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Application of the AHP Method for the Selection of Majors in Higher Education through the SNBP Route

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A B S T R A C T

SNBP is one of the entry points in state university entrance selection system which is very popular with students because selection for university entrance is carried out only based on based on the results of academic achievement tracking through report cards and students' academic and non-academic portfolios. MAN 1 Siak is one of the madrasas that registers its students through the SNBP entry. When SNBP registration opens, the role of guidance and counseling teachers is really needed to help students in choosing the right major. The aim of this research is to make it easier for guidance and counseling teachers to create a decision support system that can provide recommendations for major selection to students effectively and efficiently. The method used is the analytical hierarchy process (AHP) method. AHP is a decision making method with a systems approach, where decision makers try to understand a system condition and help make predictions in making decisions. Using the AHP method, the priorities for selecting majors in higher education via the SNBP route are education(0.2912), economics(0.2447), computers(0.2168), law(0.2007), and medicine(0.0466)..

Keywords: *Decision Support System, AHP, Major Selection, SNBP*

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INTRODUCTION

Humans are always faced with several choices in their lives. Making the right decisions will have an impact on future life. One of the problems about this decision-making is experienced by grade XII students who will choose a major when they are going to continue their education to college. Choosing a major is not an easy thing because there are many things that must be considered such as cost, self-ability, and the prospects of the intended college graduate. The choice of the wrong major will have consequences for the future of students later. Not a few prospective students make mistakes in choosing a major. These mistakes are usually caused by reasons of prestige, prestige, coolness, parental advice, following friends, or no other choice. This leads to a low level of grade points achieved and will hinder graduation.

One of the pathways to higher education is SNBP. SNBP stands for National Selection Based on Achievement, which is the process of selecting new students to enter higher education based on academic and non-academic achievements. Academic achievements that are considered in SNBP include report cards or transcripts, while non-academic achievements can be in the form of achievements in sports, art, leadership or social activities. SNBP is an alternative for prospective students who cannot or do not want to enter university through the exam-based national selection route (SNMPTN) or independent written exam (SBMPTN). Although SNBP pays attention to the achievements of prospective students holistically, the competition for a place in this pathway university is very tight with a limited quota. With this limited capacity, students must be able to determine the choice of majors and universities correctly so that they can be accepted through the SNBP route.

MAN 1 Siak is one of the madrassas that registers its students through the SNBP route. When SNBP registration is opened, the role of BK teachers is needed to help students in choosing the right major. As soon as SNBP registration is opened, the task of BK teachers becomes heavy. This is due to the large number of students who consult repeatedly to ask for input and consideration regarding the choice of major they will choose so that it can increase the possibility of being accepted into the SNBP pathway. So far, BK teachers have been overwhelmed in providing input for students manually by comparing students' scores with the majors of interest.

From these problems, an idea emerged to build a decision support system that can help students choose a major in higher education. This system uses the AHP (*Analytical Hierarchy Process*) method. AHP allows to provide an appropriate analysis in determining the most appropriate choice of major at university among the many alternatives that exist.

In conducting this study, the researcher used several study literature from previous research, among others.

Raswini *et.al* (2022) entitled Major's Selection Decision Support System Using the *Analytical Hierarchy Process* Method. From his research, the conclusion was obtained that the selection of majors at SMAN 1 Gresik was built using the *Raid Application Development* (RAD) software development model with the AHP method. The results of *the Black Box* tests conducted showed that the functionality of the system as a whole was running correctly. The results of the test with *the Confusion Matrix* method obtained an accuracy value of 77%. The level of system accuracy is in the good category and can be applied to the research subject, namely SMAN 1 Gresik.

Yohanes Setyo Prabowo *et.al* (2019) in a journal entitled SNMPTN Department Election Decision Support System for SMAN 7 Purworejo Students. The research aims to create a system that is able to help the selection of the right major according to the student's grades greatly affect selection opportunities by using *the Profile Matching method*

Rahmayu, M and Serli, K.R (2022) in a study entitled Major's Decision Support System at SMK Putra Nusantara Jakarta Using *the Analytical Hierarchy Process* (AHP). This research is a research to assess a student's interest, talent, and ability in learning in a certain department at the high school where the research is conducted, so that there is no mistake in choosing a major in the vocational school.

Fitri Retrialisca (2019) in a study entitled Decision Support System and Recommendation on SBMPTN Try-Out with Analytic Hierarchy Process (AHP). Based on this background, the author made a study on the Application of *the Analytical Hierarchy Process* (AHP) Method in the Decision Support System for Majors Selection in Higher Education Through the SNBP Pathway. In this study, there are five majors that are alternatives. This is based on the majority of majors chosen by students, namely education, economics, law, computer and medicine. The alternative majors were chosen by considering the criteria of the field of study, report card scores, interests, goals, parents, and costs.

METHOD

The methods used in this study are *Analytical Hierarchy Process* (AHP) which aims to determine the most appropriate choice among many options with several criteria for each choice. The AHP method was developed in the early 19770s by Thomas L. Saaty, of the University of Pittsburg. According to Saaty, this method is a framework for making decisions effectively on complex problems by simplifying and speeding up the decision-making process by breaking the problem into parts, arranging these parts or variables in a hierarchical order, assigning numerical value to subjective considerations about the importance of each variable and synthesizing these various considerations to determine which variable has the highest priority and act to influence the outcome of the situation. The AHP method helps solve complex problems by structuring a hierarchy of criteria, stakeholders, outcomes and by attracting various considerations to develop weights or priorities. This method also combines the strength of the feelings and logic involved in various issues, and synthesizes the various

considerations into results that match the estimates intuitively as presented in the judgments that have been made.

According to Kazibudzki and Tadeusz (2013: 8), *the Analytical Hierarchy Process* (AHP) is multicriteria decision-making with the support of methodologies that have been recognized and accepted as a priority that can theoretically provide different answers to decision-making problems as well as rank alternative solutions.

There are four basic principles of AHP (Herlinawali, 2000), namely:

Dekomposisi

That is, solving the problem into its elements. If you want to get accurate results, solving is also done on the elements until it is impossible to do further solving so that several levels of the problem can be obtained. This analysis process is called hierarchy. There are two types of hierarchies, which are complete and incomplete. In a complete hierarchy, all elements at one level have all the elements present at the next level. If this is not the case, then it is called an incomplete hierarchy.

Comparative Judgment

This principle means making judgments about the relative importance of two elements at a given level in relation to the level above. This assessment is at the core of the AHP, as it will affect the priorities of the elements.

Synthesis of Priority

From each pairwise comparison matrix, *the* eigenvector is *then searched* for to get *local priority*. Because there are all levels of *pairwise comparison* matrices , to get global *priority*, synthesis must be carried out between *local priorities*. The sequencing of elements according to relative importance through a synthesis procedure is called *priority setting*.

Logical Consistency

Consistency has two meanings. The first is that similar objects can be grouped according to their uniformity and relevance. The second meaning concerns the level of relationship between objects that is based on certain criteria.

Decision-making with AHP has advantages compared to other methods (Munthafa, 2017), namely:

Unity

AHP makes a broad and unstructured problem into a flexible and easy-to-understand model.

Complexity

AHP solves complex problems through a systems approach and deductive integration.

Interdeendence

AHP can be used on system elements that are independent of each other and do not require linear relationships.

Hierarchy Structuring

AHP represents natural thinking that tends to group system elements into different levels of each level containing similar elements.

(1) The AHP provides measurement scales and methods for determining priorities. (2) The AHP produces a comprehensive estimate of the level of desirability of each alternative. (3) This method takes into account the relative priority of various factors in the system so as to allow one to choose the best alternative according to his or her goals. (4) AHP does not require a single consensus, but can combine a variety of different assessments. (5) Through an iterative process, AHP helps individuals clarify the definition of the problem and develop their assessment and understanding more deeply.

Meanwhile, the disadvantages of the AHP method are as follows. **(1)** The dependence of the AHP model on its main input. This main input is in the form of an expert's perception so that in this case it involves the subjectivity of the expert, besides that the model becomes meaningless if the expert gives a wrong assessment. **(2)** The AHP method is only a mathematical method without any statistical testing so that there is no limit to the confidence of the truth of the model formed.

Basically the steps in the AHP method (Raswini, 2022), covers: (1) Define the problem and determine the desired solution. In this stage we try to determine the problem to be solved in a clear, detailed, and easy-to-understand way. From the existing problem, a solution that may be suitable for the problem will be determined. Solutions to problems may amount to more than one. The solution will later be further developed in the next stage. (b) Creating a hierarchical structure that begins with a general goal and continues with criteria and possible alternatives at the lowest level of criteria.

The hierarchical structure of criteria and alternatives is shown in Figure 1.

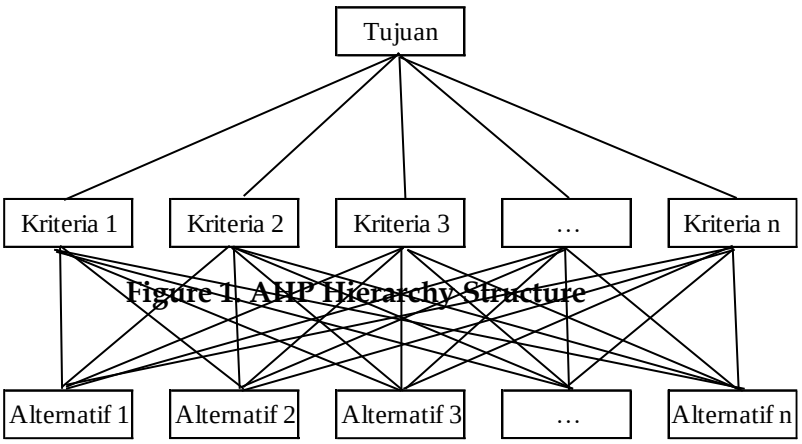

Figure 1. AHP Hierarchy Structure

Create a paired comparison matrix that describes the relative contribution or influence of each element to the criteria at the level above it is simple, has a strong position for consistency, obtains other information that may be needed with all possible comparisons and is able to analyze the overall sensitivity of priorities for changes in considerations. The matrix approach reflects a dual aspect of prioritization that is dominating and dominating. Comparisons are made based on *the judgment* of decision-making by assessing the level of importance of one element compared to other elements. To start the pairing comparison process, a criterion is selected from the highest level of the hierarchy. The paired comparison matrix is shown in Table 1.

Table 1. Paired Comparison Matrix

C	A_1	A_2	A_3	…	A_n
A_1	a_{11}	a_{12}	a_{13}		a_{n1}
A_2	a_{21}	a_{22}	a_{23}		a_{2n}
A_3	a_{31}	a_{32}	a_{33}		a_{3n}
…					
A_n	a_{n1}	a_{n2}	a_{n3}		a_{nn}

A value a_{11} is the value of a comparison of an element (row) to a (column) that expresses a relationship:A_1A_1

How far the level of importance (row) to criterion C compares to (column), orA_1A_1

How far does the dominance (row) go against (column), or A_1A_1

How much is the property of criterion C to (row) compared to (column).A_1A_1

Compare in pairs so that a *judgment* is obtained as many as a whole, with the number of elements that are compared.$n \times \left[\left(\frac{n-1}{2}\right)\right] n$

The results of the comparison of each element will be in the form of numbers 1 to 9 which shows the comparison of the level of importance of an element. If an element in the matrix is compared with itself, the result of the comparison is given a value of 1. A scale of 9 has proven to be acceptable and can distinguish the intensity between the elements. The results of the comparison are filled in in cells that correspond to the elements being compared. In determining the value of the paired comparison in the AHP analysis, values such as Table 2 are used.

Table 2. Paired Comparison Value Scale (Rahmatika, 2019)

Interests	Definition	Explanation
1	Equally important	Both elements have the same influence
3	A little more important	The assessor is slightly more in favour of one of the elements of the comparison
5	More important	The assessor is very much in favour of one of the elements of comparison
7	Very important	One of the elements is much more influential and dominant
9	Absolutely more important	One of the elements is more important than the comparator having the highest level
2, 4, 6, 8	Middle value	Element where there is a doubt between two adjacent values
The Opposite	$A_{ij} = 1/A_{ij}$	If element a has one of the numbers compared to element b, then a has the opposite value when compared to element b.

(a) Calculate *the eigenvector* value and test its consistency, if it is inconsistent, the data collection can be repeated. (b) Repeat steps 3, 4, and 5 for the entire hierarchy level. (c) Calculate the eigenvector of each paired comparison matrix. The eigenvector value is the weight of each element. This step is to synthesize the assessment in prioritizing elements at the lowest level of the hierarchy until the achievement of the goal. The calculation is done by summing the values of each column of the matrix, dividing each value of the column by the total of the corresponding column to obtain matrix normalization, and summing the values of each row and dividing it by the number of elements to get the average. (d) Checking the consistency of the hierarchy. This stage measured in AHP is the consistency ratio by looking at the consistency index. The expected existence is one that is close to perfect in order to produce a decision that is close to valid. In the calculation of the AHP model, the comparison matrix is acceptable if the consistency ratio value ≤ 0,1 must be re-assessed (Dona, 2021).

The AHP method test was carried out in calculating CI (*Consistency Index*) and CR (*Consistency Ratio*).

Perhitungan CI (Consistency Index)

To find out the consistency of the answer that will affect the error of the result.

$$CI = \frac{\lambda_{\text{maks}} - n}{n - 1}$$

THERE : *Consistency deviation ratio*

λ_{maks} : *The largest eigenvector value of an ordered matrix* n

n : *Orde matrix*

Perhitungan CR (Consistency Ratio)

Used in correcting paired comparisons that have been made with consistent results or not.

$$CR = \frac{CI}{RI}$$

THERE : *Consistency Index*

RE : *Random Index*

Table 3. Random *Index Values* [13] [14]

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RE	0,00	0,00	0,58	0.90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48	1,56	1,58

In this study, data collection techniques are used which are carried out in several stages, including: (a) Observation, which is to see and observe directly the existing data processing process. (b) Interview, which is collecting data by conducting questions and answers directly to related parties to obtain the necessary information. (c) Literature study, which is reading books or looking for references from the internet that are directly or indirectly related to find out theoretically the problems being faced.

In this study, the Quantitative Analysis method was used, to compare criteria and alternatives that can produce a decision, namely the selection of majors for prospective students using the AHP method. In the analysis process, it must first determine the criteria that will be used. After the process of determining the criteria is completed, it is then continued with the preparation of alternatives. In this study, the criteria determined are the field of study,

report card scores, interests, ideals, parents, and costs. While the alternatives are computers, law, economics, education, and medicine. *The flowchart* of the AHP method procedure is shown in Figure 2.

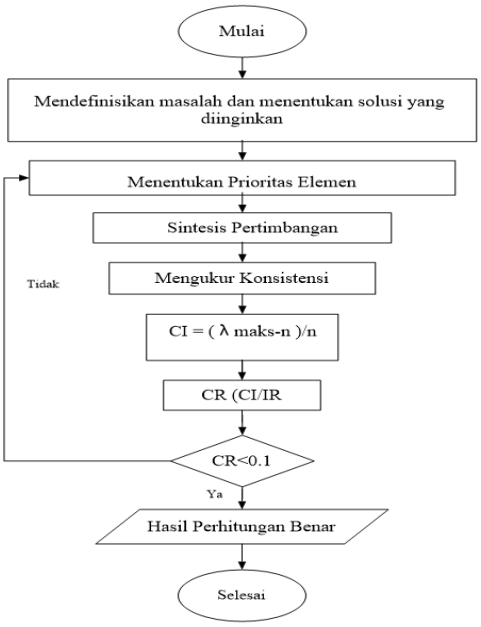

Figure 2. *Flowchart* of the AHP Method Procedure.

FINDINGS AND DISCUSSION

The result of the research that has been carried out is to create a decision support system that is able to determine the results of student weighting with predetermined criteria. In designing a system to support the decision to choose majors for prospective new students, the author uses AHP. The process of the AHP method is made in the form of *a spreadsheet*. The results obtained by the AHP method are to determine the weight of the criteria that will be the final result.

In this study, the hierarchical structure is shown in Figure 3.

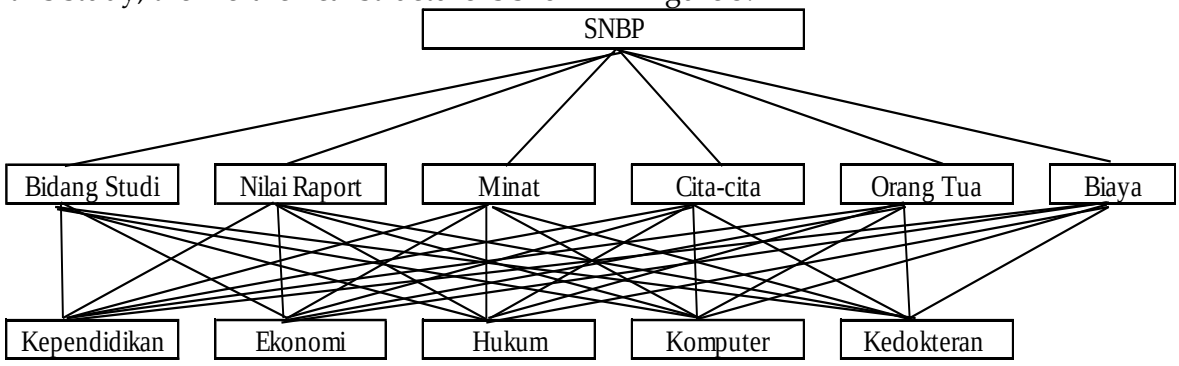

Figure 3. Research Hierarchy Structure

After the hierarchical structure is determined, data will be taken from the respondents. From the respondent result data, a paired comparison matrix will be formed. From the paired comparison matrix, a criterion value matrix will be formed as shown in Table 4.

Table 4. Criteria Value Matrix

Criterion	Field of Study	Report Card Score	Interest	Quote-quote	Parents	Cost	Sum	Average
Field of Study	0.4225	0.5172	0.3830	0.3077	0.2609	0.3390	2.230	0.372
Report Card Score	0.2113	0.2586	0.3830	0.3077	0.2609	0.3390	1.760	0.293
Interest	0.1408	0.0862	0.1277	0.2051	0.1739	0.2034	0.937	0.156
Quote-quote	0.0704	0.0431	0.0319	0.0513	0.0870	0.0339	0.318	0.053
Parents	0.0704	0.0431	0.0319	0.0256	0.0435	0.0169	0.232	0.039

Cost	0.0845	0.0517	0.0426	0.1026	0.1739	0.0678	0.523	0.087

From the table above, obtained $\lambda_{\text{maks}} = 6.4431, \text{CI} = 0.0886, \text{RI} = 1.24, \text{CR} = 0.07147. \text{CR} < 0.1$, the consistency ratio of the calculation is accepted. Next, a paired comparison matrix of each alternative will be determined. The results of the calculation can be seen in Table 5 to Table 10.

Table 5. Alternative Paired Comparison Matrix (Field of Study)

Field of Study	Computer	Law	Ekono-mi	Education	Disguise	Sum	Average
Computer	0.0800	0.0816	0.0732	0.0778	0.1176	0.430	0.086
Law	0.2400	0.2449	0.2927	0.2333	0.2353	1.246	0.249
Economics	0.1600	0.1224	0.1463	0.1556	0.1765	0.761	0.152
Educational	0.4800	0.4898	0.4390	0.4667	0.4118	2.287	0.457
Medicine	0.0400	0.0612	0.0488	0.0667	0.0588	0.275	0.055

From the table above, obtained $\lambda_{\text{maks}} = 5.0500, \text{CI} = 0.0125, \text{RI} = 1.12, \text{CR} = 0.0112. \text{CR} < 0.1$, the consistency ratio of the calculation is accepted.

Table 6. Alternative Paired Comparison Matrix (Report Score)

Report Card Score	Computer	Law	Ekono-mi	Education	Disguise	Sum	Average
Computer	0.4667	0.4500	0.4027	0.5030	0.3043	2.127	0.425
Law	0.0778	0.0750	0.0336	0.1257	0.1304	0.443	0.089
Economics	0.1556	0.3000	0.1342	0.0838	0.2174	0.891	0.178
Educational	0.2333	0.1500	0.4027	0.2515	0.3043	1.342	0.268
Medicine	0.0667	0.0250	0.0268	0.0359	0.0435	0.198	0.040

From the table above, obtained $\lambda_{\text{maks}} = 5.3976, \text{CI} = 0.0991, \text{RI} = 1.12, \text{CR} = 0.0885. \text{CR} < 0.1$, the consistency ratio of the calculation is accepted.

Table 7. Alternative Paired Comparison Matrix (Interest)

Interest	Computer	Law	Ekono- mi	Education	Disguise	Sum	Average
Computer	0.1951	0.1633	0.1760	0.2697	0.2857	1.090	0.218
Law	0.0976	0.0816	0.1056	0.0337	0.1429	0.461	0.092
Economics	0.5854	0.4082	0.5279	0.5393	0.3214	2.382	0.476
Educational	0.0976	0.3265	0.1320	0.1348	0.2143	0.905	0.181
Medicine	0.0244	0.0204	0.0587	0.0225	0.0357	0.162	0.032

From the table above, obtained $\lambda_{\text{maks}} = 5.3976, \text{CI} = 0.0994, \text{RI} = 1.12, \text{CR} = 0.0887. \text{CR} < 0.1$, the consistency ratio of the calculation is accepted.

Table 8. Alternative Pairs Comparison Matrix (Ideal)

Quote-quote	Computer	Law	Ekono- mi	Education	Disguise	Sum	Average
Computer	0.1299	0.1032	0.1250	0.1600	0.2381	0.756	0.151
Law	0.2597	0.2065	0.1667	0.4000	0.3333	1.366	0.273
Economics	0.5195	0.6195	0.5000	0.3200	0.2857	2.245	0.449
Educational	0.0649	0.0413	0.1250	0.0800	0.0952	0.406	0.081
Medicine	0.0260	0.0295	0.0833	0.0400	0.0476	0.226	0.045

From the table above, obtained $\lambda_{\text{maks}} = 5.3529, \text{CI} = 0.0882, \text{RI} = 1.12, \text{CR} = 0.0788.\ \text{CR} < 0.1$, the consistency ratio of the calculation is accepted.

Table 9. Alternative Pairs Comparison Matrix (Parents)

Field of Study	Computer	Law	Ekono- mi	Education	Disguise	Sum	Average
Computer	0.0845	0.0361	0.1196	0.1143	0.1364	0.491	0.098
Law	0.4225	0.1804	0.1495	0.2857	0.3182	1.356	0.271
Economics	0.4225	0.7216	0.5980	0.5143	0.4091	2.666	0.533
Educational	0.0423	0.0361	0.0664	0.0571	0.0909	0.293	0.059
Medicine	0.0282	0.0258	0.0664	0.0286	0.0455	0.194	0.039

From the table above, obtained $\lambda_{\text{maks}} = 5.4371, \text{CI} = 0.1093, \text{RI} = 1.12, \text{CR} = 0.0976\ \text{CR} < 0.1$, the consistency ratio of the calculation is accepted.

Table 10. Alternative Paired Comparison Matrix (Cost)

Field of Study	Computer	Law	Ekono- mi	Education	Disguise	Sum	Average
Computer	0.1304	0.1739	0.0526	0.2400	0.2143	0.811	0.162
Law	0.3913	0.5217	0.6316	0.4800	0.4286	2.453	0.491
Economics	0.3913	0.1304	0.1579	0.1600	0.1429	0.982	0.196
Educational	0.0435	0.0870	0.0789	0.0800	0.1429	0.432	0.086
Medicine	0.0435	0.0870	0.0789	0.0400	0.0714	0.321	0.064

From the table above, obtained $\lambda_{\text{maks}} = 5.4077, \text{CI} = 0.1019, \text{RI} = 1.12, \text{CR} = 0.0910. \text{CR} < 0.1$, the consistency ratio of the calculation is accepted. From all evaluations carried out on the six criteria, the next step will be to find the ranking of each alternative by multiplying the average of each alternative by the weight factor of the criteria. The results of the calculation can be seen in the following Table 11.

Table 11. Total Calculation Matrix

Field of Study	Field of Study	Report Card Score	Interest	Quote-quote	Parents	Cost	Ranking
Alternatif	0.3717	0.2934	0.1562	0.0529	0.0386	0.0872	
Computer	0.0860	0.4253	0.2179	0.1512	0.0982	0.1623	0.2168
Law	0.2492	0.0885	0.0923	0.2732	0.2713	0.4906	0.2007
Economics	0.1522	0.1782	0.4764	0.4489	0.5331	0.1965	0.2447
Educational	0.4575	0.2684	0.1810	0.0813	0.0586	0.0864	0.2912
Medicine	0.0551	0.0396	0.0323	0.0453	0.0389	0.0642	0.0466

From the results of the calculation above, the results of the percentage were obtained and the ranking was obtained from the determination of the following majors.

1st Place: Education Department with a percentage of 29%
Rank 2: Economics Department with a percentage of 24%
3rd Place: Computer Major with a percentage of 22%
4th Place: Law Department with a percentage of 20%
Rank 5: Medical Major with a percentage of 5%

CONCLUSIONS

With the creation of a decision support system for the selection of majors in higher education through the SNBP route, conclusions are drawn, namely: (a) This decision-making system allows students to find out which majors are the priority for the possibility of them passing the SNBP route. (b) This decision-making system makes it easier for BK teachers to direct students to choose the right major according to the interests and talents of students on the SNBP pathway. Based on the above conclusion, AHP is an acceptable technique in decision-making with several criteria and alternatives. In the future, there needs to be the addition of other methods for decision-making based on multi-criteria.

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