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Grouping of Student Learning Interest Data after the Pandemic at SMK Abdi Negara Binjai Using the K-Means Algorithm Clustering Method

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Abstract

The online learning system is a learning system without face to face directly between teachers and students but is carried out online using the internet network. This is in accordance with the regulation of the Minister of Education and Culture of the Republic of Indonesia regarding Circular Letter Number 4 of 2020 concerning the Implementation of Educational Policies in the Emergency Period for the Spread of Corona Virus Disease (COVID-19). Abdi Negara Vocational School is one of the schools in Binjai City that carries out offline and online learning for its students, learning began in March 2020 when COVID-19 began to hit Binjai City. The COVID-19 pandemic has had many impacts on the state of society, one of which is in the field of education. All educational institutions are trying hard to maximize their respective ways of learning according to the circumstances of their students. Abdi Negara Vocational School which follows government regulations through the Minister of Education and Culture of the Republic of Indonesia also carries out online learning, with the aim that teachers, staff and students are not infected with COVID-19 and can break the chain of spreading the virus. With these conditions, SMK Abdi Negara Binjai needs to build a system that can classify student learning interests, so that it can be used as material for consideration and evaluation of student learning outcomes. Data grouping can apply the Data Mining process with the K-Means algorithm Clustering method which is a process of processing very large amounts of data using statistical, mathematical methods, to utilizing Artificial Intelligence technology to produce a data group. The system is designed with the MATLAB R2014a programming application, after testing with the system the results are that in group 1 there are 836 data, group 2 there are 178 data and group 3 there are 91 data with a total of 1105 student data from the questionnaire results on August 31, 2022 .

Keywords: Clustering, Data_Mining, Interest_Learning_Students

INTRODUCTION

Based on these conditions a lot of interest that arises from each student, student interest in learning is influenced by the conditions experienced by each student. With these conditions, SMK Abdi Negara Binjai needs to build a system that can classify student learning interest data based on offline and online, so that it can be used as material for consideration and evaluation of the assessment of student learning outcomes. From the research that has been done, it is concluded that this research can be used as a reference for recommendations for optimizing library services both for layout and book procurement by prioritizing the types of books that are in great demand.

Based on the background of the problem above, the author raised a research entitled "Clustering of Student Learning Interest Data After the Covid-19 Pandemic at Binjai State Public Vocational School Using the K-Means Algorithm Clustering Method".

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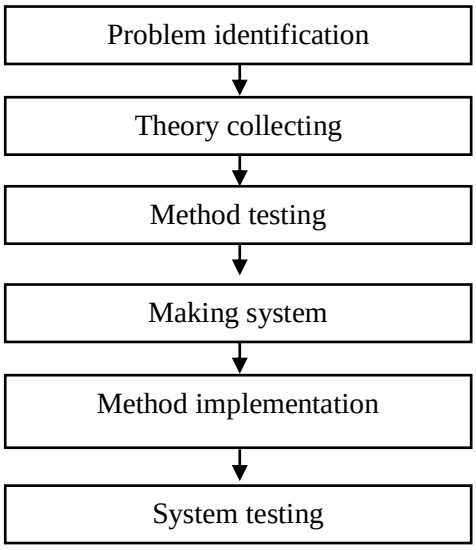
RESEARCH METHODS

Research methodology is a scientific process or method to obtain data to be used for research purposes. In conducting research in this thesis, the authors follow the steps of the methodology in this research, namely as follows:



To clarify the structure of the research methodology above, the authors make the following statement:

1. Problem Identification
   This stage is the initial stage used to identify problems with the aim of observing and looking for problems that are being faced in the object of research, namely SMK Abdi Negara Binjai. In this stage the author conducts research that aims to get a problem faced by an educational institution.
2. Collecting Theory
   The collection of theories related to the subject matter such as the theory of Data Mining, the theory of Online Learning, the methods used and the application of the required system design. In this stage, theory is collected from several sources such as books, journals, articles and other references.
3. Testing Method
   At this stage the researcher will test the method used in the process of grouping the right data, with existing guidelines on supporting theories from books and journals related to the subject matter.
4. System Design
   At this stage, a system design is carried out on the problem being studied, it can be a stage for designing the workflow of the system and also designing the design of the interface of the system to be made. The system design is made to make it easier for users to understand the system to be built.
5. Implementation Method
   Implement methods that have been tested previously with the system design that has been made and perform coding according to the programming language used to create the system.
6. System Test
   In the final stage, a series of tests are carried out on the system that has been made, the tests are carried out in order to find errors in the system and make necessary repairs.

RESULTS AND DISCUSSION

In the analysis of testing the K-means Clustering Algorithm method in the data grouping system used, data is needed as process input and analysis, after conducting research at SMK Abdi Negara Binjai and conducting a survey on students with a questionnaire, the student's interest in learning data is analyzed using the K-Algorithm Clustering method. means are as follows:

Table 1. Student Data as Analysis

No	Student's Name	Learning Value	Attendance	Ethics
1	Agung Saputra	69,45	0	Very good
2	Aidil Zacky	83,67	6	Very good
3	Aldi Trenady	89,67	1	Very good
4	Amirul Husain	82,45	2	Very good
5	Andreanto	84,00	4	Very good
6	Aril Prasetia	86,89	3	Very good
7	Egy Putra Andika	83,00	2	Very good
8	Fahmi Alfiansyah	83,45	2	Very good
9	Abdul Rohim	84,56	6	Very good
10	Aditya Kesuma Prayoga	86,67	6	Very good
11	Aditya Pratama	74,04	0	Very good
12	Ageng Asmoyo Santoso	68,09	6	Very good
13	Aji Apriansyah	84,00	1	Very good
14	Akbar Gimnastiar	81,89	2	Very good
15	Akbar Nawali Hafis	84,56	4	Very good
16	Aldi Pratama	87,34	3	Very good
17	Aldi Setiawan	83,56	2	Very good
18	Alvin Arifandi	84,34	2	Very good
19	Amri Fauzi	77,00	6	Very good
20	Andesta	84,89	16	Very good

To further analyze the Clustering method with the K-Means algorithm in grouping the data above, here are the steps:

1. Determine the Variables Used

Based on the alternative data above, the variables used are as follows:

a. Learning Value as variable X;
b. Attendance as variable Y;
c. Ethics as a Z variable.

2. Creating Alternative Data Transform Values

Based on the alternative data and the variables used, there are 3 data transformations that can be made, including:

a. Table of Data Transformation of Learning Value Variables (X)

Table 2. Variable Data Transformation Learning value (X)

No	Learning Value	Transformation Value
1	< 50	1
2	>50 – 60	2
3	> 60 – 70	3
4	>70 – 80	4
5	>80 – 90	5
6	> 90	6

b. Table of Attendance Variable Data Transformation (Y)

Table III.3 Data Transformation of Attendance Variable (Y)

No	Attendance	Transformation Value
1	0	1
2	1 – 3	2
3	4 – 6	3
4	7 – 9	4
5	10 – 12	5
6	>12	6

c. Ethical Variable Data Transformation Table (Z)

Table 4 Ethical Variable Data Transformation (Z)

No	Ethics	Transformation Value
1	Not Enough	1
2	Enough	2
3	Good	3
4	Very Good	4

1. Creating Alternative Data That Has Been Converted Into Transformed Values
The data that have been converted into transformation values are as follows:

Table 5 Data that has been modified with the value of the transformation

No	Alternatif	X	Y	Z
1	A1	2	1	1
2	A2	4	3	1
3	A3	4	2	1
4	A4	4	2	2
5	A5	4	3	1
6	A6	4	2	1
7	A7	4	2	1
8	A8	4	2	1
9	A9	4	3	1
10	A10	4	3	1
11	A11	3	1	3
12	A12	2	3	2
13	A13	4	2	1
14	A14	4	2	1
15	A15	4	3	1
16	A16	4	2	1
17	A17	4	2	1
18	A18	4	2	1
19	A19	3	3	4
20	A20	4	6	3

1. Determine the Number of Clusters
The number of clusters used is 3 data clusters.
2. Determine the Cluster Center (Centroid) Randomly (Random)
There are 3 cluster centers (Centroids) used, which are as follows:
Centroid1 is taken from the 1st data, namely alternative A1: C1 = (2,1,1)
Centroid2 is taken from the 11th data, namely alternative A11: C2 = (3,1,3)
Centroid3 is taken from the 20th data, namely alternative A20: C3 = (4,6,3)
3. Calculating the Value of Distance Between Data With Euclidean Distance Equation
Calculation of the value of the closest distance between data using the equation $D(ij) = \sqrt{(X1i - X1j)^2 + (X2i - X2j)^2 + (X3i - X3j)^2}$.
The calculation process is as follows:

ITERATION PROCESS I

- A1 (2,1,1)

Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)

C1 = $\sqrt{(2-2)^2 + (1-1)^2 + (1-1)^2} = 0{,}000$

C2 = $\sqrt{(2-3)^2 + (1-1)^2 + (1-3)^2} = 2{,}236$

C3 = $\sqrt{(2-4)^2 + (1-6)^2 + (1-3)^2} = 5{,}745$

- A2(4,3,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(3-1)^2+(1-1)^2} = 2{,}828$
  C2 = $\sqrt{(4-3)^2+(3-1)^2+(1-3)^2} = 3{,}000$
  C3 = $\sqrt{(4-4)^2+(3-6)^2+(1-3)^2} = 3{,}606$
- A3 (4,2,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(2-1)^2+(1-1)^2} = 2{,}236$
  C2 = $\sqrt{(4-3)^2+(2-1)^2+(1-3)^2} = 2{,}449$
  C3 = $\sqrt{(4-4)^2+(2-6)^2+(1-3)^2} = 4{,}472$
- A4 (4,2,2)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(2-1)^2+(2-1)^2} = 2{,}449$
  C2 = $\sqrt{(4-3)^2+(2-1)^2+(2-3)^2} = 1{,}732$
  C3 = $\sqrt{(4-4)^2+(2-6)^2+(2-3)^2} = 4{,}123$
- A5 (4,3,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(3-1)^2+(1-1)^2} = 2{,}828$
  C2 = $\sqrt{(4-3)^2+(3-1)^2+(1-3)^2} = 3{,}000$
  C3 = $\sqrt{(4-4)^2+(3-6)^2+(1-3)^2} = 3{,}606$
- A6 (4,2,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(2-1)^2+(1-1)^2} = 2{,}236$
  C2 = $\sqrt{(4-3)^2+(2-1)^2+(1-3)^2} = 2{,}449$
  C3 = $\sqrt{(4-4)^2+(2-6)^2+(1-3)^2} = 4{,}472$
- A7 (4,2,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(2-1)^2+(1-1)^2} = 2{,}236$
  C2 = $\sqrt{(4-3)^2+(2-1)^2+(1-3)^2} = 2{,}449$
  C3 = $\sqrt{(4-4)^2+(2-6)^2+(1-3)^2} = 4{,}472$
- A8 (4,2,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(2-1)^2+(1-1)^2} = 2{,}236$
  C2 = $\sqrt{(4-3)^2+(2-1)^2+(1-3)^2} = 2{,}449$
  C3 = $\sqrt{(4-4)^2+(2-6)^2+(1-3)^2} = 4{,}472$
- A9 (4,3,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(3-1)^2+(1-1)^2} = 2{,}828$

C2 = $\sqrt{(4-3)^2+(3-1)^2+(1-3)^2} = 3{,}000$

C3 = $\sqrt{(4-4)^2+(3-6)^2+(1-3)^2} = 3{,}606$

- A10 (4,3,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)

  C1 = $\sqrt{(4-2)^2+(3-1)^2+(1-1)^2} = 2{,}828$

  C2 = $\sqrt{(4-3)^2+(3-1)^2+(1-3)^2} = 3{,}000$

  C3 = $\sqrt{(4-4)^2+(3-6)^2+(1-3)^2} = 3{,}606$
- A11 (3,1,3)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)

  C1 = $\sqrt{(3-2)^2+(1-1)^2+(3-1)^2} = 2{,}236$

  C2 = $\sqrt{(3-3)^2+(1-1)^2+(3-3)^2} = 0{,}000$

  C3 = $\sqrt{(3-4)^2+(1-6)^2+(3-3)^2} = 5{,}099$
- A12 (2,3,2)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)

  C1 = $\sqrt{(2-2)^2+(3-1)^2+(2-2)^2} = 2{,}236$

  C2 = $\sqrt{(2-3)^2+(3-1)^2+(2-3)^2} = 2{,}449$

  C3 = $\sqrt{(2-4)^2+(3-6)^2+(2-3)^2} = 3{,}742$
- A13 (4,2,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)

  C1 = $\sqrt{(4-2)^2+(2-1)^2+(1-1)^2} = 2{,}236$

  C2 = $\sqrt{(4-3)^2+(2-1)^2+(1-3)^2} = 2{,}449$

  C3 = $\sqrt{(4-4)^2+(2-6)^2+(1-3)^2} = 4{,}472$
- A14 (4,2,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)

  C1 = $\sqrt{(4-2)^2+(2-1)^2+(1-1)^2} = 2{,}236$

  C2 = $\sqrt{(4-3)^2+(2-1)^2+(1-3)^2} = 2{,}449$

  C3 = $\sqrt{(4-4)^2+(2-6)^2+(1-3)^2} = 4{,}472$
- A15 (4,3,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)

  C1 = $\sqrt{(4-2)^2+(3-1)^2+(1-1)^2} = 2{,}828$

  C2 = $\sqrt{(4-3)^2+(3-1)^2+(1-3)^2} = 3{,}000$

  C3 = $\sqrt{(4-4)^2+(3-6)^2+(1-3)^2} = 3{,}606$
- A16 (4,2,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)

  C1 = $\sqrt{(4-2)^2+(2-1)^2+(1-1)^2} = 2{,}236$

  C2 = $\sqrt{(4-3)^2+(2-1)^2+(1-3)^2} = 2{,}449$

  C3 = $\sqrt{(4-4)^2+(2-6)^2+(1-3)^2} = 4{,}472$

- A17 (4,2,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(2-1)^2+(1-1)^2} = 2{,}236$
  C2 = $\sqrt{(4-3)^2+(2-1)^2+(1-3)^2} = 2{,}449$
  C3 = $\sqrt{(4-4)^2+(2-6)^2+(1-3)^2} = 4{,}472$
- A18 (4,2,1)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(2-1)^2+(1-1)^2} = 2{,}236$
  C2 = $\sqrt{(4-3)^2+(2-1)^2+(1-3)^2} = 2{,}449$
  C3 = $\sqrt{(4-4)^2+(2-6)^2+(1-3)^2} = 4{,}472$
- A19 (3,3,4)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(3-2)^2+(3-1)^2+(4-1)^2} = 3{,}742$
  C2 = $\sqrt{(3-3)^2+(3-1)^2+(4-3)^2} = 2{,}236$
  C3 = $\sqrt{(3-4)^2+(3-6)^2+(4-3)^2} = 3{,}317$
- A20 (4,6,3)
  Centroid : C1 = (2,1,1); C2 = (3,1,3) dan C3 = (4,6,3)
  C1 = $\sqrt{(4-2)^2+(6-1)^2+(3-1)^2} = 5{,}745$
  C2 = $\sqrt{(3-3)^2+(6-1)^2+(3-3)^2} = 5{,}099$
  C3 = $\sqrt{(4-4)^2+(6-6)^2+(3-3)^2} = 0{,}000$

The results of the calculation of the value of the Euclidean distance in the above iterations can be seen in the following table:

Table 6. Euclidean Distance Value in Iteration I

No	Alternatif	X	Y	Z	C1	C2	C3	Grup
1	A1	2	1	1	0,000	2,236	5,745	1
2	A2	4	3	1	2,828	3,000	3,606	1
3	A3	4	2	1	2,236	2,449	4,472	1
4	A4	4	2	2	2,449	1,732	4,123	2
5	A5	4	3	1	2,828	3,000	3,606	1
6	A6	4	2	1	2,236	2,449	4,472	1
7	A7	4	2	1	2,236	2,449	4,472	1
8	A8	4	2	1	2,236	2,449	4,472	1
9	A9	4	3	1	2,828	3,000	3,606	1
10	A10	4	3	1	2,828	3,000	3,606	1
11	A11	3	1	3	2,236	0,000	5,099	2
12	A12	2	3	2	2,236	2,449	3,742	1
13	A13	4	2	1	2,236	2,449	4,472	1
14	A14	4	2	1	2,236	2,449	4,472	1

No	Alternatif	X	Y	Z	C1	C2	C3	Grup
15	A15	4	3	1	2,828	3,000	3,606	1
16	A16	4	2	1	2,236	2,449	4,472	1
17	A17	4	2	1	2,236	2,449	4,472	1
18	A18	4	2	1	2,236	2,449	4,472	1
19	A19	3	3	4	3,742	2,236	3,317	2
20	A20	4	6	3	5,745	5,099	0,000	3

In the table of the results of the iteration process I the grouping above to determine the data grouping group can be determined with the following conditions:
Group 1 is obtained by comparing the smallest value of 3 centroids, if the smallest value is in C1 (Centroid1), then the data is entered in group 1.
Group 2 is obtained by comparing the smallest value of 3 centroids, if the smallest value is in C2 (Centroid2), then the data is entered in group 2.
Group 3 is obtained by comparing the smallest value of 3 centroids, if the smallest value is in C3 (Centroid3), then the data is entered in group 3.
Then do the calculations for iteration II, before doing the calculations for iteration II, it is necessary to make the centroid center of the three clusters first. Here are the new 3 Centroids:

- C1 (16 data):
  Total data X with group 1 = 60, then X = 60/16 = 3,750
  Total data Y with group 1 = 37, then Y = 37/16 = 2,313
  Total data Z with group 1 = 17, then Z = 17/16 = 1.063
  New Centroid1 result : C1(3,750;2,313;1,063)
- C2 (3 data):
  Total data X with group 2 = 10, then X = 10/3 = 3.333
  Total data Y with group 2 = 6, then Y = 6/3 = 2,000
  Total data Z with group 2 = 9, then Z = 9/3 = 3,000
  Result Centroid2 : C2(3,333;2,000;3,000)
- C3(1 data):
  Total data X with group 3 = 4, then X = 4/1 = 4,000
  Total data Y with group 3 = 6, then Y = 6/1 = 6,000
  Total data Z with group 3 = 3, then Z = 3/1 = 3,000
  Centroid3 Result : C3(4,000;6,000;3,000)

ITERATION PROCESS II

- A1 (2,1,1)

Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)

$C1 = \sqrt{(2-3{,}750)^2 + (1-2{,}313)^2 + (1-1{,}063)^2} = 0{,}063$

$C2 = \sqrt{(2-3{,}333)^2 + (1-2{,}000)^2 + (1-3{,}000)^2} = 2{,}236$

C3 = $\sqrt{(2-4{,}000)^2+(1-6{,}000)^2+(1-3{,}000)^2} = 5{,}745$

- A2 (4,3,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(3-2{,}313)^2+(1-1{,}063)^2} = 2{,}829$
  C2 = $\sqrt{(4-3{,}333)^2+(3-2{,}000)^2+(1-3{,}000)^2} = 3{,}000$
  C3 = $\sqrt{(4-4{,}000)^2+(3-6{,}000)^2+(1-3{,}000)^2} = 3{,}606$
- A3 (4,2,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(2-2{,}313)^2+(1-1{,}063)^2} = 2{,}237$
  C2 = $\sqrt{(4-3{,}333)^2+(2-2{,}000)^2+(1-3{,}000)^2} = 2{,}449$
  C3 = $\sqrt{(4-4{,}000)^2+(2-6{,}000)^2+(1-3{,}000)^2} = 4{,}472$
- A4 (4,2,2)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(2-2{,}313)^2+(2-1{,}063)^2} = 2{,}425$
  C2 = $\sqrt{(4-3{,}333)^2+(2-2{,}000)^2+(2-3{,}000)^2} = 1{,}732$
  C3 = $\sqrt{(4-4{,}000)^2+(2-6{,}000)^2+(2-3{,}000)^2} = 4{,}123$
- A5 (4,3,1)Centroid : C1(3,750; 2,313; 1,063); C2(3,333; 2,000; 3,000); C3(4,000; 6,000; 3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(3-2{,}313)^2+(1-1{,}063)^2} = 2{,}829$
  C2 = $\sqrt{(4-3{,}333)^2+(3-2{,}000)^2+(1-3{,}000)^2} = 3{,}000$
  C3 = $\sqrt{(4-4{,}000)^2+(3-6{,}000)^2+(1-3{,}000)^2} = 3{,}606$
- A6 (4,2,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(2-2{,}313)^2+(1-1{,}063)^2} = 2{,}237$
  C2 = $\sqrt{(4-3{,}333)^2+(2-2{,}000)^2+(1-3{,}000)^2} = 2{,}449$
  C3 = $\sqrt{(4-4{,}000)^2+(2-6{,}000)^2+(1-3{,}000)^2} = 4{,}472$
- A7 (4,2,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(2-2{,}313)^2+(1-1{,}063)^2} = 2{,}237$
  C2 = $\sqrt{(4-3{,}333)^2+(2-2{,}000)^2+(1-3{,}000)^2} = 2{,}449$
  C3 = $\sqrt{(4-4{,}000)^2+(2-6{,}000)^2+(1-3{,}000)^2} = 4{,}472$
- A8 (4,2,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(2-2{,}313)^2+(1-1{,}063)^2} = 2{,}237$
  C2 = $\sqrt{(4-3{,}333)^2+(2-2{,}000)^2+(1-3{,}000)^2} = 2{,}449$
  C3 = $\sqrt{(4-4{,}000)^2+(2-6{,}000)^2+(1-3{,}000)^2} = 4{,}472$
- A9 (4,3,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)

$C1 = \sqrt{(4-3{,}750)^2 + (3-2{,}313)^2 + (1-1{,}063)^2} = 2{,}829$

$C2 = \sqrt{(4-3{,}333)^2 + (3-2{,}000)^2 + (1-3{,}000)^2} = 3{,}000$

$C3 = \sqrt{(4-4{,}000)^2 + (3-6{,}000)^2 + (1-3{,}000)^2} = 3{,}606$

- A10 (4,3,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)

  $C1 = \sqrt{(4-3{,}750)^2 + (3-2{,}313)^2 + (1-1{,}063)^2} = 2{,}829$

  $C2 = \sqrt{(4-3{,}333)^2 + (3-2{,}000)^2 + (1-3{,}000)^2} = 3{,}000$

  $C3 = \sqrt{(4-4{,}000)^2 + (3-6{,}000)^2 + (1-3{,}000)^2} = 3{,}606$
- A11 (3,1,3)
  Centroid : C1(3,750,;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)

  $C1 = \sqrt{(3-3{,}750)^2 + (1-2{,}313)^2 + (3-1{,}063)^2} = 2{,}180$

  $C2 = \sqrt{(3-3{,}333)^2 + (1-2{,}000)^2 + (3-3{,}000)^2} = 0{,}000$

  $C3 = \sqrt{(3-4{,}000)^2 + (1-6{,}000)^2 + (3-3{,}000)^2} = 5{,}099$
- A12 (2,3,2)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)

  $C1 = \sqrt{(2-3{,}750)^2 + (3-2{,}313)^2 + (2-1{,}063)^2} = 2{,}209$

  $C2 = \sqrt{(2-3{,}333)^2 + (3-2{,}000)^2 + (2-3{,}000)^2} = 2{,}449$

  $C3 = \sqrt{(2-4{,}000)^2 + (3-6{,}000)^2 + (2-3{,}000)^2} = 3{,}742$
- A13 (4,2,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)

  $C1 = \sqrt{(4-3{,}750)^2 + (2-2{,}313)^2 + (1-1{,}063)^2} = 2{,}237$

  $C2 = \sqrt{(4-3{,}333)^2 + (2-2{,}000)^2 + (1-3{,}000)^2} = 2{,}449$

  $C3 = \sqrt{(4-4{,}000)^2 + (2-6{,}000)^2 + (1-3{,}000)^2} = 4{,}472$
- A14 (4,2,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)

  $C1 = \sqrt{(4-3{,}750)^2 + (2-2{,}313)^2 + (1-1{,}063)^2} = 2{,}237$

  $C2 = \sqrt{(4-3{,}333)^2 + (2-2{,}000)^2 + (1-3{,}000)^2} = 2{,}449$

  $C3 = \sqrt{(4-4{,}000)^2 + (2-6{,}000)^2 + (1-3{,}000)^2} = 4{,}472$
- A15 (4,3,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)

  $C1 = \sqrt{(4-3{,}750)^2 + (3-2{,}313)^2 + (1-1{,}063)^2} = 2{,}829$

  $C2 = \sqrt{(4-3{,}333)^2 + (3-2{,}000)^2 + (1-3{,}000)^2} = 3{,}000$

  $C3 = \sqrt{(4-4{,}000)^2 + (3-6{,}000)^2 + (1-3{,}000)^2} = 3{,}606$
- A16 (4,2,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)

  $C1 = \sqrt{(4-3{,}750)^2 + (2-2{,}313)^2 + (1-1{,}063)^2} = 2{,}237$

  $C2 = \sqrt{(4-3{,}333)^2 + (2-2{,}000)^2 + (1-3{,}000)^2} = 2{,}449$

C3 = $\sqrt{(4-4{,}000)^2+(2-6{,}000)^2+(1-3{,}000)^2} = 4{,}472$

- A17 (4,2,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(2-2{,}313)^2+(1-1{,}063)^2} = 2{,}237$
  C2 = $\sqrt{(4-3{,}333)^2+(2-2{,}000)^2+(1-3{,}000)^2} = 2{,}449$
  C3 = $\sqrt{(4-4{,}000)^2+(2-6{,}000)^2+(1-3{,}000)^2} = 4{,}472$
- A18 (4,2,1)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(2-2{,}313)^2+(1-1{,}063)^2} = 2{,}237$
  C2 = $\sqrt{(4-3{,}333)^2+(2-2{,}000)^2+(1-3{,}000)^2} = 2{,}449$
  C3 = $\sqrt{(4-4{,}000)^2+(2-6{,}000)^2+(1-3{,}000)^2} = 4{,}472$
- A19 (3,3,4)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(3-3{,}750)^2+(3-2{,}313)^2+(4-1{,}063)^2} = 3{,}692$
  C2 = $\sqrt{(3-3{,}333)^2+(3-2{,}000)^2+(4-3{,}000)^2} = 2{,}236$
  C3 = $\sqrt{(3-4{,}000)^2+(3-6{,}000)^2+(4-3{,}000)^2} = 3{,}317$
- A20 (4,6,3)
  Centroid : C1(3,750;2,313;1,063);C2(3,333;2,000;3,000); C3(4,000;6,000;3,000)
  C1 = $\sqrt{(4-3{,}750)^2+(6-2{,}313)^2+(3-1{,}063)^2} = 5{,}723$
  C2 = $\sqrt{(4-3{,}333)^2+(6-2{,}000)^2+(3-3{,}000)^2} = 5{,}099$
  C3 = $\sqrt{(4-4{,}000)^2+(6-6{,}000)^2+(3-3{,}000)^2} = 0{,}000$

With the same process in iteration II up to the alternative to A20, the results of the calculation of the value of the Euclidean distance in iteration II above can be seen in the following table:

Table 7. Euclidean Distance Value in Iteration II

No	Alternatif	X	Y	Z	C1	C2	C3	Grup
1	A1	2	1	1	0,063	2,236	5,745	1
2	A2	4	3	1	2,829	3,000	3,606	1
3	A3	4	2	1	2,237	2,449	4,472	1
4	A4	4	2	2	2,425	1,732	4,123	2
5	A5	4	3	1	2,829	3,000	3,606	1
6	A6	4	2	1	2,237	2,449	4,472	1
7	A7	4	2	1	2,237	2,449	4,472	1
8	A8	4	2	1	2,237	2,449	4,472	1
9	A9	4	3	1	2,829	3,000	3,606	1
10	A10	4	3	1	2,829	3,000	3,606	1
11	A11	3	1	3	2,180	0,000	5,099	2
12	A12	2	3	2	2,209	2,449	3,742	1

13	A13	4	2	1	2,237	2,449	4,472	1
14	A14	4	2	1	2,237	2,449	4,472	1
15	A15	4	3	1	2,829	3,000	3,606	1
16	A16	4	2	1	2,237	2,449	4,472	1
17	A17	4	2	1	2,237	2,449	4,472	1
18	A18	4	2	1	2,237	2,449	4,472	1
19	A19	3	3	4	3,692	2,236	3,317	2
20	A20	4	6	3	5,723	5,099	0,000	3

Next, check the similarity between the initial group and the new group, namely in the data group iteration I and the data in iteration II, this process is to check whether there is a change in the cluster group or not, the following is a comparison of the similarities between the initial group and the new group:

Table 8. Comparison of Groups Iteration I and Iteration II

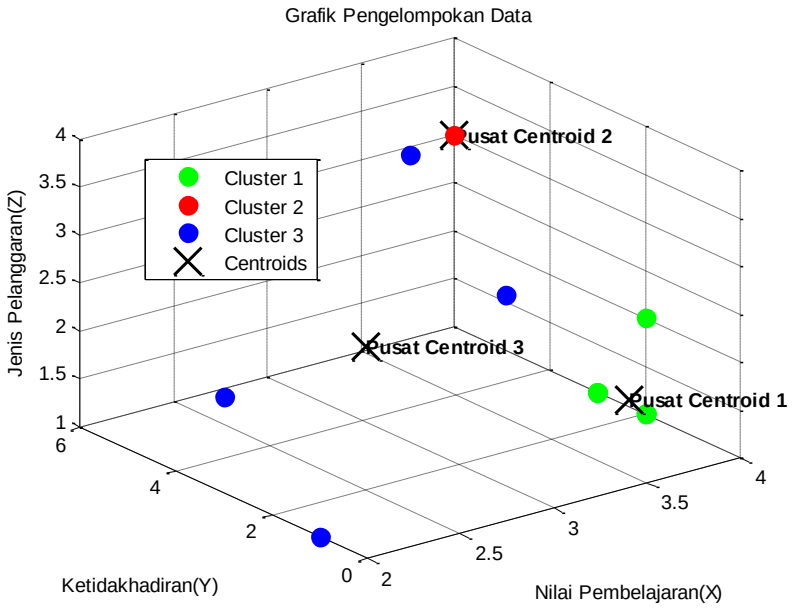
No	Alternatif	Group In Iteration I	Group In Iteration II
1	A1	1	1
2	A2	1	1
3	A3	1	1
4	A4	2	2
5	A5	1	1
6	A6	1	1
7	A7	1	1
8	A8	1	1
9	A9	1	1
10	A10	1	1
11	A11	2	2
12	A12	1	1
13	A13	1	1
14	A14	1	1
15	A15	3	3
16	A16	3	3
17	A17	3	3
18	A18	3	3
19	A19	2	2
20	A20	2	2

The comparison results from the initial group (iteration I) and the new group (iteration II) are the same, the iteration calculation is complete.

1. Create a Clustering Graph

Clustering graph is a graph that displays the coordinate points of a data after the data grouping process.

By using the MATLAB programming application, the following is the result of the Clustering graph



of data grouping:

Figure 2 Graph of Clustering Data Grouping of Student Interests.

CONCLUSION

From 20 student data which were processed into alternative data grouping using the Clustering method in this study, 3 groups were obtained; group 1 (Cluster 1) has 16 data, group 2 (Cluster 2) has 3 data and group 3 (Cluster 3) has 1 data.

1. Cluster 1 (3,750;2,313;1,063):
   The data can be grouped based on the learning scores of students 4 (>70-90), Attendance 2 (1-3), Ethics 1 (Good).
2. Cluster 2 (3,333; 2,000; 3,000):
   Data can be grouped based on student learning scores3 (>60-70), attendance 2 (1-3), ethics 3 (very good).
3. Cluster 3 (4,000;6,000; 3,000):
   The data can be grouped based on student learning scores 4 (>70-90), attendance 6 (>12), ethics3 (very good).

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