



Interactive Dashboard for Visualizing Teacher Distribution in Tangerang City Using BigQuery and Looker Studio

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Abstract. *The uneven distribution of teachers directly affects the quality and equity of educational services. The Tangerang City Government, which oversees 13 sub-districts, requires well-visualized and analyzable education workforce data to support educational planning and policy-making processes. This study involves the design of a comprehensive and interactive data visualization of teacher distribution using BigQuery and Looker Studio. The authors collected data from the Ministry of Education's Dapodik portal for the years 2021 to 2023, processed it in BigQuery, and built the visualizations in Looker Studio. The data processing involved data cleaning, transformation, SQL querying, and the development of an interactive dashboard. The final output is a dashboard that presents teacher distribution patterns based on sub-district, gender, and institution type (elementary, junior high, senior high, and vocational schools). Through this visualization, the authors aim to support educational authorities in making precise decisions to achieve equitable teacher allocation.*

Keywords : *Distribution, Teacher, BigQuery, Tangerang, Visualization*

INTRODUCTION

Educators or teachers are the most crucial aspect in determining the quality of learning. The availability of teachers in each school is a top priority to ensure balance between the number of teachers and students. The city government must ensure the availability and equitable distribution of teachers across all regions.

Data visualization technology opens new opportunities in processing and presenting informative data. Google Cloud Platform (GCP) provides BigQuery to manage and analyze large-scale data. Looker Studio is a data visualization platform that enables users to explore and present data in intuitive and engaging visual formats.

This research creates a data visualization of teacher distribution by district in Tangerang City. The visualization is presented in an interactive dashboard and a detailed report that comprehensively illustrates the teacher distribution in Tangerang. It is expected that this visualization can help authorities in acquiring the information needed to make decisions related to the availability and distribution of teachers in Tangerang City.

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The method used in the visualization design process is qualitative by collecting datasets from the Data Pokok Pendidikan website. The dataset goes through a series of processes and then imports the data into Big Query for data analysis. The data is explored using SQL to prepare the visualization. Big Query and Looker Studio integrate the data to create interactive and informative data visualizations and provide reports that include data, analysis and recommendations as a basis for city government policy planning.

LITERATURE REVIEW

Previous research has created interactive and interesting visualizations using good integration between Big Query and Looker studio. Zai, F. et al. used this integration to visualize grocery store sales data. Meanwhile, Arfandi, Z. et al. in addition to visualizing sales data, also created a visualization of sales satisfaction levels. Sifa, R. Created a visualization of visitor data and book loans in a library. Bororing, J.E. created a dashboard for visualizing Covid 19 data in Indonesia.

Dapodik is the only data reference that has been used by the Ministry of Education and Culture. For this reason, this basic student data has a very important and vital role with various functions (Dapodik.co.id, 2020). The Dapodik (Basic Educator Data) application is an information system developed and managed by the Ministry of Education, Culture, Research and Technology to carry out comprehensive data collection on educational units, namely students, educators and education personnel, educational resources, learning substances, and learning outcomes. This system operates online and is dynamic, allowing for regular data updates to ensure the accuracy and recency of information.

As a strategic instrument in managing national education data, the Dapodik application is the main foundation in formulating data-based policies. The existence of this system supports the planning, implementation, and evaluation of education programs in a more structured and evidence-based manner. In addition, Dapodik is a reference in distributing government assistance and developing the quality of education services. The obligation to update data by each education unit periodically is a crucial step to ensure

the integrity and validity of data in the system. Thus, the Dapodik application plays an adaptive role in the dynamics of national education needs.

Data visualization refers to the process of presenting data or information in the form of graphical representations, such as graphs, diagrams, or maps, with the aim of facilitating understanding of the structure and meaning of the data (Teknovidia, 2021). Through this visual approach, users can be more effective in identifying patterns, trends, and anomalies (outliers) that may be hidden in complex data sets. Data visualization is an integral component in the data analysis stage, which generally begins with the process of collecting, cleaning, and statistically processing data to form a relevant analytical model. The final results of the process are then visualized so that they can be interpreted more intuitively. The application of appropriate data visualization not only increases efficiency in interpreting analysis results but also plays an important role in supporting the data-based strategic decision-making process.

Looker Studio, formerly known as Google Data Studio, is a free web-based data visualization software provided by Google. This tool is designed to enable users to build interactive reports and dashboards by utilizing various data sources efficiently. With Looker Studio, data analysts can accelerate the process of transforming raw data into structured and easily interpretable information. The platform supports integration from various data sources, including Google Sheets, MySQL databases, and digital analytics services such as Google Analytics and Google Ads, allowing for holistic and cross-platform data analysis. (RevoU, 2025). The intuitive drag-and-drop interface is a key feature that facilitates ease of use, even for users without a deep technical background, making this tool inclusive and adaptive to various levels of user expertise.

BigQuery is a fully managed data platform developed by Google, which integrates artificial intelligence capabilities to support efficient data management and analysis processes. This platform is equipped with built-in features such as machine learning, data search, geospatial analysis, and business intelligence that enable comprehensive data exploration. By supporting serverless architecture, Bigquery allows users to execute queries using programming languages such as SQL and Python without the need to manage infrastructure directly. (Google Cloud, 2025). The architecture consists of two main components, namely the storage layer that functions to ingest, store, and optimize

data, and the computing layer that provides data processing and analysis capabilities. These two layers are designed to operate independently, utilizing Google's petabit-scale network to ensure efficient communication and high performance between the two. This architectural approach enables scalability and flexibility in managing very large data volumes, and supports the needs of advanced data analysis in modern organizational environments.

A dashboard is a visual display that presents various types of data in one centralized place that refers to the use of special applications that are able to display summary data from various existing data (Domainsia, 2024). In simple terms, a dashboard can be likened to a digital platform that visualizes data in the form of graphs, diagrams, or other visual indicators, which represent numerical values informatively. These visualizations are often equipped with color elements, icons, or other visual markers to distinguish certain types of data, time periods, or categories, making it easier for users to interpret, analyze comparisons, and monitor performance efficiently and accurately.

METHODS

The design in creating visualization of teacher distribution data consists of five stages, namely data collection, data entry, data cleaning, data analysis and data visualization as in Figure 1 below.

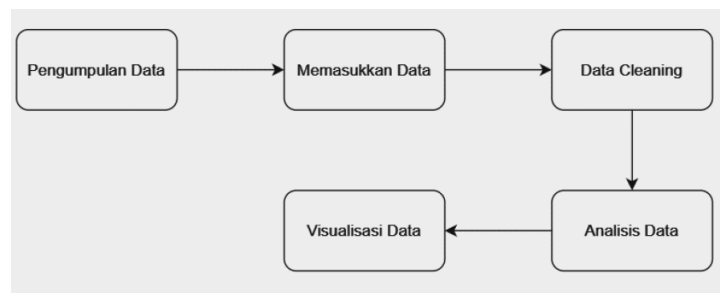


Figure 1. Data processing stages

Data collection in the form of a dataset of teacher distribution in the sub-districts of Tangerang City in 2021-2023 taken from the Basic Education Data website. The data consists of 283 rows and 8 columns including information on the category of teacher types, namely civil servant, honorary and private teachers. Data was taken from 13 sub-districts in Tangerang City.

The second stage is to enter data in the form of a csv file into Google Big Query via the Create Table feature. The third stage is to clean the data which includes adjusting the data type and transforming the data by changing and matching the data values. Data cleaning is deleting unnecessary columns. From the dataset that has been taken from the website, the data to be analyzed consists of four levels of education, namely Elementary School (SD), Middle School (SMP), High School (SMA) and Vocational School (SMK). This process is important in data preparation and ensures that only relevant data will be used in further analysis.

The fourth stage is to analyze data in Google Big Query. This analysis aims to match the data that has been collected and cleaned so that it can be further processed when visualized into a dashboard. This process ensures that the data to be displayed in the dashboard is accurate, complete and in accordance with the analysis needs. Data processing is carried out using SQL queries in Google Big Query.

The final stage is data visualization where the chart or graph used is determined based on the existing data. The results of the analysis are visualized using Looker Studio which helps in understanding the results of the analysis intuitively. The types of visualization used include bar graphs, pie charts and pie tables. Figure 2 is a dashboard design that is arranged based on several components.



Figure 2. Dashboard Design

The following are the components used in the dashboard design, including:

- a. Text Box, displays the title of the dashboard page
- b. ScoreCard Chart, displays an overview of the contents of the dataset such as Total Number of People, Total Number of Men, Total Number of Women, Total Number of Types of Institutions and Total Number of Districts.
- c. Pie Chart, displays a comparison of the number of male and female teachers
- d. Bar Chart, displays data on the distribution of teachers in a certain year in various districts including the number of people
- e. Doughnut Chart, displays a comparison of data on the distribution of teachers based on the type of each agency.
- f. Stacked Combo Chart, displays data on the distribution of teachers in a certain year including the number of people, men and women. displays data on the distribution of teachers in a certain year in various districts including the number of people.
- g. Stacked Column Chart, displays data on the distribution of teachers in a certain year including the number of people, men and women
- h. Column chart, displays data on the distribution of teachers in a certain year in various districts including the number of people.

Figure 3 shows a pie chart comparing the number of males and females for 2021 to 2023 based on visualization (top) and query (bottom).

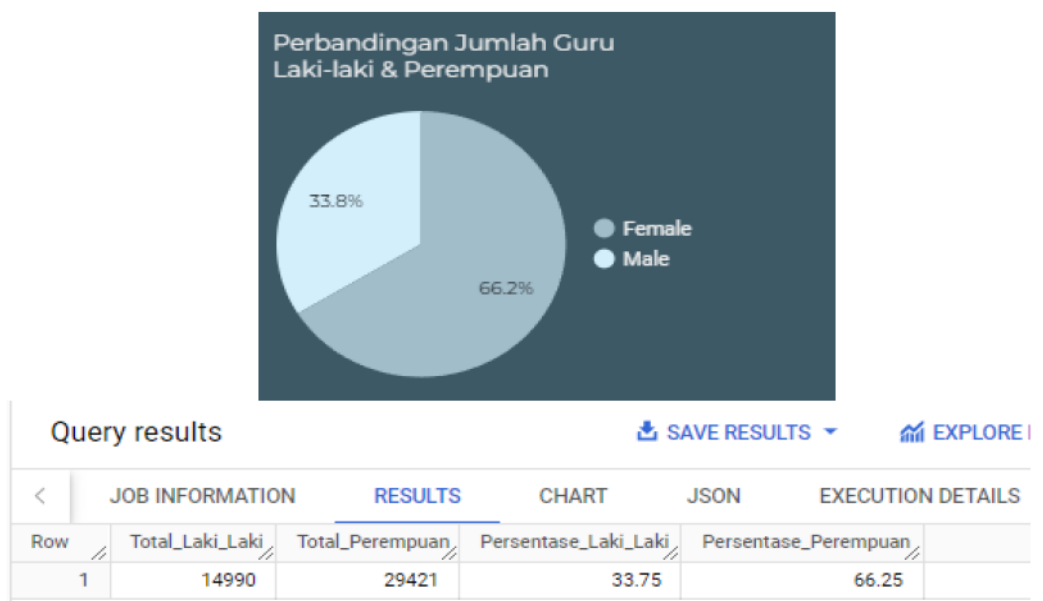


Figure 3. Comparison of the Number of Men and Women

Figure 4 shows the distribution of the 5 highest sub-districts in Tangerang City in 2021. To create the visual, a Bar chart is used on the panel. The sub-district is selected as the dimension and the number of people as the metric.

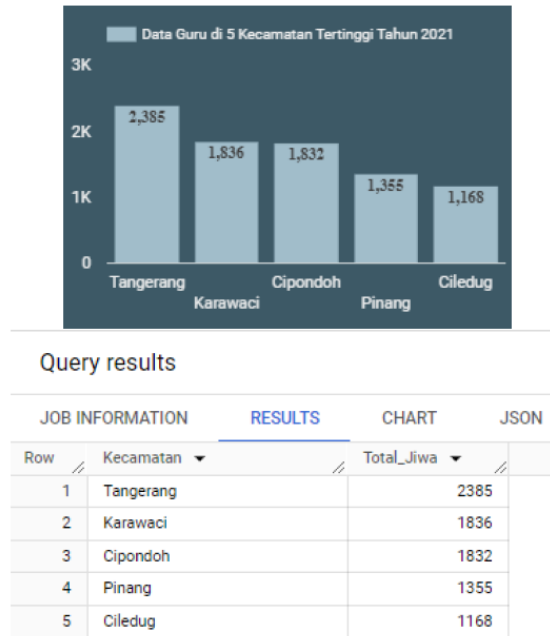


Figure 4. Distribution of the 5 highest sub-districts in 2021

Figure 5 shows the number of teachers based on the type of institution in the form of a percentage and is visualized in the form of a Doughnut Chart. The type of institution is selected as a dimension and the number of people as a metric, then entered into the fields.

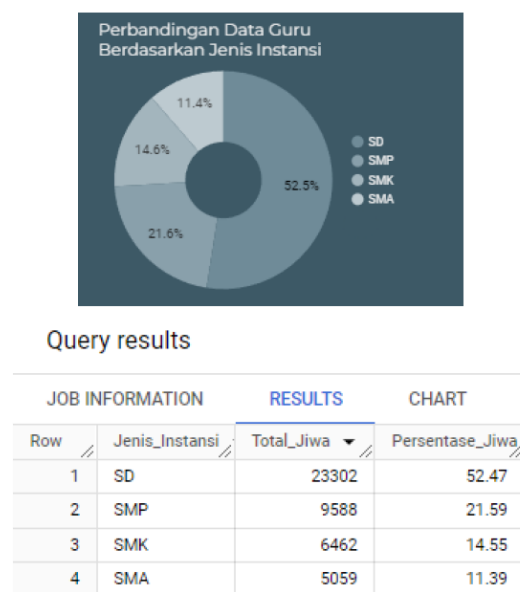


Figure 5. Number of Teachers by Institution

Figure 6 shows the distribution data of teachers in 2023 in each sub-district. The sub-district is chosen as the dimension and the total number of male and female people is chosen as the metric. In this chart, the visualization is in the form of Stacked Combo.

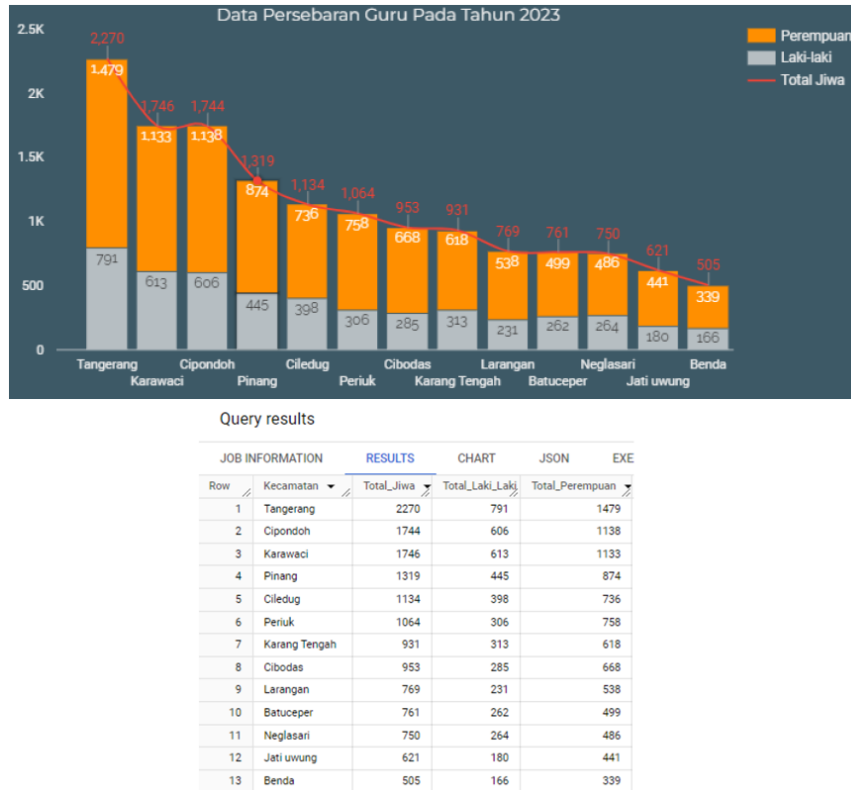


Figure 6. Teacher Distribution Data in 2023

Figure 7 shows the distribution data of elementary school teachers in 2022 in each sub-district. The sub-district is chosen as the dimension and the total number of people is chosen as the metric. Visualization uses the Line Chart form.



Figure 7. Data on Distribution of Elementary School Teachers in 2022

RESULTS

According to finereport.com, creating a data visualization dashboard must pay attention to things like:

1. Layout

Most readers will read from top to bottom, and the middle position is the most interesting, so important content should be placed at the top or center.

2. Background

In a different situation, if the background color is dark, the effect will be more obvious when the dashboard is placed on a large screen. In order to display the visuals more clearly, the color between the text and the background should be contrasting, which means the text color is bright.

3. Use of Graphics

The use of appropriate graphics or visuals is very important in creating a dashboard. The selection of visuals is adjusted to the data to be displayed.

By considering the layout, background and use of the graphs above, the visualization is designed as in Figure 8. Figure 8 shows the dashboard visualization of the entire chart that has been processed through Looker Studio. According to the image, the dashboard design results successfully show data with diverse chart visualizations accompanied by contrasting and attractive colors.

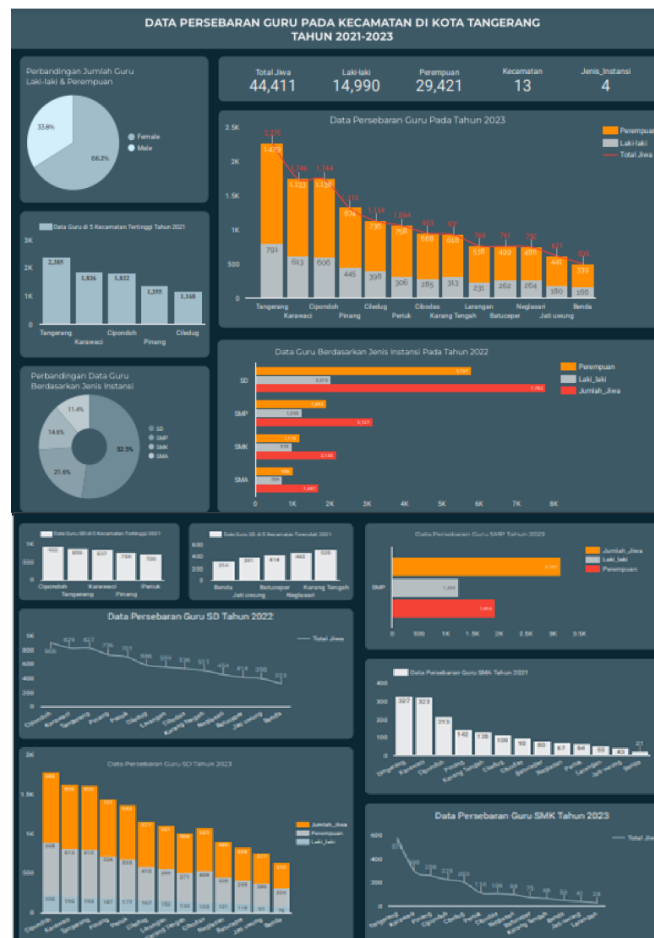


Figure 8. Results of Visualization of Teacher Distribution Data

DISCUSSION

According to the results of the data analysis conducted, the distribution of teachers in Tangerang City is still uneven, with several sub-districts experiencing excess or shortage of teachers. However, this needs to be reviewed by considering the ratio between teachers and students in accordance with Government Regulation Number 74 of 2008 concerning Teachers. The regulation regulates the ratio of teachers and students at all levels of education. Further analysis based on this ratio is needed to determine more accurate teacher needs in each sub-district in Tangerang City. After this was done, the data analysis successfully identified which sub-districts were experiencing a shortage or excess of teachers. This information can be used as a basis for planning teacher placement to achieve equity.

The use of Google Big Query and Looker Studio in data visualization can present information interactively and informatively. The resulting dashboard has provided an

overview of the distribution of teachers in each sub-district, so that certain parties can use the visualization results as decision makers and policy planning.

CONCLUSION

A comprehensive dashboard has been successfully developed to visualize teacher distribution in Tangerang City. This dashboard provides insights that can be directly used by policy makers to support data-driven planning and improve information transparency.

Data visualization of teacher distribution by sub-district in Tangerang City has been designed using BigQuery and Looker Studio for the period 2021 to 2023. Based on the results of data analysis, teacher distribution in Tangerang City is not evenly distributed. Some sub-districts have an excess of teachers, while other sub-districts have a shortage.

However, this conclusion needs to be re-evaluated by considering the ratio between the number of teachers and students in accordance with Government Regulation Number 74 of 2008 concerning Teachers. This regulation stipulates that at the elementary, junior high, and senior high school levels, one teacher serves 20 students, while at the vocational high school level, one teacher serves 15 students.

Further analysis based on this ratio needs to be carried out to determine more accurate teacher needs in each sub-district. After adjustments based on the teacher-student ratio were made, the data analysis successfully identified sub-districts that needed additional teachers and sub-districts that had excess teachers.

This information is very useful for education planners in determining teacher placement strategies to achieve equity. In addition, the use of BigQuery and Looker Studio has proven to be very effective in presenting data interactively and informatively. The dashboard, which displays bar, line, and pie charts, provides a very clear picture of the distribution of teachers in each sub-district, thus facilitating the decision-making process and formulating education policies.

LIMITATION

Limitations include the reliance on available public datasets, which may lack some detail or accuracy. Also, the focus on Tangerang City restricts broader generalization.

Visualization and analysis are dependent on the quality of input data and internet access. Furthermore, the use of descriptive analysis without predictive modeling limits the forecasting potential of the system. Another limitation is the absence of integration with real-time data sources, which could enhance the timeliness and relevance of insights. Finally, user access to the dashboard is contingent on platform familiarity and availability of supporting digital infrastructure.

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