APPLICATION OF ANALYTICAL HIERARCHY PROCESS METHOD AS A DECISION SUPPORT SYSTEM IN THE RECRUITMENT OF LECTURERS AT UNIVERSITAS NAHDLATUL ULAMA SUNAN GIRI

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Abstract. *Each college is obliged to create an ideal ratio of lecturers and students. To improve internal quality or quality on an ongoing basis to meet the ideal ratio of lecturers and students, Universitas Nahdlatul Ulama Sunan Giri always recruits lecturers every year. The file selection flow at the administrative selection stage of lecturer recruitment at Universitas Nahdlatul Ulama Sunan Giri is still carried out conventionally to ensure prospective lecturers are selected to pass to the next stage. The assessment process is subjective, and this can cause inconsistency in the provision of grades in each prospective alternative lecturer. This study aims to design and apply the Analytical Hierarchy Process method to support decisions in the recruitment of lecturers at Universitas Nahdlatul Ulama Sunan Giri. So that in this calculation, the priority of Recruitment of Lecturers at Universitas Nahdlatul Ulama Sunan Giri is obtained as follows; Recent Education 41.22%, GPA 20.61%, Achievement 13.74%, Accreditation 10.3%, Experience 8.24%, and Test 5.89%. Based on the research conducted, the same results were obtained with data in the field that those selected to become lecturers in the mathematics education study program were prospective lecturers with the initials FN, with a total score of 0.1168. The results of applying the Analytical Hierarchy Process method can provide recommendations for selecting alternative lecturer candidates for Universitas Nahdlatul Ulama Sunan Giri who are more objective.*

***Keywords*:** *analytical hierarchy process, decision support system, lecturer recruitment.*

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1. INTRODUCTION

A *Decision Support System* is a computer-based system that can support decision making to solve semi-structured problems by utilizing existing data and then processed into information in the form of proposals toward a certain decision [1]. A Decision Support System is a specific information system aimed at assisting management in making decisions related to semi-structured issues [2]. Decision support systems are interactive computer-based systems which help decision makers to leverage data and models to solve unstructured and semi-structured problems [3]. Meanwhile, according to [4], the decision support system is the implementation of decision-making theories that have been introduced by sciences such as operation research and management science. The only difference is that if, in the past, to find a solution to the problem at hand had to be done manually iteration calculations to find the minimum, maximum, and optimum value, now the computer has offered its ability to solve the same problem in a relatively short time. From the understanding of the decision support system, it can be concluded that it is a computerized information system used to assist humans in making correct and appropriate decisions. Several methods in decision support systems can be used to help solve unstructured problems, including Simple Additive Weighting. The Simple Additive Weighting method is the most basic and widely used strategy. The basic concept of the Simple Additive Weighting method is to look for the weighted summation of the performance rating on each alternative on all attributes [5]

Such as research conducted by Telaumbanua, Sihombing, and Irmayani [6]. The study aims to apply the Simple Additive Weighting method as decision support in the admission of permanent lecturers at Universitas Labuhan Batu. The study proved that the Simple Additive Weighting Method could be used in helping to make decisions in the admission process for permanent lecturers at Universitas Labuhan Batu. Then the research was conducted by Sipayung [7]. The study aims to apply the Simple Additive Weighting method as decision support in the admission of teachers at Permata Harapan School. The research proves that the system built can simplify and speed up the selection process for new teachers and assist the principal in making decisions to determine new teachers at Permata Harapan School. In addition to the Simple Additive Weighting method, there is a similar method, namely the Weighted Product method. The way the Weighted Product method works is to determine the criterion factor as a benefit or cost (conflict between criteria) by looking for the result of multiplying the value of alternative criteria by the weight of the criterion [8]. Such as research conducted by Alamsyah and Gustian [9] using the weighted product and Simple Additive Weighting methods. The study aims to apply the Weighted Product and Simple Additive Weighting methods as a decision support system in teacher admissions at schools. In this study, the Weighted Product method was used to find the weight value of the criteria, while the Simple Additive Weighting method was used to find the final weight value of the alternative. From the results of testing, the system was declared feasible to assist school management in the admission of teachers.

Next is the Analytical Hierarchy Process method. According to Taylor [10], the Analytical Hierarchy Process is a method to rank alternative decisions and choose the best one with several criteria. The Analytical Hierarchy Process develops a single numerical value to rank each alternative decision based on the extent to which each alternative meets the decision-making criteria. Such as research conducted by Puspitasari & Ilmi [11] using the Analytical Hierarchy Process method. The study aims to apply the Analytical Hierarchy Process method in making decisions to select outstanding lecturers at the Universitas Balitar. The research shows that the system of selecting outstanding lecturers made is free from syntax errors and functionally outputs the results as expected. Then the research was conducted by Lukmansyah [12] using the Simple Additive Weighting and Analytical Hierarchy Process methods. The study aims to provide recommendations for new lecturer candidates to the leadership of the Faculty of Industrial Technology, Universitas Islam Indonesia. The Analytical Hierarchy Process method determines the criteria's priority weight, and the Simple Additive Weighting method ranks each alternative. The study shows that the recommendations for the selection of lecturers are more objective because they can be weighted against predetermined criteria using the Analytical Hierarchy Process method. The difference between this study and the previous research lies in the target, subject matter, and criteria used.

Based on circular number 1041/BAN-PT/LL/2020 dated April 7, 2020, each college is required to create an ideal ratio of lecturers and students. The ideal ratio of the number of lecturers to students is (1) the ratio of lecturers and students is at most 1:60 for S-1 and Diploma. (2) 1:20 ratio for S-2 Academic. (3) 1:30 ratio to Applied S-2. (4) 1:10 ratio to S-3. Based on data in PDDikti, the ratio between the number of lecturers and students at Universitas Nahdlatul Ulama Sunan Giri is still lacking, with a 1:69 ratio. The ratio is too

high for the maximum capacity limit. In achieving these ideal conditions, efforts are made to realize its Universitas Nahdlatul Ulama Sunan Giri vision and mission always strive to improve quality or internal quality sustainably as an institutional strategy to compete with other universities. One way to improve the quality of a university is to select the admission of teaching staff or lecturers because the quality of lecturers will greatly determine the high and low quality of a university. The recruitment registration for Lecturers at Universitas Nahdlatul Ulama Sunan Giri in the admission period in January 2022 starts on January 11, 2022, and until January 31, 2022. One of the study programs that open vacancies is S1 Mathematics Education with the formation of one prospective lecturer. However, the selection flow for lecturer admissions at Universitas Nahdlatul Ulama Sunan Giri is still conducted conventionally to ensure prospective lecturers who want to be accepted. The assessment process is subjective, and this can cause inconsistency in the provision of grades for each prospective alternative lecturer. The impact of this can be an error in the selection of lecturer candidates, where lecturers who should be accepted become not accepted.

Based on the analysis that has been carried out, the decision-making process in the recruitment of lecturers in the research carried out chooses to use the Analytical Hierarchy Process (AHP) method. The AHP method was chosen because this method excels in data accuracy. The weight value of the criteria in this method is not arbitrarily determined but is generated based on calculations [13]. Based on research conducted by Estining Nur Sejati Purnomo in 2013 by analyzing the comparison of Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and AHP-TOPSIS methods in a case study of the student admission decision support system acceleration program with the results of the AHP method research to be the best method. Then, the AHP method became the best-recommended method for the school in a case study of student admissions for accelerated programs [14]. In addition, the AHP method tests the consistency of the assessment. If a deviation is too far from the excellent contingency value, the assessment needs to be improved, or the hierarchy must be restructured. This study used the AHP to determine alternative weights against criteria and sub-criteria. The process of determining alternative weights for criteria and sub-criteria using the AHP was carried out by providing comparison values in pairs between elements and checking the consistency of the given comparison values.

2. RESEARCH METHODS

2.1 Research Design

A research design is a plan to collect, process, and analyze data systematically and purposefully so that research can be carried out efficiently and effectively following research objectives [15]. The research design, as stated in Figure 1.

2.2 Data Collection

According to Sugiyono [16] the method or technique of data collection can be done by interviews, questionnaires, observations, and a combination of the three. In this study, the data used was lecturer recruitment data in the admission period in January 2022 in the S1 Mathematics Education study program. Data collection was carried out by interviews and in the admissions subdivision of academic staff and lecturers at the Quality Assurance Institute of Universitas Nahdlatul Ulama Sunan Giri. This data is taken and collected as material for calculating and analyzing decision support systems by applying the Analytical Hierarchy Process method.

2.3 Data Analysis

Data analysis, according to Sugiyono [17], is the process of systematically finding and compiling data obtained from the results of interviews, field notes, and documentation, by organizing data into categories, describing them into units, performing synthesis, compiling into patterns, choosing which ones are important and which ones will be studied, and making conclusions so that they are easily understood by themselves and others. The decision-making process in lecturer recruitment in the research is assisted by applying the analytical hierarchy process method. The AHP is a decision support method developed in the 1970s by mathematician Thomas L. Saaty at the University of Pittsburgh, United States. The AHP algorithm is a quantitative method to rank various alternatives and choose one or several of the best results based on

specified criteria. This method uses a comparison of several choices with predetermined criteria [18]. Prioritization with the AHP method is carried out by going through several stages, namely:

a. Drawing up a hierarchical structure.
b. Conduct an assessment of criteria and alternatives.
c. Choose priority.
d. Specifies logical consistency values.
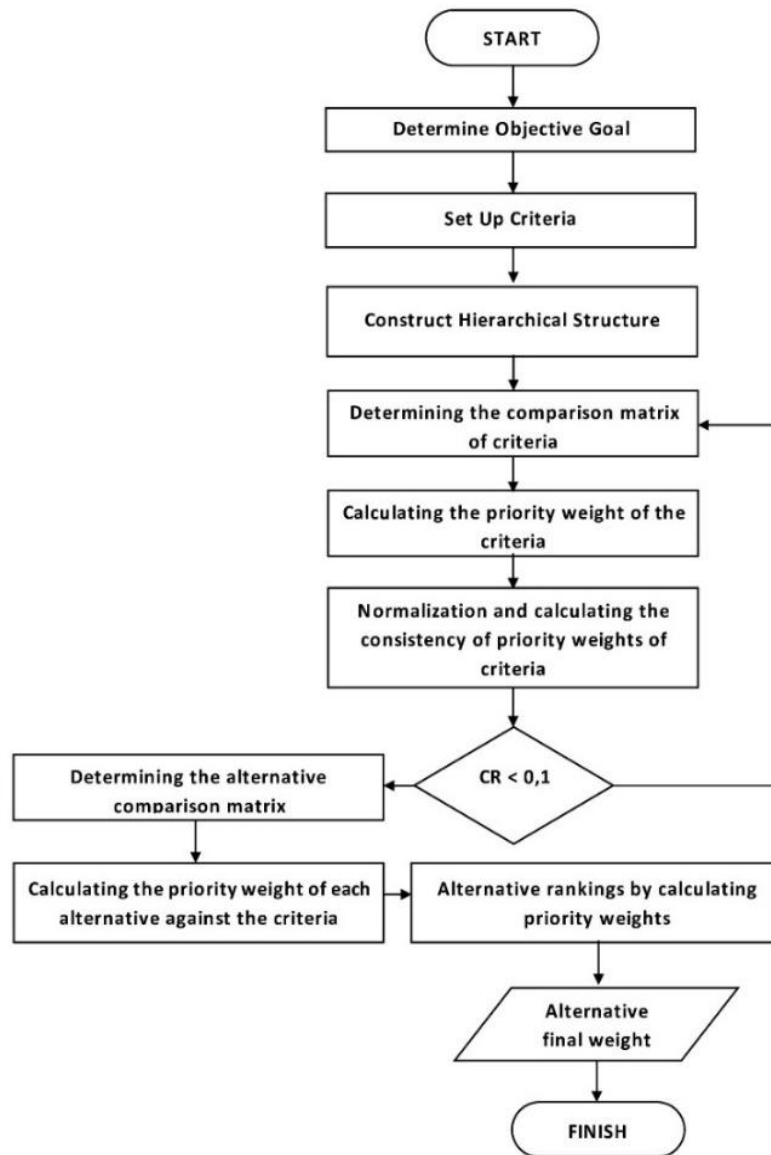
Figure 1. Research Design

When making a decision, we need to know how consistency is used. The things done in this step are as follows:
1) Calculates the value in the first column by multiplying the priority weight of the first element. Each value in the second column is multiplied by the priority weight of the second element, and so on.
2) The calculation result of step number one in each row is divided by the total number in each column.
3) Look up priority weight values by calculating the average per row.
4) Looks up Lambda (λ) by multiplying each of the priority weight values per row by the total number per column.
5) Looking for Lambda (λ max) by summing the results of Lambda.

e. Determine the *consistency index* (CI) value by using the following formula:

$$CI = \frac{(\lambda max - n)}{n - 1} \qquad (1)$$

Description:
n = number of criteria used

f. Determine the *consistency ratio* (CR) value using the following formula:

$$CR = \frac{CI}{RC} \qquad (2)$$

Description:

CR = *Consistency Ratio*
CI = *Consistency Index*
RI = *Random Index*

The value of the RI has been determined based on the comparison matrix formed and can be presented in the following Ratio Index table:

Table 1. Value Random Index

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

g. Check the consistency of the hierarchy.

If the value is more than 10% or 0.1, then the assessment of the judgment data must be corrected. But if the consistency ratio is less or equal to 0.1, the calculation result can be declared correct.

3. RESULTS AND DISCUSSION

3.1 Goals and Criteria

The target of this study is the Recruitment of Universitas Nahdlatul Ulama Sunan Giri in the S1 Mathematics Education study program for the admission period in January 2022. The criteria used are Recent Education, GPA, Achievement, Accreditation, Experience, and Tests (the question test is a written test).

3.2 Taking 10 Best Alternatives

Before applying the AHP method, an assessment was first carried out for all registrants by looking at the qualifications of applicants in the curriculum vitae. Then the 10 best alternatives were obtained as follows:

Table 2. Result of Best 10 Alternative Assesments on 6 Criteria

Code	C1	C2	C3	C4	C5	C6
EI	20	20	5	23	1	1
FN	19	16	5	20	1	78
MMU	15	15	5	18	5	65
DIA	18	15	1	18	5	76
FA2	18	15	1	18	4	54
AH	18	12	2	18	5	1
LIA	18	12	1	18	6	36
MRW	18	15	1	18	3	73
KZ	18	13	1	18	5	60
MQS	18	16	2	16	2	40

Furthermore, create a hierarchical structure that begins with the target, followed by criteria and alternatives for prospective lecturers, as stated in Figure 2.
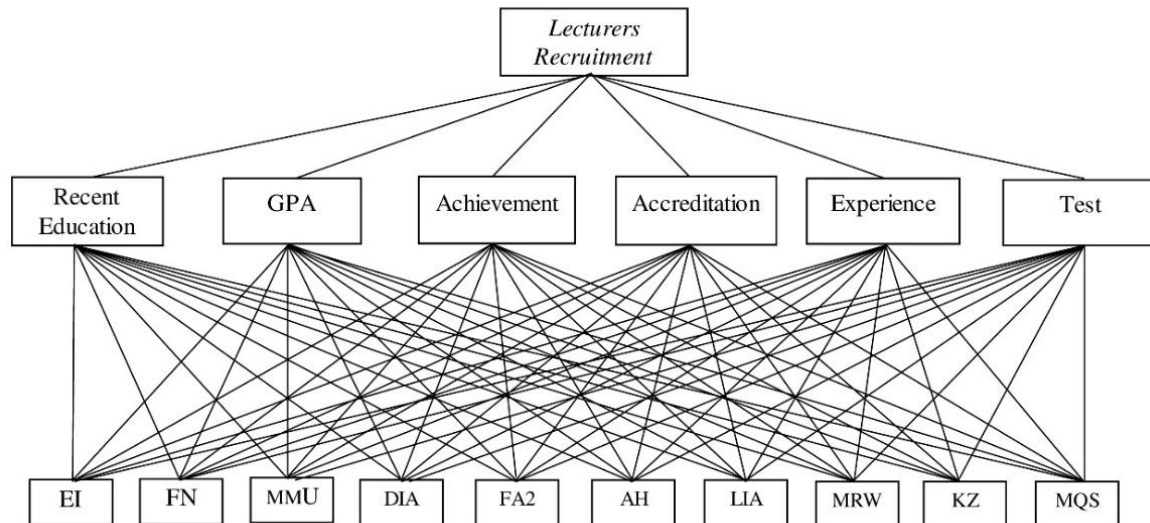
Figure 2. Structure Hierarchy Lecturers Recruitment

Table 3. Matrix of Pairwise Comparisons Between Criteria

Criteria	Recent Education	GPA	Achievement	Accreditation	Experience	Test
Recent Education	1,0000	2,0000	3,0000	4,0000	5,0000	7,0000
GPA	0,5000	1,0000	1,5000	2,0000	2,5000	3,5000
Achievement	0,3333	0,6667	1,0000	1,3333	1,6667	2,3333
Accreditation	0,2500	0,5000	0,7500	1,0000	1,2500	1,7500
Experience	0,2000	0,4000	0,6000	0,8000	1,0000	1,4000
Test	0,1429	0,2857	0,4286	0,5714	0,7143	1,0000
Sum	2,4262	4,8524	7,2786	9,7048	12,1310	16,9833

Table 4. Calculation Result of Lambda Max Lecturers Recruitment

Criteria	Recent Education	GPA	Achievement	Accreditation	Experience	Test	Eigen	λ (Lambda)	λ (Max)
Recent Education	0,4122	0,4122	0,4122	0,4122	0,4122	0,4122	0,4122	1,0000796	6,0099341
GPA	0,2061	0,2061	0,2061	0,2061	0,2061	0,2061	0,2061	1,0000796	
Achievement	0,1374	0,1374	0,1374	0,1374	0,1374	0,1374	0,1374	1,0000796	
Accreditation	0,1030	0,1030	0,1030	0,1030	0,1030	0,1030	0,1030	0,9995944	
Experience	0,0824	0,0824	0,0824	0,0824	0,0824	0,0824	0,0824	0,9995944	
Test	0,0589	0,0589	0,0589	0,0589	0,0589	0,0589	0,0589	1,0105064	

3.3 Calculation by the AHP Method

Calculations by applying the AHP method are carried out through the following steps:

a. Develop a hierarchy of lecturer recruitment

Figure 2 is a hierarchical structure that shows that the first level position is a goal or objective. The goal or target in question is the recruitment of lecturers at Universitas Nahdlatul Ulama Sunan Giri in the S1 Mathematics Education study program. Positions at the second level are criteria that include recent education, GPA, achievements, accreditation, experience, and tests. Meanwhile, the third position is an alternative: prospective lecturers who are assessed.

b. Assessment of criteria and determining priorities

Table 3 is a comparison table with each criterion based on a predetermined scale. For example, recent education compared to recent education will result in a value of 1.000, meaning 1.0000/1.0000 = 1.0000. The GPA compared to the Recent Education will result in 0.5000, meaning 1.0000/2.0000 = 0.5000, followed by a comparison to all criteria.

c. Logical Consistency

In determining the consistency value, it is carried out with stages in accordance with the AHP method, and results are obtained as stated in Table 3.3. Table 4 shows the calculations:

$$\text{Eigen}: \frac{0{,}4122 + 0{,}4122 + 0{,}4122 + 0{,}4122 + 0{,}4122 + 0{,}4122}{6} = 0{,}4122$$

$$\lambda \text{ (Lambda)}: 0{,}4122 \times 2{,}4262 = 1{,}0000796$$

$$\lambda \text{ (Max)}: 1{,}0000796 + 1{,}0000796 + 1{,}0000796 + 0{,}9995944 + 0{,}9995944 + 1{,}0105064 = 6{,}0099341$$

so that the calculation of consistency index (CI) is as follows:

$$CI = \frac{\lambda\,Max - n}{n - 1}$$
$$= \frac{6{,}0099341 - 6}{6 - 1}$$
$$= 0{,}00198682$$

Then calculate the Consistency Ratio (CR) as follows:

$$CR = \frac{CI}{RI}$$
$$= \frac{0{,}00198682}{1{,}24}$$
$$= 0{,}0016022742 \leq 0{,}1 \text{ (Consistent)}$$

d. Checking hierarchy consistency

If the CR value is more than 10% or 0.1, then the data review must be corrected. But if the CR is less or equal to 10% or 0.1, then the calculation is correct. From the calculation results obtained the CR value of 0.0016022742 is less than 0.1, then the calculation is declared correct. So that the eigen of lecturer recruitment priorities is recent education 41.22%, GPA 20.61%, achievement 13.74%, Accreditation 10.3%, Experience 8.24%, and Test 5.89%.

After obtaining the priority eigenvalue, calculations are then carried out on alternatives in each criterion. The calculations are carried out on the number processing application program Microsoft Excel 2013. The results obtained from the calculation of the research conducted are presented as Table 5, follows:

Table 5. Examples of Comparative Matrix Calculations on the Recent Educational Criteria

Recent Education	EI	FN	MMU	DIA	FA2	AH	LIA	MRW	KZ	MQS
EI	1,0000	1,0526	1,3333	1,1111	1,1111	1,1111	1,1111	1,1111	1,1111	1,1111
FN	0,9500	1,0000	1,2667	1,0556	1,0556	1,0556	1,0556	1,0556	1,0556	1,0556
MMU	0,7500	0,7895	1,0000	0,8333	0,8333	0,8333	0,8333	0,8333	0,8333	0,8333
DIA	0,9000	0,9474	1,2000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
FA2	0,9000	0,9474	1,2000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
AH	0,9000	0,9474	1,2000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
LIA	0,9000	0,9474	1,2000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
MRW	0,9000	0,9474	1,2000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
KZ	0,9000	0,9474	1,2000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
MQS	0,9000	0,9474	1,2000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
Total	**9,0000**	**9,4737**	**12,0000**	**10,0000**	**10,0000**	**10,0000**	**10,0000**	**10,0000**	**10,0000**	**10,0000**

Table 6. Normalization and Eigen Value of Comparative Matrix Calculation on the Recent Educational Criteria

Recent Education	EI	FN	MMU	DIA	FA2	AH	LIA	MRW	KZ	MQS	Eigen
EI	0,1111	0,1111	0,1111	0,1111	0,1111	0,1111	0,1111	0,1111	0,1111	0,1111	0,1111
FN	0,1056	0,1056	0,1056	0,1056	0,1056	0,1056	0,1056	0,1056	0,1056	0,1056	0,1056
MMU	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833	0,0833
DIA	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000
FA2	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000
AH	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000
LIA	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000
MRW	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000
KZ	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000
MQS	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000

Table 7. Comparative Matrix Values of All Criteria and Eigen Priority

Prospective Lecturers	Recent Education	GPA	Achievement	Accreditation	Experience	Test	Eigen Priority
EI	0,1111	0,1359	0,0471	0,1243	0,0270	0,0020	0,4122
FN	0,1056	0,0883	0,2343	0,1081	0,0270	0,1612	0,2061
MMU	0,0833	0,1019	0,2078	0,0973	0,1351	0,1343	0,1374
DIA	0,1000	0,1019	0,0688	0,0973	0,1351	0,1570	0,1030
FA2	0,1000	0,1019	0,0416	0,0973	0,1081	0,1116	0,0824
AH	0,1000	0,0815	0,0791	0,0973	0,1351	0,0021	0,0589
LIA	0,1000	0,0815	0,0456	0,0973	0,1622	0,0744	
MRW	0,1000	0,1019	0,0416	0,0973	0,0811	0,1508	
KZ	0,1000	0,0965	0,0456	0,0973	0,1351	0,1240	
MQS	0,1000	0,1087	0,0831	0,0865	0,0541	0,0826	

Table 8. Alternative Ranking of Prospective Lecturers

Prospective Lecturers	Value	Ranking
FN	0,1168	1
MMU	0,1130	2
DIA	0,1021	3
KZ	0,0958	4
EI	0,0953	5
MRW	0,0935	6
FA2	0,0934	7
MQS	0,0933	8
LIA	0,0920	9
AH	0,0902	10

e. Comparison Matrix for Each criterion

The results of the assessment on each alternative carried out by the researcher have then calculated the comparison matrix of each prospective lecturer for each criterion. An example of the calculation results of the comparison matrix on the Recent Educational criterion is shown in Table 5.

An example of the calculation of the comparison matrix for the Recent Educational criterion was carried out by comparing each prospective lecturer's value. For example, a value is 1 then 20/20, EI / FN then 20/19, or 1.0526. Next, the calculation of the alternative comparison matrix will then produce eigenvalues for each prospective alternative lecturer for each criterion.

f.   Determining the Ranking

To perform the ranking of each eigen of each criterion that has been obtained, as shown in Table 6. Table 6 shows that the priority values for EI were obtained from $(0.1111 \times 0.4122) + (0.1359 \times 0.2061) + (0.0471 \times 0.1347) + (0.1243 \times 0.1030) + (0.0270 \times 0.0824) + (0.0020 \times 0.0589) = 0.0953$ and so on up to MQS. Calculating the comparison matrix of all criteria and priority eigenvalues used produces alternative rankings of prospective lecturers, as stated in Table 7.

Table 7 shows that the alternative lecturer candidates selected according to the needs of the formation are only one lecturer candidate, namely FN, with a value of 0.1168. Ranked second is MMU with a value of 0.1130, the third place is DIA with a value of 0.1021, the fourth place is KZ with a value of 0.0958, the fifth place is EI with a value of 0.0953, the sixth rank is MRW with a value of 0.0935, the seventh place is FA2 with a value of 0.0934, the eighth rank is MQS with a value of 0.0933, the ninth rank is LIA with a value of 0.0920, and ranked tenth is AH with a value of 0.0902.

4.   CONCLUSIONS

The research results obtained priority Recruitment of Lecturers at Universitas Nahdlatul Ulama Sunan Giri, which were needed as follows; Recent Education 41.22%, GPA 20.61%, Achievement 13.74%, Accreditation 10.3%, Experience 8.24%, and Test 5.89%. Then the results of applying the Analytical Hierarchy Process method using six criteria perspectives can provide recommendations or support for alternative decisions for prospective FN lecturers with a final score of 0.1168. The calculation results obtained the same results as the data that occurred in the field where the alternative lecturer candidates selected to become lecturers in the S1 Mathematics Education study program were alternatives to prospective lecturers with the initials FN. The results of this study show that the addition of the written test criteria obtained the same results as the data in the field. Adding written test criteria is considered more effective than the criteria used at the administrative selection stage.

Furthermore, the analytical hierarchy process method can help in the Lecturer Recruitment process only with the written test selection based on data/information in the form of an assessment of criteria on the qualification data of lecturers at Universitas Nahdlatul Ulama Sunan Giri as well as consideration and planning in decision making for the leadership of Universitas Nahdlatul Ulama Sunan Giri. Thus, the Analytical Hierarchy Process method can be applied to the recruitment of lecturers at the Sunan Giri Nahdlatul Ulama University for the next period. Researchers are aware of imperfections and suggestions that researchers can give to improve the same research, namely the need for research using other methods as a comparison to get the best alternative. Then there is a need to add other test variables such as interviews, microteaching, the ability to write papers, and so on.

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