DECISION SUPPORT SYSTEM FOR DETERMINING STUDENT ELIGIBILITY TO PARTICIPATE OF MBKM IN THE INFORMATICS STUDY PROGRAM USING AHP AND TOPSIS

Yan Puspitarani[1)*], Fitrah Rumaisa[2)], Sriyani Violina[3)], Feri Sulianta[4)], Ai Rosita[5)]
[1,2,3,4,5)]Teknik Informatika Universitas Widyatama
Jl. Cikutra No. 204A Bandung
e-mail: yan.puspitarani@widyatama.ac.id[1)], fitrah.rumaisa@widyatama.ac.id[2)], sriyani.violina@widyatama.ac.id[3)], feri.sulianta@widyatama.ac.id[4)], ai.rosita@widyatama.ac.id[5)]
[*]e-mail korespondensi : yan.puspitarani@widyatama.ac.id

ABSTRACT

To be able to have mastery of various sciences that are useful for experience in the world of work, students are encouraged through the MBKM program. Most students of the Informatics Study Program will choose an internship scheme and independent study in applying for the MBKM. However, the increasing number of students' interest in this program requires the Informatics Study Program to be more selective in analyzing the eligibility of students to take part in the MBKM program it has chosen. For this reason, a decision support system is needed that can assist the study program in determining and assessing the eligibility of these students. This study created a DSS modeling using the Analytical Hierarchy Process (AHP) method and the Technique For Order Preference by Similarity to Ideal Solution (TOPSIS) using 8 criteria.

***Keywords**: MBKM, decision support system, AHP, TOPSIS*

I. INTRODUCTION

The Ministry of Education and Culture made the Merdeka Belajar - Kampus Merdeka (MBKM) policy with the aim of making students master much useful knowledge as capital to enter the world of work. The opportunity to choose courses is also given to students through the Merdeka Campus. The Independent Learning Policy - Independent Campus is in accordance with Permendikbud Number 3 of 2020 concerning National Higher Education Standards, in Article 18 which states that the period and study load of undergraduate or applied undergraduate students can be carried out by following the entire learning process regulated by the study program according to the period and study load in universities, and through participating in learning in the study program part and the rest outside the program [*1*].

Based on this policy, the University also facilitates students to participate in the MBKM program. One of the programs that attracts students of the Informatics Study Program is the Internship and Independent Study Program. So, along with the 2 years running of this program, more and more students are interested in joining this program. This requires the Informatics Study Program to be more selective in analyzing the eligibility of students to take part in the MBKM program they have chosen because not a few students take advantage of this program to escape their responsibilities to study. Things like this will certainly harm students and the University. Students who are determined to seek knowledge for their experience in the world of work will be greatly helped by this MBKM program. However, students who only intend to escape the responsibility of studying courses in a certain semester will consider that this MBKM program is an opportunity. Even though the recognition of values that are not in accordance with their learning outcomes will actually harm these students in the world of work later. Therefore, although participating in the MBKM program is a student's right, the study program needs to determine the eligibility criteria for students who will take part in the MBKM program. Thus, the goals of MBKM for students can be achieved. So, to facilitate the study program in determining decisions regarding student eligibility, a decision support system is needed.

According to Kusrini, the decision support system can be interpreted as an action among various alternatives in solving problems that are believed to provide the best solution to get goals (Kusrini, 2007). Through decision support systems, the process and quality of decision making results can be improved so that objective decisions can be produced and the process to produce decisions can run efficiently2. There are several combination methods of Decision Support Systems that are widely used for various purposes, namely the combination of SAW and WP34, the combination of AHP and TOPSIS 567 [], and the combination of AHP and SAW [] [] [*8*].

One popular type of DSS is the Analytic Hierarchy Process (AHP) and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). AHP and TOPSIS are mathematical modeling tools used for decision

making in complex situations involving many criteria. These tools are widely used in various fields, such as engineering, finance, project management, and marketing. The AHP method involves breaking complex decision problems into hierarchical levels and making paired comparisons of criteria at each level. This process allows decision-makers to assess the relative importance of each criterion, and ultimately arrive at a preferred alternative [*9*].

Meanwhile, the TOPSIS method helps decision makers to choose the preferred alternative based on how well it meets all criteria compared to the ideal solution. Overall, the AHP and TOPSIS methods play an important role in helping decision makers make informed decisions that lead to better organizational outcomes. Theuse of AHP and TOPSIS methods enables decision makers to deal with complex situations involving many criteria by providing a systematic approach 10.

Several studies on Decision Support Systems using AHP and TOPSIS have also been conducted, including Harpad (2018) which utilizes AHP and TOPSIS to be implemented into the Decision Support System to determine the selection of computer laboratory assistants using 5 criteria, namely teaching ability, material mastery, interviews, responsibility and discipline11 . Furthermore, in 2020, Mahendra also created a decision support system with the same method to determine the placement of Automated Teller Machine (ATM) using 4 criteria, namely ATM Availability, Security, Land Price, Customer Request12. Then, in the same year, Apriliani implemented AHP and TOPSIS to assist the Tegal city government in determining the priority of assistance to SMEs using 7 criteria, namely turnover, assets, amount of production, number of demands, number of sales, number of workers and also quality of production13. In addition, in 2021, Katili also utilizes AHP and TOPSIS in determining recommendations for outstanding students. In this research, Katili used criteria that could be adjusted to the needs of study programs / faculties and focused on making the system14. These studies provided satisfactory results using AHP and TOPSIS.

Therefore, this study will model the Decision Support System using the *Analytical Hierarcy Process* (AHP) method and the *Technique For Order Preference by Similarity to Ideal Solution* (TOPSIS) to determine the eligibility of students to join the MBKM program. There are 8 criteria that will be used as a basis for decision makers and students who apply for MBKM Internship and Independent Study programs which are used as alternatives.

II. RESEARCH METHODOLOGY

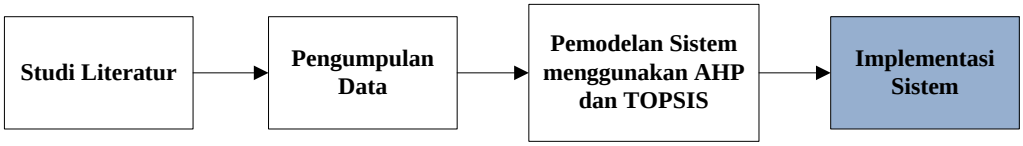

Figure.1. Research Flow

In this study, four stages were carried out, namely:

1. Literature Study
   At this stage, a literature search was carried out regarding the stages of making SPK using AHP and TOPSIS and guidelines on the MBKM program.
2. Data Collection
   At this stage, data collection is carried out in the form of data on students who apply for the MBKM program along with the requirements needed in the form of transcripts, Integrity Pact, SPK, and Jobdesk at the MBKM place through the study program. In addition, interviews were also conducted to obtain system needs with guardian lecturers, study programs, faculties, and students.
3. System Modeling
   At this stage, the process of determining the criteria needed by the study program is carried out, determining weights using AHP, and sequencing alternatives using TOPSIS.
4. System Implementation
   At this stage, system implementation is carried out using *Waterfall*, namely Software Requirements Analysis, Design, Program Coding, Testing and Maintenance.

This research uses a combination of AHP and TOPSIS methods to determine the eligibility of informatics study program students to participate in the MBKM program with an internship scheme and independent study. The AHP method is used to determine the weight of each criterion so that the importance determination process in the TOPSIS method is more objective. The TOPSIS method will be applied to determine the order of student eligibility to take part in MBKM according to the resulting preference value.

There are 8 criteria that will be used as an assessment as a decision maker. These criteria are:

1. Grade Point Average
2. Number of credits taken
3. Suitability of learning outcomes
4. Software Engineering Course Grades
5. Grade for Computer Networking course
6. Grade for Operating System course
7. Grade for Database course
8. Grade for Web-based Application Development course

These criteria will be weighted using AHP. The stages of the AHP Method are illustrated through the following figure 2 .

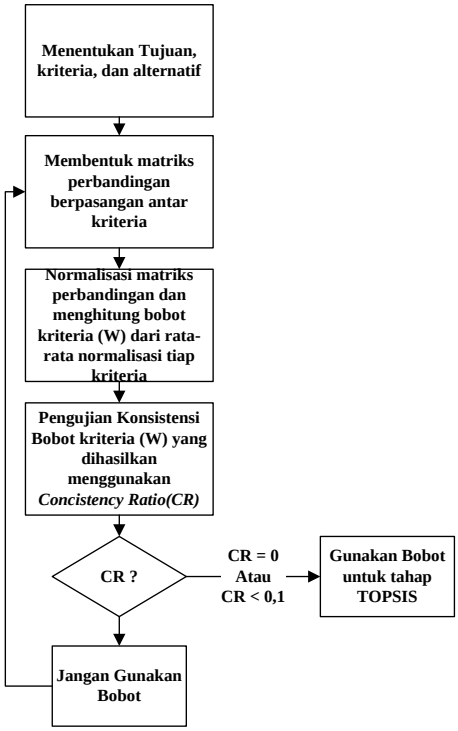

Figure.2. AHP Stages

After obtaining weighting, the next step is to apply each weight to alternatives by sorting alternatives based on their preference value using TOPSIS. Accordingto this the stages of the TOPSIS method carried out.

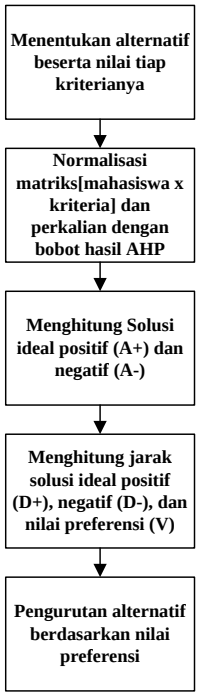

Figure 3. Stages of TOPSIS

The output of this study is a list of students who apply for MBKM internship and independent study programs which have been sorted based on the results of preference calculations. This sequence shows the eligibility of students to participate in the MBKM program which will support the study program's decision.

III. RESULTS AND DISCUSSION

This research resulted in Decision Support System modeling in the form of criteria weighting mechanism using AHP and alternative sequencing mechanism using TOPSIS. Through the combination of these two methods, the study program can determine the eligibility of students to take part in the MBKM Internship and Independent Study program.

The combination of AHP and TOPSIS methods in modeling this decision support system is illustrated in figure 4 below.

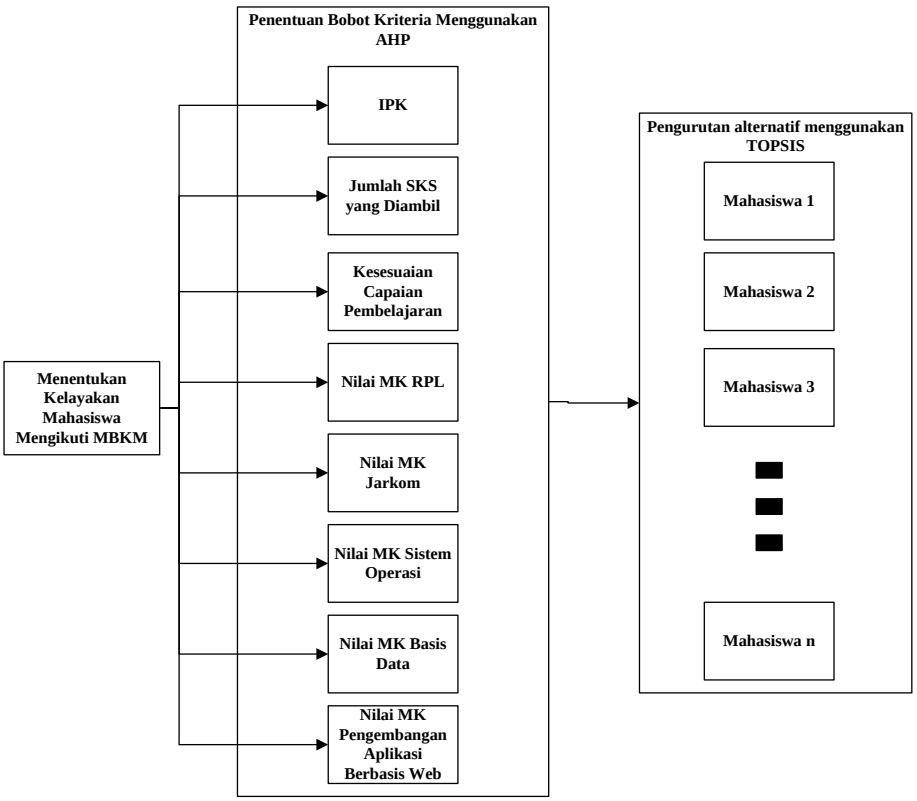

Figure 4. Scheme of use of AHP and TOPSIS against criteria and alternatives to determine decisions.

The first stage of this research is to determine the objectives, criteria, and alternatives for calculating the assessment. The purpose of the Decision Support System is the eligibility of students to participate in MBKM. In addition, an alternative to this Decision Support System is All students applying for the MBKM program and limited to internship and independent study programs. While the criteria for decision makers are described in the following table.

Table.1. Criteria for decision makers

Code	Criterion	Valuation	Nature of Criteria
K1	Grade Point Average	Student GPA score (score range: 0.00-4.00)	Benefit
K2	Number of credits taken	The number of credits that students have taken until when taking MBKM	Benefit
K3	Suitability of learning outcomes	Presentation of the suitability of learning outcomes with the jobdesk at the MBKM location (value range: 0-100)	Benefit
K4	Software Engineering Course Grades	The score obtained by students when taking Software Engineering courses (value range: 0.00-4.00)	Benefit
K5	Grade for Computer Networking course	The value obtained by students when taking the Computer Network course (value range: 0.00-4.00)	Benefit
K6	Grade for Operating System course	The value obtained by students when taking the Operating System course (value range: 0.00-4.00)	Benefit
K7	Grade for Database course	Scores obtained by students when taking Database subjects (value range: 0.00-4.00)	Benefit
K8	Grade for Web-based Application Development course	Scores obtained by students when taking Web-Based Application Development courses (value range: 0.00-4.00)	Benefit

After determining the criteria, the next step is to make pairwise comparisons between criteria in the form of a matrix [criterion x criterion]. Each pair of criteria is compared for importance to each other by following the scale values in the following table.

Table.2. Paired comparison scale [*15*]

Table 1 The fundamental scale of absolute numbers

Intensity of Importance	*Definition*	*Explanation*
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	A reasonable assumption
1.1–1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

The results of the pairwise comparison between criteria are listed in table 3. For example, in the matrix below it can be seen that the criteria pairs K2 (row), K1 (column) are 5, meaning that the criteria K2 *is strong importance*

(scale 5) compared to K1. This is true, where the criterion pair K1(row), K2(column) will be inverse/inverse, i.e. 1/5 = 0.2.

Table.3. Pairwise comparison matrix between criteria

	K1	K2	K3	K4	K5	K6	K7	K8
K1	1	0,2	0,33	0,2	0,33	0,33	0,33	0,2
K2	5	1	1	3	1	1	1	3
K3	3	1	1	3	3	3	3	3
K4	5	0,33	0,33	1	3	3	3	1
K5	3	1	0,33	0,33	1	1	1	0,33
K6	3	1	0,33	0,33	1	1	1	0,33
K7	3	1	0,33	0,33	1	1	1	0,33
K8	5	0,33	0,33	1	3	3	3	1

Once the pairwise comparison matrix between criteria has been created, the next step is to calculate the normalization from Table 3 above. This normalization is calculated by dividing each pair of criteria by the sum of all criteria in one column.

Table.4. Matrix Normalization

	K1	K2	K3	K4	K5	K6	K7	K8
K1	0,035714	0,03413	0,082915	0,021763	0,024756	0,024756	0,024756	0,021763
K2	0,178571	0,170648	0,251256	0,326442	0,075019	0,075019	0,075019	0,326442
K3	0,107143	0,170648	0,251256	0,326442	0,225056	0,225056	0,225056	0,326442
K4	0,178571	0,056314	0,082915	0,108814	0,225056	0,225056	0,225056	0,108814
K5	0,107143	0,170648	0,082915	0,035909	0,075019	0,075019	0,075019	0,035909
K6	0,107143	0,170648	0,082915	0,035909	0,075019	0,075019	0,075019	0,035909
K7	0,107143	0,170648	0,082915	0,035909	0,075019	0,075019	0,075019	0,035909
K8	0,178571	0,056314	0,082915	0,108814	0,225056	0,225056	0,225056	0,108814

Based on the normalization results above, the average value of each criterion per row is calculated and produces the weight of each criterion result, namely W = (0.033819; 0.184802; 0.232137; 0.151325; 0.082197; 0.082197; 0.082197; 0.151325). This weight (W) will later be used as the weight of importance of each criterion in the TOPSIS method. However, this weight (W) must be checked for consistency using the Concistency Ratio (CR). For this reason, it is necessary to calculate the maximum eigenvalue (λ) which is the result of transposing the comparison matrix in pairs with weight (W).

$$\begin{bmatrix} 1 & 0,2 & 0,33 & 0,2 & 0,33 & 0,33 & 0,33 & 0,2 \\ 5 & 1 & 1 & 3 & 1 & 1 & 1 & 3 \\ 3 & 1 & 1 & 3 & 3 & 3 & 3 & 3 \\ 5 & 0,33 & 0,33 & 1 & 3 & 3 & 3 & 1 \\ 3 & 1 & 0,33 & 0,33 & 1 & 1 & 1 & 0,33 \\ 3 & 1 & 0,33 & 0,33 & 1 & 1 & 1 & 0,33 \\ 3 & 1 & 0,33 & 0,33 & 1 & 1 & 1 & 0,33 \\ 5 & 0,33 & 0,33 & 1 & 3 & 3 & 3 & 1 \end{bmatrix} \begin{bmatrix} 0,033819 \\ 0,184802 \\ 0,232137 \\ 0,151325 \\ 0,082197 \\ 0,082197 \\ 0,082197 \\ 0,151325 \end{bmatrix} = \begin{bmatrix} 0,28929 \\ 1,809702 \\ 1,919529 \\ 1,102519 \\ 0,627134 \\ 0,627134 \\ 0,627134 \\ 1,102519 \end{bmatrix}$$

Gambar.5. Matriks Perhitungan λ Maksimum

From the calculation of the Maximum eigen(λ), to obtain the CR value, it is necessary to calculate the value of $t = \frac{1}{n}\sum_{i=1}^{n}\frac{\lambda \max_i}{W_i}$ t and CI where the values of , $CI = \frac{t-n}{n-1}$, and $CR = \frac{CI}{R_n}$. If the CR value <= 0.1 then the weight is consistent, but if the CR > 0.1 then the weight is inconsistent.

Based on calculations, the value of t = 8.009503 and CI = 0.001358 is obtained. So that by using 8 criteria, the value RI = 1.41 (obtained from the matrix order table) and produces the value CR = 0.000963. This CR number shows that the weight produced by AHP is consistent and can be used for the next process, namely alternative sequencing using TOPSIS.

In the next stage, an alternative sequencing process with TOPSIS will be explained using 6 student samples as examples. If given student data with the following criteria.

Table.5. Score each criterion against 6 students

NAMA MAHASISWA	K1	K2	K3	K4	K5	K6	K7	K8
Student A	3,83	114	60	4	4	4	4	4
Student B	3,79	111	80	3,33	4	4	3,67	4
Student C	3,73	114	50	4	4	4	3,67	4
Student D	3,61	108	80	3	4	4	3,67	3,67
Student E	2,35	136	50	3,67	2,33	3	3,67	4
Student F	2,61	138	50	4	1	3	2,67	1,33

Then the data above is normalized and multiplied by the weight of the AHP calculation results, namely W = (0,033819; 0,184802; 0,232137; 0,151325; 0,082197; 0,082197; 0,082197; 0,151325). This stage produces the following [student x criteria] grade matrix.

0,015671	0,071214	0,090094	0,067025	0,039178	0,036309	0,037468	0,067999
0,015508	0,06934	0,120126	0,055798	0,039178	0,036309	0,034377	0,067999
0,015262	0,071214	0,075079	0,067025	0,039178	0,036309	0,034377	0,067999
0,014771	0,067466	0,120126	0,050269	0,039178	0,036309	0,034377	0,062389
0,009616	0,084957	0,075079	0,061495	0,022821	0,027232	0,034377	0,067999
0,01068	0,086206	0,075079	0,067025	0,009795	0,027232	0,02501	0,02261

Gambar.5.Hasil normalisasi dan perkalian dengan bobot AHP terhadap matriks [mahasiswa x kriteria]

From the matrix above, a calculation is made to determine the ideal solution of positive (A+) and negative (A-) each criterion where the value of A+ is taken from the maximum value and the value of A- is taken from the minimum value of the matrix per criterion (column). The result is as follows.

Table.6. Ideal solution values are positive(A+) and negative(A-)

	K1	K2	K3	K4	K5	K6	K7	K8
A+	0,015671	0,086206	0,120126	0,067025	0,039178	0,036309	0,037468	0,067999
A-	0,009616	0,067466	0,075079	0,050269	0,009795	0,027232	0,02501	0,02261

After that, the calculation of the distance value of the positive ideal solution (D +) is carried out with the formula $D_i^+ = \sqrt{\sum_{j=1}^{n}\left(y_i^+ - y_{ij}\right)^2}$), negative ideal (D-) with formulas $D_i^- = \sqrt{\sum_{j=1}^{n}\left(y_i^- - y_{ij}\right)^2}$), and preference value (V) with formula $V_i = \frac{D_i^-}{D_i^- + D_i^+}$ as follows.

Tabel.7. hasil perhitungan jarak ideal positif (D+), negatif (D-), dan nilai preferensi (V)

	D+	D-	V
Student A	0,033566	0,060977	0,644966
Student B	0,020496	0,072054	0,778539
Student C	0,047579	0,058484	0,551411
Student D	0,025958	0,06835	0,724754
Student E	0,049574	0,052437	0,514033
Student F	0,072217	0,025162	0,258389

The last stage is sorting data based on preference value (V) to determine the order of student eligibility to take part in MBKM. This value will be a reference for the study program to determine which students are eligible to be approved for their MBKM application. Based on the sample above, the sorting results are as follows.

Table.8. Preference Value Sorting Results

NAMA MAHASISWA	V
Mahasiswa B	0,778539
Mahasiswa D	0,724754
Mahasiswa A	0,644966
Mahasiswa C	0,551411
Mahasiswa E	0,514033
Mahasiswa F	0,258389

From the table above, it can be seen that Student B gets the greatest preference value. This shows that Student B is very worthy of participating in the MBKM program. In fact, when viewed per criterion, the GPA and average score of courses according to the criteria are much smaller than Student A. In addition, Student D also has a higher preference value. This can happen because the criteria score of 2 Student B and Student D are greater than Student A. This result shows that not always students with high GPA and grades will get high preference scores. The results of this sequencing will be a recommendation for selecting student eligibility which will be decided by the study program.

IV. CONCLUSION

In this study, Decision Support System modeling has been carried out to determine the eligibility of Informatics study program students in participating in MBKM internship and independent study programs. This modeling uses a combination of AHP and TOPSIS Decision Support System methods with 8 beneficial criteria and students who apply for MBKM as an alternative.

AHP and TOPSIS modeling are powerful tools that help decision makers to make decisions by objectively evaluating criteria relevant to a given situation. In addition, study programs can benefit from implementing this type of decision support system because it provides a structured and objective approach to complex decision making.

Through AHP, 8 weights were produced that were tested for consistency and then used in the TOPSIS method to determine the order of eligibility of each student. The results show that not always students with high GPAs and grades have high eligibility scores. This depends on the weight of the criteria. In the next research, the implementation stage of this modeling will be carried out through the application of the MBKM Program Submission System in the Informatics study program environment.

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