Implementation of Artificial Intelligence (AI) Role-Based NormalizationMap of Demographic Data of Prospective Students of SD Al-Imam Islamic School (AI IS)

Faik Bajsair

Universitas Indraprasta PGRI
faikbajsair@gmail.com[1]

Abstract

This research examines the application of rule-based Artificial Intelligence (AI) to address demographic data inconsistency among prospective students at SD Al-Imam Islamic School. Unstructured applicant data, particularly in the village/sub-district address column, often impedes efficient analysis and strategic decision-making. By implementing a dictionary-based normalization technique (normalizationMap) using Google Apps Script, this study aims to enhance data quality and minimize input inconsistencies. The role-based approach ensures that various input formats are mapped to a predefined standard. The implementation results demonstrate a significant improvement in the accuracy of the address data, directly supporting more precise demographic visualization. This practical and effective AI solution facilitates data-driven decision-making for future student enrollment strategies, showcasing a tangible contribution to data management within a limited-resource educational environment.

Keywords: *Artificial intelligence; Data normalization; Demography; Google Apps Script; Rule-based.*

1. Introduction

The new student admission (Penerimaan Peserta Didik Baru - PPDB) process is a critical stage in educational institutions that necessitates meticulous and accurate data management [1]. SD Al-Imam Islamic School faces a significant challenge in managing the increasing volume of applicant data, where a fundamental issue is the pervasive inconsistency and non-uniformity in writing demographic details, particularly village or sub-district addresses [2]. Input variations (e.g., differences in capitalization, abbreviations, or typographical errors) lead to data fragmentation, complicating the aggregation process and hindering the generation of comprehensive reports.

This data anomaly limits the school's capacity to derive in-depth insights from demographic data [3], even though demographic information is vital for formulating precise marketing strategies and effectively planning resource allocation [4]. Without clean and standardized data, subsequent analytical efforts, such as spatial mapping, will yield biased and misleading information for decision-making. This unstructured data phenomenon is exacerbated by the use of semi-automated data collection systems, which are prone to human errors [5].

Within the context of SD Al-Imam Islamic School, which utilizes the Google Workspace ecosystem, there is substantial potential to optimize data management through the implementation of a relatively simple yet significantly impactful Artificial Intelligence (AI)-based solution. The AI approach, in the form of automated data normalization, can serve as a proactive remedy for data inconsistency issues, thus elevating overall data quality and supporting better decision-making.

Based on these challenges, this study focuses on the implementation of an AI Role-Based NormalizationMap for the demographic data normalization of prospective students at SD Al-Imam Islamic School. The primary objective of this research is to demonstrate the effectiveness and accuracy of implementing an AI solution based on Google Apps Script in cleansing and standardizing applicant demographic data.

2. Literature Review

2.1. Normalization Data

Data normalization is the process of restructuring data to reduce data redundancy and improve data integrity (Indriani & Pratama, 2023). In the context of relational databases, normalization often refers to a set of rules for designing an efficient database schema. However, in the context of data cleansing or data preprocessing, data normalization focuses on standardizing the format and value of data to ensure

consistency (Susanto & Ramadhan, 2022). The main goal is to ensure that each of the same data entities has a uniform representation across the dataset, despite the variation of inputs.

2.2. Artificial Intelligence (AI) in Data Management

Artificial intelligence, particularly the sub-fields of machine learning and natural language processing (NLP), is increasingly being applied to automate and improve data management processes (Chen et al., 2024). The use of AI can range from identifying patterns in big data, automating repetitive tasks, to improving data quality through anomaly detection and normalization. In the context of demographic data management, AI can be leveraged to identify writing variations, group similar entities, and apply transformation rules to achieve data consistency (Saputra & Lestari, 2023).

2.3. Google Apps Script for Data Automation

Google Apps Script (GAS) is a cloud-based JavaScript development platform that enables automation, integration, and functionality expansion across Google Workspace services, including Google Sheets (Nugroho & Putra, 2022). With GAS, users can write custom scripts to manipulate data in spreadsheets, interact with other Google services, and even create menus or simple user interfaces. Its flexibility and ease of integration make GAS an ideal tool for implementing data automation solutions in Google Workspace environments without the need for complex external server infrastructure.

3. Research Methodology

This study uses a qualitative-descriptive approach with a case study at SD Al-Imam Islamic School. The stages of the research include

3.1. Data Collection

The data used is demographic data of prospective students of SD Al-Imam Islamic School for the 2025/2026 school year which is stored in Google Sheets. This data includes information on name, gender, school origin, residential address, and urban village.

Table 1: Data collection

Name	Gender	School From	Address	Kelurahan
Ramita Azzahra Harumurti	Perempuan	PG-TK Al-Imam	Perumahan kota wisata	Kota Wisata
Mikkail Kalandra Stophia	Laki- Laki	TK Abata	Kota Wisata	Kota Wisata
Sofia Arabella Tjokronolo	Perempuan	PG-TK Al-Imam	Kota Wisata	Kota Wisata
Ukaysyah Al Maishan	Perempuan	TK Darrul Basyar	Kota Wisata	Kota Wisata
Fariz Achmad	Laki- Laki	PG-TK Al-Imam	Limus Pratama Regency	Limus Pratama Regency
ADEEVA KEISHA AZZAHRA	Perempuan	TK Darrul Basyar	Limus Pratama Regency	Limus Pratama Regency
Radika Putra Irawan	Laki- Laki	TK Al Ikhlas	Pangkalan 5	Pangkalan 5
Azma Hafiza Rahma	Perempuan	PG-TK Al-Imam	ARMED 7	Armed 7
M. Zhafran Althafarizqi	Laki- Laki	PAUDQU MIZBAH	Griya Alam Sentosa	Gas
M. Ilham Mardhotillah	Laki- Laki	TK Darrul Basyar	Limus Pratama Regency	Limus Pratama Regency
Sweta Karsa	Laki- Laki	Home Schooling	Limus Pratama Regency	Limus Pratama Regency
Kelana Askara	Laki- Laki	Home Schooling	Limus Pratama Regency	Limus Pratama Regency
Gema Ammara	Perempuan	TK Nurul Jannah	Limus Pratama Regency	Limus Pratama Regency
Nafisha Habibah	Perempuan	TK ABA 5 GAS	Griya Alam Sentosa	Gas
M. Khalid Abdussalam	Laki- Laki	PG-TK Al-Imam	LPR Limus Pratama Regency	Limus Pratama Regency
Uwais Ahsan Pratama	Laki- Laki	TK Nurul Hikmah	Limus Pratama Regency	Limus Pratama Regency
Khalif Athmar Nugia	Laki- Laki	PG-TK Al-Imam	Harvest City	Harvest City
Azkiya Sheza Naureen	Perempuan	TK Aisyah 3 kp. bakom	kp.bakom	Kampung Bakom
Azkayra Navisha A	Perempuan	TK Regina Ceili	Gardenia Cileungsi	Gardenia Cileungsi
Giandra Bumi Narapatih	Laki- Laki	PG-TK Al-Imam	Limus Pratama Regency	Limus Pratama Regency

Ayesha Nuha Qanita	Perempuan	PG-TK Al-Imam	kp. bakom	Kampung Bakom
Alkariza Khalif	Laki- Laki	PG-TK Al-Imam	Legenda Wisata	Legenda Wisata
Muhammad Abil Shidiq	Laki- Laki	Bimba	Perum Taman Ria Persada	Perumahan Taman Ria Persada
Hanief Reyvanno Maheswara	Laki- Laki	TK Darrul Basyar	Limus Pratama Regency	Limus Pratama Regency
Raiq Kaysan Denali	Laki- Laki	TK Darrul Basyar	Limus Pratama Regency	Limus Pratama Regency
Alby Putra Damanik	Laki- Laki	PG-TK Al-Imam	Kota Wisata	Kota Wisata
Alqisya Shafhah Hafidzah	Perempuan	TK Darrul Basyar	Limus Pratama Regency	Limus Pratama Regency
Dinda Annisa Jabbar	Perempuan	PG-TK Al-Imam	Kp. Sawah Cileungsi-Kidul	Kampung Sawah
Danish Zayyan Prasetyo	Laki- Laki	TK As Salam	Griya Alam Sentosa	Gas
Maherza Putra Dedu	Laki- Laki	TK Rumah Anak	Kota Wisata	Kota Wisata
Muhammad Rayyan Noor	Laki- Laki	TK As Sa'ad	Kota Wisata	Kota Wisata
Delisha Kirana	Perempuan	PG-TK Al-Imam	Limus Pratama Regency	Limus Pratama Regency
Misha Davira	Perempuan	PG-TK Al-Imam	Limus Pratama Regency	Limus Pratama Regency
Arsya Khalif Pradityaputra	Laki- Laki	PG-TK Al-Imam	Limus Pratama Regency	Limus Pratama Regency
AZKA ABELANO	Laki- Laki	TK. CILEUNGSI		Belum Tau Lokasi
ZELINE	Perempuan	TK Abata	Kota Wisata Cluster Coatestville	Kota Wisata
ARSENIO AHMAD	Laki- Laki	TK HUDA Bekasi	LImus Pratama Regency	LImus Pratama Regency

3.2. Identify Data Issues

Initial analysis was carried out to identify inconsistencies and variations in the writing in the "Kelurahan" column (Column F) which was the focus of normalization. This identification is done manually and semi-automatically through direct observation of the data and the use of the search function in Google Sheets.

3.3. Normalization System Design

The normalization system is designed using a rule-based approach implemented through Google Apps Script. The normalization rules are compiled based on the identification of the most frequently occurring writing variations and the writing standards desired by SD Al-Imam Islamic School. A mapping dictionary (normalizationMap) is created to accommodate the intended pair of writing variations and standard forms.
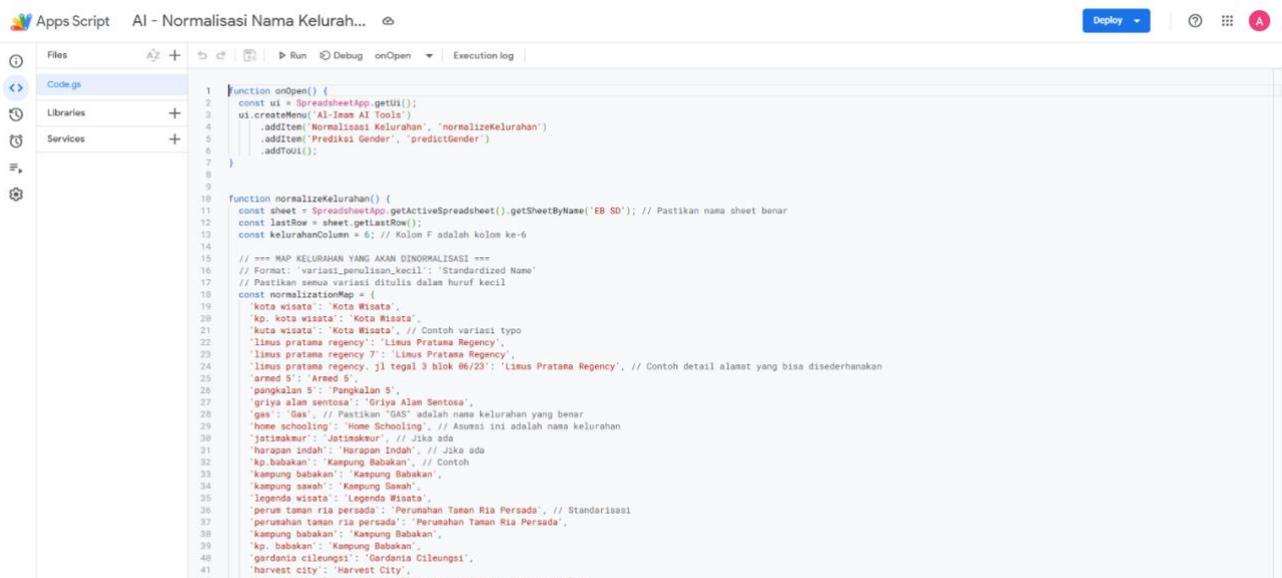

Fig. 1: Display of the Kelurahan Coding Normalization Feature Menu in the PPDB Spreadsheet file of SD Al-Imam with GAS

The following is a display of the spreadsheet file in which there is an EB SD sheet can be seen from fig 2, and in the file we create a new menu using javascript coding in Google Apps Script, make sure that column F is a column that contains village data, when clicked the "Normalize Village" button, then all village data whatever the form, whatever the text, will be corrected according to the village data that is input in the javascript coding, and it will minimize the occurrence of village naming errors and the name of the village will be more valid, the leadership of SD Al-Imam will be easy to make decisions with the correct data

Fig. 2: Kelurahan Normalization Feature Menu Display in fil Spreadsheet PPDB SD Al-Imam

3.4. Implementation of AI (Data Normalization)

The implementation is carried out by writing a Google Apps Script script that will read each line of data in the "Kelurahan" column. This script performs a string transformation (e.g., lowercase, trim whitespace) on the original value, and then compares it to the keys in the normalizationMap. If a match is found, the original value will be replaced with a predetermined standard value.

This code consists of two main functions: onOpen() dan normalizeKelurahan().

3.4.1.   Function onOpen()

This function is a **simple trigger function** that automatically runs every time a spreadsheet is opened. The goal is to create a custom menu in the Google Sheets user interface.
This code uses javascript :

```javascript
function onOpen() {
 const ui = SpreadsheetApp.getUi();
 ui.createMenu('Al-Imam AI Tools')
    .addItem('Normalisasi Kelurahan', 'normalizeKelurahan')
    .addItem('Prediksi Gender', 'predictGender')
    .addToUi();
}
```

- **function onOpen() { ... }**: This defines a function called onOpen. Google Apps Script will automatically execute this function when the spreadsheet is opened.
- **const ui = SpreadsheetApp.getUi();**: This row gets the **user interface (UI) object** from the active spreadsheet. These ui objects allow you to interact with UI elements such as menus and dialog boxes.
- **ui.createMenu('Al-Imam AI Tools')**: This creates a new menu in the Google Sheets menu bar with the name **"Al-Imam AI Tools"**.
- **.addItem('Normalisasi Kelurahan', 'normalizeKelurahan')**: It adds items to the newly created menu.
  - 'Normalisasi Kelurahan': This is the text that will be displayed in the menu.
  - 'normalizeKelurahan': This is the name of the function that will be called when this menu item is clicked.
- **.addItem('Prediksi Gender', 'predictGender')**: It adds a second item to the menu, similar to the first. When clicked, this item will call a function named predictGender (this function is not provided in your code, but it can be added later).
- **.addToUi();**: This line finishes building the menu and adds it to the spreadsheet's user interface.

3.4.2.   Function normalizeKelurahan()

This function is responsible for reading the village data from a specific column in the spreadsheet, comparing it to the normalization map, and updating the cells with the standardized village name.
This code uses javascript :

```javascript
function normalizeKelurahan() {
 const sheet = SpreadsheetApp.getActiveSpreadsheet().getSheetByName('EB SD'); // Pastikan nama sheet benar
 const lastRow = sheet.getLastRow();
 const kelurahanColumn = 6; // Kolom F adalah kolom ke-6

 // === MAP KELURAHAN YANG AKAN DINORMALISASI ===
```

```
// Format: 'variasi_penulisan_kecil': 'Standardized Name'
// Pastikan semua variasi ditulis dalam huruf kecil
const normalizationMap = {
  'kota wisata': 'Kota Wisata',
  'kp. kota wisata': 'Kota Wisata',
  'kuta wisata': 'Kota Wisata',
  // ... (dan seterusnya untuk entri lainnya)
};

for (let i = 2; i <= lastRow; i++) { // Mulai dari baris 2 (setelah header)
  let originalKelurahan = sheet.getRange(i, kelurahanColumn).getValue();
  if (originalKelurahan) { // Pastikan sel tidak kosong
    let lowerCaseKelurahan = String(originalKelurahan).toLowerCase().trim(); // Ubah ke huruf kecil dan hapus spasi ekstra
    if (normalizationMap.hasOwnProperty(lowerCaseKelurahan)) {
      sheet.getRange(i, kelurahanColumn).setValue(normalizationMap[lowerCaseKelurahan]);
    }
    // Opsional: Jika Anda ingin menandai yang tidak cocok:
    // else {
    // sheet.getRange(i, kelurahanColumn).setBackground('yellow'); // Tandai dengan warna kuning
    // }
  }
}
SpreadsheetApp.getUi().alert('Normalisasi Kelurahan Selesai!');
}
```

- **function normalizeKelurahan() { ... }**: This defines a function named normalizeKelurahan. This function will be invoked when the user clicks on the menu item "Normalisasi Kelurahan".
- **const sheet = SpreadsheetApp.getActiveSpreadsheet().getSheetByName('EB SD');**: This row gets a specific **sheet object from** an active spreadsheet. In this case, he searched for a sheet with the name **"EB SD".** It's important to make sure the name of this sheet is correct.
- **const lastRow = sheet.getLastRow();**: It gets the last line number that contains the content in the selected sheet. It is used to determine up to which lines the loop will run.
- **const kelurahanColumn = 6;**: It declares the kelurahanColumn and set the value 6. This means that the column to be normalized is **the 6th column**, which corresponds to column **F** in Google Sheets (A=1, B=2, etc.).
- **const normalizationMap = { ... };**: It defines a JavaScript object **(often called a "map" or "dictionary")** that serves as a normalization map.
  - **The keys** of this object are the variations of the village writing that you want to standardize (all in lowercase).
  - **The values** of this object are the names of the standardized villages that you want.
    - Example: 'kota wisata': 'Kota Wisata' means that if the cell contains "kota wisata" (after changing to lowercase), it will be replaced with "Kota Wisata".
- **for (let i = 2; i <= lastRow; i++) { ... }**: This is a loophole **for** which will iterate through each row in the sheet.
  - **let i = 2**: The iteration starts from line 2 because usually the first line (line 1) is a header and does not need to be normalized.
  - **i <= lastRow**: The repetition will continue as long as the value i is less than or equal to lastRow.
  - **i++**: After each iteration, the i value will increase by 1 to proceed to the next line.
- **let originalKelurahan = sheet.getRange(i, kelurahanColumn).getValue();**: Within each iteration of the loop, this row gets a value from the cells on the i row and the column kelurahanColumn (column F). This value is stored in the originalKelurahan.
- **if (originalKelurahan) { ... }**: This is a condition that checks if the retrieved cell is not empty (has value). This prevents errors if there are empty cells in the village column.
- **let lowerCaseKelurahan = String(originalKelurahan).toLowerCase().trim();**:
  - **String(originalKelurahan)**: Ensures that cell values are treated as strings, even if their contents are numbers or other data types.
  - **.toLowerCase()**: Converts the entire string to **lowercase**. This is important so that the comparison with normalizationMap to be case-insensitive (does not distinguish upper/lowercase letters).
  - **.trim()**: Removes empty spaces from the beginning and end of the string. This helps to address the issue of extra spacing that may be present in the data.
- **if (normalizationMap.hasOwnProperty(lowerCaseKelurahan)) { ... }**: This is the condition that checks whether normalizationMap have a **key that** corresponds to lowerCaseKelurahan that has been processed.
- **hasOwnProperty()**: This method is a safe way to check if an object has a specific property as its direct property (not from the prototype).
- **sheet.getRange(i, kelurahanColumn).setValue(normalizationMap[lowerCaseKelurahan]);**: If lowerCaseKelurahan found as a key in normalizationMap, This row will update the cell values in row i and columns kelurahanColumn with **a standardized** value of normalizationMap.
- **// Opsional: Jika Anda ingin menandai yang tidak cocok: ...**: This section is a comment. If you remove the tag, the code in it will be active. This will mark (in yellow) cells whose village values are not found in normalizationMap, helps you identify the data that needs to be added to the map.
- **SpreadsheetApp.getUi().alert('Normalisasi Kelurahan Selesai!');**: Once the loop finishes processing all the rows, it displays a pop-up dialog box in Google Sheets informing the user that the normalization process is complete.

3.5. Testing and Evaluation

After implementation, the test is carried out by running a script on the prepared dataset. Evaluation is carried out by comparing data before and after normalization to measure the level of data consistency. The accuracy of normalization is measured based on the number of entries that have been successfully standardized according to the established standards. A positive impact on the efficiency of data analysis was also observed.

3.6. Data normalization and artificial intelligence

Data normalization refers to a systematic set of processes aimed at reducing data redundancy and improving data integrity [6]. In the context of data cleansing or data preprocessing, normalization involves standardizing data formats and values to ensure consistency. The goal is to ensure that identical data entities have a uniform representation throughout the dataset, despite input variations arising from human error [7]. This process is crucial for accurate data analysis.
Artificial Intelligence (AI), specifically the sub-fields of rule-based systems and natural language processing (NLP), is increasingly applied to automate and enhance data management processes [8]. In demographic normalization, AI is leveraged to identify variations in writing, group similar entities, and apply transformation rules to achieve data consistency efficiently [9].

3.7. Research methodology

This research adopts a qualitative-descriptive approach using a case study strategy at SD Al-Imam Islamic School. The research stages systematically cover problem identification, solution design, implementation, and impact evaluation.

3.7.1. Data collection and identification

Demographic data for prospective students in the 2025/2026 academic year were collected via online forms and stored digitally in Google Sheets. The 'Village/Housing Address' column became the primary focus of normalization. Initial identification revealed significant inconsistency and variations in writing, including differences in capitalization, use of abbreviations, and the inclusion of irrelevant details.

Table 1 presents a snippet of the village/address data before the normalization process.

Table 2: Example Snippet of Village Data Before Normalization

Name	Village/Housing Address
ADEEVA KESHA AZZAHRA	Limus Pratama Regency
Radika Putra Irawan	Pangkalan 5
Azma Hafiza Rahma	ARMED 7
Sweta Karsa	Limus Pratama Regency
Gelana Asmara	Home Schooling
Kiki Ahmad Numia	Harvest City
Nafaisha Rabbah	GAS
Alika Khanifa	Legenda Wisata
Danyza Praetyo	Griy Alam Sentosa
ZELINE	Belum tau lokasi

3.7.2. Role-based normalizationmap design

The normalization system was designed using a rule-based approach implemented via Google Apps Script. A normalization dictionary (normalizationMap) was created as a JavaScript object, serving as a lookup table. This dictionary maps potential writing variations (the key) to a single agreed-upon standard form (the value), after undergoing string pre-processing (e.g., case folding and trimming whitespace). The structure of this dictionary was manually initialized based on the common error patterns identified.
Table 2 illustrates a simple mapping of data within the normalizationMap.

Table 3: Illustration of Data Mapping in Role-Based NormalizationMap

Input (Key)	Standard Output (Value)	Role/Rule
kota wisata	Kota Wisata	Case Folding & Standardization
kuta wisata	Kota Wisata	Typographical Correction
kp. kota wisata	Kota Wisata	Abbreviation & Standardization
limus pratama regency	Limus Pratama Regency	Case Folding & Standardization
griy alam sentosa	Griya Alam Sentosa	Typographical Correction

3.7.3.   Google apps script implementation

Implementation was carried out by developing a JavaScript function (normalizeKelurahan) within Google Apps Script. This script retrieves all data from the target column, applies string pre-processing to each value, and then performs a lookup against the normalizationMap. If a match is found, the original value in the Google Sheet is replaced with the corresponding standard value from the dictionary [12][13]. The script is integrated into the target Google Sheet via a custom menu, "Al-Imam AI Tools," allowing for on-demand execution.

Figure 3 illustrates the workflow diagram of the data normalization process using Google Apps Script.
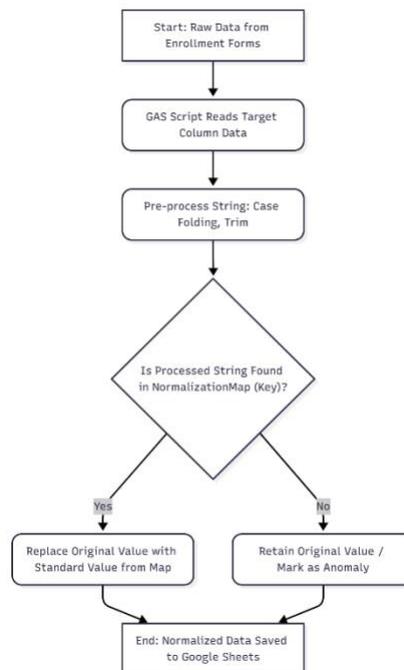
Fig. 3: Workflow Diagram of the Demographic Data Normalization Process Using Google Apps Script

3.8. Results and impact of normalization

Following the execution of the normalization script, the data in the 'Village/Housing Address' column showed a substantial increase in consistency. Writing variations that were previously scattered have now been standardized into a single form.
Table 3 presents a snippet of the data after normalization, demonstrating the uniformity of entries.

Table 4: Example Snippet of Village Data After Normalization

Name	Village/Housing Address
ADEEVA KESHA AZZAHRA	Limus Pratama Regency
Radika Putra Irawan	Pangkalan 5
Azma Hafiza Rahma	Armed 7

Sweta Karsa	Limus Pratama Regency
Gelana Asmara	Home Schooling
Kiki Ahmad Numia	Harvest City
Nafaisha Rabbah	GAS
Alika Khanifa	Legenda Wisata
Danyza Praetyo	Griya Alam Sentosa
ZELINE	Belum Tau Lokasi

The positive impact of this normalization includes:
1. Accurate Data Aggregation: Enabling the calculation of the number of applicants per village without fragmentation issues.
2. Effective Visualization: The data is ready for mapping applicant distribution, helping to geographically identify areas with high or low potential. Figure 4 displays an example of the demographic visualization made possible by the normalized data.
3. Informed Decision-Making: Providing a strong data foundation for directing promotion and socialization strategies [10].

4. Result and Discussion

The implementation of rule-based Artificial Intelligence for the demographic data normalization of prospective students at SD Al-Imam Islamic School has successfully enhanced data quality and consistency significantly. Through the use of Google Apps Script and the role-based approach with normalizationMap, variations in village/address writing can be standardized efficiently, which in turn facilitates data analysis and supports strategic decision-making.

Although this solution is limited as a simple rule-based AI (requiring manual updates to the normalization dictionary for new variations), it proves that accessible AI technology can be implemented practically and effectively in educational settings. Moving forward, development efforts should focus on automating dictionary maintenance and integrating normalization for other data fields, such as street names.

5. Conclusion

The implementation of this simple rule-based AI has proven effective in mitigating inconsistent data issues in the school environment, demonstrating that practical AI solutions can provide significant added value [11].

Fig. 4: Example of Demographic Distribution Visualization of Prospective Students Based on Normalized Data

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