| RESEARCH ARTICLE

Web Application for Determining Outstanding Lecturers Using the Analytical Hierarchy Process (AHP) Method

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ABSTRACT
Higher education emphasizes efforts to maintain the quality of lecturers in the three pillars or tridharma of Higher Education (education and teaching, research and development and community service). The selection of outstanding lecturers is aimed at increasing the motivation, dedication, loyalty, and professionalism of lecturers. Sindang Kasih Majalengka University currently does not have a process to maintain the quality of lecturers so that to overcome this, a Forum Group Discussion (FGD) was formed at Sindang Kasih University to standardize the criteria for selecting outstanding lecturers in the hope of motivating lecturers to be even better. After that, an information system design is needed that can be presented. This is done by building a decision support system, namely a web application to determine outstanding lecturers by utilizing the Analytical Hierarchy Process (AHP) method. AHP as a method that serves to process data from criteria that have been agreed upon in the Forum Group Discussion (FGD). The criteria include discipline, attendance, education, community service, and research. After that, the system provides recommendations for the level of outstanding lecturers at the Universitas Sindang Kasih Majalengka.

KEYWORDS
Decision Support System, Best Teacher, Forum Group Discussion (FGD), Analytical Hierarchy Process (AHP), Prototype.

I. INTRODUCTION
Improving the competence of lecturers can be obtained in various ways. One of the inputs that can be obtained by lecturers to motivate and develop themselves is by assessing the process of implementing three pillars or tridharma of Higher Education (education and teaching, research and development and community service). At the Universitas Sindang Kasih Majalengka, the selection of outstanding lecturers has not been carried out because there is no application that can process the criteria for outstanding lecturers. Therefore, an information system is needed that can manage the criteria for outstanding lecturers and can recommend outstanding lecturer decisions based on the weight value of the criteria. Then, a ranking process that can select from outstanding lecturers.

The determination of outstanding lecturers is carried out as an effort to improve the quality of lecturer knowledge and the quality of learning [1]. Achievement itself can be interpreted as an achievement in accordance with predetermined standards so as to get an award from the abilities that have been achieved [2]. In this case, determining outstanding lecturers is important to improve and maximize quality. Determination of outstanding lecturers can be done through information systems.

Decision Making System (SDM) is an interactive computer-based information system. Data processing from various models is carried out to solve unstructured problems. Thus, the use of computer-based information systems can provide information that can be used by decision makers in making a decision. In this case, intellectual resources are combined with computer capabilities to help improve the quality of decisions taken. Decision making is a process of choosing an action among several alternatives, so that the desired goal is achieved [3]. Decision support systems are more intended to support management in doing analytical work in less structured situations with less clear criteria [4].

[5] used a decision support system for selecting outstanding lecturers in the campus environment using Fuzzy Multiple Attribute Decision Making (FMADM). The utilization of FMADM is used as an alternative solution for determining outstanding lecturers. In addition, [6] applied a decision support system in determining the best lecturer using the Analytical Hierarchy Process (AHP) method at STMIK Primakara. The findings are in the form of ranking the best lecturers and the amount of decision consistency value based on the results of calculating the consistent ratio of the AHP method using random index values from several researchers. [7]evaluated core capabilities for *strategic outsourcing* decisions in the aviation maintenance industry. AHP is used as a selection tool in decision making with quantitative and qualitative criteria that must be considered. The criteria, including effectiveness of flight operations, flight safety, technological features, cost effectiveness, number of uses, adequacy of procurement and manpower, were incorporated into the model. [8]examined the reconfiguration decision making and feasibility concept of reconfigurable pilot line analysis in industry, research, and education. Evaluation criteria for feasibility analysis were determined to assess the concept of reconfiguration as feasible in terms of technical, resource, and economic aspects. [9]analyzed the potential of rivers for cargo transportation in Indonesia. AHP was used to analyze the opinions and preferences of relevant stakeholders, such as government transport officers. The results of this analysis showed that rural river segments should be prioritized so that the government can pay serious attention.

[10] conducted research on a decision support system for lecturer performance appraisal using the AHP method at STMIK. The criteria assessed from a lecturer include attendance, disciplinary assessment, behavior, work performance, and work experience. These criteria are processed using the AHP method with the PHP programming language and MySql as the database. The conclusion of the research is that from the results of data processing based on the criteria that have been agreed upon and processed using the AHP method, the best teacher rankings appear, and the system recommends one lecturer's name to get the first rank. AHP can be used for decision making, not only in the decision of the best lecturer or teacher. [11]utilized the AHP method for a decision support system for finding tutoring places for prospective SBMPTN participants. However, there is the SAW (Simple Additive Weighting) method used by [12] as a decision support system for the most favorite lecturer of student choice.

The selection of outstanding lecturers involves staff as the manager of the application that has been designed, and in the process of inputting data must be based on documents that have been collected based on predetermined (agreed) criteria. The Decision-Making System (SPK) that has been designed uses the Delphi program and MySql as its database. The conclusion is that there are five assessment criteria, each of which has an agreed weight and value and is processed using the Multi Attribute Decision Making Method Weighted Product (MADM WP) method. From the results of the data processing, the outstanding lecturers will be recommended to the leadership of the university.

There are fundamental differences between this research and previous research, namely in the design of desktop applications and MySql databases as data processing for selecting outstanding lecturers with a number of criteria. In addition, there is the use of web-based applications and MySql as a database for data processing for selecting the best teachers with criteria including attendance, assessment, behavior, work performance, and work experience. Meanwhile, this research was built using a website-based application with MySql as a medium for managing outstanding lecturer data with a total of five criteria including attendance, discipline, education, service, and research criteria. In addition, based on previous research, there is the use of the Simple Additive Weighting (SAW) method. This shows that this research can still be developed by comparing the utilization of the AHP method with SAW. In this study, researchers only utilized AHP to solve problems related to decision making for outstanding lecturers.

II. METHODOLOGY

The research process begins with a literature study comparing several methods including AHP, SAW, TOPSIS, and Fuzzy methods. Among these methods, this research applies the AHP method because of the criteria for the hierarchy creation process, the assessment of criteria and alternatives, the process of determining the priority value, and logical consistency. Problem identification at the research site by interviewing the foundation, rector, and dean was carried out to determine the criteria needed to determine outstanding lecturers at Sindang Kasih Majalengka University. Furthermore, the criteria that have been agreed upon through FGD between the leadership of the foundation, the rector, and the dean, are weighted using the AHP method. Then, testing using the AHP method which results in the form of rankings so that the results can be seen. After that, making an application prototype so that it is easier to do ranking and testing the system which aims to test the application can function properly.

AHP is a decision-making method developed by Prof. Thomas. L. Saaty from the University of Pittsburgh in the 1970s. According to Saaty, AHP is a process based on theory by building hierarchies, setting priorities, and reasonable consistency [13]. The AHP method is also one of several methods that can help in solving a complex and unstructured problem situation by dividing these problems into several components into an arrangement that looks like a hierarchy, and by giving subjective values about the importance of each variable in relative terms, and determining the variables that have the highest priority to influence the outcome of the situation [14]. According to [15] in preparing the comparison scale table, researchers can describe the intensity of the importance of the criteria and define the importance of the criteria and explain the comparison. The following is a table created by [15].

TABLE 1.
AHP Comparison Scale

No	Intensity of Interest	Column Head Table	
		Definition	Explanation
1	1	*Both elements are equally important*	*Two elements contribute equally to that trait*
2	3	*One element is slightly more important than the others*	*Experience and judgment slightly favor one data element over the other*
3	5	*One element is more important than the other*	*Experience and judgment strongly favor one element over the other*
4	7	*One element is absolutely more important than the other*	*One element is strongly endorsed and its dominance has been seen in practice*
5	9	*One element is absolutely more important than the other*	*Evidence that favors one element over another has the highest degree of corroboration possible.*
	2,4, 6, 8	*Values between two values Adjacent considerations*	*Evidence and experience that are close in level between the above assessments*

Source: Saaty, 2012

The use of the AHP method has many ways. However, in general, the AHP method that will be applied has the following steps [16].

1. The first step is to add up the column matrix formula by calculating the value of the column elements and criteria using the formula of each column element, then dividing by the number of column matrices.
2. The second step in the application of AHP is to calculate the value of the criteria priority using the formula of summing the row matrix from the previous calculation process and the result is divided by the number of criteria that have been determined. Thus, an equation is produced as follows.
    a. Calculate lamda max with the formula

$$Aw = \lambda \max W \quad (2.1.)$$

    b. Calculate CI with the formula

$$CI = \frac{\lambda maks - n}{n-1} \quad (2.2.)$$

    c. Calculate CR with the formula

$$CR = \frac{CI}{RI} \quad (2.3.)$$

The design of this research system uses UML (Unified Modeling Language), namely the use case diagram. Use Case Diagram is one of the various types of UML diagrams that describe the interaction relationship between the system and actors. The Use Case describes the type of interaction between system users and the system. Grady Booch and James Rumbaugh (1940) introduced UML. Class diagrams show the existing classes of a system and their logical relationships. Class diagrams display the static structure of a system because class diagrams are the basic strength of almost every object-oriented method. Merriam Webster Dictionery mentions the word prototype was first used in 1552 in France from Greek, namely prototypon. Prototypon is defined as an original model of something that is being modeled or developed. According to Darmawan and Fauzy, prototyping is a version of a potential system that gives developers and potential users an idea of how the system will function in its finished form.

III. RESULTS AND DISCUSSION

The data collection process regarding the determination of the criteria for outstanding lecturers was carried out using interview techniques. Interviews were conducted to the foundation, rectorate, dean through FGDs. Furthermore, several criteria have been agreed upon including: attendance, discipline, education, service, and research. The following are the criteria codes that have been determined.

TABLE 2.
CRITERIA CODE COMPARISON

No	Criteria	Code	Ideal
	DESCRIPTION		
1	Lecturers who attend, and carry out class teaching activities can carry out class management to the guidance of individuals.	Attendance	Benefit
2	A state of order and regularity that lecturers have in working on campus, without any violations that are detrimental either directly or indirectly to themselves, peers and to the campus as a whole.	discipline	Benefit
3	Lecturers who carry out teaching as many as 12 credits and complete teaching learning tools such as RPS, modules, or teaching materials.	Education	Benefit
4	Carrying out community service activities carried out once a semester and in collaboration with lecturers and lecturers - cross-scientific lecturers and evidenced by a community service report.	Devotion	Benefit
5	The implementation of research is carried out once a semester and reported in the form of a research report and research outputs in the form of articles published in research journals.	Research	Benefit

Description:
1. The criteria listed in the table above refer to the *Forum Group Discussion* (FGD) conducted on campus.
2. The assessment of each criterion is based on the lecturer's academic performance over the last five years.

The following is a table of assumptions for the acquisition of academic data for lecturers for five years which will then become a reference in the calculation process with the AHP method.

TABLE 3.

COMPARISON OF ACADEMIC DATA ACQUISITION ASSUMPTIONS

Alternatives/Criteria	Attendance	Discipline	Education	Devotion	Research
Lecturer 1	10	2	1	4	2
Lecturer 2	3	4	5	2	1
Lecturer 3	2	3	2	1	4
Lecturer 4	5	2	1	2	3
Lecturer 5	1	1	0	0	0
Total	Benefit	Benefit	Benefit	Benefit	Benefit

Table 3 above contains information about the comparison of the assumptions of obtaining academic data for each lecturer with the criteria of attendance, discipline, education, service, and research. The following is the hierarchical structure of lecturer performance assessment.

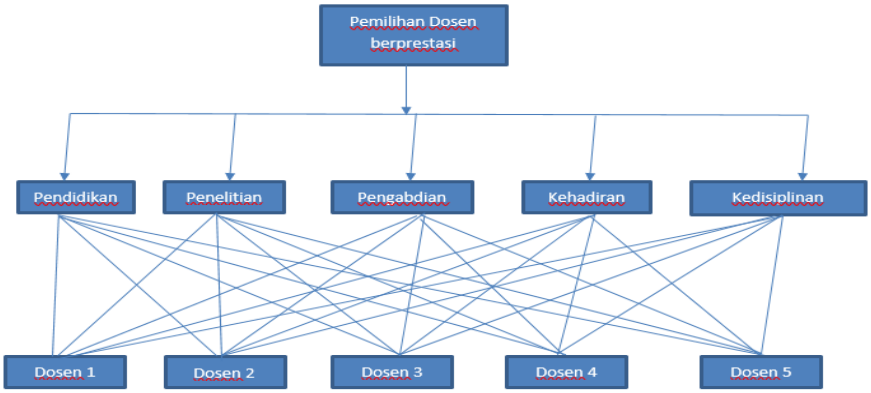

FIGURE 1. HIERARCHICAL STRUCTURE OF LECTURER PERFORMANCE APPRAISAL

The hierarchical structure of lecturer performance assessment above illustrates the selection of outstanding lecturers from various criteria. In addition, the steps that must be taken in determining the priority of elements are as follows.

TABLE 4.

PAIRWISE COMPARISON MATRIX OF RESEARCH CRITERIA

Criteria	Education	Research	Devotion	Attendance	Discipline
Education	5.00	5.00	0.11	7.00	0.14
Research	1.00	1.00	0.14	5.00	3.00
Devotion	0.20	0.20	0.14	5.00	0.14
Attendance	7.00	7.00	1.00	7.00	0.20
Discipline	0.20	0.20	0.14	1.00	0.14
Total	13.40	13.40	1.54	25.00	3.63

Creating a Criterion Value Matrix (Normalization Matrix)

This matrix is obtained with the formula: row value/sum of each old column, then the result is:

TABLE 5.
MATRIX NORMALIZATION

No.	Criteria	Education	Research	Devotion	Attendance	Discipline	Total	Priority Vector	Eigen Value/λMax
1	Education	0.373	0.373	0.072	0.280	0.039	1.138	0.228	3.049
2	Research	0.075	0.075	0.093	0.200	0.827	1.269	0.254	3.400
3	Devotion	0.015	0.015	0.093	0.200	0.039	0.362	0.072	0.111
4	Attendance	0.522	0.522	0.649	0.280	0.055	2.029	0.406	10.147
5	Discipline	0.015	0.015	0.093	0.040	0.039	0.202	0.040	0.147
6	Total	1	1	1	1	1	5	1	

Consistency Ratio Calculation

The next step is to measure consistency, AHP measures the consistency of considerations with a consistency ratio (CR).

TABLE 6. RANDOM CONSISTENCY INDEX

N	RI
2	0
3	0,58
4	0,9
5	1,12
6	1,24
7	1,32

Calculation of the consistency ratio of research criteria T (number) = Total Eigen value / Number of criteria = 16.854
Ci = (t-number of criteria)/(number of criteria-1) = 2.964
IR5= seen from the Index Random Consistency table value = 1.12. Then the consistency value is = Ci/IR5 = 2.6460

Application System Design

Use cases are used to describe the process of *user* interaction with the *prototype* that will be created sequentially and can also be about the sequence of *prototype* operations.
Admin/Staff Personnel

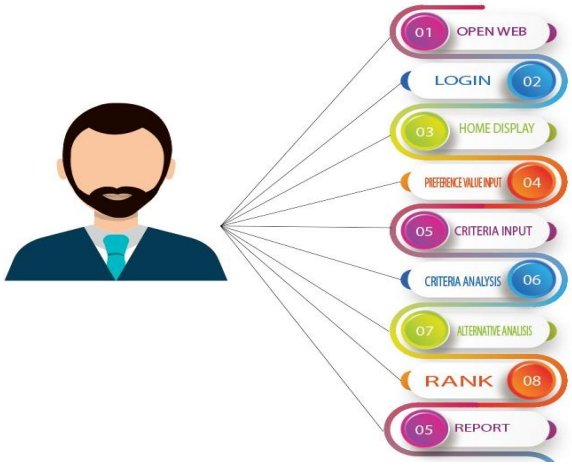

Figure 2. AHP Use Case Analysis

The input use case diagram above displays one actor. The actor acts as an admin or staffing staff. Admins have full access to the process of inputting criteria, alternatives, and processing outstanding lecturer selection data at the Universitas Sindang Kasih Majalengka. The steps begin with creating a web, logging in, entering the home view, inputting prefession values, inputting criteria, analyzing criteria, analyzing alternatives, ranking, and reports.

Class Diagram

Class Diagram describes the state of the application, explaining the relationships that exist in the application to determine authentication technology with the AHP algorithm. The following is an image of the *Class Diagram of* the application to determine authentication technology with the AHP algorithm.

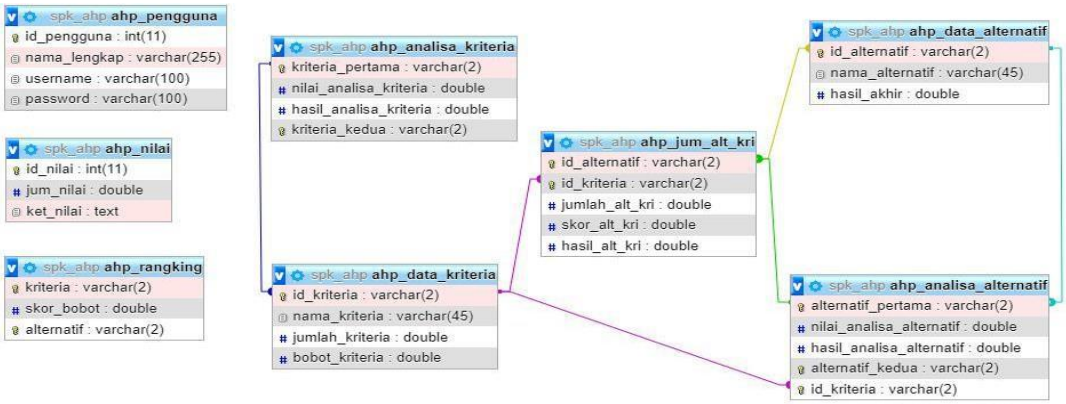

FIGURE 3. CLASS DIAGRAM

System Implementation Web-based System

The implementation of a web-based system is used to facilitate and streamline decision making, including the selection of outstanding lecturers. The database used for storing outstanding lecturer data uses MySQL DataBase. Therefore, the system from DataBase MYSQL has a data history that is useful as a reference for selecting outstanding lecturers by providing an assessment of the conclusions of the data that has been studied before. The following is an application display to make it easier to determine the calculation of the AHP method.

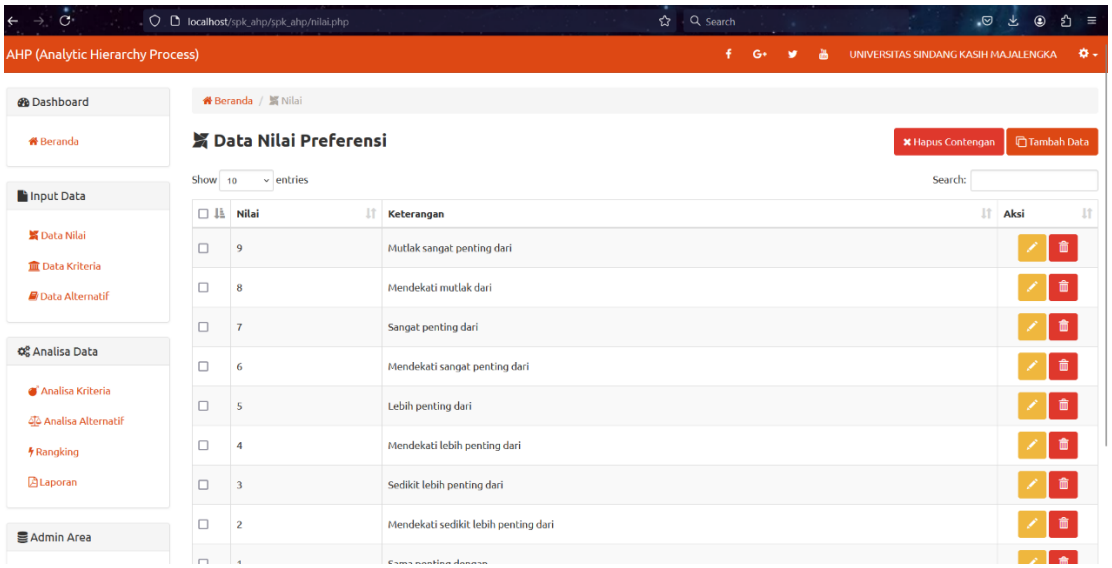

FIGURE 4. PREFERENCE SCORE DATA

The picture above is a preference value *form* page that aims to assume the reality or imaginary between alternatives and the possibility of ranking these alternatives based on criteria.

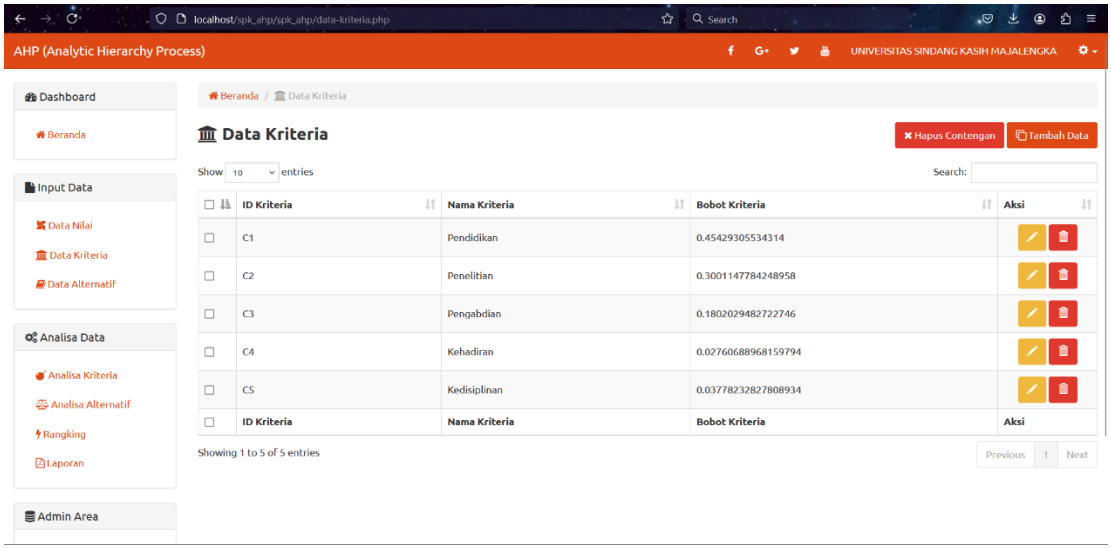

FIGURE 5. CRITERIA DATA

The image above explains the display of the *form* page that sets *the* number of criteria and criteria weights.

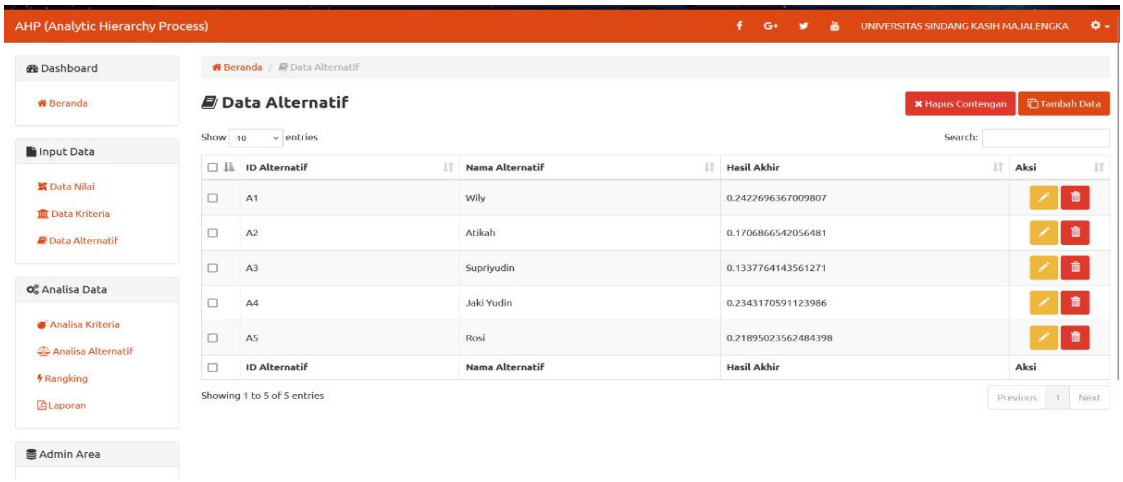

FIGURE 6. ALTERNATIVE DATA

The form page above displays alternative data and the results of processing input data based on each alternative weight. The aspects displayed are alternative ID, alternative name, final result, and action. Alternative ID displays codes, such as A1, A2, A3, A4, and A5. Alternative names can be filled with the names of lecturers who will be selected as outstanding lecturers. The final result describes the ranking report.

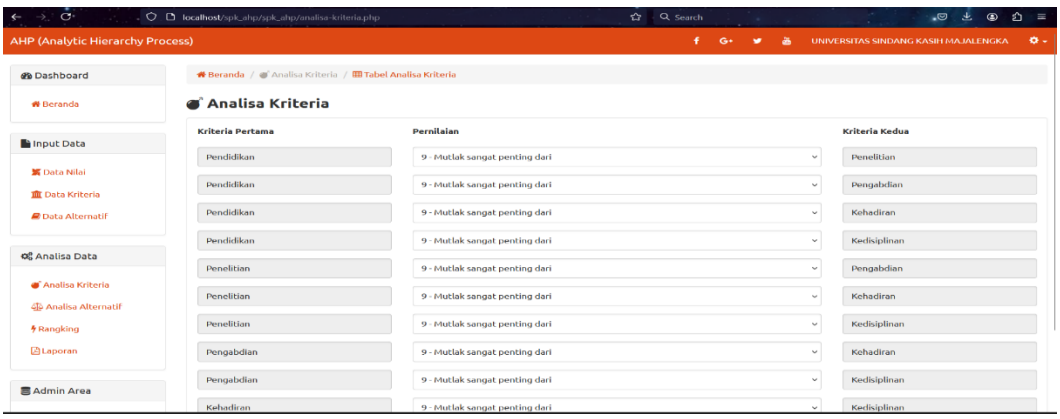

FIGURE 7. CRITERIA ANALYSIS

Criteria analysis displays the criteria in making outstanding lecturer decisions. Criteria analysis serves to analyze criteria that have been determined in number and type, and compare between criteria, namely education, research, service, attendance, and discipline criteria. Education criteria are compared with research criteria, education with service, education with attendance, education with discipline, and so on.

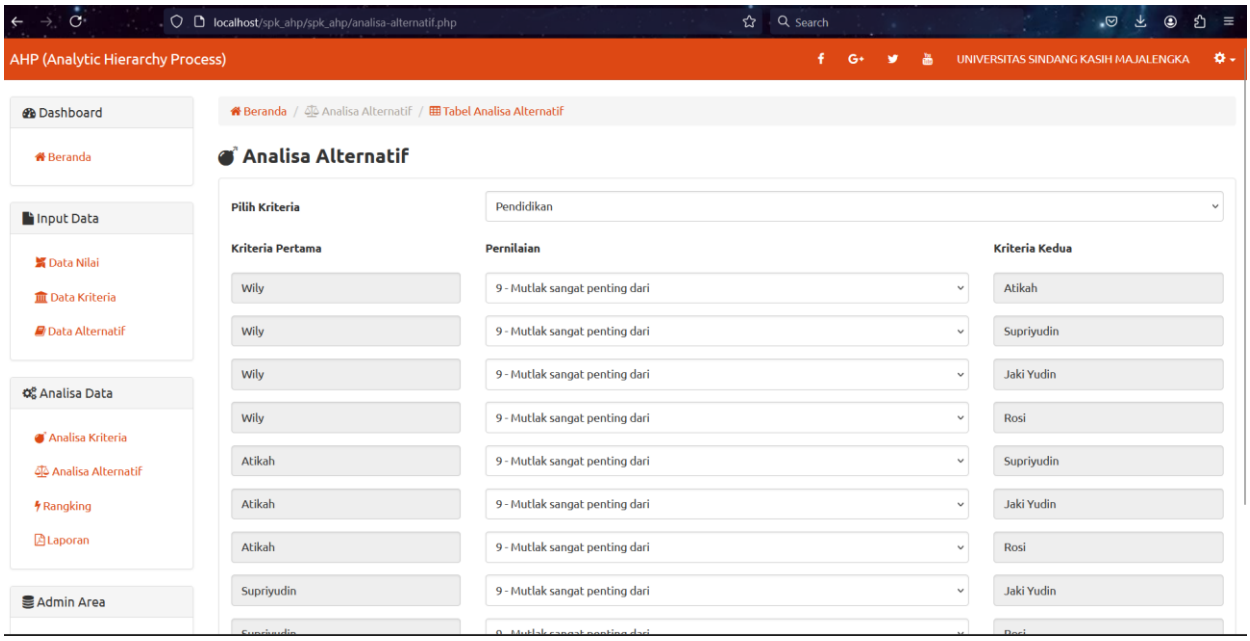

FIGURE 8. ALTERNATIVE ANALYSIS

The image above is a display of the alternative analysis *form* page that functions to compare between alternatives.

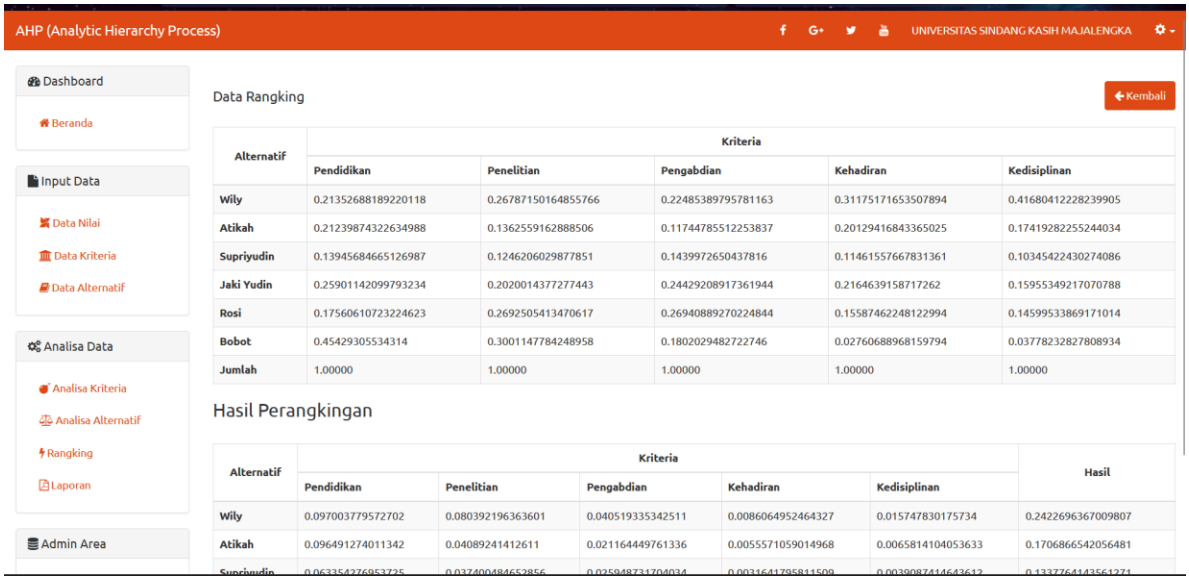

FIGURE 9. RANKING DATA

The picture above is a display of the page *form for* the final results of the calculation of criteria and alternatives

IV. CONCLUSION

AHP is a good alternative method used in this research case, because the Analytical Hierarchy Process (AHP) method has provided an assessment of the weight of each existing criterion, namely attendance, discipline, education, service, and research. Calculation with the AHP method, the standard value for each lecturer can be known with the results of the ranking of the

processed values, so decision making can be used as a solution or recommendation for the leaders of the Universitas Sindang Kasih Majalengka.

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