GIS-Based Application for DepEd Schools in the Philippines using Spatial Data Analysis

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Abstract:- The study "GIS-based Application of DepEd Schools in the Philippines" is applied to the geospatial data of DepEd schools in the Philippines with the use of the Internet. The application plays a significant role in the decision making activities of the DepEd National as it help address the need to determine the required information in the real time monitoring the DepEd schools in the country. The information is cascaded to the national level as an efficient way of information dissemination via client-server configuration. The school location likewise be viewed using the visualized maps based from the geospatial information of the school. A validated 5-point Likert survey questionnaire was utilized to evaluate the extent of compliance of the developed application to ISO 25010:2011 software quality standards among IT experts and DepEd ICT coordinators. Result of the elauation showed that the application developed is found to be efficient, usable, reliable, portable, easily maintained, compatible, suitable and secured. With the GIS-based application, there is a real time update of school information from the local school in the municipality, legislative district, province and region in the Philippines.

Keywords:- DepEd School, GIS-Based Application, Spatial Data.

I. INTRODUCTION

Geographic Information System (GIS) is an emerging powerful technology encompassing different fields. Today, with the growing capability of the Internet, it has created an avenue for the development of the GIS-based applications centralizing the maintenance of services and information needed. With the merging capability of the Internet and GIS-based applications, permitted users can gain access to the information they needed for a specific tasks which can be easily updated for information dissemination and for an efficient and effective decision making activities of any organization.

The integration of GIS and Internet technologies is allowing GIS developers to provide access to geo-information and processing without burdening end users with complicated and expensive software and dedicated hardware[1]. The recent convergence of multiple information and communication technologies including Internet and GIS has given rise to a new class of location based applications and services. With this, location based services deliver geographic information and geo-processing power through the Internet in order to achieve greater scalability, reliability and efficiency.

Relative to the development of the GIS-based application in the Philippines, literatures corroborated evidences that it was indeed an emerging powerful tool which were applied in different services on health, public transport, land used, agriculture and education. Specific to the education system, there has been applications developed but it is limited on secondary education as well as in the higher education institution and no application developed in the general management of the Department of Education (DepEd) schools in the country. With the mandate of DepEd which was established through the Education Decree of 1863 as the Superior Commission of Primary Instruction under a Chairman, it underwent many reorganization efforts in the 20th century in order to better define its purpose vis a vis the changing administrations and charters. At present, the DepEd was eventually mandated through Republic Act 9155, otherwise known as the Governance of Basic Education act of 2001. The DepEd formulates, implements, and coordinates policies, plans, programs and projects in the areas of formal and non-formal basic education. It supervises all elementary and secondary education institutions, including alternative learning systems, both public and private; and provides for the establishment and maintenance of a complete, adequate, and integrated system of basic education relevant to the goals of national development. With the available geospatial data in the DepEd national level, it help bridge the gap to address their concern and to take advantage on the benefits of the merging powerful technology - GIS.

The GIS-based application likewise included the classification of students by Gender and Age, and the classification of schools by Grade Level (elementary, junior high school, senior high school), by sector (private or public), by curricular offering (all offering k-12, elementary and junior high school, junior high school with senior high school, purely elementary school, purely junior, purely senior). It also includes the classification of a DepEd teacher according to their specialization. The map access level was based from the location of the school by barangay level, municipality, legislative district, province and region. Each was managed by the system administrator which can view the map within the location of the school including the school information thereon. The adding and updating of the information per school was done by the ICT coordinators including viewing of such. From the national level, the

database administrator from the DepEd National was in-charged in managing the whole network.

From the foregoing, it is imperative to address the concern of DepEd schools in the country and help bridge the gap to make use of their available geospatial data in order to improve the kind and quality of their services which is cognizant to help realize their mandate thus paving the way for an effective and efficient decision making activities of the agency.

II. METHODOLOGY

A. Research Design

The study is a descriptive research as well as developmental research. Descriptive research as it involves gathering of DepEd schools information as well as analyzing and describing of the data gathered. On the other hand, it is developmental research as it involves analysis, design and development of the proposed GIS-based application as well as testing and evaluation of the same.

The framework of the study as presented in Fig 1 was anchored on the concept of GIS-based System using a client-server configuration via the Internet[2]. The client sends a request for service and the server processes the request and returns information to the client.
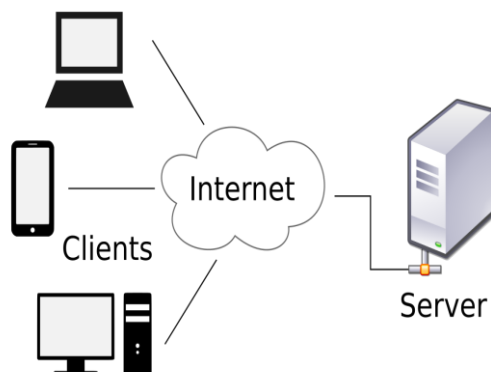

Fig 1. GIS-based System

In this study, the same concept of GIS-based application was adopted for the general management of DepEd Schools in the country with the inclusion of Decision Support as the data resides from the server interface. The data obtained from the DepEd Central office were used as basis for the development of the application. The DepEd Central office likewise served as the data repository. These data are loaded from the database server which was used for the map plotting and extraction of the clustered data based from the location. This kind of set-up provides a simplified way of application development, deployment and maintenance of data as the individual client can access the data directly through the internet with the permission from the server interface. This provides a novel way of managing data as it creates a significant positive implication for performance and reliability for the user access based from its location.

B. Data Gathering Procedures

Formal communications was prepared and was sent to the concerned persons at the DepEd Central office in order to extract the necessary data needed for the study. Interview was likewise conducted among DepEd ICT coordinators to better understand the technical terms and the processes that were involved during data collection.

The data or the dataset was taken from the DepEd Central office and it was used solely for the conduct of research and educational purposes only. These data that was stored in different tables was cleaned by removing duplicate records. Records that contain empty or null values were likewise deleted. The different tables were integrated in order to create meaningful groups within the attributes to match that of the objectives of the study.

For the evaluation of the system, an orientation about the system was first conducted by the researcher to the end-users that involve the DepEd ICT coordinators and IT experts. After the live orientation and demonstration about the system, the link for the Google Survey Form was distributed to the participants. The filled up survey form was submitted by the participants through the same link and scores were tallied and tabulated into a master datasheet or through MS Office Excel. The sets of data coded and inputted in the spreadsheet application and subjected to statistical analysis using the MS Excel Data Analysis ToolPack and the weighted means were computed on each item in the evaluation. After the statistical treatments, the results were analyzed and interpreted based on the purpose of the study.

C. Instrumentation

An interview guide was formulated in order to understand the technical terms and the processes that were involved during the data gathering. Specific terms on the datasets were considered for better understanding which was validated by the DepEd ICT coordinator. The study used the secondary data or dataset of DepEd schools.

Google Survey form was utilized to determine the extent of compliance of the system which was based from an international standard, ISO 25010:2011 Software Quality Model[3], which is rated in eight dimensions namely: Efficiency, Usability, Reliability, Portability, Maintainability, Functional Suitability, Compatibility and Security. The test case scenario was answered using a 5-point Likert scale.

D. Data Analysis

To determine the challenges encountered by the DepEd National in terms of the general management of Dep. Schools in the country, the Google survey form was prepared. To determine what GIS application is appropriate for DepEd Schools and the features of the GIS-based application in the general management of the DepEd Schools in the Philippines, content analysis was employed.

The descriptive statistical tool used in the evaluation of the developed system was the Weighted Mean. This was used to calculate for the extent of compliance to ISO 25010 of the developed GIS-based application. The extent of compliance

of the system was rated using the Likert Scale shown in Table 2.

Table 2. *Measurement of the Extent of Compliance to ISO 25010:2011 Software Quality Standard*

Mean Range	Descriptive Equivalent
4.20 – 5.00	Compliant to the very high extent
3.40 – 4.19	Compliant to a high extent
2.60 – 3.39	Compliant to a moderate extent
1.80 – 2.59	Compliant to a low extent
1.00 – 1.79	Compliant to the very low extent

III. RESULTS AND DISCUSSION

A. Challenges Encountered by the DepEd National in terms of the general management of DepEd schools in the country

As the education system transitions into the "new normal", DepEd faces challenges in terms of the general management of DepEd schools in the country. These challenges were determined using the Google Survey Form on the Challenges Encountered by the DepEd National in Managing the DepEd schools in the country. Table 3 presents the challenges encountered by the DepEd National in the general management of DepEd schools in the country.

Table 3. Challenges Encountered by the DepEd National in Terms of the General Management of Deped Schools in the Country
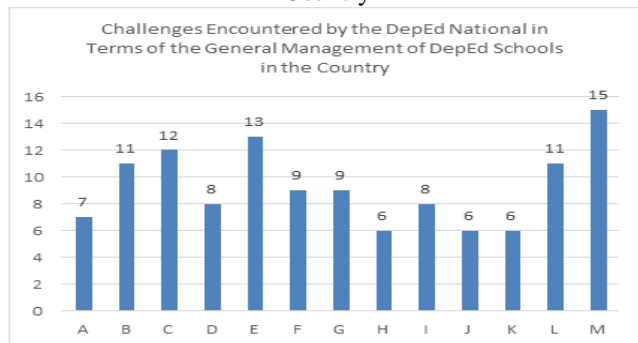

A. Limited means of notifications regarding school related information
B. Limited capacity building activities on ICT
C. Lack of real time platform to manage the DepEd schools in the country
D. Limited technical support in the ICT service
E. Limited capacity to develop ICT-enabled applications
F. Limited support in developing ICT-enabled solutions
G. Limited delivery in education governance through the use of ICT
H. Limited mechanism of receiving, processing and analyzing information from the DepEd schools
I. Misuse of ICT facilities
J. Wasteful utilization of resources
K. Limited platform to provide school information in terms of geographic location
L. Limited network-based applications/systems in DepEd schools
M. Limited capacity in managing sustainable programs or projects related to ICT

Table 3 revealed that the top 5 challenges encountered by the DepEd School in the general management of DepEd schools in the country is the limited capacity in managing sustainable programs or projects related to ICT, limited capacity to develop ICT-enabled applications, the lack of real time platform to manage the DepEd schools in the country, limited capacity building activities on ICT and limited network-based applications/systems in DepEd schools. This may be attributed to the fact that there is no existing platform used by the DepEd National in the general management of DepEd schools.

B. Application appropriate in the General Management of DepEd Schools in the Country

In terms of the application that is appropriate in the general management of DepEd schools in the country, content analysis was employed. Based from the result of analysis, the GIS-based application developed for DepEd schools was found to be the appropriate application just in time to the "new normal" set-up brought about by Covid-19 pandemic to monitor the DepEd schools in the country. This was supported by the result of the survey conducted about the possible applications to be addressed by the DepEd school and the application that would likely be developed in the future. Tables 4 and 5 revealed that the GIS-based applications and Information Systems is the top application that needs to be addressed.

Table 4. Possible Applications to be addressed by the DepEd Schools
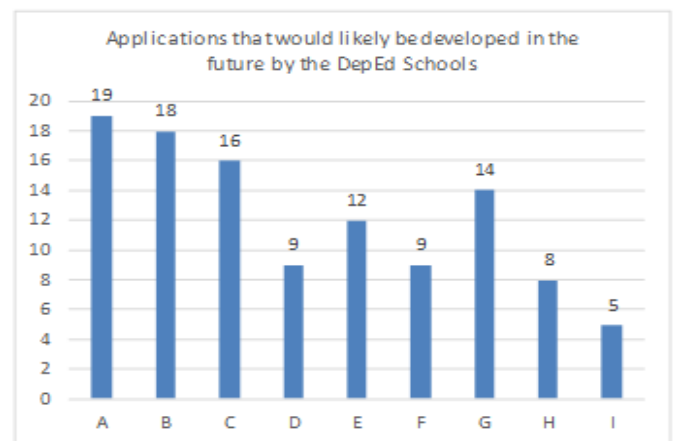
A. GIS-based applications and Information Systems
B. Web Applications
C. Mobile Applications
D. Game Application Development
E. Database System Applications
F. Application of Artificial Intelligence
G. Human-Computer Interaction on Education
H. Application of Robotics
I. Data Mining Applications

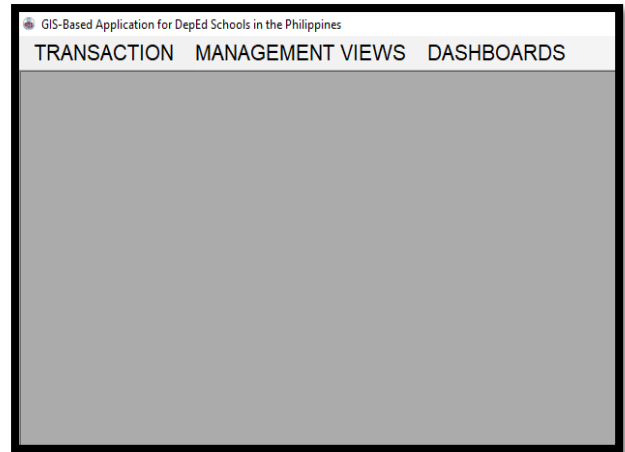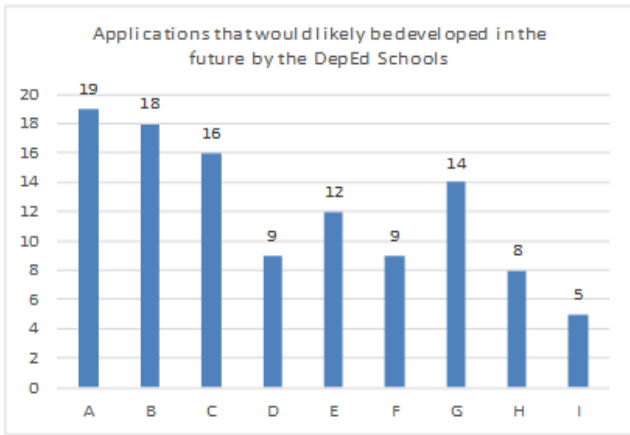Table 5. Applications that would likely to be developed in the future by the DepEd Schools.

C. The Application: "GIS-Based Application for DepEd Schools in the Philippines using Spatial Data Analysis"

The GIS-Based application for DepEd schools in the Philippines explored the development of a platform using Spatial Data Analysis in order to provide information that is necessary which forms part of monitoring DepEd schools which eventually aid in the decision-making activities of the organization.

Based on the result of the application development, screenshots necessary for the achievement of the objectives are presented in the succeeding paragraphs.

To access the system, you need to log-in as shown in Fig 2.

Fig 2. Log-in Window

After successfully entering the user name and password, the main window will be displayed as shown in Fig 3 with four main modules namely: Transaction, Management Views and Dashboards.

Fig3. Main Window

The Transaction Window contains two sub-modules namely Map and Check Internet Connection as shown in Fig 3. The map presents the DepEd schools in the Region, Province and Municipality with its curricular offering.
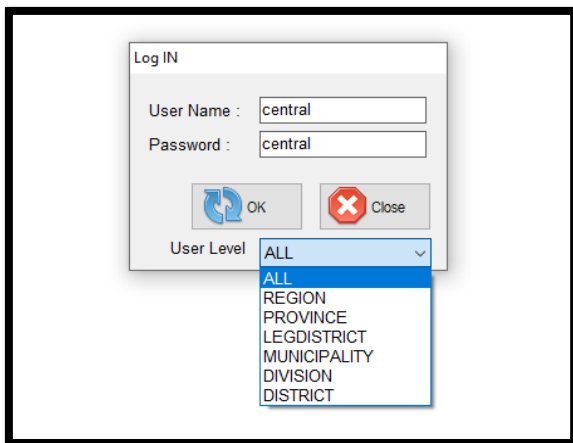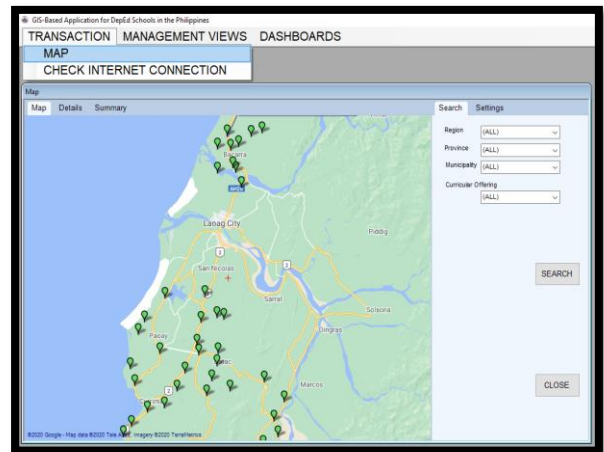

Fig 4. Transaction Window

Fig 5 shows the Management View Window. This shows the number of school district, number of school by municipality, number of students by school district, number of students by municipality, number of teachers by school district, number of teachers by municipality, number of schools, teachers and students, list of schools with no number of teachers submitted, list of schools with no number of students submitted which can be used in monitoring the DepEd schools and help support in the decision making activities of the DepEd school.
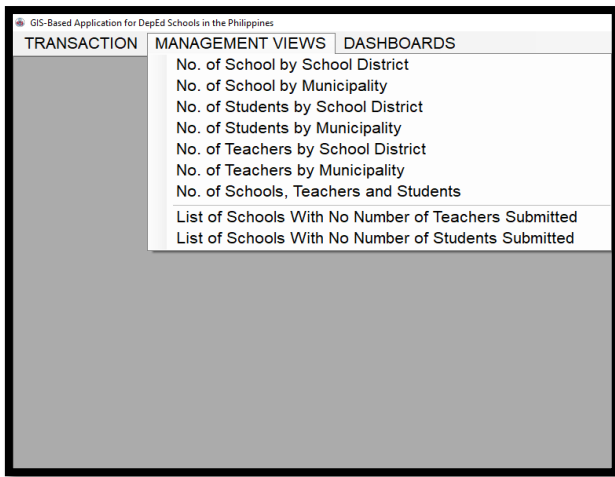
Fig 5. Management Views

Fig 6 shows the Dashboard for School. This shows the region, school type, sector, Modified Curriculum, Classification of schools and the number schools based from the classification. The information is used to provide reports which is updated in real time based on the inputted school data.
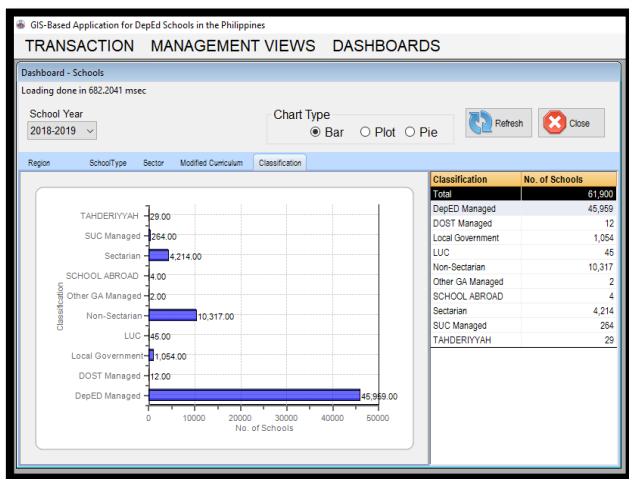

Fig 6. Dashboard for the School by School Year

D. Extent of Compliance of the Proposed GIS-Based Application to ISO 25010:2011

Table 6 presents the summary of evaluation of the IT experts and DepEd ICT coordinators in terms of the platform developed. Interestingly, results show that IT experts have higher evaluation rating of the platform across all criteria than that of the DepEd ICT Coordinators' rating. This could be attributed to their difference of perspectives as IT experts view the evaluation criteria according to the known design principles whereas the DepEd ICT Coordinators rely on their experiences in their work environment. There may be differences of rating, unarguably the platform is perceived to be compliant to a very high extent with an overall weighted mean of 4.61. This implies that the platform has 'Outstanding' performance on all of the criteria as defined.

Table 6. Summary of the System Evaluation

Indicators	IT Experts	DepEd Schools	Overall Mean	Descriptive Equivalent
1. Efficiency	4.93	4.90	4.92	Compliant to a Very High Extent
2. Usability	4.90	4.86	4.88	Compliant to a Very High Extent
3. Reliability	4.92	4.88	4.90	Compliant to a Very High Extent
4. Portability	4.92	4.88	4.90	Compliant to a Very High Extent
5. Maintainability	4.91	4.88	4.90	Compliant to a Very High Extent
6. Compatibility	4.93	4.90	4.92	Compliant to a Very High Extent
7. Functional Suitability	4.93	4.90	4.92	Compliant to a Very High Extent
8. Security	4.93	4.80	4.87	Compliant to a Very High Extent
Category Mean	4.92	4.88	4.90	Compliant to a Very High Extent

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