Quality Analysis of Al-Qur'an Learning Qiro'ati Method with Apriori Algorithm
(Case Study: SMK Al Irsyad Al Islamiyyah)

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Abstract

Learning the Qur'an is an important part of Islamic education because it includes the ability to read and understand tajweed and makharijul huruf. At SMK Al Irsyad Al Islamiyyah Cirebon, the Qiro'ati method is used as the main approach. However, its effectiveness is not optimal as only 50-60% of students read according to the standard. This study aims to analyze the factors that affect the quality of Qur'an learning with a data mining approach using the Apriori algorithm. The analysis process follows the CRISP-DM stages, starting from understanding the problem, collecting data from 175 students, cleaning, data transformation, to exploring association patterns. Evaluation was done with three metrics: support, confidence, and lift. The results showed that most of the rules met the criteria of support ≥ 0.3, confidence ≥ 0.8, and lift > 1, indicating strong and relevant patterns. One of the best rules showed that the combination of parental support, teacher guidance, and intermediate level verse connection skills were positively correlated with improved reading quality. The most consistently influential factors were parental support, teacher quality, verse connection ability, and understanding of makharijul huruf. These findings suggest that the Apriori algorithm is effective in identifying hidden patterns for designing strategies to improve the quality of Qur'anic learning in schools.

Keywords: Qur'an Learning; Qiro'ati Method; Data Mining; Algoritma Apriori: CRISP-DM

1. Introduction

The Qur'an is the holy book of Muslims, has the highest position in the structure of faith and serves as the main guide for personal and social life. Therefore, the ability to read and understand the Qur'an correctly is essential for every Muslim. Learning the Qur'an includes mastering the rules of tajweed and makharijul huruf, both of which determine the quality of a person's reading [1]. The choice of the right method is very influential in the level of effectiveness and efficiency of the learning process [2]. Regular and continuous learning of the Qur'an in schools has great benefits in character building, spiritual values, and increasing discipline towards religious teachings.

Various Islamic Education institutions in Indonesia have implemented the Qiro'ati method to teach the Qur'an. With the aim that students can read the Qur'an tartil and fashih, this method emphasizes hands-on practice, gradual learning, and systematic repetition [3]. One of the school institutions in Cirebon, SMK Al Irsyad Al Islamiyyah applies the Qiro'ati method as part of the flagship program. However, initial observations show that about 50%-60% of students are able to read the Qur'an with the standard Qiro'ati method. This condition indicates that there are obstacles that can come from various factors that can affect the quality of learning such as mastery of tajweed and makharijul huruf or such as the quality of teaching and parental participation in learning.

Information technology approaches such as data mining offer solutions to the problem of learning effectiveness. Data mining is a process that is widely used in the fields of education and business to assist in decision making [4]. One of the processes of finding hidden patterns from very large data sets, Association Rule Mining is a relevant data mining method that uses algorithms such as Apriori to find associations between items based on support and confidence. Although FP-Growth is considered more efficient in handling larger datasets, Apriori is a widely used algorithm in the field of Education due to the ability to create association rules that are more easily understood directly by educators and researchers [5].

Soni et al. (2025) examined how the Apriori algorithm succeeded in finding customer purchase patterns in the Ngenyod'S Kedai MSME. The study shows how important transaction data is for making strategic decisions and customizing offers to customer needs. The findings show that the association approach can also be applied to non-commercial environments, such as education to understand the relationship between various learning factors. By applying the Apriori algorithm in Islamic education, it is expected to reveal patterns of relationships between factors of Qur'anic learning quality that have not yet been discovered.

Previous studies have examined the utilization of association algorithms in general and pesantren education (Hudawi, 2024; Fatah, 2024). But until now, there has been no study that specifically uses the Apriori algorithm to analyze the relationship between the factors of correct

tajweed reading, the accuracy of makharijul huruf, pronunciation in accordance with the rules, gradual fluency without spelling, the ability to read connect, and for external factors such as teacher quality, parental support.

Thus, this research becomes very important to do to fill the gap. The purpose of this study is to find the relationship of several factors that can affect the quality of Qur'an learning using the Qiro'ati method both in terms of internal and external factors using the Apriori Algorithm. This research is expected to make a real contribution to improving the quality of the Qur'an learning program at SMK Al Irsyad Al Islamiyyah Cirebon. In addition, this research will also be a reference for making policies and data-based learning strategies.

2. LITERARURE REVIEW

2.1. SMK Al Irsyad Al Islamiyyah

Al Irsyad Al Islamiyyah is an Islamic organization founded on 6 September 1914 by Sheikh Ahmad Surkati Al-Anshari, with a focus on education, da'wah, and social affairs. Since its inception, Al Irsyad has been known as a pioneer of modern Islamic education that integrates religious studies and general science, and upholds moral values and independence. One of its educational institutions is SMK Al Irsyad Al Islamiyyah Cirebon, which has three main majors: Software Engineering (RPL), Computer and Network Engineering (TKJ), and Visual Communication Design (DKV). The school combines vocational education in the field of technology with religious education, especially Qur'anic learning, as part of the effort to form graduates who excel intellectually and spiritually. Thus, SMK Al Irsyad is committed to producing a generation with high morals and competence, especially in the field of technology and Islamic understanding [6].

2.2. Learning the Al-Qur'an

Learning the Qur'an is an educational process that aims to teach students how to read, understand, memorize and practice the contents of the Qur'an in everyday life. Qur'anic learning does not only focus on cognitive aspects such as the ability to read, but also on affective aspects such as attitudes and values internalized from its teachings [7]. Learning the Qur'an must be done consistently with an interesting approach, adapted to student development, and involve learning activities. The principles of persistence (tadarruj) and habituation (ta'wid) are very important to improve the ability to read and understand the Qur'an [8].

Therefore, learning the Qur'an is a complex process that requires careful preparation, selection of appropriate methods and continuous implementation and evaluation to achieve the highest goal. So that the formation of a Muslim personality can be achieved optimally.

2.3. Qiro'ati Method

The Qiro'ati method is one of the methods of learning to read the Qur'an developed by KH. Dachlan Salim Zarkasyi from Semarang, Central Java. This method is designed with the aim of accelerating the ability to read the Qur'an tartil in accordance with the rules of tajweed. With the Qiro'ati method, students are trained to read directly per series of letters or syllables this makes the learning process faster and more efficient. The Qiro'ati method emphasizes the importance of training students to read correctly from an early age by reading the letters of the Qur'an with the rules of tajweed [9].

One of the distinctive features of the Qiro'ati method is the use of tiered textbooks arranged systematically from the most basic level to the advanced level. Each level must be fully mastered before students can proceed to the next level, in line with the principle of stages (tadarruj) in Islamic education which aims to allow the ability to read the Qur'an to develop naturally and firmly. One of the advantages of this method lies in the practice of direct reading with close supervision from the teacher, where every small mistake is immediately corrected, so that students avoid the habit of reading wrong. Evaluation in the Qiro'ati method must go through the tasmi' (reading test) stage before it can proceed to the next stage. This evaluation process emphasizes aspects of accuracy in the pronunciation of letters, the accuracy of reading long and short, and fluency in reciting Qur'anic verses [10].

2.4. Data Mining

Data Mining is one part of artificial intelligence that can extract data to produce knowledge and information [11]. Data mining is the process of parsing or extracting knowledge from existing data sets. Data is considered as raw material, while information is data that has been processed and changed so that it has additional value and can help decision making. Data mining in computer science includes the use of algorithms such as machine learning, statistics, and data processing to find patterns or relationships that were previously invisible [12].

2.5. Algoritma Apriori

Agrawal and Srikant proposed Apriori Algorithm to be a basic algorithm that was first discovered in 1994 to find a collection of items that often appear together. Apriori Algorithm is one of the algorithms that searches for frequent itemsets that often appear together and forms association rules using Boolean based on support and confidence values. During the pre-calculation stage, Apriori Algorithm calculates the support value for each database element that meets the minimum threshold set as a frequent item [13].

2.6. Association Rule Mining

Association Rule Mining is one of the data mining methods that functions to identify association relationships between items in transaction data sets. Association Rule Mining also produces if-then rules that can be used for decision making and finding combinations of items that

often appear together in transactions [14]. Association Rule Mining uses two main metrics namely support, which shows the frequency of occurrence of a set of items, and confidence which measures the strength of the relationship between items in the rule [15].

3. Reasearch Method

This research uses the CRISP-DM (Cross-Industry Standard Process for Data Mining) approach which consists of six stages: business understanding, data understanding, data preparation, modeling, evaluation, and result dissemination. The main objective of this research is to find association patterns between factors that affect the quality of learning the Qur'an of the Qiro'ati method.
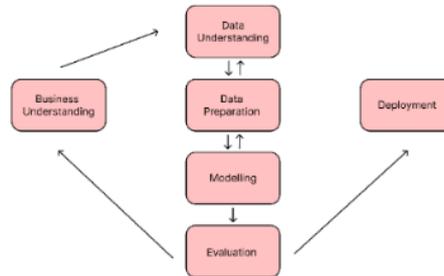

Fig. 1: CRISP-DM Stages

The initial stage started with identifying important factors such as tajweed ability, letter articulation (makharijul huruf), reading fluency, teacher quality and support. Data was collected from 175 students in six classes through observations and interviews. In the data preparation stage, data cleaning, missing data handling, and data transformation using one-hot encoding were performed to fit the Apriori algorithm format. In the modeling stage, Apriori algorithm is used to find frequent itemsets and form association rules based on certain support and confidence value thresholds. The analysis results are visualized using association network graphs to show the strong relationships between variables. Evaluation is done by assessing the strength and relevance of the rules generated, while the deployment stage aims to convey the findings to the school as a basis for decision making to improve the learning strategy of the Qur'an.

By applying the CRISP-DM method, this research was conducted systematically and produced insights that can be applied in the context of Qur'anic education.

4. RESULT AND DISCUSSION

4.1. Data Understanding

At the Data Understanding stage, exploration of data consisting of 175 respondents, namely students from SMK Al Irsyad Al Islamiyyah Cirebon. This data is used to build models with the Apriori algorithm to find patterns of relationships between variables that affect the quality of Qur'an learning using the Qiro'ati method.

The data was collected through distributing questionnaires directly to students in the 2025/2026 academic year. Some of the main attributes contained in the data include the level of ability to read tajweed, mastery of makahrijul huruf, accuracy of pronunciation, gradual fluency without spelling, ability to read connect, teacher quality and parental support. These attributes will be analyzed to identify combinations of patterns that appear frequently and are interrelated with the quality of learning outcomes.

4.2. Data Preparation

In the data preparation stage, data was collected through questionnaires from 175 students of SMK Al Irsyad Al Islamiyyah Cirebon covering various aspects of the quality of Qur'anic learning, such as tajweed reading, spelling ability, connecting verses, teacher quality, and parental support. The collected data then went through a cleaning process to ensure there were no blank values or missing information on important attributes. A thorough check was conducted, and the results showed that all data was complete and consistent. Furthermore, irrelevant attributes such as name and class were removed as they did not contribute directly to the formation of association rules.

After cleaning, the data was converted from categorical form to binary format using one-hot encoding technique. As shown in Table 1.

Table 1: Data Transformation Results with One-Hot Encoding

Bacaan Tajwid1_A	Bacaan Tajwid1_B	Bacaan Tajwid1_C	Bacaan Tajwid2_A	Bacaan Tajwid2_B	Bacaan Tajwid2_C	Bacaan Tajwid1_A	Bacaan Tajwid1_B	Bacaan Tajwid1_C
1	0	0	0	1	0	1	0	0
1	0	0	0	1	0	1	0	0
0	1	0	0	1	0	0	1	0
0	1	0	0	1	0	0	1	0
1	0	0	1	0	0	1	0	0

The data that has been converted into this format is then used as the main input in the process of finding frequent itemsets and association rules using the Apriori algorithm. Each column represents one "item" in a "transaction", i.e. the answer of one respondent.

Each rating is classified into three categories, namely A (good), B (fair), and C (poor), and then coded in the form of 1 to indicate the presence of a category in the respondent, and 0 otherwise. This transformation results in a dataset in a transactional format, where each row represents one respondent's answer and each column indicates items that can be analyzed by the Apriori algorithm. This format allows the process of finding frequent itemsets and association rules to be done efficiently to find combinations of factors that frequently appear and influence the quality of Qur'anic learning.

4.3. Modelling

4.3.1. Model Selection

The choice of Apriori algorithm in this study is motivated by its ability to explore patterns of relationships or associations between attributes in categorical data. This algorithm is specifically utilized to identify combinations of items that often appear together (frequent itemsets) and form association rules that are able to provide a deeper understanding of the relationship between variables, especially in the context of improving the quality of Al-Qur'an learning.

4.3.2. Determination of Frequent Itemset

In this study, the Apriori Algorithm was run with a minimum support parameter of 0.3. This value means that a combination of attributes will be considered important if it appears in at least 30% of the total data. From the results, the combination of attributes (itemsets) that most often appear together is obtained. The top ten combinations are visualized in the form of a horizontal bar chart
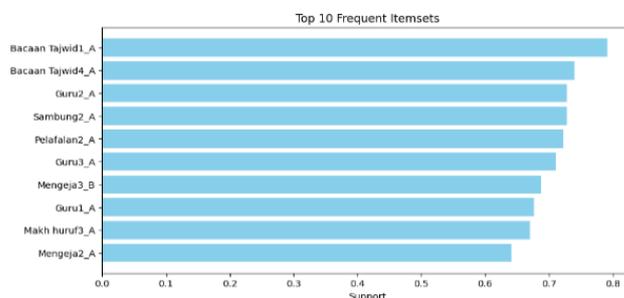
Fig. 2:Top 10 Frequent Itemset

Based on Figure 1. above displays visualization of the top 10 frequent itemsets found through the Apriori algorithm analysis. Each bar on the graph represents an itemset (or in this case, the most frequent single item), and the length of the bar indicates the support value of the itemset. Support is a metric that measures how often an itemset appears in the entire dataset. The longer the bar, the higher the support value, which means that the itemset is found more frequently in the transaction data.

From Figure 1. it can be observed that "Bacaan Tajwid1_A" has the highest support, indicating that this attribute is the most frequently occurring among all the analyzed attributes. It is followed by "Bacaan Tajwid4_A", 'Guru2_A', and so on, until "Mengeja2_A" which has the lowest support among the top 10. This visualization is very useful for identifying the most dominant or frequently occurring attributes or attribute combinations in the dataset, providing an initial insight into the patterns before analyzing more complex association rules.

4.3.3. Association Rule Generation

After getting frequent itemsets, the next step that needs to be done is to form association rules between attributes. In this research, the rules taken are those that have a confidence value ≥ 0.8 and lift > 1. Confidence shows how likely the consequent appears if the antecedent occurs, while lift shows the strength of the relationship between attributes compared to the possibility of appearing randomly. To obtain robust and relevant rules, further filtering is done based on the following criteria:

a.   Support ≥ 0.3: The rule must have a minimum support of 0.3, meaning that the itemsets involved in the rule appear quite frequently in the data.
b.   Confidence ≥ 0.8: The rule must have a minimum confidence level of 0.8. Confidence measures how often the consequent appears when the antecedent exists. A high confidence value indicates that the rule is reliable.
c.   Lift > 1: The rule must have a lift value greater than 1. Lift measures how likely the consequent is to appear if the antecedent exists, compared to the likelihood of the consequent appearing independently. A lift value greater than 1 indicates a strong positive relationship between the antecedent and consequent.

The filtering results show the number of association rules that meet these criteria. These rules are organized by the highest lift value to identify the most significant relationships.

Table 2: Strongest Association Rules

No	Antecedents	Consequents	Support	Confidence	Lift
1	(Ortu1_A, Sambung2_A, Guru3_A)	(Ortu2_A, Guru1_A)	0.312139	0.900000	2.104054

2	(Ortu2_A, Guru2_A, Guru1_A)	(Ortu1_A, Guru3_A)	0.312139	0.830769	2.082943
3	(Ortu1_A, Guru2_A)	(Guru3_A, Ortu2_A, Guru1_A)	0.312139	0.830769	2.082943
4	(Ortu1_A, Guru3_A, Guru2_A)	(Ortu2_A, Guru1_A)	0.312139	0.885246	2.069561
5	(Sambung2_A, Ortu2_A, Guru1_A)	(Ortu1_A, Guru3_A)	0.312139	0.818182	2.051383

Table 2. shows the ten strongest association rules based on the highest lift values. Rules such as the combination of Ortu1_A, Sambung2_A, Guru3_A where Ortu2_A, Guru1_A has a confidence value of 90% and a lift above 2, which indicates a very strong and relevant relationship between attributes in the process of learning the Qur'an.

4.3.4. Visualization of Association Rule Results

To clarify the relationship between attributes formed from association rules, a visualization of the Association Network Graph is made as shown in Figure 2.
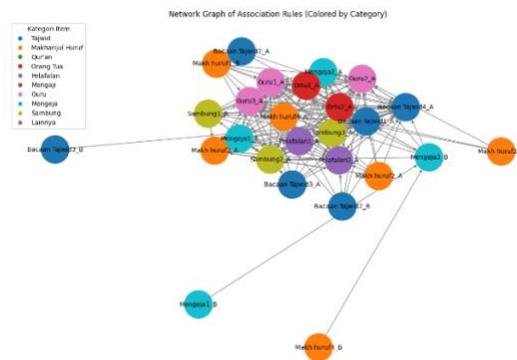

Fig. 3: Network Association Graph

The figure above is an Association Network Graph that shows the association relationship between items from the Apriori analysis. Each blue circle represents one item, such as teacher, parent, tajweed recitation, letter makhraj, or spelling ability. Connecting lines indicate an association, and arrows depict the direction of the relationship. Items in the center with many connections show strong linkages and co-occur frequently, while items on the periphery with few connections have more specific or limited associations. This graph makes it easy to understand patterns of relationships between variables that are not visible from a normal table.

4.4. Evaluation

At this stage, an evaluation of the association analysis results obtained using the Apriori algorithm is carried out. Evaluation aims to assess the quality of association patterns or relationships between influencing factors.

Figure 3 shows the distribution of the evaluation metrics of the association rules formed. This graph helps in seeing the distribution of rule quality, as well as identifying the best rule that can be used as a reference for learning improvement. The association rule says that if a person has the attributes Ortu1_A, Guru3_A, and Sambung2_A, then it is likely that they also have Guru1_A and Ortu2_A. This is supported by the support value of 0.35 which indicates that 35% of all data consists of that combination. Confidence 0.82 indicates that 82% of the data that has Ortu1_A, Guru3_A and Sambung2_A also has Ortu1_A and Ortu2_A. A lift value of more than 1 indicates a positive correlation in other words, the presence of the left part of the rule increases the likelihood of the right part of the rule appearing by 1.34
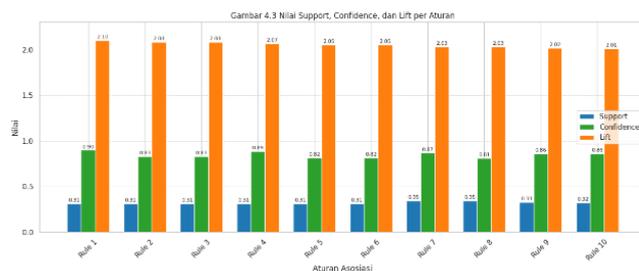

Fig. 4: Support, Confident, and Lift Value Distribution Chart

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Most of the selected rules have support ≥ 0.3, confidence ≥ 0.8, and lift > 1, indicating that the patterns found are quite strong and reliable. This shows that there is a consistent relationship between factors such as tajweed comprehension, verse connection ability, and the role of teachers and parents in determining the quality of student learning. It can thus be concluded that the factors of parental and teacher support, as well as consistency in reading and connecting verses, are important components that consistently appear in the best patterns. Association rules that have a lift value of more than 1 are of major concern as they indicate a potential causal relationship, not a coincidence. Thus, the factors that most influence the quality of learning at SMK Al Irsyad Al Islamiyyah are parental support, teacher guidance, the ability to connect verses and understanding the makharijul huruf.

This evaluation supports the validity of using the Apriori algorithm in finding hidden patterns and identifying the main factors that affect the quality of learning the Qur'an with the Qiroati method. These results can be used as a basis for recommendations for improving teaching methods and student coaching strategies in the future.

4.5. Deployment

At the deployment stage, the results of this research are organized to provide direct benefits for teachers, parents, and educational institutions at SMK Al Irsyad Al Islamiyyah Cirebon City. Analysis using the Apriori algorithm successfully reveals association patterns that show the relationship between factors that affect the quality of learning the Qiroati method.

The data obtained is used to become a strategic recommendation for decision making. With the example of Rule 1, it was found that parental support (Ortu1_A) and consistency of the mentor teacher (Guru3_A) correlated with increased understanding of tajweed and the ability to connect verses. Based on this, schools can develop programs such as parenting forums, personal consultations, regular teacher training, and annual guidance modules and evaluations. Interventions can also be tailored to students' specific abilities, especially in the aspects of makharijul huruf and verse connection.

This deployment stage is expected to be the first step in improving the Al-Qur'an learning system in a sustainable and data-based manner. It is also important to conduct periodic evaluations of the effectiveness of the strategies applied and update the association patterns according to the development of student conditions so that the interventions carried out remain relevant and adaptive to the dynamics of learning needs.

5. Conclusion

Based on the results and discussion of the research, a number of strong association rules were found through the Apriori algorithm, with a support value > 0.31, confidence > 0.81, and lift > 2.0. This indicates a significant relationship between several factors on the quality of Qur'an learning Qiroati method at SMK Al Irsyad Al Islamiyyah Cirebon City. The best rule analysis shows that parental support (Ortu1_A, Ortu2_A), consistent teacher guidance (Guru1_A, Guru3_A), as well as students' ability to connect verses and read tajweed at intermediate to high levels, are the main factors that support optimal learning. The best rule reveals that the combination of Ortu1_A, Sambung2_A, and Guru3_A has a strong association with Ortu2_A and Guru1_A, reflecting the synergy between teachers and parents. Student success depends not only on individual ability, but also emotional, academic and social support.

This finding confirms the importance of collaboration between schools and parents. These results can be used as a basis for designing programs such as teacher training, parent coaching, and special guidance for students, to make Qur'an learning more effective and appropriate.

Acknowledgement

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