Decision Support System For Determining The Provision Of Single Tuition Relief Using KNN and SAW Methods

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Abstract— The COVID-19 pandemic has caused a decline in the economic level of the people. This requires universities to quickly take concrete steps in helping their students. The purpose of this study is to assist the tertiary institution in determining who are eligible students to get a single tuition relief (UKT) using the KNN and SAW methods. The results of the UKT relief test show that this decision support system produces the same output as a manual calculation performed with Microsoft Excel. A further development that can be done is the addition of criteria by the situation and conditions of the relevant agencies.

Keywords— DSS, KNN, SAW, Single Tuition Fee

I. INTRODUCTION

The spread of COVID-19 in Indonesia is increasingly showing an increasing trend. The COVID-19 pandemic has had a significant economic impact on a number of communities, especially in areas directly affected. There are so many layoffs (layoffs) that the unemployment rate increases. This resulted in a decline in the economic level of the community.

The education sector is a field that is directly affected, one of which is felt by universities. With the declining level of the community's economy, it is likely that many students cannot afford to pay for their tuition [1]. Not to mention the teaching and learning process that was originally carried out with a regular model (face to face) switch to using an online model that requires data quota. So that there are more expenses that must be spent by students. In this regard, the university should provide assistance to students such as the reduction of tuition fees (UKT).

The purpose of this study is to assist the university in determining who students are eligible to receive the relief of single tuition (UKT) by using a decision-making system (SPK). This research is very important because the situation of the COVID-19 pandemic and the current decline in the economic level of society is happening, so universities must quickly take concrete steps to help their students. The goal is that not many students drop out of college [2] .

II. RELATED WORK

Research on this topic has been discussed by previous researchers. Methods used in research are SAW [3]–[10], KNN [11]–[19], TOPSIS [3], [20], K-Means [21], and C45 [14], [22]. Model combination that has been used before are KNN and C45 [14] with SAW and TOPSIS [20].

The results have variation, that is 80% accuracy [15], 90% accuracy [12], 90.70% accuracy [14], 90.90% accuracy [16], 94.74% accuracy [22], 95.83% accuracy [13], [23], until 98,46% accuracy [24]. This range of accuracy is depends on the data testing and data training used in research.

There are many criteria used, but the most criteria in other research are GPA, parents income, and parents dependents [3], [4], [16], [17], [19], [24], [5]–[8], [12]–[15]. Other criteria used are tuition fee [3], achievement [3], [6], [14], [17], [21], [22], insurance [11], electric bill and tax [5]. For the international scholarship, criteria used are age, degree, field majors, IELTS score, and Japanese Language fluent [18]. For special cases, they also include home address [17] to make sure that subsidy are given to students need the most.

Nadiem Makarim, as the Ministry of Education, said that university need to give subsidy to students that affected by COVID-19, especially on parents income and students that not scholarship member. In UGM, criteria used for its students are income after COVID-19 and parents occupation status, in UIN, student only need to have one criteria, that is income affected by COVID-19. In USU, there are three criteria, that is income, occupation status, and not scholarship member. In UNS, there are also three criteria, that is income, grade, and load total or parents dependents. In UPN, there are five criteria that must be there, that is income, occupation status, not scholarship member, load total, and health status. In IAIN, there are three criteria, that is income, occupation status, and health status. Therefore, for this research, we determine that we will use five criteria, that is income after COVID-19, occupation status, load total, area zone, and health status.

Research about single tuition fee has been done before, but with WP and TOPSIS method [25]. Therefore, the research GAP this research try to fill are using the combination of KNN

and SAW method. From previous related work, there's no paper using both of KNN and SAW method as data mining and decision-making systems. KNN method is chosen because it is resulting in no assumptions about data, is a simple algorithm, has high accuracy, and versatile. No assumptions about data mean KNN useful for non-linear data. The simple algorithm means KNN easy to explain, understand, and interpret. High accuracy means KNN's results have high accuracy because of the testing data. Versatile means KNN useful for classification or regression. Meanwhile, the SAW method is chosen because it is able to select the best alternative from a number of alternatives that exist based on the criteria specified. The dataset we used for the training data was 120 data and the tests were carried out on 20 test data.

III. DESIGN AND CONCEPT

In general, the assessment of this research can be seen in Fig. 1 of the research flow below.

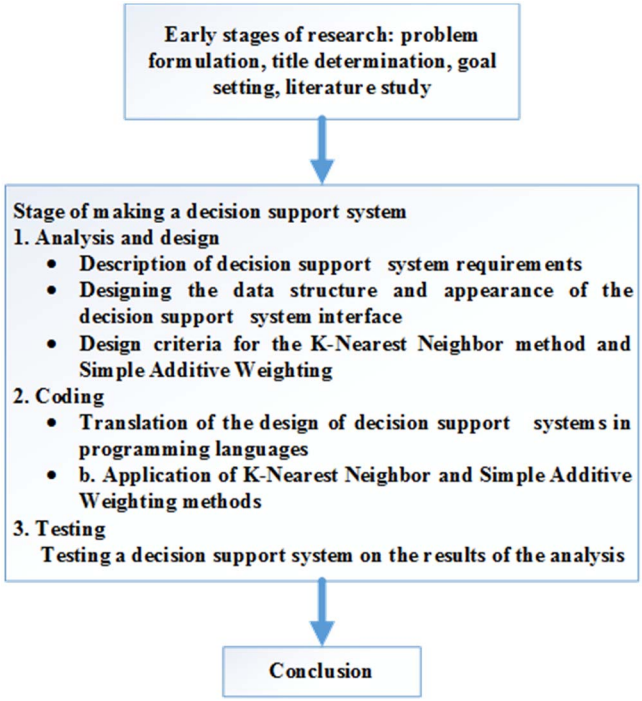

Fig. 1. Research Flow

A. Planning

The initial phase of the research is carried out by formulating the problem, determining the title, setting goals, and conducting literature studies. The output obtained after doing this stage is the formulation of the problem, the title of the study, the purpose of the study, and the literature review.

B. Process

The stage of making a decision support system is done by analysis and design, coding, and testing. Design analysis is done by describing the needs of decision support systems, designing data structures and interface display decision support systems, and designing data processing methods. The method used is K-Nearest Neighbor and Simple Additive Weighting. Coding is done by translating the design of decision support systems into programming languages and applying the KNN and SAW methods. Testing is done using the BlackBox method. The output obtained after doing this stage is the design of the data structure, interface display, the design of the KNN and SAW methods, coding, and the decision support system test.

The final stage of the study was conducted by drawing conclusions from the decision support systems that have been made. The output obtained after doing this stage is the Support System for Decision of Determination of Student UKT Relief for KNN and SAW Method.

C. Blackbox Testing

Blackbox trial method is a test that focuses on the functional requirements of the software. Therefore, BlackBox trials allow software developers to create a set of input conditions that will train all the functional needs of a program. Blackbox testing is not an alternative to white box testing, but is a complementary approach to determining other errors, besides using the white box method. Blackbox testing is done by proving that all objects in the system can run according to the functions provided. Blackbox test results can be seen in TABLE I.

TABLE I. BLACKBOX TESTING

Function	Testing	Expected results	Explanation
Login	Enter User and Password according to user data	Enter the dashboard page according to the user's access rights	Success
Category Setup	Select the category menu, then fill in the code, category and value in the textbox, the system will display the category data changes	Displays category data and saves it to the database	Success
Criteria Setup	Select the Criteria menu, then fill in the Code, Criteria, Weight, KNN Status, Attributes, and Values in the textbox, the system will display the changes in the Criteria data	Displays Criteria data and saves it to the database	Success
Criteria Details	Select the Criteria menu, then fill in the Code, select Criteria Type, select Category Type, and fill in the Description, the system will display data changes	Displays Criteria Details data and saves it to the database	Success

Function	Testing	Expected results	Explanation
Student Setup	Select the Student menu, then fill in the NIM, Code, Year, Gender, Name, Address, select information Help, status data, Religion, and Occupation, the system will display changes in Student data	Display Student data and save it in the database	Success
Student Details	Select the Student menu, then fill in the NIM, select Requirements, and Need information, the system will display changes in Student Details data	Display Student Details data and saves it in the database	Success
Import Data Training	Select the Import Data menu, then select the file containing the training data, the system will show the training data	Displays training data that has been stored in the database	Success
Testing KNN Method	Select the KNN menu, press the arrow button, the system will show the results of the KNN method calculation	Displaying submission data and data from the KNN calculation results	Success
SAW data	Select the SAW menu, the system will show the data to be processed by the SAW method	Showing SAW submission data	Success
Normalization of the SAW Method	Select the SAW menu, press the green arrow button, the system will show data that is normalized by the SAW method	Displays data from the SAW normalization calculation results	Success
Ranking of the SAW Method	Select the SAW menu, press the two arrow buttons to the right, the system will show ranking data using the SAW method	Displaying SAW ranking data	Success
Print Report	Select the report menu, then specify the desired start and end date, press OK	Displays report data on the determination of UKT relief according to the time chosen	Success

D. Testing Calculation

An example of implementing calculations to get the results of determining UKT relief. Examples of data used as a dataset are shown in TABLE II.

TABLE II. DATASET KNN

Code	Health Status	Occupation Status	Load Total	Income After Impacted	Area Zone	Dispensation
M1	Probable	Work	3	<500.000	Yellow	Yes
M2	Healthy	Work	<1	500.000-1.000.000	Yellow	No
M3	Confirmed	Discharge	2	1.000.000-1.500.000	Red	Yes

The data will be used as a reference for processing new data. Examples of new data to be processed are shown in TABLE III.

TABLE III. NEW DATASET KNN

Code	NIM	Name	Health Status	Occupation Status	Load Total	Income After Impacted	Area Zone
C1	18.02.0028	Nina	Probable	Work	2	500.000-1.000.000	Yellow
C2	17.02.0027	Dio	Suspect	Discharge	3	500.000-1.000.000	Yellow
C3	16.02.0026	Sari	Probable	Work	2	500.000-1.000.000	Yellow
C4	18.03.0038	Lala	Probable	Work	3	500.000-1.000.000	Yellow
C5	17.03.0037	Puji	Healthy	Work	>4	500.000-1.000.000	Green

The initial step in calculating the KNN method is to determine the closeness and weight of the attribute, as shown in TABLE IV.

TABLE IV. PROXIMITY AND WEIGHT OF KNN CRITERIA

No	Closeness					Attribute Score				
	K1	K2	K3	K4	K5	K1	K2	K3	K4	K5
1	1	1	0,5	0,5	1	0,9	0,7	0,5	0,5	0,3
2	0,5	1	0,5	1	1	0,9	0,7	0,5	0,5	0,3
3	0,5	0	1	0,5	0,5	0,9	0,7	0,5	0,5	0,3
4	0,5	0	1	0,5	1	0,9	0,7	0,5	0,5	0,3
5	0,5	0	0,5	1	1	0,9	0,7	0,5	0,5	0,3
6	0,5	1	0,5	0,5	0,5	0,9	0,7	0,5	0,5	0,3
7	1	1	0,5	0,5	1	0,9	0,7	0,5	0,5	0,3
8	0,5	1	0,5	1	1	0,9	0,7	0,5	0,5	0,3
9	0,5	0	1	0,5	0,5	0,9	0,7	0,5	0,5	0,3
10	1	1	1	0,5	1	0,9	0,7	0,5	0,5	0,3
11	0,5	1	0,5	1	1	0,9	0,7	0,5	0,5	0,3
12	0,5	0	0,5	0,5	0,5	0,9	0,7	0,5	0,5	0,3
13	0,5	1	0,5	0,5	0,5	0,9	0,7	0,5	0,5	0,3
14	1	1	0	1	0,5	0,9	0,7	0,5	0,5	0,3
15	0	0	0,5	0,5	0	0,9	0,7	0,5	0,5	0,3

After that, the distance is calculated. From these results, the determination of conclusions is seen based on the highest ranking, as shown in TABLE V.

TABLE V. CALCULATION OF DISTANCE AND CONCLUSION OF KNN

No	Closeness					Distance	Rank	Conclu-sion
	K1	K2	K3	K4	K5			
1	0,9	0,7	0,25	0,25	0,3	0,828	1	Yes
2	0,45	0,7	0,25	0,5	0,3	0,759	2	
3	0,45	0	0,5	0,25	0,15	0,466	3	
4	0,45	0	0,5	0,25	0,3	0,517	2	
5	0,45	0	0,25	0,5	0,3	0,517	2	
6	0,45	0,7	0,25	0,25	0,15	0,621	1	Yes
7	0,9	0,7	0,25	0,25	0,3	0,828	1	Yes
8	0,45	0,7	0,25	0,5	0,3	0,759	2	
9	0,45	0	0,5	0,25	0,15	0,466	3	
10	0,9	0,7	0,5	0,25	0,3	0,914	1	Yes
11	0,45	0,7	0,25	0,5	0,3	0,759	2	
12	0,45	0	0,25	0,25	0,15	0,379	3	
13	0,45	0,7	0,25	0,25	0,15	0,621	2	
14	0,9	0,7	0	0,5	0,15	0,776	1	No
15	0	0	0,25	0,25	0	0,172	3	

KNN calculation results in a decision whether students will be given UKT relief or not, as shown in TABLE VI.

TABLE VI. PROCESSING RESULTS OF THE KNN METHOD

No	Code	NIM	Name	Dispensation
1	C1	18.02.0028	Nina	Yes
2	C2	17.02.0027	Dio	Yes
3	C3	16.02.0026	Sari	Yes
4	C4	18.03.0038	Lala	Yes
5	C5	17.03.0037	Puji	No

SAW data is obtained from the previous KNN calculation results, as shown in TABLE VII.

TABLE VII. SAW METHOD DATA

Code	K1	K2	K3	K4	K5	K6
C1	Probable	Work	2	500.000-1.000.000	Yellow	0,83
C2	Suspect	Discharge	3	500.000-1.000.000	Yellow	0,62
C3	Probable	Work	2	500.000-1.000.000	Yellow	0,83
C4	Probable	Work	3	500.000-1.000.000	Yellow	0,91

The first step of the SAW is to carry out a weighting according to predetermined criteria. The weighting results are shown in TABLE VIII.

TABLE VIII. BLACKBOX TESTING

No	Code	NIM	Name	K1	K2	K3	K4	K5	K6
1	C1	18.02.0028	Nina	3	1	2	2	2	4
2	C2	17.02.0027	Dio	2	4	3	2	2	3
3	C3	16.02.0026	Sari	3	1	2	2	2	4
4	C4	18.03.0038	Lala	3	1	3	2	2	4

The second step of SAW is to determine the attribute criteria, whether including costs or benefits. The results of determining the criteria attributes are shown in TABLE IX.

TABLE IX. DETERMINATION OF SAW CRITERIA ATTRIBUTES

Student	K1	K2	K3	K4	K5	K6
Attribute	benefit	benefit	benefit	cost	benefit	benefit
C1	3	1	2	2	2	4
C2	2	4	3	2	2	3
C3	3	1	2	2	2	4
C4	3	1	3	2	2	4

The third step of SAW is to normalize. The results of normalization are shown in.

TABLE X. NORMALIZATION SAW

Student	K1	K2	K3	K4	K5	K6
Criteria	4	4	4	1	4	4
C1	1	0,25	0,67	1	1	1
C2	0,67	1	1	1	1	0,75
C3	1	0,25	0,67	1	1	1
C4	1	0,25	1	1	1	1

The fourth step of the SAW is to add the criteria. The results of the summation of the criteria are shown in TABLE XI.

TABLE XI. ADDITION OF THE SAW METHOD

Student	K1	K2	K3	K4	K5	K6	Total
C1	4	1	2,68	1	4	4	16,68
C2	2,68	4	4	1	4	3	18,68
C3	4	1	2,68	1	4	4	16,68
C4	4	1	4	1	4	4	18,00

The fifth step of the SAW is to rank. Ranking results are shown in TABLE XII.

TABLE XII. RANKING SAW

Code	Total	Rank
C1	16,68	3
C2	18,68	1
C3	16,68	3
C4	18,00	2

The results of this SAW ranking will be the basis for decision making by the agency. The amount of relief provided is adjusted to each policy. An example of a UKT relief decision is shown in TABLE XIII.

TABLE XIII. UKT DECISION

Code	Decision
C1	10%
C2	50%
C3	10%
C4	25%

IV. DISCUSSION

In this study using 3 test scenarios, for each test using different amount of data. First test using 40 data, the second test using 80 data, and the third test using 120 data. The results of the three test scenarios can be seen in TABLE XIV. below:

TABLE XIV. ACCURACY RESULT

No	Data Training	Accuracy
1	40	100%
2	80	90%
3	120	95%

For more details, the True-Prediction Test results can be seen in TABLE XV. belowuntil TABLE XVII. below:

TABLE XV. TRUE – PREDICTION TEST 40 DATA

	Prediction Yes	Prediction No
True Yes	1	-
True No	-	19

TABLE XVI. TRUE – PREDICTION TEST 80 DATA

	Prediction Yes	Prediction No
True Yes	1	-
True No	2	17

TABLE XVII. TRUE – PREDICTION TEST 120 DATA

	Prediction Yes	Prediction No
True Yes	1	-
True No	1	18

Based on TABLE XV. aboveuntil TABLE XVII. above, it can be seen that based on the results of the test it can be seen that the first test using 40 data has the highest accuracy value of 100%.

V. CONCLUSION

This decision support system application will help classify students who apply for waivers with the KNN method, then make ranking with the SAW method. The results of the UKT relief test show that this decision support system produces the same output as a manual calculation performed with Microsoft Excel. The accuracy of this method is up to 100% depends on the amount of data used. A further development that can be done is the addition of criteria by the situation and conditions of the relevant agencies.

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