

ANALYSIS OF SANTRI CLEANLINESS VIOLATION PATTERNS USING APRIORI ALGORITHM APPROACH AT SALAFIYAH SYAFI'YAH BOARDING SCHOOL

Ilham Rafi Jawara⁻¹, Zaehol Fatah⁻², Akhlis Munazilin⁻³

Science and Technology

Ibrahimy University, Sukorejo Situbondo East Java

ilhamrafiawara@gmail.com⁻¹, zaeholfatah@gmail.com⁻², akhlismunazilin@gmail.com⁻³

Abstract

Islamic boarding schools (*pondok pesantren*) are religious-based educational institutions that emphasize not only Islamic teachings but also the development of character and student discipline, particularly in maintaining environmental cleanliness. However, managing cleanliness often poses a challenge due to low student awareness and the suboptimal implementation of sanitation systems. This study aims to identify behavioral patterns related to student cleanliness through a data mining approach utilizing the Apriori algorithm. This method enables the analysis of students' habitual behaviors using collected data to uncover hidden patterns related to cleanliness violations. The research was conducted at Salafiyah Syafi'iyah Sukorejo Islamic Boarding School and provides valuable insights for pesantren administrators to design more effective, data-driven cleanliness management strategies. The findings are also expected to enhance student awareness of cleanliness as an essential aspect of Islamic values. Overall, the results serve as a foundation for strategic decision-making to foster a healthy, clean, and supportive environment conducive to optimal learning in Islamic boarding schools.

Keywords: Islamic Boarding School, Cleanliness Behavior, Apriori Algorithm, Data Mining, Sanitation Management.

Abstrak

Pondok pesantren adalah lembaga pendidikan berbasis agama yang tidak hanya menekankan pada ajaran Islam, tetapi juga pada pengembangan karakter dan kedisiplinan santri, khususnya dalam menjaga kebersihan lingkungan. Namun, pengelolaan kebersihan sering kali menjadi tantangan karena rendahnya kesadaran santri serta penerapan sistem sanitasi yang kurang optimal. Penelitian ini bertujuan untuk mengidentifikasi pola perilaku yang berkaitan dengan kebersihan santri melalui pendekatan data mining dengan menggunakan algoritma Apriori. Metode ini memungkinkan analisis terhadap kebiasaan perilaku santri berdasarkan data yang dikumpulkan untuk mengungkap pola tersembunyi yang berkaitan dengan pelanggaran kebersihan. Penelitian ini dilakukan di Pondok Pesantren Salafiyah Syafi'iyah Sukorejo dan memberikan wawasan berharga bagi pengelola pesantren dalam merancang strategi manajemen kebersihan yang lebih efektif dan berbasis data. Temuan ini juga diharapkan dapat meningkatkan kesadaran santri akan pentingnya kebersihan sebagai bagian esensial dari nilai-nilai Islam. Secara keseluruhan, hasil penelitian ini menjadi landasan dalam pengambilan keputusan strategis untuk menciptakan lingkungan yang sehat, bersih, dan mendukung proses pembelajaran yang optimal di pondok pesantren.

Kata kunci: Pondok Pesantren, Perilaku Kebersihan, Algoritma Apriori, Data Mining, Manajemen Sanitasi.

INTRODUCTION

Islamic boarding schools are educational institutions that serve not only as centers for Islamic learning but also as places where character, discipline, and social behavior are nurtured (Yono & Abrista Devi, 2025). These institutions play a pivotal role in Indonesian society by integrating

Islamic teachings with practical life competencies. This holistic educational model emphasizes both academic achievement and strong moral values. Among these core values, environmental cleanliness is especially significant, as it embodies Islamic principles linking hygiene with faith and spiritual integrity (Farhany et al., 2023). Within this framework, cleanliness is considered both a

personal religious duty and a shared community responsibility.

Despite its importance, many Islamic boarding schools still face significant challenges in maintaining cleanliness. Various studies have reported issues such as low student awareness, inadequate sanitation infrastructure, and the lack of systematic cleanliness management (Adiansyah et al., 2023). A study by the Islamic Education Research Institute (Rianti & Triwinarto, 2020) found that over 60% of Islamic boarding schools in Indonesia struggle with waste management and sanitation. These conditions can pose serious health risks, including skin infections and respiratory problems. Such findings emphasize the urgent need for a structured, data-driven strategy to improve cleanliness management in Islamic boarding schools.

Recent advancements in data science offer practical solutions to these problems. Data mining—an approach used to extract meaningful patterns from large datasets—can provide valuable insights into students' cleanliness-related behaviors (Ali, Rizaldi, Miliyani, & Putri, 2024). By analyzing behavioral data, administrators can identify trends and relationships that may not be apparent through direct observation, thereby enabling more targeted interventions and improved resource allocation.

One widely used data mining technique is the Apriori algorithm, which is effective in identifying frequent itemsets and association rules. This algorithm can reveal recurring combinations of behaviors, such as repeated neglect of cleaning tasks or improper waste disposal (Mayaza, Buaton, & Ramadani, 2023). Due to its simplicity and reliability, Apriori has been successfully applied in behavioral, environmental, and educational research (Abdullah & Setiawan, 2023).

While several studies have applied the Apriori algorithm to analyze hygiene practices in general school settings, few have focused specifically on Islamic boarding schools, where religious norms and community culture strongly influence behavior. This study aims to address that gap by applying the Apriori algorithm to analyze cleanliness violations among students at Salafiyah Syafi'iyah Sukorejo Islamic Boarding School.

The analysis focuses on behavioral and environmental data to identify recurring patterns of hygiene violations, including scattered clothing, laundry hung in public areas, missed cleaning duties, garbage accumulation, dirty bathrooms, unwashed utensils, stained windows, stagnant water, and other signs of uncleanness. The Apriori algorithm uncovered frequent co-occurrences, such

as students who skipped cleaning duties also leaving personal items scattered or contributing to littering. By identifying these patterns, school administrators can design targeted cleanliness programs and awareness campaigns based on actual behavioral data.

By integrating Islamic values, institutional discipline, and data-driven analysis, this study presents a comprehensive approach to improving cleanliness in *pesantren* settings. It demonstrates how tools such as the Apriori algorithm can support better decision-making, enhance student well-being, and foster a healthier and more conducive learning environment.

RESEARCH METHODS

Types of research

This study employs a quantitative research approach with a descriptive-analytical design. The main focus is to analyze the pattern of cleanliness violations among santri at Pondok Pesantren Salafiyah Syafi'iyah Sukorejo using data mining techniques, specifically the Apriori algorithm for association rule mining. The quantitative method is suitable for this research as it involves numerical data analysis to discover patterns and relationships within the behavioral data of santri (Arief Wibowo, Vasthu Imaniar Ivanoti, & Megananda Hervita Permata Sari, 2023; Sumacot, 2024).

Time and Place of Research

The research was conducted from January to April 2025 at Pondok Pesantren Salafiyah Syafi'iyah Sukorejo, located in Sukorejo, East Java, Indonesia. The *pesantren* provides a controlled environment ideal for observing and collecting data related to cleanliness behaviors of the santri (Gafur, Zainuddin, Walid, & Barizi, 2024; Pawitra et al., 2023).

Research Target / Subject

The research subjects are the santri residing in the *pesantren* during the research period. The target population includes approximately 300 santri across various levels of study. Sampling was conducted using a purposive sampling technique, selecting santri who were actively participating in daily activities related to environmental maintenance and cleanliness to ensure relevant data collection (Qodariyati & Naniek Ratni Ar, 2024; Rohmah & Sayuti, n.d.).

Procedure

The research procedure involved several stages:

1. Data collection on cleanliness behavior through observation and recorded logs maintained by the pesantren's sanitation management team.
2. Preprocessing the collected data to structure it for input into the data mining software.
3. Application of the Apriori algorithm using a data mining tool to extract association rules and identify frequent itemsets that represent patterns of cleanliness violations.
4. Interpretation of the association rules to determine behavioral trends and potential factors influencing cleanliness compliance among santri.
5. Formulating recommendations based on the analysis to improve pesantren cleanliness management (Aji & Devi, 2023).

Data, Instruments, and Data Collection Techniques

The data used in this study consist of behavioral records documenting various cleanliness violations committed by students (*santri*) in the pesantren environment. These records include actions such as leaving clothes scattered, failing to perform cleaning duties, improper trash disposal, and poor hygiene in communal areas. Data were collected using structured observation checklists and sanitation monitoring logs maintained daily by pesantren staff. Additional validation was conducted through informal interviews with sanitation officers and dorm supervisors. Observations were carried out over a three-month period to ensure a diverse and representative sample of behaviors (Qodariyati & Naniek Ratni Ar, 2024).

Data Preprocessing and Item Coding

To prepare the dataset for analysis with the Apriori algorithm, the following data preprocessing steps were applied:

1. Data Cleaning: Duplicate records and inconsistent entries were removed or standardized. Incomplete or ambiguous records were excluded.
2. Normalization: All behavioral descriptions were formatted consistently and assigned short codes for easier processing.
3. Item Coding: Each unique behavior or combination of behaviors was labeled using a predefined code (e.g., A1, A2). These codes represent specific cleanliness violations or behavior sets.

4. Transaction Formation: Each transaction represents a set of co-occurring violations observed in a single incident or reported by the same student group. These transactions were used as input for the Apriori algorithm to identify frequent behavior patterns (Ritonga, Juledi, & Mutia, 2024).

Table 1. Sample Transaction Format

Transaction ID	Behavior Code(s)	Decoded Behavior
T001	A1	Clothes Scattered
T002	A3	Piled Clothes + Laundry Hanger
T003	A13	Hang Clothes + No Cleaning Duty + Less Clean
T004	A28	Less Clean + Littering
T005	A36	Littering + No Cleaning Duty

The coded behavior transactions formed the input dataset used for frequent pattern mining using the Apriori algorithm, as detailed in the subsequent analysis section.

Data analysis technique

Data analysis was conducted using the Apriori algorithm implemented in Python with the *mlxtend* library. This technique was chosen for its ability to discover frequent itemsets and generate association rules that reveal patterns in student cleanliness behavior. The algorithm calculated three key metrics—support, confidence, and lift—to evaluate the significance and strength of the associations between different cleanliness violations (Hahsler, 2023).

To enhance the clarity and transparency of the analytical workflow, a process flowchart is provided in Figure 1, illustrating each step from raw data input to result interpretation. The overall analysis process followed these stages:

1. Data Input: Cleaned and coded behavior data were compiled into a transaction dataset, with each transaction representing one observed behavior set.
2. Preprocessing: This included data cleaning, normalization, and conversion of qualitative descriptions into standardized codes.
3. Frequent Itemset Generation: The Apriori algorithm identified recurring combinations of cleanliness violations that

met a predefined minimum support threshold.

4. Association Rule Mining: Based on the frequent itemsets, rules were derived that satisfied the minimum confidence and lift values.
5. Result Interpretation: The strongest rules were selected and interpreted to reveal insights into common cleanliness issues and their co-occurrences.
6. Strategy Formulation: Insights were used to propose targeted interventions and policy recommendations for improving student cleanliness behavior (Sibarani, 2020).

Apriori-Based Cleanliness Behavior Analysis Workflow

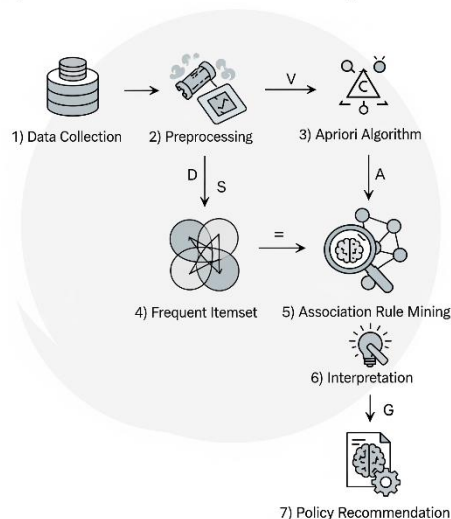


Figure 1. Apriori-Based Cleanliness Behavior Analysis Workflow.

This structured approach ensures a systematic analysis that not only identifies behavioral trends but also supports the development of practical solutions aligned with the pesantren's educational and religious values.

RESULTS AND DISCUSSION

The research results generated through the Apriori algorithm were not only analyzed statistically but also subjected to validation to ensure their reliability and practical relevance. To enhance the credibility of the association rules derived from the algorithm, a multi-step validation process was employed. First, cross-validation was conducted by dividing the dataset into several subsets and repeatedly applying the algorithm to

test the consistency of the rules generated. Second, a panel of pesantren administrators and cleanliness supervisors reviewed the findings to assess whether the identified patterns aligned with their direct observations and operational experience. Third, field verification was carried out by comparing the algorithm's results with real-world conditions within the pesantren, including site inspections and student interviews. This triangulated validation process ensured that the findings were not only statistically significant but also contextually accurate and applicable for practical interventions in cleanliness management (Lukman Hakim, 2024).

To further support the findings, data visualization techniques were used to present the frequent itemsets and association rules clearly. These visualizations help in understanding the patterns of cleanliness violations more intuitively.

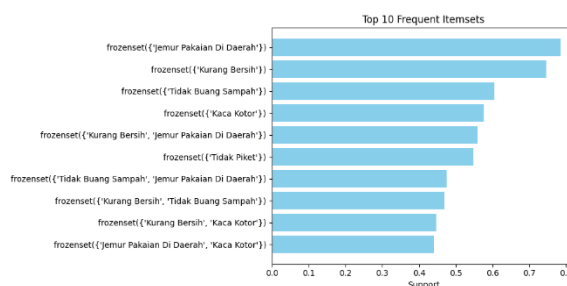


Figure 2. Top 10 frequent itemsets of cleanliness violations based on support value.

Figure 2 shows the ten most frequent combinations of cleanliness violations committed by students. The combinations with the highest support values represent the most common behavioral patterns, such as leaving trash behind or neglecting bathroom cleanliness, indicating key areas that require intervention.

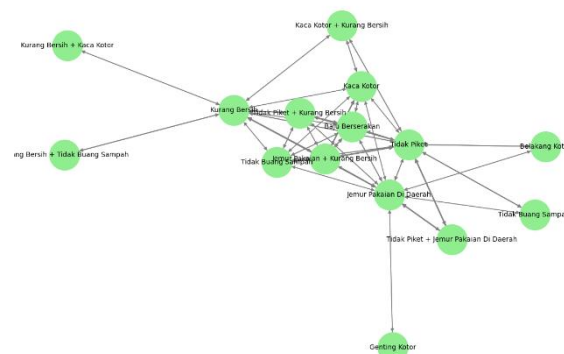


Figure 3. Network graph of association rules among cleanliness violations with lift as edge weight.

Figure 3 illustrates the association rules between different cleanliness violations using a network graph. The directional edges show the implication relationships (from antecedents to consequents), while the edge thickness represents the strength of the relationship measured by lift. This visualization aids in identifying how one violation may trigger or relate to another, supporting the pesantren in developing integrated cleanliness improvement programs. The corresponding rules, including metrics such as support, confidence, and lift, are also detailed in Table 2.

Table 2 below shows the representation of student cleanliness behavior items that were used as input data for the Apriori algorithm:

Table 2. Representation of Santri Cleanliness Behavior Items

Code	Student Behavior
A1	Clothes Scattered
A2	Clothes Scattered + Laundry Hanger
A3	Piled Clothes + Laundry Hanger
A4	No Cleaning Duty + Less Clean
A5	Back Area Dirty
A6	Back Area Dirty + Laundry Hanger
A7	Front Room Messy
A8	Hang Clothes + Wash Water
A9	Hang Clothes in Public Area
A10	Hang Clothes + Wash Water
A11	Hang Clothes + Clothes Scattered
A12	Hang Clothes + No Cleaning Duty
A13	Hang Clothes + No Cleaning Duty + Less Clean
A14	Hang Clothes in Public Area
A15	Hang Clothes in Public Area + Back Area Dirty
A16	Hang Clothes in Public Area + Dirty Window
A17	Hang Clothes in Public Area + Littering
A18	Hang Clothes in Front of Room
A19	Dirty Window
A20	Dirty Window + Hang Clothes in Public Area
A21	Dirty Window + Littering
A22	Less Clean
A23	Less Clean + Wash Water
A24	Less Clean + Hang Clothes

A25	Less Clean + Hang Clothes in Public Area
A26	Less Clean + Dirty Window
A27	Less Clean + Side Area Dirty
A28	Less Clean + Littering
A29	Less Clean + No Cleaning Duty
A30	Dirty Gutter + No Cleaning Duty
A31	Littering
A32	Littering + Clothes Scattered
A33	Littering + Hang Clothes in Public Area
A34	Littering + Dirty Window
A35	Littering + Less Clean
A36	Littering + No Cleaning Duty
A37	Littering + No Cleaning Duty + Less Clean
A38	No Cleaning Duty
A39	No Cleaning Duty + Hang Clothes in Public Area
A40	No Cleaning Duty + Hang Cap
A41	No Cleaning Duty + Less Clean
A42	Dirty Courtyard
A43	Dirty Roof
A44	Wash Water

The Apriori algorithm was applied to transactional data derived from observed student behavior. Using Python and the mlxtend library, the frequent itemsets and association rules were generated based on the minimum support of 0.2 and confidence of 0.6.

Table 3. Frequent Itemsets (Support ≥ 0.2)

Itemsets	Support
(Littering)	0.45
(No Cleaning Duty)	0.38
(Less Clean)	0.33
(No Cleaning Duty, Littering)	0.30
(No Cleaning Duty, Less Clean)	0.27
(Littering, Less Clean)	0.25
(No Cleaning Duty, Littering, Less Clean)	0.22

Table 4. Association Rules (Confidence ≥ 0.6)

Rule	Support	Confidence	Lift
Littering $\rightarrow$ No Cleaning Duty	0.30	0.67	1.76
Littering $\rightarrow$ Less Clean	0.25	0.56	1.70
No Cleaning Duty $\rightarrow$ Littering	0.30	0.79S	1.76

No Cleaning Duty → Less Clean	0.27	0.71	2.15
Less Clean → No Cleaning Duty	0.27	0.81	2.15
No Cleaning Duty, Littering → Less Clean	0.22	0.73	2.21

The results of the Apriori algorithm revealed that “Littering,” “No Cleaning Duty,” and “Less Clean” were the most frequently co-occurring behaviors among the students. The rule No Cleaning Duty → Less Clean had a high confidence value of 0.71 and a lift of 2.15, indicating a strong association. This implies that students who neglected their cleaning duties were also likely to contribute to less clean environments.

The three-way association No Cleaning Duty, Littering → Less Clean (support = 0.22, confidence = 0.73, lift = 2.21) suggests that targeted interventions focused on cleaning responsibilities and anti-littering campaigns could significantly improve overall cleanliness.

These findings align with previous studies emphasizing the importance of discipline and structured cleaning systems in educational institutions, particularly in Islamic boarding schools (*pesantren*). Cleanliness routines integrated with religious teachings—such as communal cleaning (*kerja bakti*) and personal hygiene as a form of worship—have been shown to promote not only a clean environment but also spiritual development (Arranury, Wijaya, Yusmaniar, & Bahsur, 2024). The role of institutional discipline and leadership is also crucial, as clear regulations and role modeling by senior students and religious leaders significantly enhance students’ commitment to cleanliness (Bahtiar, Syaifuddin, & Khasibah, 2023). These insights reinforce the current study’s conclusion that both discipline and structured systems are fundamental in fostering sustainable cleanliness practices within *pesantren* environments. Furthermore, the application of the Apriori algorithm yielded behavioral insights that would be difficult to obtain through observation alone, demonstrating the effectiveness of data mining in analyzing cleanliness-related behavior in boarding school contexts.

By understanding these associations, the management of Pondok Pesantren Salafiyah Syafi’iyah Sukorejo can design more effective, data-driven strategies to reduce cleanliness violations. Future studies may expand the analysis by incorporating other environmental and psychological factors that influence student behavior.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on the Apriori analysis of 44 cleanliness-related behaviors at Pondok Pesantren Salafiyah Syafi’iyah Sukorejo, the study concludes the following:

1. The most frequently observed violations include Littering, No Cleaning Duty, and Less Clean conditions, all of which had high support values.
2. The strongest association rule identified was No Cleaning Duty → Less Clean with a confidence of 0.71 and a lift of 2.15, indicating a strong correlation between the neglect of cleaning duties and poor sanitation.
3. The three-item rule No Cleaning Duty, Littering → Less Clean (confidence = 0.73, lift = 2.21) further reinforces the importance of structured responsibilities in reducing cleanliness violations.
4. The Apriori algorithm effectively uncovered hidden patterns within behavioral data that are often difficult to detect through traditional methods.

This demonstrates the practical value of data mining techniques in informing behavioral and cleanliness management strategies in religious educational institutions.

Suggestion

Based on the conclusions above, several suggestions can be put forward for stakeholders and future research:

1. Policy Enhancements: Strengthen monitoring and enforcement systems, incorporating clear sanctions and reward mechanisms to ensure compliance with cleanliness protocols.
2. Educational Campaigns: Organize routine awareness programs to instill a stronger sense of responsibility and environmental consciousness among students.
3. Technology-Based Monitoring: Adopt digital systems for regular monitoring and analysis of student behavior using data mining approaches like Apriori.
4. Further Research: Expand future studies to include psychological, environmental, or leadership-related variables. Applying other algorithms like FP-Growth or classification models may offer comparative insights.

By implementing these suggestions, it is expected that a cleaner and more disciplined environment can be realized, contributing positively to the overall learning atmosphere and character development of students.

REFERENCES

- Abdullah, & Setiawan, K. (2023). Implementasi Algoritma Apriori Terhadap Data Penjualan Untuk Mengetahui Pola Pembelian Konsumen Pada Koperasi Idn Boarding School. *Jurnal Indonesia : Manajemen Informatika Dan Komunikasi*, 4(3), 1646–1653. <https://doi.org/10.35870/jimik.v4i3.390>
- Adiansyah, J. S., Nurhayati, N., Ibrahim, I., Sukuryadi, S., Johari, H. I., & Putra, A. P. (2023). Waste segregation and processing training at Lenterahati Islamic Boarding School (LHIBS) West Lombok. *Community Empowerment*, 8(7), 1065–1069. <https://doi.org/10.31603/ce.8948>
- Aji, G. W., & Devi, P. A. R. (2023). Data Mining Implementation For Product Transaction Patterns Using Apriori Method. *Sinkron*, 8(1), 421–432. <https://doi.org/10.33395/sinkron.v8i1.12071>
- Ali, K., Rizaldi, M. A., Miliyani, S., & Putri, D. (2024). *Original Article Environmental Sanitation and Scabies Incidence among Santri in Islamic Boarding School in Jember Regency*.
- Arief Wibowo, Vasthu Imaniar Ivanoti, & Megananda Hervita Permata Sari. (2023). Employee Education and Training Recommendations using the Apriori Algorithm. *Jurnal RESTI (Rekayasa Sistem Dan Teknologi Informasi)*, 7(5), 1118–1131. <https://doi.org/10.29207/resti.v7i5.4973>
- Arranury, Z. F., Wijaya, D. R., Yusmaniar, W., & Bahsur, M. N. I. (2024). Peningkatan Kesadaran Perilaku Hidup Bersih dan Sehat di Pondok Pesantren Abnaul Amir Kabupaten Gowa. *PengabdianMu: Jurnal Ilmiah Pengabdian Kepada Masyarakat*, 9(1), 169–175. <https://doi.org/10.33084/pengabdianmu.v9i1.5892>
- Bahtiar, Y., Syaifuddin, M., & Khasibah, N. (2023). Strategi Pengurus Pondok Pesantren Dalam Membina Kedisiplinan Belajar Santri. *Jurnal AlifLam: Journal of Islamic Studies and Humanities*, 3(2), 35–54. <https://doi.org/10.51700/aliflam.v4i1.413>
- Farhany, F. F., Amalia, I., Rachmawati, M. B., Ernias, W., Rinonce, H. T., Kusumawati, H. I., & Muslichah, R. (2023). An Overview of Clean and Healthy Living Behavior Practices in the Islamic Boarding-Based Education (Pondok Pesantren) Environment. *Journal of Community Empowerment for Health*, 6(2), 87. <https://doi.org/10.22146/jcoemph.77396>
- Gafur, A., Zainuddin, M., Walid, M., & Barizi, A. (2024). *Enhancing the Quality of Life for Santri : Management of Pesantren through the Strengthening of Clean and Healthy Living Culture*. 08(03), 747–759.
- Hahsler, M. (2023). *ARULESPY: Exploring Association Rules and Frequent Itemsets in Python*. (Raschka 2018). Retrieved from <http://arxiv.org/abs/2305.15263>
- Lukman Hakim, M. A. R. & A. M. (2024). *Penentuan pola pelanggaran santri pada bidang keamanan dan ketertiban dengan menggunakan algoritma apriori*. 1(2), 480–485.
- Mayaza, S. B., Buaton, R., & Ramadani, S. (2023). Application of Data Mining in Analyzing the Effect of Parents' Employment and Education Level on Student Behavior Using the A PRIORI Method (Case Study: SDN 024769 Binjai). *Journal of Artificial Intelligence and Engineering Applications (JAIEA)*, 3(1), 164–171. <https://doi.org/10.59934/jaiea.v3i1.279>
- Pawitra, A. S., Diyanah, K. C., Putri, N. K., Alchamdani, Ma'ruf, M. A., & Juwono, K. F. (2023). Pembiasaan Perilaku Hidup Bersih dan Sehat di Pondok Pesantren di Era Adaptasi Kebiasaan Baru. *Journal of Public and Community Service*, 2(1), 1–17. Retrieved from <https://ejournal2.undip.ac.id/index.php/jphcs/article/view/15437>
- Qodariyati, S., & Naniek Ratni Ar, J. (2024). Pengaruh Perilaku Santri Terhadap Kondisi Sanitasi Lingkungan di Pondok Pesantren Al-Urwatul Wutsqo. *Jurnal Serambi Engineering*, IX(2), 9008–9014.
- Rianti, E., & Triwinarto, A. (2020). *Efforts to Improve Management of Student Health Services at Islamic Boarding Schools in Indonesia*. (February 2020). <https://doi.org/10.2991/ahsr.k.200215.091>
- Ritonga, M. Z., Juledi, A. P., & Mutia, R. (2024). Implementation of Data Mining to Determine Sales Patterns Using the Apriori Method. *Sinkron*, 8(2), 1100–1106. <https://doi.org/10.33395/sinkron.v8i2.13621>
- Rohmah, F. N., & Sayuti, A. F. (n.d.). *INTEGRATION OF ECOLOGICAL PRINCIPLES IN THE*

PESANTREN. (c).

- Sibarani, A. J. P. (2020). Implementasi Data Mining Menggunakan Algoritma Apriori Untuk Meningkatkan Pola Penjualan Obat. *JATISI (Jurnal Teknik Informatika Dan Sistem Informasi)*, 7(2), 262–276. <https://doi.org/10.35957/jatisi.v7i2.195>
- Sumacot, R. M. (2024). *Association Analysis Using Apriori Algorithm of GANs-Expanded Student Performance Dataset*. 15(December). <https://doi.org/10.21512/comtech.v15i2.11948>
- Yono, Y., & Abrista Devi. (2025). HOLISTIC HYGIENE JURISPRUDENCE IN ISLAMIC EDUCATION INSTITUTIONS: INTEGRATING FAITH, SELF, ENVIRONMENT, AND MORAL-SPIRITUAL DIMENSIONS. *Edukasi Islami: Jurnal Pendidikan Islam*, 14(01), 229–246. <https://doi.org/10.30868/ei.v14i01.8104>

