DEVELOPMENT OF GEOGRAPHIC INFORMATION SYSTEM IN EDUCATION BY USING THE RATIONAL UNIFIED PROCESS IN BANDUNG

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ABSTRACT

Education must be obtained and guaranteed by the government with quality and equitable services in all regions in Indonesia. Geographic information systems become one of the solutions that can help the process of equitable education and help the government take appropriate actions. This study discusses how the development of a website-based geographic information system that can be used to map the distribution of educational data in the city of Bandung using the Rational Unified Process (RUP) and Unified Modeling Language (UML) methods for system modeling. The process of making maps in this study uses Quantum GIS (QGIS) software with database storage using PostgreSQL. The output target of this study is in the form of a geographic information system website mapping educational data distribution in the city of Bandung. This website is created as a graphic summary dashboard based on the spatial field of education so that the public and government can easily draw conclusions about the distribution of existing education such as knowing the balance of the number of schools, teachers and students in an area that can affect the quality of teaching and learning activities in schools and the quality of education in that area.

Keywords: Education, Webgis, RUP, GIS, Qgis

INTRODUCTION

Geographic Information Systems (GIS) are systems that can be applied in various fields of science, events, and occupations that require good and interactive spatial data display so that system users can more easily understand the concepts of data distribution in education, population, location, spatial, etc (Hamdani & Virgana, 2019). An example of the application of GIS in the field of education is GIS distribution of educational data that results in thematic maps of the distribution of schools in an area, this map can be used for analysis of school distribution and assisting in the distribution of education programs in the area.

The zoning system is one of the efforts of the Indonesian government to realize equitable access to services and quality of education throughout Indonesia as stated in Law No.20 of 2003 concerning the National Education System Chapter IV Article 5 (1) namely that every citizen has the same right to get a quality education. And Article 11 (1), namely the Government and Regional Governments must provide services and facilities, as well as guarantee the quality of education for every citizen without discrimination (Pemerintah Indonesia, 2003). With this zoning system, it is expected to be able to overcome problems around education such as student capacity, inequality of infrastructure, and equitable quality of teachers.

The purpose of this study is to create a website-based geographic information system that maps the distribution of educational data including schools, teachers, students and zoning in the city of Bandung. This mapping is expected to help the educational equality process and help the government take appropriate actions. To create this system, researchers used Rational Unified Process (RUP) software development methods with Unified Modeling Language (UML) modeling language tools. In addition, for the process of making maps using Quantum GIS (QGIS) software, while for database storage using PostgreSQL. QGIS (Quantum GIS) is a free desktop geographic data (GIS) framework application that is used to survey, change, and investigate geospatial information. The advantages that QGIS has besides being free are a shorter preparation time, good rendering capacity, and are easy to use in making GIS Applications (Khan & Mohiuddin, 2018). PostgreSQL is an open source object relational database system (ORDBMS) that uses standard SQL as an interface language and uses a GiST index that can be used to index geometric data types, as well as full text search (Makris, Spiliopoulos, Tserpes, & Anagnostopoulos, 2019). In PostgreSQL there is a special extension called PostGIS which integrates several geographical functions and supports geographical objects and geometry types for Points, LineStrings, Polygons, MultiPoints, MultiLineStrings, MultipPolygons and GeometryCollections. GIS in this study is a Web-based Geographic Information System (WebGIS), a geographic information system (GIS) application that uses a computer network to integrate and convey geographical information in the form of map data visualization on the World Wide Web (Rizky, Nugraha, & Wijaya, 2015).

In the literature, several examples of educational mapping can be found. There is a paper discusses about the analysis of the spatial distribution of kindergarten facilities in the Mukalla district in Yemen (Lagrab & Aknin, 2015). Another paper discusses about school mapping and school geospatial analysis in Jasra block of Allahabad district, India (Agrawal & Gupta, 2016).

METHODS

To define a good software project flow, researchers use the Rational Unified Process (RUP) software engineering approach developed by IBM, and can be done repeatedly (iteratively) as shown in Figure 1 (Mubarok, Harliana, & Hadijah, 2015).

RUP has 4 stages or phases, namely inception, elaboration, construction, and transition. Inception is the first stage that is doing business modeling and identification of system requirements to be made. Elaboration (expansion/planning) is the stage of architectural planning, analysis and system design. Construction is the stage of developing, implementing and testing the system. Transition is the stage of system installation, user training, system maintenance and testing.

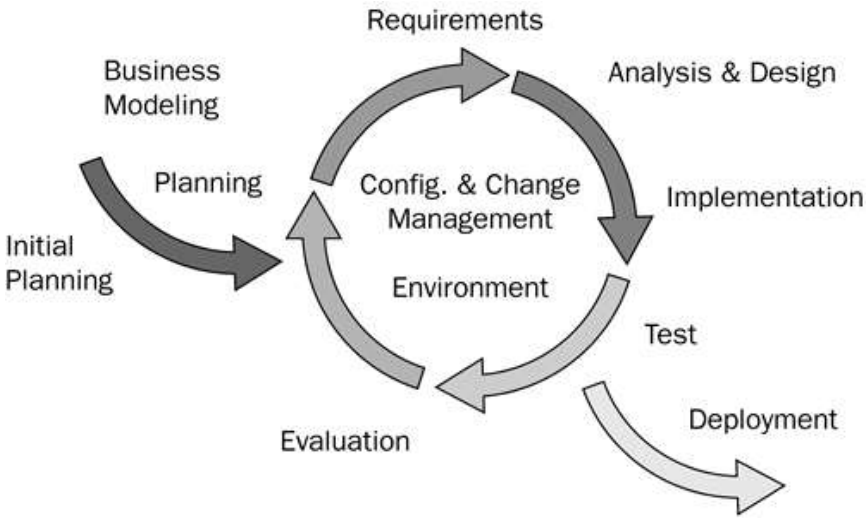

Figure 1. RUP Iterative Process

RESULTS AND DISCUSSION

In this section the results of the research carried out will be described. From the research that has been done, some data on the distribution of Bandung city education in the Bandung City Education Office has not been visualized into a map and is still in the form of a table. This makes the data distribution of education such as the distribution of schools, teachers and students difficult to understand directly and requires further analysis to obtain information about the distribution of data needed. The following is an example of data on the number of primary schools in the city of Bandung in the form of a table as shown in Table 1 and 2.

Table 1. Sample Data on Number of Public and Private Primary Schools in Bandung City

No.	ID	Sub-district	Number of public elementary schools	Number of private elementary schools
1	3273050	Astanaanyar	11	6
2	3273190	Cicendo	15	12
3	3273070	Lengkong	11	11
4	3273110	Cibiru	12	2
5	3273111	Panyileukan	5	3
6	3273250	Sukasari	15	7
7	3273030	Bojongloa Kaler	5	5
8	3273010	Bandung Kulon	17	10
9	3273210	Cibeunying Kidul	10	6
10	3273170	Sumur Bandung	5	9
11	3273230	Coblong	14	8
12	3273130	Arcamanik	10	7
13	3273150	Kiaracondong	13	4
14	3273040	Bojongloa Kidul	7	7
15	3273020	Babakan Ciparay	13	7
16	3273060	Regol	13	9
17	3273180	Andir	6	18
18	3273240	Sukajadi	13	10
19	3273101	Gedebage	5	2

Table 2. Sample Data on Number of Public and Private Primary Schools in Bandung City (continue from table 1)

No.	ID	Sub-district	Number of public elementary schools	Number of private elementary schools
20	3273100	Rancasari	5	3
21	3273080	Bandung Kidul	6	3
22	3273141	Antapani	10	4
23	3273142	Mandalajati	10	3
24	3273220	Cibeunying Kaler	6	4
25	3273160	Batununggal	10	6
26	3273260	Cidadap	7	8
27	3273121	Cinambo	2	0
28	3273090	Buahbatu	9	3
29	3273200	Bandung Wetan	2	15
30	3273120	Ujung Berung	7	1

To facilitate the process of designing a geographic information system website for the distribution of Bandung city education data, researchers used UML diagrams that are easy to learn and illustrate systems with different perspectives (De Sousa, Kelvin, Neto, & De Carvalho, 2017). UML diagrams used by researchers are usecase diagrams with 2 actors namely Admin and Public. Admin in this system is the official of the education office in charge of managing the GIS website and the Public is another user such as the public or parties who need information on the distribution of educational data, the user can only view maps on this GIS website as shown in Figure 2.

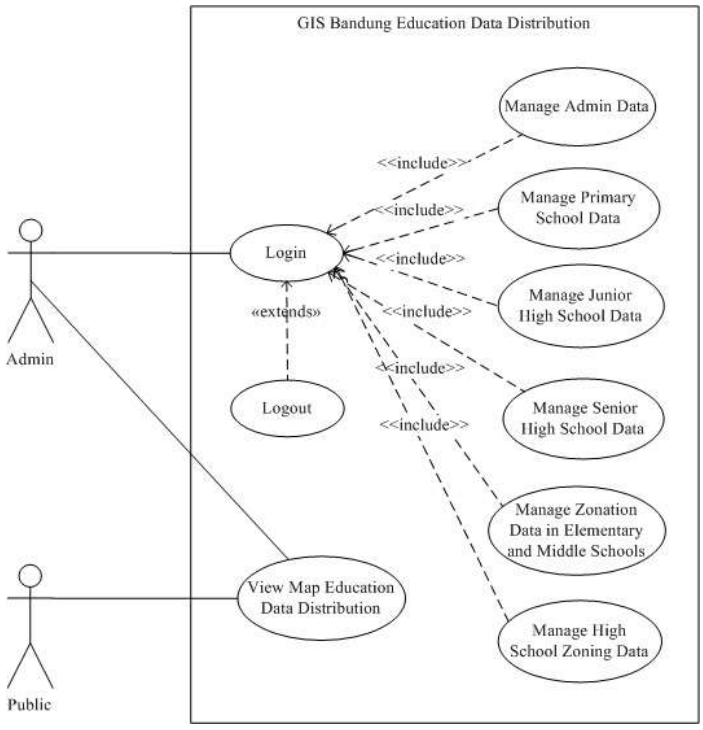

Figure 2. Usecase Diagram of WebGIS Bandung Education

The following Figures 3, 4 and 5 which are examples of the appearance of a geographic information system website that has been designed:

Figure 3. Display Page Home Website GIS Bandung Education

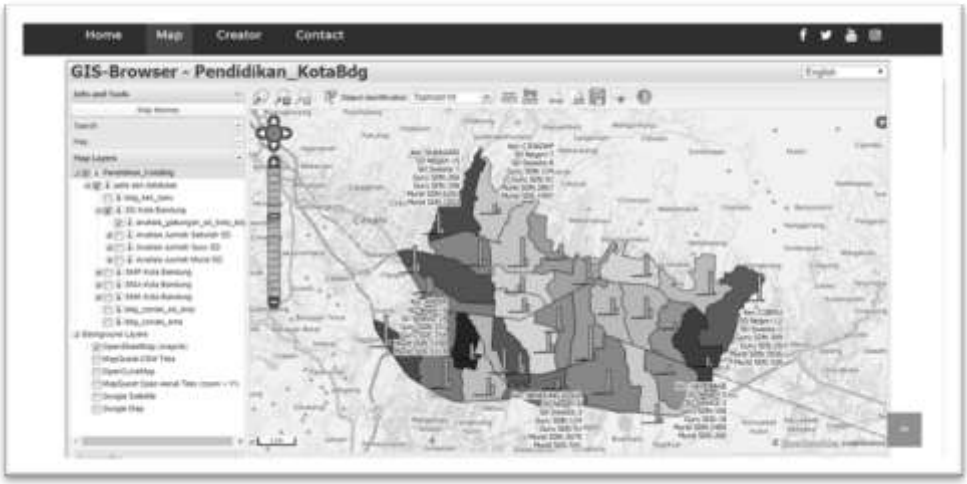

Figure 4. Display Page Map Website GIS Bandung Education

Figure 5. Display Page Login Admin Website GIS Bandung Education

Figure 3 is the main page display/ home website of the Bandung city education geographic information system which contains some information related to the Bandung city education department. Figure 4 is a map or map page that can be accessed by the public and the admin. On the map or map page there are several maps of education analysis in the city of Bandung such as the analysis of the number of schools, teachers and students of elementary, junior high, high school, and vocational education. This map is equipped with captions, histogram diagrams, and different colors to make it easier and faster to understand. Figure 5 shows the login page for the admin to be able to enter the admin dashboard page to manage map and website data.

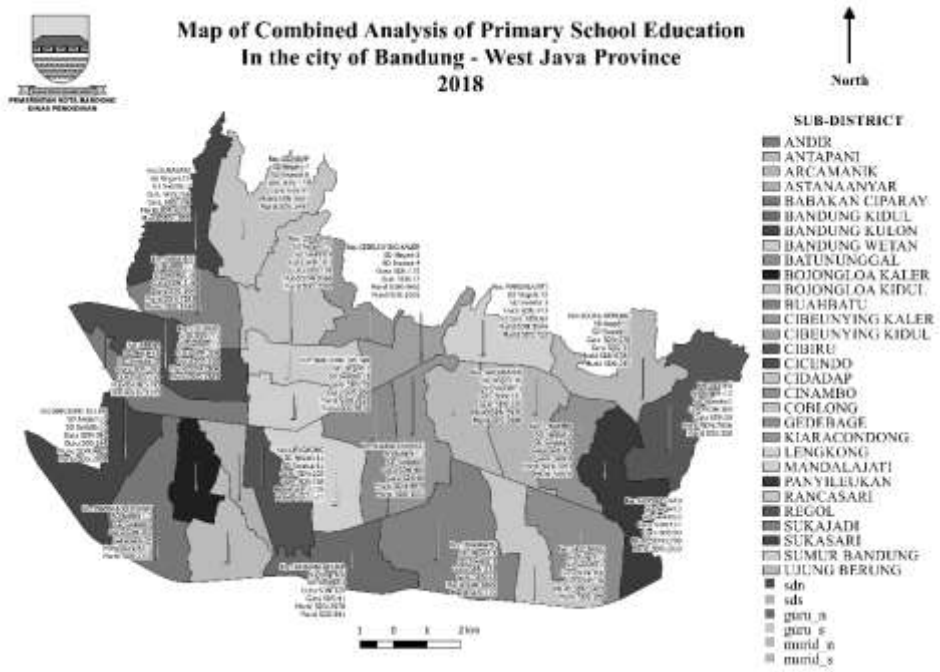

Figure 6. Map of Combined Analysis of Education in Primary School with Legend

Figure 6 is a map of the analysis of education based on districts in the city of Bandung that has been made. Figure 6 also features a legend that shows districts and information for charts of the number of public and private primary schools, the number of teachers, and the number of students.

In this study the researchers conducted a blackbox testing process to test the website to function as expected. Testing is done by testing the function, appearance, and navigation of the website. Blackbox test results can be seen in the following table:

Table 3. Website Display and Navigation Test Results

No.	Tested Functions	Testing Scenarios	Expected results	Test result	
1.	Displays website	Run a local web server, then access the website through a browser.	The browser can display web pages	According to expectations	Succeed
2.	Display the home page	Access the Home page through the Home menu navigation.	The browser can display the Home page	According to expectations	Succeed
3.	Displays the Map page	Access the Map page via the Map menu navigation.	The browser can display the Map page	According to expectations	Succeed
4.	Displays the Creator page	Access the Creator page via the Creator menu navigation.	The browser can display the Creator page	According to expectations	Succeed
5.	Displays the Contact page	Access the Contact page through the Contact menu navigation.	The browser can display the Contact page	According to expectations	Succeed
6.	Display the Login page	Access the Login page via the Login menu navigation.	The browser can display the Login page	According to expectations	Succeed

Table 4. Process Function Testing Results on the website

No.	Tested Functions	Testing Scenarios	Expected results	Test result	
1.	Perform the login process	Fill in your username and password correctly as they are registered in the database, then click Enter.	Login successful	According to expectations	Succeed
		Fill in the username correctly and fill in the wrong password, then click Enter.	Login failed	According to expectations	Succeed
		Fill in the wrong username and fill in the password correctly, then click Enter.	Login failed	According to expectations	Succeed
		Fill in the wrong username and fill in the wrong password, then click Enter.	Login failed	According to expectations	Succeed
		Leave the username and password field blank, then click Enter.	Login failed	According to expectations	Succeed
2.	See a map of the distribution of educational data	Enter the Map menu then select the analysis result you want to display.	The map of the selected analysis results is displayed	According to expectations	Succeed
		Enter the Map menu and then don't select the results of the analysis.	Map of analysis results is not displayed	According to expectations	Succeed

CONCLUSION

Geographic information system website for educational data that is designed can present thematic maps of the distribution of educational data in the city of Bandung in the form of a more interesting, informative, and accessible visualization at any time. With this system, it can also help the process of analyzing the distribution of education that is useful for the government in making decisions regarding the distribution of education in the city of Bandung. In addition, residents of the city of Bandung get information about the distribution of education in the city of Bandung easily and quickly.

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