The query was carried out using the query builder. The query builder tool is accessed by clicking on selection on the menu bar and pointing to ‘Select By Attributes’ and clicking. A dialog box appears. The query expression is built either by typing it in or clicking on the required fields, operators and values in the dialog box.

**RESULTS AND DISCUSSION**

The figures below display the result of the queries for Public, Private and Missionary schools without internet facilities; Public schools without a science laboratory; Public schools without a Library and their results in map format.
Fig. 1: Queries on public schools without internet (list of schools with spatial representation)

<table>
<thead>
<tr>
<th>Theme of query</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools without internet</td>
<td>32</td>
<td>60.38</td>
</tr>
<tr>
<td>Public schools without science laboratory</td>
<td>12</td>
<td>63.16</td>
</tr>
<tr>
<td>Overpopulated public schools</td>
<td>7</td>
<td>36.8</td>
</tr>
<tr>
<td>Public schools without library</td>
<td>4</td>
<td>21.05</td>
</tr>
</tbody>
</table>

From Fig. 1, 2, 3 and Table 1, 60.38% do not have internet facilities. From Fig. 4 and Table 1, it can be seen that 12 out of the 19 public schools in the districts do not have a science laboratory; only 7 have, indicating that approximately 63.16% of schools in the districts do not have a science laboratory. Out of the seven, 6 were secondary schools and 1 primary school.

Figure 5 reveals that 7 out of the 19 public schools are overpopulated. They exceed the maximum number of pupils/students set at 45 per class room by the Local Education Authority (LEA) and the Universal Basic Education (UBE) for the schools. We can infer that 36.84% of the schools in the districts have over crowded class rooms.

Table 2: Spatial (distance) analysis of schools to the central bus stop (area “1” Garki)

<table>
<thead>
<tr>
<th>Name of school</th>
<th>Approximate distance (Km)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JSS Apo, area “3”</td>
<td>1.15</td>
<td>Closest public school</td>
</tr>
<tr>
<td>Little angels academy, area “3”</td>
<td>1.63</td>
<td>Closest private school</td>
</tr>
<tr>
<td>Stellar maris pry</td>
<td>0.323</td>
<td>Closest missionary school</td>
</tr>
<tr>
<td>Junior high, area “1”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 displays that 4 out of the 19 schools do not have a library complex, representing 21.05% are in need of a library.

According to Table 2, the closest public school to the central Bus stop Area “1” Garki, is JSS Apo, Area “3” which is 1159 m to the Bus stop, the closest Private school is Little Angels Academy which is 1631 m from the central Garki Bus Stop, while the closest Missionary School (Stellar Maris Primary School and Junior High) is about 322 m from Central Garki Bus stop Area “1”.

According to Table 3, the closest public school to the central Wuse Bus stop is Pilot Science Primary School.
Fig. 2: Queries on private schools without internet

Fig. 3: Queries on public schools without science laboratory
Fig. 4: Queries on public schools without library

Fig. 5: Queries on overpopulated public schools
Table 3: Spatial (distance) analysis of schools to the central bus stop (Wuse).

<table>
<thead>
<tr>
<th>Name of school</th>
<th>Approximate distance (km)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot science primary school, Zone 5, Wuse</td>
<td>0.769</td>
<td>Closest public school</td>
</tr>
<tr>
<td>Lightway academy, parakou crescent, Wuse</td>
<td>1.038</td>
<td>Closest private school</td>
</tr>
<tr>
<td>Wesley nursery and primary school, Wuse</td>
<td>0.997</td>
<td>Closest missionary school</td>
</tr>
</tbody>
</table>

Wuse, which is 769 m to the bus stop. The closest private School is Lightway Academy Wuse which is 1038 meters to the bus stop, while the closest missionary school to the bus stop is Wesley Nursery and Primary School which is 997 meters away.

CONCLUSION

The study presents three classes of schools (Private, Public and Missionary) in AMAC- Abuja with a total of fifty-three (53) schools. Private schools contribute the bulk with 20 schools. It is closely followed by Public schools which are 19 in number.

Adequate analysis can be made through queries there by enhancing decision making by parents/guardians and policy makers. For example, to effectively implement the MDG target for primary education, policy makers must increase the number of primary schools within the metropolis. This is due to the fact that out of the nineteen (19) public schools, only seven (7) were primary.

The GIS database for public/private primary and secondary schools in Garki and Wuse districts of Abuja Municipal Area Council (AMAC) has been produced successfully using ArcGIS 9.2 software.

A map showing the distribution of schools in the Abuja Municipal Area Council has also been produced. The database system allows for easy access, storage and retrieval of schools records in the districts.

REFERENCES


