
APPLICATION OF DATA MINING TO MEASURE THE EFFECTIVENESS OF THE ISLAMIC BOARDING SCHOOL'S INDEPENDENT CURRICULUM BASED ON LEARNING ACHIEVEMENT USING THE CLUSTERING METHOD

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ABSTRACT

The evolution of educational curricula has been a focal point for institutions aiming to enhance learning outcomes and adapt to students' diverse needs. In this context, Islamic boarding schools, or pesantren, are increasingly exploring independent curricula to better serve their students. This research aims to measure the effectiveness of the independent curriculum at the Al Binaa Bekasi Islamic Boarding School, especially regarding learning achievements in general and Islamic subjects. The method used is data mining clustering to analyze student learning achievement data. In the initial stage, the data collected includes student scores in general subjects (such as Islamic Religious Education, Pancasila Education, Indonesian, English, Mathematics, Science, Social Sciences, Arts, Sports, ICT, Sundanese) and Syar'i (Quran tajwid, hadith, aqidah, fiqh, Hadassah, short). Then, data mining clustering techniques are used to group students based on their achievements in the two subjects. The results of the analysis show that the independent curriculum at Al Binaa Islamic Boarding School effectively increases student learning achievement. The groups formed from data mining clustering show patterns consistent with curriculum objectives, where students in the same group have similar levels of achievement in general and star subjects. This indicates that the independent curriculum has succeeded in leveling student learning achievement. This research contributes to understanding the effectiveness of the independent curriculum in Islamic boarding schools. It can be a basis for further development in designing Islamic boarding school education curricula that are more adaptive and responsive to student needs.

Keywords: Independent Curriculum, Islamic Boarding School, Data Mining, Clustering, Educational Effectiveness.

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INTRODUCTION

Islamic boarding schools are often seen as educational institutions that seem traditional, anti-social, and do not accept change (Authar, 2017). Islamic boarding schools can accept changes in the social environment and adapt their learning process to the needs of society. Islamic boarding schools will look at observing and adopting, of course, taking into account the advantages and disadvantages of a case, as well as promising new traditions (Rahman, 2017). Islamic boarding schools might make changes in leadership patterns, student interpersonal communication, and implementation of a more strategic and flexible vision and mission (Düşek & Ayhan, 2014). One of them is developing a learning curriculum, which can become a selling point for Islamic boarding schools in the community. It can also become a map of social change in society, which will later be considered when determining the direction and future of Islamic boarding schools (Zahro, 2020).

Education at Islamic boarding schools is integral to the rich and diverse Islamic scientific tradition. One of the critical aspects in developing Islamic boarding schools is the effectiveness of

the curriculum, especially in ensuring learning achievement in general and Islamic subjects (Bostwick et al., 2023). In today's digital and information era, approaches that combine traditional education with technology are becoming increasingly relevant for understanding and improving the effectiveness of the curriculum in Islamic boarding schools (Ilyasin, 2020).

An Islamic boarding school curriculum can be developed by combining national and independent curricula (Soleman et al., 2020). Combining these two curricula will likely produce students or graduates with good spiritual and social character. The curriculum content given to students emphasizes character education, which is good academically and morally. However, this, of course, needs to be supported by examples that can be provided by teachers and parents (Qutni, 2021). The Islamic boarding school curriculum must be composed of two curriculum contents: the general (government) curriculum, which comprises compulsory subjects such as Civics, Indonesian, Mathematics, and Natural Sciences. It is also an Islamic religious curriculum whose components are returned to the uniqueness of the vision and mission of each Islamic boarding school (Zulkarnain, 2022).

This research aims to investigate the effectiveness of the Islamic Boarding School Independent Curriculum, focusing on learning achievements in general and star subjects. One of the methods used in this research is data mining clustering, which allows for identifying complex patterns and relationships in learning data. By using this approach, it is hoped that in-depth insight can be found regarding the factors that influence the effectiveness of the curriculum in Islamic boarding schools. The importance of this research lies not only in academic development but also in supporting better decision-making in curriculum design in Islamic boarding schools. By understanding learning achievements in these two subjects, Islamic boarding schools can better prepare students to face global challenges by combining general skills and Islamic knowledge.

This research aims to significantly contribute to our understanding of the effectiveness of the curriculum in Islamic boarding schools and provide recommendations that can improve the quality of education in these institutions. Thus, it is hoped that the results of this research will have a broad positive impact on the development of Islamic education in Indonesia and throughout the world (Abdullah, 2017).

METHOD

This research took data on the grades of Al-Bina Bekasi Islamic Boarding School Middle School students in Bekasi for the last seven semesters, resulting in a total of 6101 data. Preprocessing activities aim to eliminate outliers/noise and inconsistent, incomplete, or missing data. The obtained data is still raw and cannot be processed into clustering. The data ready to be processed is entered into the Rapid Miner application, and the DBI value is determined. The DBI value is intended as a reference for the number of clusters that will be created. Data is created into clusters according to the K-means method. The three clusters formed are high, medium, and low-value clusters. The cluster validity test is carried out to determine whether the cluster created is optimal so that the group formed is optimal. The optimal group is where the distance between data is minimal. It has a reasonably significant difference or distance from other groups. The Davies Bouldin Index (DBI) is done by calculating the average value of each point in the group. The value calculation for each point is the sum of the compactness values divided by the distance between the two cluster center points

as separation. DBI is used to optimize the distance outside the cluster and minimize the distance within the cluster with similarities.

RESULTS AND DISCUSSION

Data Collecting

The data processed in this research are the results of junior high school students' learning over the last three years (Gumantan et al., 2021). This period is assumed to represent an increase in learning outcomes to determine the effectiveness of implementing the integrated curriculum. Obtained at least 97,616 data on student scores in general subjects (Civics, Indonesian, English, Mathematics, Science, Social Sciences, Sports, ICT, Arts, Sundanese) as well as Sha'l subjects (Qur'an-Tajwid et al., PAI An overview of data acquisition can be seen in Table 1.

Table 1. Data on Students' Score

Students	Alqur'an	Hadist	Aqidah	Natural Sciences	Social Sciences	Art
MENU	87	82	80	83	88	85
AHM	55	65	60	70	80	81
SPN	55	84	60	70	81	75
...	...	...	...	...	...	...

Data Preprocessing

Data preprocessing is an essential stage in data mining. We must identify missing, incomplete data and detect and handle outliers (Zhu et al., 2018). If necessary, data normalization or standardization can be done to minimize significant scale differences. In other words, if done correctly, this stage will minimize data interference. In this way, the results obtained will be maximum, and of course, the analysis results obtained are valid and reliable (del Mar Seguí et al., 2015).

K-Means Clustering Algorithm

K-means clustering is a clustering method that is often used in data analysis. In this algorithm, data is grouped into several categories or clusters; each data point is included in the cluster with the closest center (Ikotun et al., 2023). In this research, K-means clustering was carried out with the help of Rapid Miner. The data is entered into the software, and the application will group the data into effective clusters. The Rapid Miner design can be seen in Figure 1.

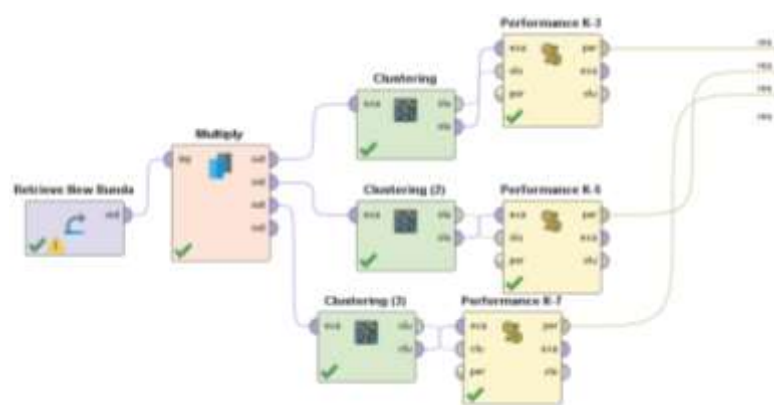


Figure 1. Rapid Miner Clustering Data Design

After the data was input and the design was carried out, the smallest DBI values were obtained in the 3 clusters. So, the following analysis, cluster 3, was carried out. The design is shown in Figure 2.

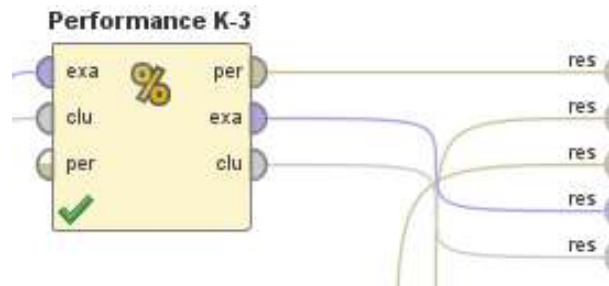


Figure 2. 3 Clusters Operating Design

After running, the data will be divided into three clusters, namely cluster-0, cluster-1 and cluster-2. The results of dividing the data per cluster can be seen in Figure 4. In the picture, you can see that data in cluster-0 shows the highest value, cluster 2 shows a value in the medium category, and cluster-1 shows the lowest value among the three. Thus, Cluster_0 is the High Category, Cluster_1 is the Low Category, and Cluster_2 is the Medium Category. The amount of data per cluster can be seen in Figure 3.

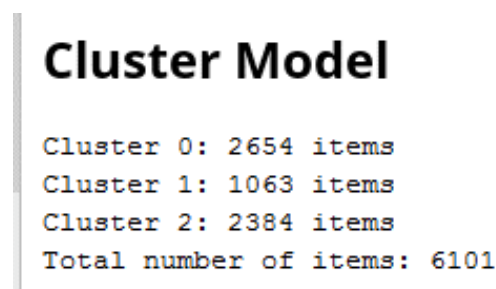


Figure 3. The Amount of Data in Each Cluster

Table 2. Centroid Table

Attribute	cluster_0	cluster_1	cluster_2
Quran_Tajwid	91.450	73.747	83.943
Hadits	93.521	72.361	85.817
Agenda	91.834	71.743	84,115
Fight	92.518	75,215	86,245
Muhadatsah	93.837	73,479	85,766
Short	94,450	69,569	84,268
Islamic Religious Education	92,390	81.935	87.852
Civic Education	89,544	81.659	85.593
Indonesian	87.454	78.552	82.419
English	89.067	79.166	84.279
Mathematics	88.161	76.800	81.022
Natural Sciences	88.720	76.803	82.011
Social Sciences	87.844	80.438	83.357
Art	90.215	81.709	86,258
Sport	90.444	83,691	87,753

Based on the data above, the number of students with high and medium scores is much greater than students with low scores. This shows that the average cognitive achievement of students has reached the high and medium categories. Based on the education data approach, clustering conditions like this show an abnormal graph where the high and medium classes are more numerous than the low classes. So it can be concluded that most students who learn with an integrated independent curriculum between syar'i and Ashri experience a pretty good grade increase. So, it can be indirectly concluded that implementing an integrated independent curriculum between syar'i and ash (general) has been carried out effectively (SARI, 2022).

A good curriculum can develop students' thinking skills. Increasing thinking skills aligns with increasing cognitive values (Kwangmuang et al., 2021). This is reflected in the students belonging to the high group, which has the most significant number of clusters. Further research needs to be carried out to review the more essential factors that influence the effectiveness of this integrated curriculum. Other supporting factors may be found that can improve learning outcomes besides the effectiveness of curriculum implementation (Wahono et al., 2020).

CONCLUSION

Based on the research results, student scores are clustered into three categories: high, medium, and low. The High Category contains 2,654 data items, the Medium Category contains 2,384 data items, and the Low Category contains 1,064 data items. Thus, this research can provide an understanding that the independent Islamic boarding school curriculum currently being implemented is quite adequate, as can be seen from the students' achievement of grades in both general and Islamic subjects. Learning Achievement: Using the data mining clustering method, this research can identify the extent of learning achievement in these two subjects. This can be an illustration for Islamic boarding schools in evaluating the learning process in the future. The Importance of Data Mining Clustering: Applying data mining clustering using the Rapidminer data mining tool can help group learning data and vast amounts of data, making analysis easier.

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