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DATA VISUALIZATION FOR EDUCATION DOMAIN AT DINAS PENDIDIKAN JAWA BARAT

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Abstract

The purpose of this research is to make a proper visualization which can be used in West Java Provincial Education Board to look education equity level in the West Java Province. This research is to help the Planning and Reporting Sub Division understand the case of education equity. Based on the results of interviews to one of the employees in the sub division, there were problems such as receiving information from the visualization used today were not as expected. It happened because the information does not support education equity. There are several methods used to produce the right form of information including statistics, data mining, and the application of data visualization rules. After designing and refining the existing visualization, the outcome is implemented in website-based prototypes. The results of prototypes were efficient and effective, it was tested by Usability Testing. The result of usability testing reached 95.45%, which means that the design used has achieved a minimum goal. From these results, prototypes of data visualization can help the sub division to understand information about education equity.

Keywords: Acceptance testing , Data mining, Data visualization, Education equity, Statistics, Usability testing.

1. Introduction

Equal distribution of education monitoring must be carried out to create equitable education throughout West Java Province. Monitoring is carried out to produce a focus on the education plan for the following year. It is because there are a lot of educational equity indicators, the obtained information might be wrong and need a long time to obtain the true meaning of the information [1]. Misinformation can result in non-conformity of program plans in the following year. Visualization can also be useful to improve knowledge effectively and optimally [2]. The results of visualization will be efficient and effective in accordance with the information requirements requested by the sub division.

The results of interviews and observations discovered a problem with the presentation of information related to the current distribution of education. Presentations in the form of statistical graphs have not been able to explain information on equal distribution per district and sub-district area in detail. Besides, the information obtained was not in accordance with the wishes of policy makers in the Education Board. The large number of indicators in the distribution of education caused errors in concluding an information and it requires a long time to get one information[3].

Data visualization can run well if the method of delivering information from visualization to the recipient of information are in accordance with the answers to be submitted [4]. Visualization purpose is that users can easily understand and interpret a large and complex collection of information [5]. The visualization that is built is used to help the Planning and Reporting Subdivision in monitoring various indicators of educational equity.

2. Research Methodology

Methodology used was inspired by eight stages of visualization in the book "Visualizing Data" by Ben Fry. These stages are adjusted to the research as produce stages that shown in Fig. 1 [4].

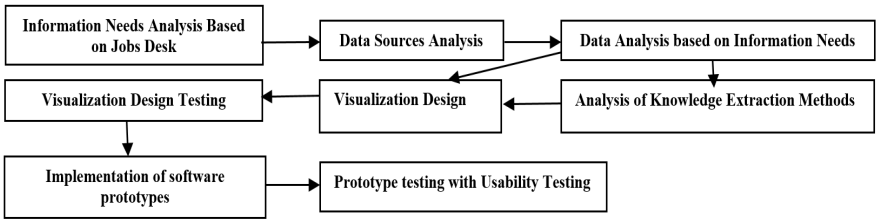

Fig. 1. Research methodology.

All stages in Fig. 1 were done in several stages. The stage of designing visualization consists of six stages in more detail, namely understanding the context, determining the appropriate form of presentation, eliminating clutter, giving attention to focus on the user, then improving visualization by thinking as a designer and finally telling the visualization results [4]. The last stage of testing was using the usability testing method. This method is evaluative where the user will be given a task so that they can find out the success level in completing a given task.

3. Results and Discussion

3.1. Information needs analysis base on jobs desk

At this stage, jobs desk analysis of Planning and Reporting Sub Division of the West Java Provincial Education Office was done. The sub division has three major jobs such as collecting data, planning, and evaluating the data. However, not all jobs require the results of data visualization but only two of the three jobs that require visualization.

3.2. Data sources analysis

The data used in this research came from the West Java Provincial Education Office and Statistics Indonesia. The data were obtained from the Education Office is the output of the system in Microsoft Excel documents which consist of various attributes. Data obtained from the Statistics Data is data taken from several Microsoft Excel documents. The following data used in this study is shown in Table 1.

Table 1. Used tables.

Data	Table
Population data	The population of the school people table
	Development table
	Population table based on age
	Table of government performance indicators
Education data	Education table

3.3. Data analysis based on information needs

The data mapping stage used attributes related to the problem to be resolved and the existing strategic information needs. These attributes are formed by a collection because of the values number used [5]. The results of data mapping are shown as follows:

a. To obtain information on the number and percentage of increase or decrease in students repeating in the sub-district area, it is ideal to use pd_tkt_mengulang.
b. To find out the increase or decrease students' number and percentage in dropout students in the sub-district area is using pd_tkt_putus_sekolah.
c. To get information on the increase or decrease students' number and percentage of students who did not graduate from school in the sub-district area is using pd_tkt_tdk_lulus.
d. To obtain information on the ratio of teachers and students in the sub-district area is using pd_rasio_guru_siswa.
e. To obtain information on the increase or decrease percentage in teacher worth teaching in the sub-district area is using guru_lyk.
f. To obtain information on the increase or decrease percentage of certification teachers in the sub-district area is using a certification teacher.
g. To find out the teacher quality development from time to time and to see the lowest developments based on sub-district and district areas are using the development of teachers.
h. To find out the total quality of damaged infrastructure in that year per sub-district area is using means_rusak.
i. To find out the total quality of infrastructure that was damaged in a year per sub-district area is using means_rusak.

j. To find out about schools without spaces such as libraries, schools, laboratories, labkom in one school in the district is using school facilities.

The mapping above is part of all the strategic information needs in this study to be mapped against the data used. The data is mapped based on data sources related to the monitoring and dissemination of education in West Java.

3.4. Analysis of knowledge extraction methods

This stage is a process where the selection of knowledge extraction methods based on information needs was done. However, not all information can be delivered directly. At this stage, the selection of methods for information needs was done through exploratory or explanatory analysis. Information needs number 3, 11, 14 use explanatory analysis method and the rest of the information needs was using exploratory knowledge extraction methods [6, 7]. The calculation of information needs is shown as follows:

1. Information on the number and percentage of increase or decrease in students repeating.

After the calculation of this year and the previous year, the results of these calculations were reduced to see the increase or decrease occurred. The results of the increase or decrease occurred in Baleendah Subdistrict are shown as follows:

$$Repeating\ figures\ this\ year\ -\ Figures\ Repeating\ Previous\ Years = 0{,}21 - 0{,}22\%$$
$$Repeating\ figures\ this\ year\ -\ Figures\ Repeating\ Previous\ Years = -0{,}01\%$$

It can be concluded that the Repeating Year is 0.01 better than the previous year. However, it is still not ideal because there are still students who have not graduated yet.

2. Information of total students and percentage of the number of dropout students are shown as follows.

$$Dropout\ rates\ this\ year = \frac{74}{10055} * 100\%$$
$$Dropout\ rates\ this\ year = 0{,}73\%$$
$$Previous\ Year\ dropout\ rate = \frac{92}{10932} * 100\%$$
$$Previous\ Year\ dropout\ rate = 0{,}84\%$$
$$Dropout\ rates\ this\ year - Previous\ Year\ dropout\ rate = -0{,}11\%$$

It can be concluded that the dropout rate for this year is 0.11 better than the previous year but still not ideal.

3. Information on the increase or decrease student's number and percentage who did not graduate from school is shown as follows.

$$Graduate\ Numbers\ This\ year = \frac{3015}{3015} * 100\%$$
$$Graduate\ Numbers\ This\ year = 100\%$$
$$Number\ Not\ Passed = 0\%$$
$$Previous\ Year\ Graduates\ Figures = \frac{3532}{3532} * 100\%$$
$$Previous\ Year\ Graduates\ Figures = 100\%$$
$$Previous\ Year\ Graduates\ Figures = 0\%$$
$$Numbers\ Not\ Passing\ This\ Year\ -\ Numbers\ Not\ Passing\ Previous\ Years = 0\%$$

It can be concluded that the number of not graduating from school this year is the same as the previous year and is ideal.

4. Information on the ratio of teachers and students in the subdistrict area is shown as follows:

$$\frac{S}{G} = \frac{The\ number\ of\ students}{Total\ number\ of\ teachers} * 100\%$$
$$\frac{S}{G} = \frac{10055}{481} * 100\%$$
$$\frac{S}{G} = 20{,}90$$

Ratio of students:teachers = 20 : 1 ideal

5. Information on the percentage of increase or decrease of good teachers in the sub-district area is shown as follows.

$$\%GL = \frac{Number\ of\ authorized\ teachers}{Total\ number\ of\ teachers} * 100$$
$$\%GL = \frac{160+300}{161+320} * 100\%$$
$$\%GL = 96\%$$
$$\%GL\text{Previous year} = \frac{Number\ of\ authorized\ teachers}{Total\ number\ of\ teachers} * 100$$
$$\%GL\text{Previous year} = \frac{132+331}{143+340} * 100\%$$
$$\%GLTahunSebelumnya = 95\%$$

Therefore, we could see that only 96% of teachers are eligible. There is an increase of 1% from the previous year.

6. Information on the percentage of increase or decrease in certification teachers in the sub-district area.

$$GS = \frac{Number\ of\ certified\ teachers}{Total\ number\ of\ teachers} * 100\%$$
$$\%GS = \frac{132+287}{161+320} * 100\%$$
$$\%GS = 87{,}11\%$$
$$\%GS\text{Previous year} = \frac{Number\ of\ certified\ teachers}{Total\ number\ of\ teachers} * 100$$
$$\%GS\text{Previous year} = \frac{82+92}{143+340} * 100\%$$
$$\%GSTahunSebelumnya = 36\%$$

Therefore, it could be condluded that there is only 87.11% of teachers who received certification. This shows an increase of 51.11%.

7. Regional information affordable ideal education services in the sub-district area are shown as follows.

$$KPUS = \frac{Specific\ age\ population}{An\ area}$$
$$KSek = \frac{Certain\ level\ schools}{An\ area}$$
$$KPUS = \frac{4962}{41{,}933}$$
$$KPUS = 118{,}33$$
$$KSek = \frac{20}{41{,}933}$$
$$KSek = 0{,}476$$
$$DTSek = \frac{22}{7} * 10^2 * 0{,}476$$
$$DTSek = 149{,}89$$
$$DT = \frac{37189{,}34}{149{,}89}$$
$$DT = 248{,}1$$

The results of the summation were informed that there were only 248 children aged 16-18 years who could attend one secondary school. If 20 schools are available, 99.95% of children can enter the school.

8. To obtain information on the level of teacher needs per region

The method used here was grouping using the K-Means algorithm. Variables used include number of teachers, schools, and students. The desired group determination is 3. After several iterations have been obtained, the first cluster of centroids 1 has 15 members, centroid 2 has 11 members, and centroid 3 has 1 member. The implementation is done with the programming language R. From these results, it can be seen that the characteristics of the groups formed. Group 1 is for groups with less distribution of teacher distribution. Group 2 has evenly distributed teacher distribution. Group 3 has the level of distribution of teachers who have fulfilled and excess.

9. To see the spread of the area that is evenly distributed

Variables used are percentage of apk, APM, student / teacher ratio, and s / k ratio, student / school ratio. The desired group determination is 2. After several iterations are obtained, the results of the first cluster of centroids 1 have 20 members while centroid 2 has 7 members. The results can be seen that group 1 is an area that is not evenly distributed, and group 2 is an evenly distributed area.

3.5. Design visualization

At this stage, the visualization of the information that need to be conveyed was carried out. The design stage of transpiration visualization in storytelling books with data is the result from understanding the context of information needs, selecting visualization forms, eliminating existing clutter, focusing attention, and testing using acceptance testing techniques [8, 9]. Some of the following designs are shown as follows:

a. Understanding context

The following table is the context understood in this information need is shown in Table 2.

Table 2. Understanding context.

WHAT	Knowing the number of repeating students has increased or decreased in order to determine one of the ideal indicators of student quality.
HOW	Showing the number of repeating students compared to the previous year to see a comparison the ideal or away from the ideal.

b. Selection of visualization

The following table is the selection of forms that have been adapted to the required context which shown in Table 3.

Table 3. Selection of visualization.

Visualization	Simple text and symbols
Reason	Can display one to two information needs simultaneously

c. Remove clutter

The following table is the results of clutter removal (See Table 4).

Table 4. Remove clutter.

Clutter	Reason
Alignment	Left-aligned usage to facilitate reading from left to right
White Space	Use of white space to provide space for labels and content so that they do not overlap.
Closure	There is no use of borders in this form of visualization
Similarity	Colors used to indicate relationship

The following figure is the results of the existing clutter removal which is shown in Fig. 2**.**

Fig. 2. Result remove clutter.

d. Focus attention

Attention focusing was done by giving different font colours and sizes. The following figure is the results of attention focusing (See Fig. 3).

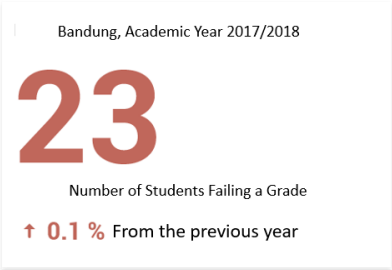

Fig. 3. Result focusing attention.

Here are some visualization results. Fig. 4 shows the results of the need for information on the number of school dropouts who have been given different colours and font sizes.

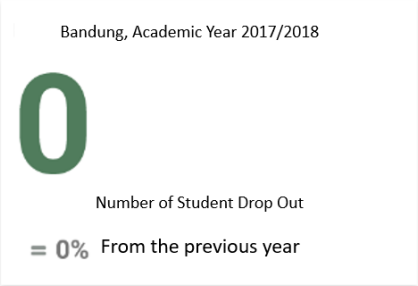

Fig. 4. Result visualization dropout students.

After removing the clutter, Fig. 5 is an emphasis on the number of students failing to pass within a certain period of time.

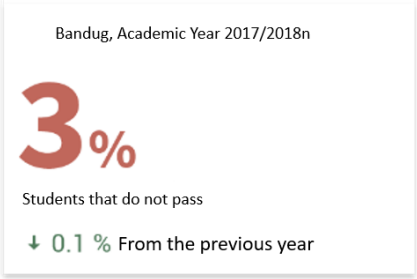

Fig. 5. Result visualization students don't graduate.

The main focus in Fig. 6 is the percentage of the gross enrolment rate. This is indicated by the distinguished font size and colour. The green colour indicates the percentage of the target set by the government for that year.

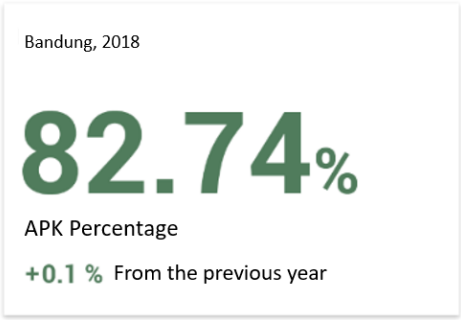

Fig. 6. Result visualization percentage APK.

Figure 7 is the result of visualization that has emphasized the information to be conveyed.

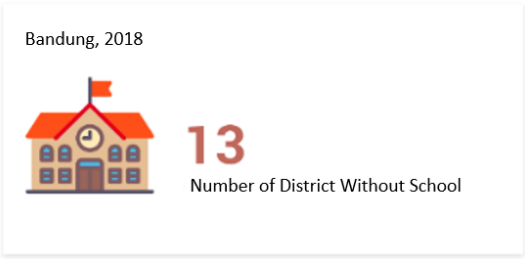

Fig. 7. Result Visualization the area does not have a school.

The information needs of teachers in a simple text visualization form and a choropleth map are shown in Fig. 8**.**

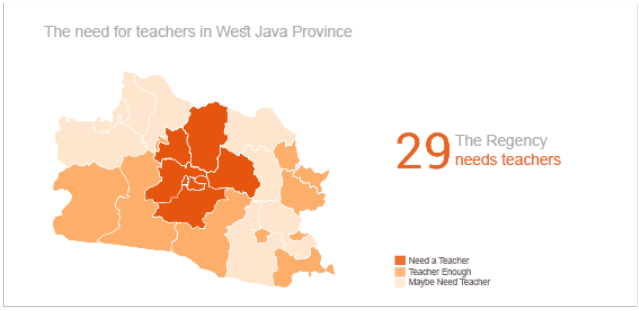

Fig. 8. Result Visualization education equity.

The simple text visualization was chosen because it is suitable for displaying one or two pieces of information simultaneously. Choosing the form of choropleth map visualization for the division of regions was based on geographic location. Combining these two types of visualization can add value to information in an information need.

3.6. Visualization design testing

Tests conducted for participants who are experts in their fields [10, 11]. The following table is the results of the acceptance test which is shown in Table 5.

Table 5. Visualization design testing.

Information Needs	Visualization	Acceptance results
The number of students repeating experienced an increase or decrease from the previous year in the sub-district area per academic year is ideal	Simple text and symbols	accepted
The number of students dropping out of school experienced an increase or decrease from the previous year in the sub-district area per academic year is ideal	Simple text and symbols	accepted
The percentage of students graduating from school experienced an increase or decrease from the previous year in the sub-district area per academic year is ideal	Simple text and symbols	accepted

3.7. Implementation of software prototypes

At this stage, the software prototype was designed as well as supporting technology for prototype development [10]. The following figure is the dashboard display that shows information related to the quality of education at the high school level (See Fig. 9).

Designing prototype software quality of facilities describes information related to the quality of educational facilities and infrastructure in West Java Province is shown in Fig. 10.

Moreover, designing prototype software availability of educational services describes information related to the availability of educational services from schools in West Java (see Fig. 11).

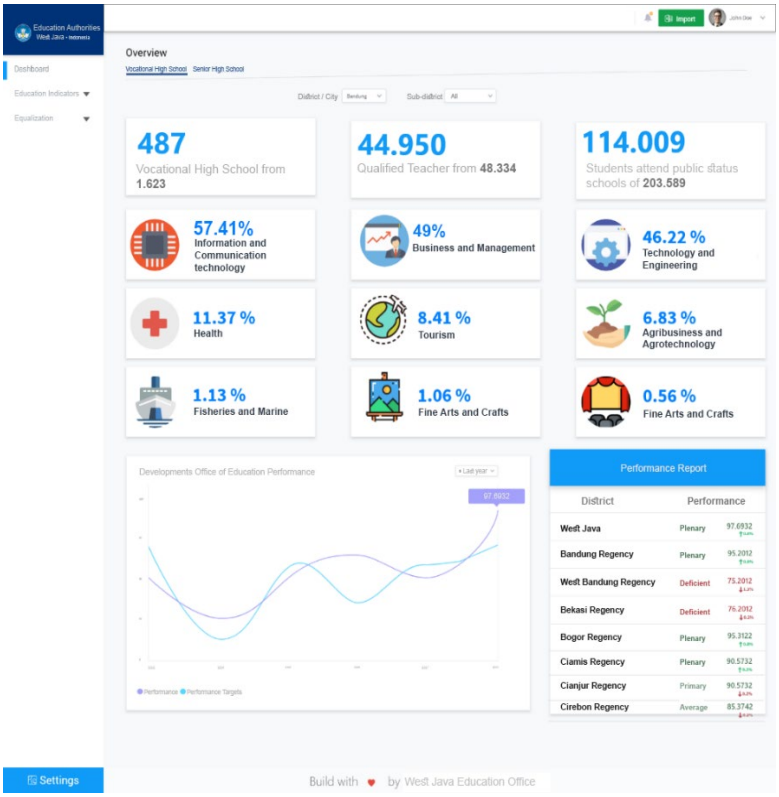

Fig. 9. Dashboard of the quality of education at the high school level.

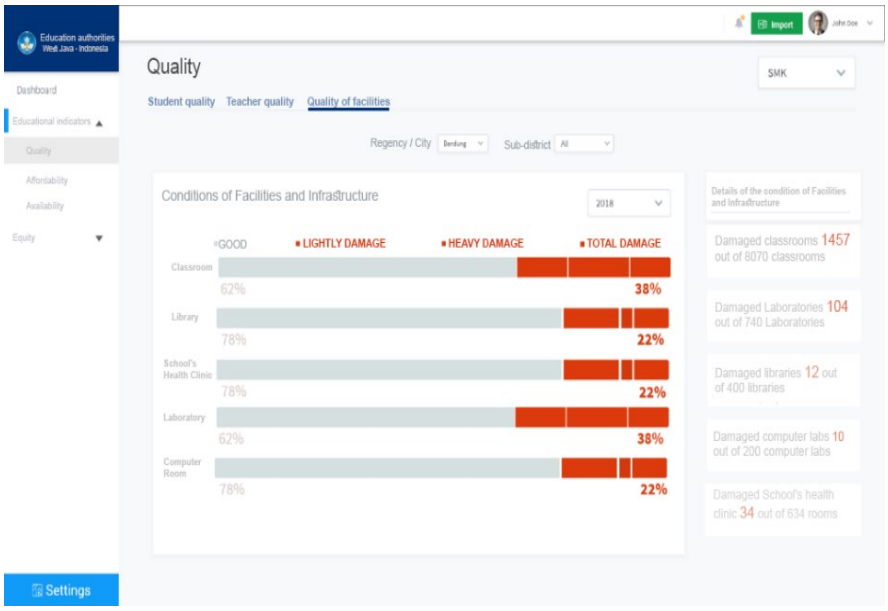

Fig. 10. Designing prototype software quality of facilities.

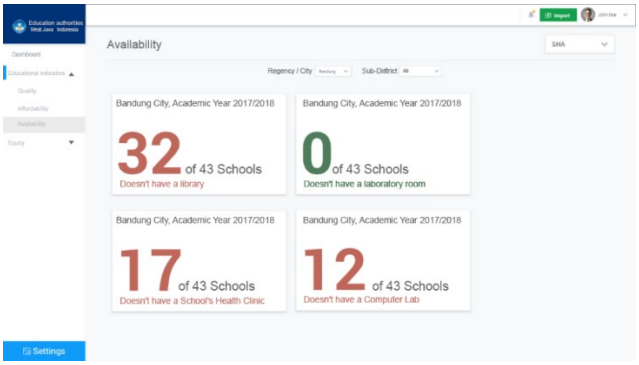

Fig. 11. Designing prototype software of availability of educational services.

3.8. Testing software prototypes

Testing software prototypes aims at determining the design of the prototypes that have been made effectively and efficiently [12]. The following table is a test scenario for each menu that contain each visualization which shown in Table 5.

Table 6. Testing prototypes.

No.	Task	Scenario	Expected results
1.	Enter the page that contains the visualization of the vocational students in West Java quality	I am an employee of the planning and reporting subdivision who wants to know information about the quality of vocational students in West Java	Successfully enter the page that contains visualization of the quality of vocational students in West Java through the education indicator menu.
2	Enter the page that contains the visualization of the quality of vocational teachers in the province of West Java	I am an employee of the planning and reporting subdivision who wants to know information about teachers of vocational students in the province of West Java.	Successfully enter the page containing visualization of the quality of vocational teachers in the province of West Java through the education indicator menu.

Prototype testing can determine the success rate of prototype design. The following figure is the results of mapping efficiency testing based on tasks that shown in Fig. 12.

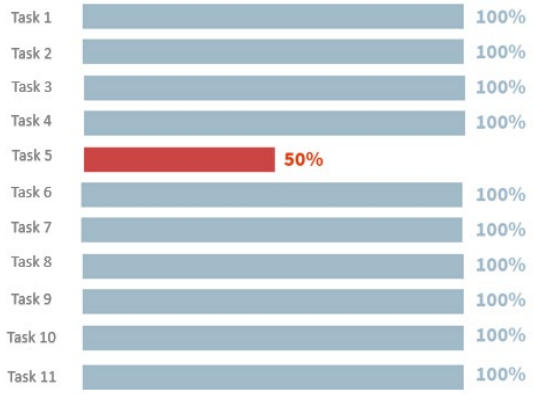

Fig. 12. Visualization result testing.

From the test results, it can be concluded that the effectiveness and efficiency in the completion of the task is 95.45% which can be said as successful because achieving the minimum goal, which is 70%.

4. Conclusion

Based on the results of the implementation and testing, it can be concluded that visualization makes it easier to see and understand the data of each information displayed. Data visualization can solve problems that occur and can meet the objectives of this study. However, there are still obstacles faced in visualizing population data that can be accessed in a limited way because of using open data. Therefore, suggestions for the development of data visualization systems in the future are to collaborate with the statistical centre to access population data in more detail.

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