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Visualization of the Distribution of Formal and Non-Formal School Locations in Asahan Regency Based on GIS

Visualisasi Penyebaran Lokasi Sekolah Formal dan Non-Formal di Kabupaten Asahan Berbasis SIG

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A B S T R A C T

Equal access to education remains a key challenge in the development of human resources at the regional level. Asahan Regency is home to a variety of formal and non-formal educational institutions spread across multiple districts. However, the distribution data of these institutions is still fragmented and not yet integrated into a centralized system. This study aims to map the locations of formal and non-formal schools registered under the Department of Investment and One-Stop Integrated Services (DPMPTSP) in Asahan Regency using Geographic Information System (GIS) technology. The developed system presents spatial information through an interactive digital map that helps the public locate schools according to their needs and supports the local government in planning equitable distribution of educational facilities. In addition, the system includes a feature that allows school administrators to upload administrative documents digitally, thereby streamlining the registration process at the Public Service Mall. The research employs a descriptive qualitative approach with data collection techniques such as observation, documentation, and interviews. The results show that GIS implementation effectively provides accurate visualizations of school distribution patterns and helps identify areas lacking in educational facilities. The system also enhances the efficiency of the administrative process for school licensing.

Keyword: Geographic Information System, School Mapping, Formal Education, Non-Formal Education

A B S T R A K

Pemerataan akses pendidikan merupakan salah satu tantangan utama dalam pembangunan sumber daya manusia di daerah. Kabupaten Asahan memiliki berbagai lembaga pendidikan formal dan non-formal yang tersebar di berbagai kecamatan, namun informasi sebarannya masih tersebar dan belum terdokumentasi secara terintegrasi. Penelitian ini bertujuan untuk memetakan lokasi sekolah formal dan non-formal yang terdaftar di Dinas Penanaman Modal dan Pelayanan Terpadu Satu Pintu (DPMPTSP) Kabupaten Asahan menggunakan teknologi Geographic Information System (GIS). Sistem yang dikembangkan menampilkan informasi spasial berupa peta interaktif yang memudahkan masyarakat dalam mencari sekolah sesuai kebutuhan, serta mendukung pemerintah daerah dalam perencanaan pemerataan fasilitas pendidikan. Selain itu, sistem ini dilengkapi dengan fitur unggah berkas secara digital bagi admin sekolah untuk mempermudah proses administrasi ke Mal Pelayanan Publik. Metode penelitian yang digunakan adalah pendekatan kualitatif deskriptif dengan teknik pengumpulan data berupa observasi, dokumentasi, dan wawancara. Hasil dari penelitian ini menunjukkan bahwa pemanfaatan GIS mampu memberikan visualisasi yang akurat terhadap pola penyebaran sekolah dan membantu identifikasi wilayah dengan kekurangan fasilitas pendidikan. Sistem ini juga meningkatkan efisiensi proses administrasi perizinan sekolah.

Kata Kunci: Sistem Informasi Geografis, Pemetaan Sekolah, Pendidikan Formal, Pendidikan Non-Formal

1. INTRODUCTION

Educational progress plays a strategic role in improving the quality of human resources and promoting regional development. The presence of equitable educational facilities is an important factor in ensuring decent access to education for all members of society[1]. Asahan Regency, as one of the regions in North Sumatra Province, has a variety of formal and non-formal educational institutions spread across several sub-districts. Formal education includes levels of Elementary School (SD), Junior High School (SMP), and Senior High School (SMA), while non-formal education encompasses Playgroups (KB), Kindergartens (TK), Community Learning Centers (PKBM), as well as course and training institutions.

However, information regarding the distribution of educational institutions in Asahan Regency remains scattered across various sources and lacks systematic integration. This limitation hinders access for the community, educators, and policymakers to accurate and comprehensive data on the locations and number of available schools. As a result, it may impede educational planning efforts and the equitable distribution of educational facilities in the region [2]. Geographic Information System (GIS) offers a technological solution that enables spatial mapping and interactive visualization of location-based data [3]. By applying GIS, school distributions can be presented in the form of digital maps that assist stakeholders in analyzing school locations, identifying underserved areas, and helping the public find schools that best meet their needs[4].

This study aims to develop a Geographic Information System that provides a comprehensive and interactive visualization of the distribution of formal and non-formal schools in Asahan Regency. Additionally, the system includes administrative support features, such as the ability for schools to upload registration documents to the Public Service Mall (MPP). It is expected that the system will improve transparency, operational efficiency, and the overall quality of educational services in the region.

2. METHODOLOGY

This study employs a qualitative approach aimed at describing the distribution of formal and non-formal schools in Asahan Regency[5]. Data on school locations were obtained from the Investment and One-Stop Integrated Services Office (DPMPTSP) of Asahan Regency. The data were then analyzed and visualized using Geographic Information Systems (GIS). This visualization presents the distribution of schools in an interactive and informative manner, facilitating a better understanding of the spatial patterns of educational institutions in the area. The strategy used to obtain the necessary information for a research study is referred to as the data collection technique [6]. The information gathered may consist of secondary data obtained from existing sources or primary data collected directly from the source[7]. This data is then analyzed to produce findings and conclusions that align with the research objectives. An optimal and efficient data collection process is essential to ensure accurate and reliable research results [8]. The data collection techniques employed to map the distribution of formal and non-formal schools in Asahan Regency include:

1. Observation**:** Observation was conducted by directly monitoring the data collection process from relevant institutions, such as the Investment and One-Stop Integrated Services Office (DPMPTSP), to obtain data related to the locations of formal and non-formal schools [9] .
2. Literature Review**:** Secondary data was obtained through a literature review, which included books, articles, and journals related to GIS, school mapping, and web-based information systems.
3. The current system workflow refers to the sequence of processes used in managing and presenting information related to the distribution of formal and non-formal schools in Asahan Regency [10]. This process includes how school data is collected, recorded, and disseminated, as well as how the information is accessed by relevant stakeholders, such as administrators and the general public. At present, the system remains largely manual and is not yet based on a Geographic Information System (GIS), which may affect the effectiveness of data delivery to the public.
4. Currently, the management of information regarding formal and non-formal schools is still carried out using simple documents, such as PDF files or spreadsheets, which are stored internally by the Investment and One-Stop Integrated Services Office (DPMPTSP) of Asahan Regency. Members of the public who require school location information must request access directly from the relevant office or rely on available physical documents. This workflow does not yet support interactive location searches on a digital map, thereby limiting the ease of accessing accurate and timely information [11].
5. The proposed system workflow is a series of processes designed to manage and present information more efficiently through a web-based platform integrated with Geographic Information System (GIS) technology[12]. This system enables the collection, processing, storage, and presentation of location data for formal and non-

formal schools in the form of an interactive map. The workflow includes data input by administrators, information searches by users, and interactions through location-based search features and spatial displays that facilitate understanding and support decision-making.
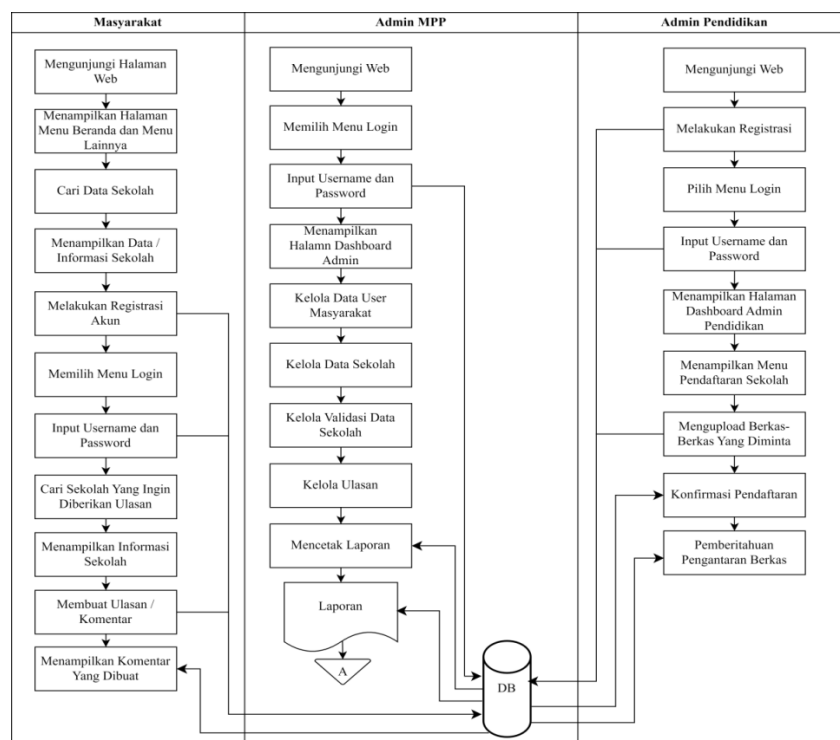

Figure 1. Proposed Information System Flow

Figure 1 illustrates the proposed information system workflow, which integrates GIS technology to manage and present school location data through an interactive web platform. The process includes data input, spatial search, and user interaction to support efficient information access and decision-making.

6. The system development was carried out to build a web-based platform that presents information on the distribution of formal and non-formal schools in Asahan Regency by utilizing Geographic Information System (GIS) technology [13]. The system offers features such as account registration, login, school data search, user reviews from the public, and data management by DPMPTSP administrators. Education administrators can also register new schools by uploading the required documents. All activities by users and administrators are recorded in the database to support administrative and reporting needs. The system is developed using PHP with the CodeIgniter framework, a MySQL database, and interactive maps powered by Leaflet because this is make easy system. It will be implemented following a testing phase and user training to ensure optimal system performance [14].

3.   RESULTS AND DISCUSSION

The result of this study is the implementation of a system based on Geographic Information System (GIS) technology to map the distribution of formal and non-formal schools in Asahan Regency. The system is designed to facilitate public access to information about officially registered schools, as well as to support the performance of the Education Office and the Investment and One-Stop Integrated Services Office (DPMPTSP) in managing educational data. Developed as an interactive web-based platform, the system displays information such as school names, addresses, and educational categories through a digital map that can be accessed in real time. Equipped with features such as school search, user reviews, and data management by administrators, the system contributes to equitable access to educational information, supports regional planning, and improves the efficiency of public

information services. With this system, the problem of difficulties in finding information on formal and non-formal schools can be addressed. The user interface of the Geographic Information System is presented as follows:
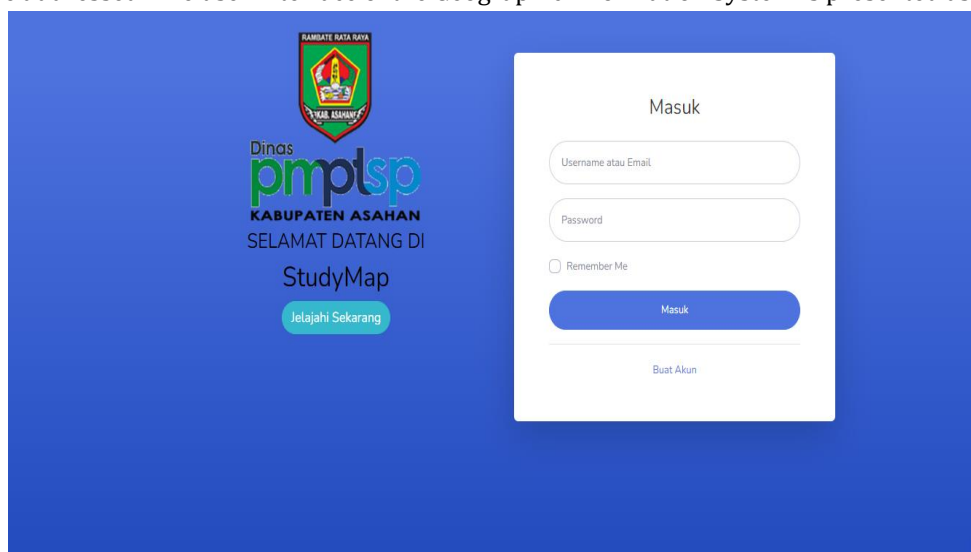

Figure 2. Login form interface

The login interface allows MPP administrators to manage school data and reviews, education administrators to submit school data, and the public to search for school information and provide reviews. Users can log in using a username/email and password, and are provided with options to register or reset their password. After logging in, the administrator will be directed to the dashboard page, which provides a summary of information including the number of schools, types of education, districts, and registered educational programs. The administrator can access various menus on the sidebar to manage school data, user accounts, and reviews as illustrated in Figure 2.
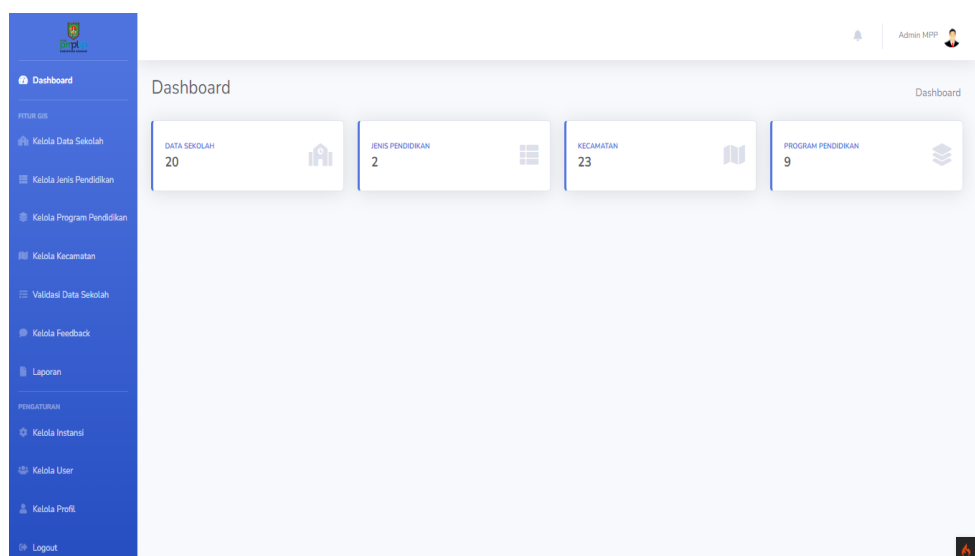

Figure 3. Display of the Dashboard Menu for MPP Administrator

After that, we can view the distribution results of the formal and non-formal schools that have been entered data with some sample, as shown in Figure 3 below.
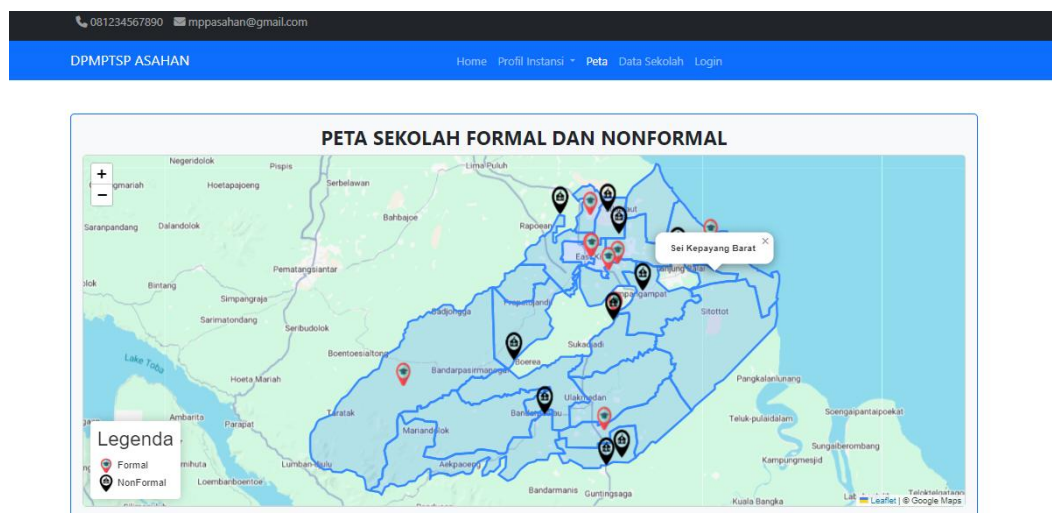
Figure 4. Interface of the map view page

The map view interface displays the distribution of formal and non-formal schools based on geographic location. Users can interact with the map by zooming, panning, and clicking on markers to view detailed information about each school, such as name, address, type of education, and available programs. This interactive feature enhances spatial understanding and helps users make informed decisions based on location data, as shown in Figure 4.

The spatial distribution analysis of formal and non-formal schools in Asahan Regency reveals a pronounced clustering of formal institutions (elementary, junior high, and senior high schools) in the central area of Kisaran and adjacent subdistricts. This observation is consistent with Satria et al.'s finding that public services, including educational facilities, concentrate around regional administrative centers [1], and with Chen et al.'s identification of multi-center clustering of educational resources in major urban agglomerations [15].

Non-formal education providers (playgroups, kindergartens, community learning centers, and vocational courses) show a more dispersed pattern extending into peripheral villages. Nevertheless, subdistricts with hilly terrain and limited paved roads, particularly along the western coast, host only one or two schools of any type. Junior et al. referred to these under-served zones as educational black spots, linking them to inadequate transportation infrastructure [3].

On the technological front, the WebGIS framework developed by Abdurrohman and Utami, which integrates Leaflet with a CodeIgniter backend, proved capable of combining diverse data sources while maintaining a responsive user interface [4]. Our platform extends this model by adding a document-upload module and interactive review capabilities, thereby enriching each school's metadata. A comparable large-scale approach using point-of-interest data and geographic detectors further demonstrates the value of spatial analytics in uncovering the determinants of educational facility placement [5].

This discussion underscores the necessity of continuous collaboration among local government agencies, educational institutions, and community stakeholders to ensure data accuracy and completeness. Recommended next steps include incorporating accessibility layers such as distance to public transit stops, performing network-based travel-distance analyses, and integrating student demographic profiles. By evolving the WebGIS into a dynamic decision-support system rather than a static map, regional planners can more effectively promote equitable distribution of educational resources in Asahan.

4.   CONCLUSION

This study successfully designed and developed a WebGIS system that displays the distribution of formal and non-formal schools in Asahan Regency. The system was developed to facilitate public access to information regarding school locations, types of education, and available educational programs in the area. In addition, the system helps MPP administrators and education administrators manage school data in a centralized and efficient manner. Testing results show that all main features function properly according to each user's access rights. With the presence of this system, it is expected that educational information in Asahan Regency can be delivered more transparently and support the planning of equitable distribution of educational facilities across the region.

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