

# Mapping Teacher Distribution Analysis with Digitation Technology Implementation to Improve Education Management in Bengkulu City

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**Abstract**—Embedded technology in education management is one of the most important things as an aid for Education Department. Not only help in learning process, the use of technology has been also used in many part of education to improve learning process. In this paper, we proposed the idea of mapping the digitation of High School (SMA) in Bengkulu city to manage the teacher distribution. The technology is based on mobile and web to see the mapping and comparison between subject among Senior High School in Bengkulu city. The system has been tested by using black box method that showed 100% right in quantity result and gaining 86.8% in user satisfaction. Social science ratio for Geography:Sociology:Economy are in 24:31:69, while the ratio in science for Physics:Biology:Chemistry are in 16:26:23. Furthermore, this research can be extended to map the teacher distribution for all school in Bengkulu city to improve the process of education management. This data can also be used for another research such as informatics to retrieve the knowledge inside the data by using machine learning algorithm.

**Keywords**—*technology; mapping; educational management; teacher distribution; Bengkulu*

## I. INTRODUCTION

Digitation of teacher in education planning, originally developed by educational planners in France in 1959, in an effort to solve the problem of renewing the structure of education in the country and research activities to meet real needs [1,2]. Then it was intensively tested by IIEP (International Institute for Education Planning). Finally, UNESCO realized and recognized its usefulness both in the context of the use of educational funding sources that were limited as efficiently as possible, and to encourage increasing equal treatment or even distribution in an education system. Teacher distribution mapping is an effort that helps in regional education planning [3,4]. It includes two meanings, namely processes and products or results, so it's not just a map. Product mapping is a description of the educational situation of a region in terms of quantitative education variables, demographic data, geographical conditions and expected conditions in the future. The digitation process is an activity which stages include:

- Preparation of necessary statistical data, routine data and non-routine data;

- Procurement of maps on a certain scale;
- Determination of standards about teachers, student and ratio between the student and teachers to meet the goal of learning process;
- Activities preparing formats;
- Analyzing the data collected and comparing it with standards to develop recommendations on efforts to develop educational facilities and infrastructure quantitatively and qualitatively (at this stage of activity the school location is determined).

Senior High School is a secondary education level in formal education in Indonesia after graduating from junior high school (or equivalent). High school duration is 3 years, starting from grade 10 to grade 12. This stage is a very important due to the level of this school must be prepared for university level where the students are supposed to have a better critical thinking [4]. To improve this critical thinking and to develop the basic knowledge of the students, it is important for them to be taught by high quality of teacher which is expert on their subject. Not only for the need of finding their path of subject, the student would also need the teacher for their role model. By, this subject, the government need the system that monitor the distribution of teachers for school to improve the decision process.

Seeing the extent of the problems that were worked out in teacher distribution can be thought about how many types of disciplines or knowledge that helped to provide assistances. Mapping the teacher distribution is very dependent on the education system, existing regulations or regulations, socio-economic conditions and so on [5-7]. By using the digitation technology with mobile and website technology, the problem of teacher distribution mapping can help the process of management in education. This implementation is synchronized with the development and the use of spatial data in the past decade that has increased dramatically. This is also related to the widespread use of Geographic Information Systems (GIS) and technological developments in acquiring, recording, and collecting spatial data [8]. Information systems or data based on space at this time is one of the most important

elements, because it serves as the foundation in implementing and supporting various kinds of applications. An example of an application that can be made since GIS is a school mapping using the digitation.

In this research, we tried to develop the digitation of teacher distribution in senior high school level to know the distribution of teacher in Bengkulu city [4,9]. The android system and Code igniter were occupied to empower the system of teacher distribution to see the data.

## II. METHOD

Teacher distribution is closely related to allocation planning and school location. What is meant by teacher allocation is the number of specific teachers that have been planned or determined for an area to reach its target. Whereas what is meant by the location of the teachers is the location or where the teacher is teach students. Teachers distribution in order to provide learning places for those who are of school age and plan changes in the organizational structure of the school system. School mapping is a macro or regional planning approach that uses geographical maps as a tool to demonstrate and explain plans. School mapping is an effort to help plan education in the region.

### A. Data Collection Techniques

1) *Observation*: The process of collecting data is obtained by looking directly at the condition of the school and coming to the place of research by making observations and systematic recording of symptoms or phenomena that exist in the object of research. The observed data include, school coordinates and other information about the school in question.

2) *Interviews*: Interviews are a way to collect data by asking questions directly to an informant or an authority (an expert or authority in a problem). The data collection process would also record the data information of the teachers inside the school.

3) *The document*: This step was to collect data that already exists or is collected by the relevant schools. Data obtained by means of documentation in this study include the name of the school, the name of the principal, address, accreditation, year of establishment, land area, building area, facilities, coordinate points, class data, student data, teacher data, Administration data (TU), and Pictures and school history.

4) *Library studies*: This process is carried out by citing books, journals, e-journals and e-books intended to obtain references that can be used to discuss geographic information systems.

### B. System Development Model

1) *Analysis of system needs*: The geographic information system needed is a geographic information system that displays the map / floor plan / theme location of SMA (Senior High School) in Bengkulu city and provides other needed information that becomes a reference for the next stage, and formulates a system that will built.

2) *System design*: The steps that must be taken in designing of SMA (Senior High School) in Bengkulu city geographical information system are data analysis and system design [10]. To design the system using Use-Case Diagrams, Class Diagrams, and Sequence Diagrams.

3) *Coding*: Coding was done by using HTML, CSS, JQuery, PHP, XML, and Google Maps programming and database using MySQL. Android Studio is used for coding and application interfaces, and the Android SDK API 16 Android Oreo.

4) *Testing*: This stage is testing software that has been built, whether it is appropriate or not.

### C. Location

Our location of the study can be seen in Figure 1. Bengkulu city is one of the cities in Sumatra island. The city of Bengkulu with an area of 144.52 km<sup>2</sup>, is located on the west coast of the island of Sumatra with a coastline of about 525 km. The area of the city stretches parallel to the Bukit Barisan mountains and is directly opposite the Indian Ocean.

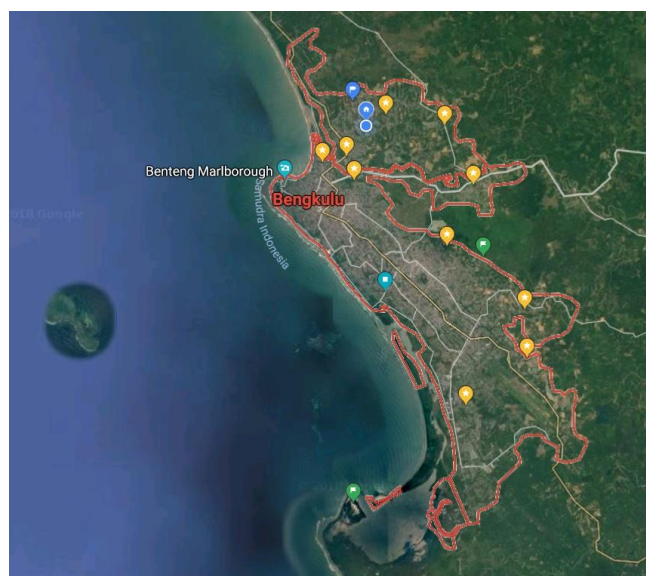


Fig. 1. Bengkulu city.

## III. RESULTS AND DISCUSSION

### A. Mapping Interface

In figure 2, we can see the process of digitation for the mapping process of digitation for Senior High School in Bengkulu city. With the digitation process the user of management can be easier to see the distribution of school and teach in Bengkulu city. The user could also use the data for further assessment for the better education process in Bengkulu city. The data would also show the area of the school for each district to see the equality of school distribution in Bengkulu.

The digitation process itself could be used the mobile application based on any platform that can be provide by the government. The assessment data can use original data that already stored in Province Bengkulu Government and Ministry. The existence of data that would be stored in server and would

be published in internet can also provide the real time information for public and internal development. The data that can be seen by public are about the school and the list of teachers available inside the current school. This information is one kind of development process to improve the understanding the need of the system inside the school.



Fig. 2. Digitation process for teacher distribution in Bengkulu City.

After the digitation and interview to collect the data of teacher distribution, described in Figure 2. The data collected from the schools were about the data of how many teachers are teaching in each school. The subjects collected in this paper were Maths, Chemistry, Biology, Physics, Economy, Counselling, History, Sociology, Economy, Crafting, Islam Education (PAI), Technology and Information science (TIK), Geography, Physical Exercise (PE), Civics, English and Bahasa Indonesia. From Figure 3 the teacher distribution in of High School in Bengkulu city in map can be seen properly. Furthermore, the result of digitation of teacher distribution were shown in figure 3.

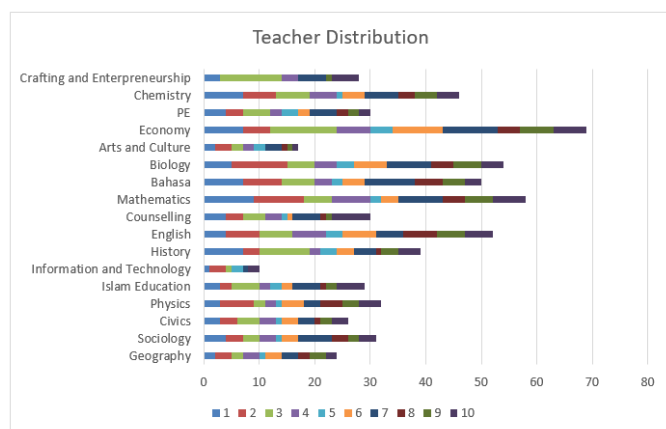


Fig. 3. Teacher distribution in senior high school in Bengkulu city.

## B. Results and Discussion

From the digitation process, the data were tabulated and presented as graphics in Figure 3. From Figure 3, the most amount of High School teacher in Bengkulu city is in subject of Economy, Math, and English respectively. While the lowest number of teachers were in subject Geography, Arts and Culture, and Information and Technology respectively. The lowest number of teachers in these subjects could be the indication that the hour's number of that subject is not as much as the main subject in High School Level.

Furthermore, the concern about this data is because the distribution of the number of teachers teaching in one school is also showing the unbalanced value. Some of the schools has zero number of some subject which is showing that there is no uniformity in education of High School level. It is shown in Information and Technology teacher distribution that showing unbalanced value since the new policy from local government about the subject of Information and technology in High School level. Another subject that showing unbalanced value were Crafting and Entrepreneurship, which showing some zero value for some schools. This is also the indication that each school has different policy for its subject that would be teach in the school.

In table 1 and 2 we can see the percentage of teacher distribution for each school and subjects. Each school should have 10% for each subject as the assumption for this research all of the schools are inside the normal distribution. In fact, the data shown that there is none of the subject has been equally distributed from the management of the school. The data shown that each school is independently manage the school without the participation and involvement from local government.

The biggest rate of distribution was in High School number 3 and High School Number 7. Each school has 10 classes for each level which are distributed equally between Science and Social Science. The rate of teacher distribution was overload in some subjects but limited in other subjects. This number could be the indication that the distribution of teacher in high school level in Bengkulu is based on the demand of the student without management process and planning.

TABLE I. PERCENTAGE OF TEACHER DISTRIBUTION IN SMA 1-5

	High School				
	1	2	3	4	5
<i>Geography</i>	2.66666667	<b>12.5</b>	8.33333333	<b>12.5</b>	4.16666667
<i>Sociology</i>	<b>12.9032258</b>	9.67741935	9.67741935	9.67741935	3.22580645
<i>Civics</i>	11.5384615	11.5384615	<b>15.3846154</b>	11.5384615	3.84615385
<i>Physic</i>	9.375	<b>18.75</b>	6.25	6.25	3.125
<i>Islamic Edu</i>	10.3448276	6.89655172	17.2413793	6.89655172	6.89655172
<i>Technology</i>	10	30	10	0	20
<i>History</i>	17.9487179	7.69230769	<b>23.0769231</b>	5.12820513	7.69230769
<i>English</i>	7.69230769	11.5384615	11.5384615	11.5384615	5.76923077
<i>Counselling</i>	13.3333333	10	13.3333333	10	3.33333333
<i>Mathematics</i>	<b>15.5172414</b>	<b>15.5172414</b>	8.62068966	12.0689655	3.44827586
<i>Bahasa Indonesia</i>	<b>14</b>	<b>14</b>	12	6	4
<i>Biology</i>	9.25925926	<b>18.5185185</b>	9.25925926	7.40740741	5.55555556
<i>Art</i>	11.7647059	<b>17.6470588</b>	11.7647059	11.7647059	11.7647059
<i>Economy</i>	10.1449275	7.24637681	<b>17.3913043</b>	8.69565217	5.79710145
<i>Physical Exercise</i>	13.3333333	10	16.6666667	6.66666667	10
<i>Chemistry</i>	<b>15.2173913</b>	13.0434783	13.0434783	10.8695652	2.17391304
<i>Entrepreneurship</i>	10.7142857	0	<b>39.2857143</b>	10.7142857	0
	11.5149226	12.6215221	<b>14.2863108</b>	8.68919693	5.92909425

TABLE II. PERCENTAGE OF TEACHER DISTRIBUTION IN SMA 1-5

	High School				
	6	7	8	9	10
<i>Geography</i>	<b>12.5</b>	<b>12.5</b>	8.33333333	<b>12.5</b>	8.33333333
<i>Sociology</i>	9.67741935	19.3548387	9.67741935	6.4516129	9.67741935
<i>Civics</i>	11.5384615	11.5384615	3.84615385	7.69230769	11.5384615
<i>Physic</i>	12.5	9.375	12.5	9.375	12.5
<i>Islamic Edu</i>	6.89655172	<b>17.2413793</b>	3.44827586	6.89655172	<b>17.2413793</b>
<i>Technology</i>	0	10	0	0	20
<i>History</i>	7.69230769	10.2564103	2.56410256	7.69230769	10.2564103
<i>English</i>	11.5384615	9.61538462	11.5384615	9.61538462	9.61538462
<i>Counselling</i>	3.33333333	16.6666667	3.33333333	3.33333333	<b>23.3333333</b>
<i>Mathematics</i>	5.17241379	13.7931034	6.89655172	8.62068966	10.3448276
<i>Bahasa Indonesia</i>	8	<b>18</b>	10	8	6
<i>Biology</i>	11.1111111	14.8148148	7.40740741	9.25925926	7.40740741
<i>Art</i>	0	<b>17.6470588</b>	5.88235294	5.88235294	5.88235294
<i>Economy</i>	13.0434783	14.4927536	5.79710145	8.69565217	8.69565217
<i>Physical Exercise</i>	6.66666667	<b>16.6666667</b>	6.66666667	6.66666667	6.66666667
<i>Chemistry</i>	8.69565217	13.0434783	6.52173913	8.69565217	8.69565217
<i>Entrepreneurship</i>	0	17.8571429	0	3.57142857	17.8571429
	7.55093278	<b>14.2860682</b>	6.14193524	7.23224702	11.4144367



These facts are also connected to the data of distribution of subject that show unbalanced distribution of the subject in classes. In Social science data, we can see that the ratio of Geography:Sociology:Economy has ratio of 24:31:69 while in Science, the ratio of Physics:Biology:Chemistry are in 16:26:23. This ratio would be a good measurement that the education management in high school level is urgently needed for better improvement. Bottom up management process is needed to achieve the balanced of teacher distribution. Furthermore, the policy of subject uniformity is also in urgent state as the existences of the management education in Bengkulu city is not exist.

### C. System Testing Result

System testing carried out in this study, carried out by quantity testing and quality testing on the application built. Quantity testing using black box, while quality testing using usability testing.

1) *Quantity testing*: Testing applications using black box testing, was conducted to find errors in the process of mapping and introducing existing buildings and rooms at the University of Bengkulu in accordance with field data. The black box testing technique carried out in this study was the equivalence partitioning technique.

a) *Black box testing*: This test was conducted to find out whether the game was successfully built according to the aim of the research. The results of the test can be seen in table 3

TABLE III. BLACK BOX RESULT

Testing Class	Scenario	Expected	Reality
<i>School Interface</i>	School digitation	Showing the school digitation	Succeed
	Place the digitation	Reality of school is correspondent with the data	Succeed
	School Information	Information shown each data of school	Succeed
	Region Information	Information corresponded with the reality	Succeed
<i>Teacher Data</i>	Digitation Process	Showing the teacher distribution digitation	Succeed
	Distribution Interface	Showing distribution value	Succeed
	Details value	Showing the real value of distribution	Succeed
<i>Subjects</i>	Digitation Process	Showing the teacher distribution digitation	Succeed
	Distribution Interface	Showing distribution value	Succeed
	Details value	Showing the real value of distribution	Succeed
<i>Overall System</i>	Button <i>ratio</i>	Show ratio	Succeed
	Button <i>information</i>	Show information	Succeed
	Home Button	Back to Home	Succeed
	Process Button	Process the input	Succeed

Based on table 3, it can be seen that the results of the Black Box test for Gameplay or how to play in the game with 14 scenarios with a number of successful results of 14. Using the following percentage of successes:

$$\text{Successful Rate (\%)} = (\text{Number of scenarios}) / (\text{Number of successful scenarios}) \times 100\%$$

So that the results obtained from Black Box testing for teacher distribution is 100%.

b) *Quantity testing*: Functional testing of this system is carried out to determine the level of success of the system seen from testing the buttons on the system. The test results can be seen in table 4.

TABLE IV. SATISFACTION TESTING RESULT

No.	Satisfaction Element	Usability result(%)
1	This system is user friendly	82
2	This system is easy to use	83
3	This system helps the process of management	91
4	You are using this application on your own mobile	86
5	This system helps the coordination process	92
6	Posts on the screen are easy to read	88
7	The colours in the system are clear	84
8	The system is interactive	85
9	The button is easy to use	86
10	The sound in the system is easy to hear	85
11	System show the right result	93
12	The system calculates the right parts	97
13	The system is working as its functions	94
14	The system helps in data management	84
15	Material is easy to understand	83
User satisfaction		86,8

From table 4, the results of the level of user satisfaction on usability testing with 20 respondents at **86.8%**.

## IV. CONCLUSION AND FURTHER RESEARCH

Based on the data shown in previous section we can see that:

- The digitation of teacher distribution in Bengkulu city would give a good information to the education management in Bengkulu city
- The teacher distribution in Bengkulu city showed unbalanced number as the ratio of teacher distribution was outrageous.
- Social science ratio for Geography:Sociology:Economy are in 24:31:69, while the ratio in science for Physics:Biology:Chemistry are in 16:26:23.
- The greatest number of the teachers are in Economy subject that were 69 for overall school while the littlest number of teachers were in information and technology that only 10 teachers
- School number 7 is the school with the greatest number of teachers while School number 5 is the lowest number of teachers for its distribution.

From this result the further research could be:

- Developing another data for all of education levels exist in Bengkulu city

- Clustering the area of data which show the further analysis of good education requirements for better management in education

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