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A Decision Support System is Developed to Determine the Optimal Criteria for Selecting Exceptional Lecturers Based on Their Lecturer Performance Index

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Abstract—Decision Support Systems (DSS) are computer systems that analyze data and convert it into actionable information for decision-making. The prior application mainly emphasized design analysis in web development, neglecting the use of decision-making knowledge as a responsibility within the Tri Dharma of Higher Education. Analyzing data to transform it into information is a complex task involving decision-making. The process of decision-making has a significant impact on the information generated for recommendation purposes. Suggestions in a decision-making process only sometimes serve as a standard for leaders to implement immediately. However, it is essential to acknowledge that multiple suggestions are required to make a final decision since they provide a basis for comparison with earlier recommendations. The Decision Support System (DSS) utilized in this research focuses on selecting the optimal criteria from several criteria. The research employed the Analytical Hierarchy Process (AHP) technique, which consists of six stages : Criteria Alternative Determination, Pairwise Matrix Comparison, Criteria And Making Matrix, Square of Pairwise Matrix, Normalization, and Alternative Ranking. All six steps must be sequentially executed without skipping any stage, ensuring each stage complements the others and generates accountable information. The research concludes by proposing a Decision Support System for Determining the Best Criteria for Lecturer Selection. This system utilizes the Lecturer Performance Index to provide recommendations to parties seeking information on selecting criteria for assessing lecturer performance. The system aims to enhance accountability in the performance of the Tri Dharma of Higher Education.

***Keywords*—**DSS, AHP, Criteria, Tri Dharma, Higher Education

I. Introduction

The advancement of technology in the contemporary world is relentless due to its crucial role in facilitating decision-making processes. This development is closely tied to the pursuit of information to connect expert viewpoints with the utilization of technology in data processing to generate information (Hendriyanto Novy, et al., 2019). Information technology, often known as decision support, incorporates expert opinions that are verified through analysis (Sulisyono, Nugraini, Ernawati, & Yuantari, 2020). The outcome of the analysis is a proposal that aids in decision-making and allows for the decision to be justified (Zm, Lubis, & Maha, 2023).

Because decisions are required for all professions to be held accountable now or in the future, they apply to all fields. Decisions are necessary in all disciplines as data for predictions that will be made now or in the future. Decisions are necessary in all fields as knowledge is used to forecast actions that will be taken now or in the future (Dede Aprilia Haspita & Jimi Ali Baba, 2019). When there is no other option, and a decision needs to be made quickly, the DSS's involvement will be helpful. The DSS findings will assist those in positions of authority decide how best to address the current issues (Marsyela, Marsyeli, & Maidiana, 2023).

A procedure must be applied when making decisions that result in recommendations. When making decisions, a method is a means, a stage, or an approach to reach objectives to solve problems correctly (Gudiato, Cahyaningtyas, & P., 2024). In order to maximize the final aim, selecting the appropriate approach is essential to producing the proper conclusion. Weighted Product (WP), Topsis, Linear Programming, Analytical Hierarchy Process (AHP), Simple Additive Weighting (SAW), and many more are popular techniques for making decisions (Rahma, Amrozi, Diana Fahma Salsabila, & Miqdad G, 2023). At the same time, all these approaches aim to solve multi-criteria problems. Practically speaking, every approach has pros and cons. Based on these considerations, testing is done on real-world issues. It will be simple to decide which approach will be utilized to address the problem once each method has been tested and the problem and its solution have been established (Indriaturrahmi & Fitriani, 2021).

Information is needed in education, specifically higher education, the emphasis is on lecturers who fulfill the Tri Dharma of Higher Education's obligations to locate competent educators in their domains. This study aims to identify experts in their domains who can teach, as it is the lecturers' responsibility to educate the future generation. There must be many issues in locating qualified lecturers in their fields. These issues include applying more directly without considering research findings, computing the Lecturer Performance Index using outdated techniques manual, and choosing criteria incompatible with the lecturer's employment circumstances.

The Undergraduate Information Systems Study Program at Dian Nuswantoro University evaluates lecturers' responsibilities from both an employee's and an educator's perspective. Lecturers at Dian Nuswantoro University are expected to fulfill their responsibilities as full-time staff members, which include regularly attending classes every day, managing the study program atmosphere, and many other tasks. It is simpler for them to organize, uphold the vision and goal, obtain accreditation, provide student guidance, and perform other tasks related to their employment. The university and higher education have decided on the Tri Dharma of Higher Education, which guides the lecturer's responsibilities as an educator.

This study builds upon prior research that focused on the lecturer performance index, with a greater emphasis on programming analysis rather than a decision support system. The goal is to provide recommendations for enhancing the professionalism of teaching lecturers (Sukanto & Subagio, 2019) (Dewi, Hermanto, Gumelar, Widodo, & Sulistyono, 2021). Another issue that develops is the limited focus on the application derived solely from prior research. Additionally, the criteria for evaluation are solely centered on the perspective of lecturers as instructors, without considering their role as employees. In order to establish the conditions for organizational work, student mentorship, and furthering the vision and mission, it is not guaranteed that all requirements connected to lecturers as employees would be fully met (Dewi et al., 2021). Furthermore, apart from the issues above, a crucial difficulty is absent in the research on the lecturer performance index. The issue is the lack of student input regarding the performance of lecturers throughout the teaching and learning process. In the absence of feedback on the tone of teaching and learning activities, the lecturers' performance is limited to administrative tasks or simply gathering paperwork to meet performance requirements (Sukanto & Subagio, 2019). The performance of lecturers can be evaluated based on three main aspects: education, research, and community service. However, if there is no feedback on these aspects, only fulfilling obligations as a professor is considered. Feedback allows for the identification of lecturers' strengths and flaws throughout teaching and learning activities. It is crucial to assess lecturers' effectiveness as educators, as they are responsible to both the educational institutions they work for and the Kopertis if private universities employ them.

In response to the issues above, a decision support system (DSS) has been developed to aid in selecting the most qualified lecturers based on the Lecturer Performance Index. This system aims to establish accountability in the performance of lecturers as both educators and employees, aligning with the Tri Dharma of Higher Education. The goal is to create an information system that enables decision-making regarding assessing lecturers' performance as educators and their professionalism as employees.

II. METHODS

This study employs the Analytical Hierarchy Process (AHP) technique, which consists of several research phases outlined in Figure 1. These stages include determining criterion alternatives, conducting pairwise matrix comparisons, producing and generating matrices, calculating the square of the pairwise matrix, normalizing the data, and ranking the alternatives accordingly.

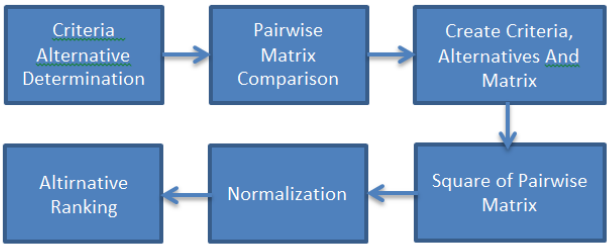

Figure 1. Displays the several stages of the Analytic Hierarchy Process (AHP) approach.

A. *Criteria Alternative Determination*

AHP, or Analytic Hierarchy Process, is a decision-support paradigm that Thomas L. Saaty created. The decision support model described by Petrus Sokibi Sukanto and Ridho Taufiq Subagio in 2019 breaks down intricate situations with several factors or criteria into a hierarchical structure. A hierarchy, as defined by Saaty, is a multi-level structure that represents a complicated problem. The initial level of the hierarchy is the aim, followed by subsequent levels of components, criteria, sub-criteria, and finally, options (Yasa, Werthi, & Satwika, 2021). By employing a hierarchy, a convoluted problem can be deconstructed into its constituent groupings, which are subsequently organized hierarchically, resulting in a more organized and systematic presentation of the problem (Yahya, Mikael, Ramadhan, & Badrul, 2021).

Figure 2 depicts the simplification of the multicriteria problem in AHP as a hierarchy with three primary components: the decision-making goal, assessment criteria, and alternative alternatives. Each criterion will have access to all choices or alternatives, as criteria will gain them from one another (Maysaroh, Fahmi, Destiana, Maulana, & Komarudin, 2022).

In Figure 2, in determining criteria and alternatives based on input from the college structure. The criteria and alternatives are determined in a meeting to determine what items will be included in the criteria and alternatives. (Dede Aprilia Haspita & Jimi Ali Baba, 2019).

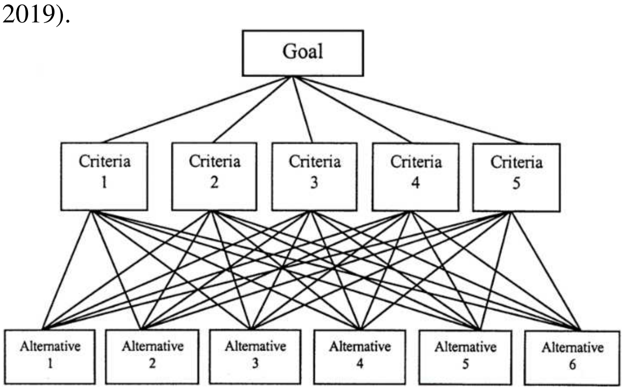

Figure 2. Displays the AHP structure.

B. Pairwise Matrix Comparison

In determining the comparison of the pairwise matrix, it is determined by comparing each criterion. In each criterion, it is determined which weight is higher than the other weights on a weight basis. This determination is based on the Table 1. (Safira & Susanty, 2021)

The criteria and alternatives in Table 1 are evaluated through pairwise comparisons, utilizing the criteria and alternatives provided by structural officials. The findings of the meeting are then integrated with a comparison scale. The purpose of this comparison is to determine the relative importance of different criteria or alternatives in relation to each other.

Table 1. Comparison scale

Importance Entity Score	Description
1	Both Elements are Equally Important
3	One Element is Less Important than the Other
5	One Element is More Important than the Other
7	One element is very more important than the other
9	One Element is Extremely More Important Than the Other Element
2,4,6,8	Average

C. Create Criteria, Alternative And Matrix

Determining criteria and creating a matrix, each criterion is gathered and organized in specific row and column positions to create the matrix. The rows and columns are subsequently populated by pairwise comparisons, ensuring that all rows and columns are filled with comparison data. Subsequently, each cell undergoes division to generate a numerical output, which represents the value assigned to that particular cell inside the matrix (Oktapiani, Subakti, Sandy, Kartika, & Firdaus, 2020).

The alternative determination is derived from the name of each educator, utilizing information gathered from the study program. The alternative determination includes the participation of lecturers in the evaluation process, organized according to the name of the lecturer who participated in the assessment. Figure 3 illustrates the process of creating a pairwise matrix is :

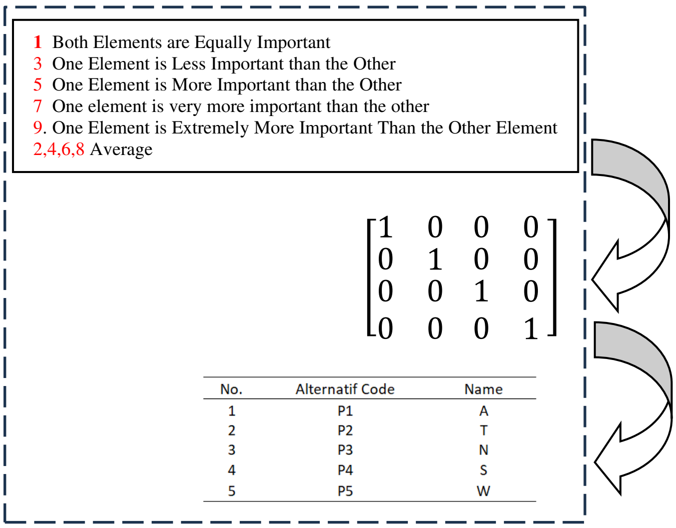

Figure 3. Creating a Matrix Pairwise

D. Square of Pairwise Matrix

The matrix is multiplied by itself or squared in order to normalize it, enabling vector search in the form of an eigenvector. The eigenvector will then serve as the criterion value (Pant, Kumar, Ram, Klochkov, & Sharma, 2022) (Bulan & Bulan, 2019).

The equation for calculating the square of a pairwise matrix in equation (1) is :

$$Ws = [C]xW \quad (1)$$

Ws represents the total sum of weights, C denotes the criteria, and W represents the weight.

E. Normalization

The matrix results obtained from the Square of the Pairwise Matrix are aggregated for each row, and then the overall sum is calculated. Subsequently, the summation outcome is divided by the overall quantity of matrices in order to acquire the eigenvector value (Mhlanga & Lall, 2022) (Khoiriah, Sari, & Muryeti, 2020).

The equation for normalization in equation (2) is :

$$CV = Ws \; x \; \frac{1}{W} \tag{2}$$

CV refers to the Consistency Vector, and Ws represents the Sum. Wight and W are synonymous, both referring to the measure of an object's heaviness.

F. Alternative Ranking

The alternative value is multiplied by the eigenvector. The outcome of this multiplication yields a sequence of integers, with the highest number representing the optimal choice (ALINDA & MUSTOFA, 2021) (Setiyawan, Siswanti, & Hasbi, 2020). The formula for alternative ranking in equation (3) is :

$$Ci = \frac{(\lambda - n)}{(n-1)} \tag{3}$$

Ci represents the consistency index, ƛ represents the lambda or eigenvector, and n represents the data.

III. Results and Discussion

The outcome of this research is the generation of criteria for alternative determination, pairwise matrix comparison, criteria for making a matrix, square of pairwise matrix, normalization, and alternative ranking.

1. Outcome of Criteria Alternative Evaluation

   The outcomes of the criteria and options set by the Structural Officials of the Study Program in Table 2. Table 2 displays four factors used to determine performance: C1 for Class Attendance, C2 for Student Feedback, C3 for Completing Tasks, and C4 for Working Hours as an Employee.

Table 2. Criteria Determination

Code	Criteria
C1	Class Attendance
C2	Student Feedback
C3	Completing Tasks
C4	Working Hours as an Employee

2. Pairwise matrix comparison results

   The results of the Pairwise Matrix Comparison determined by the Study Program structure are :

   1) C1, 4 times more important than C2
   2) C1, 2 times more important than C3
   3) C1, 3 times more important than C4
   4) C2, 2 times more important than C3
   5) C2, 3 times more important than C4
   6) C3, 2 times more important than C4

   The comparison matrix will be constructed by combining criteria, comparison scale, and comparison matrix. The comparison matrix in aquation (4) produces a 4x4 order matrix.

$$\begin{bmatrix} 1/1 & 4/1 & 2/1 & 3/1 \\ 1/4 & 1/1 & 2/1 & 3/1 \\ 1/2 & 1/2 & 1/1 & 2/1 \\ 1/3 & 1/3 & 1/2 & 1/1 \end{bmatrix} \tag{4}$$

   The matrix results displayed above are derived from a mix of comparison scales and criteria established by Structural. In this formulation, the row represents the left side, and the column represents the right side. On the left, there is a row that includes criteria, while on the right, there is a column that includes criteria.

3. Results of Criteria And Making Matrix

   The outcome of the Criteria and Decision Matrix in aquation (5) is obtained by converting the pairwise comparison matrix into decimal values.

$$\begin{bmatrix} 1/1 & 4/1 & 2/1 & 3/1 \\ 1/4 & 1/1 & 2/1 & 3/1 \\ 1/2 & 1/2 & 1/1 & 2/1 \\ 1/3 & 1/3 & 1/2 & 1/1 \end{bmatrix} \Rightarrow \begin{bmatrix} 1 & 4 & 2 & 3 \\ 0.25 & 1 & 3 & 3 \\ 0.5 & 0.5 & 1 & 2 \\ 0.33 & 0.33 & 0.3 & 1 \end{bmatrix} \tag{5}$$

   The matrix above each cell will be partitioned into decimal form, resulting in decimal values that will be further processed in the subsequent stage.

4. Results of Square of Pairwise Matrix

   The decimal pairwise comparison matrix is squared in order to determine the eigenvalue, which represents the value of each criterion, in equation (6).

$$\begin{bmatrix} 1 & 4 & 2 & 3 \\ 0.25 & 1 & 3 & 3 \\ 0.5 & 0.5 & 1 & 2 \\ 0.33 & 0.33 & 0.3 & 1 \end{bmatrix} x \begin{bmatrix} 1 & 4 & 2 & 3 \\ 0.25 & 1 & 3 & 3 \\ 0.5 & 0.5 & 1 & 2 \\ 0.33 & 0.33 & 0.3 & 1 \end{bmatrix} = \begin{bmatrix} 3.99 & 9.99 & 13.5 & 22 \\ 2.49 & 3.99 & 6 & 10.75 \\ 1.78 & 3.66 & 4 & 7 \\ 0.99 & 2.23 & 2.32 & 3.98 \end{bmatrix} \tag{6}$$

   The multiplication of identical matrices yields a scalar value that can be used to normalize the comparison matrix. The objective is to achieve a commensurate value during the processing.

5. Results of Normalization

   By aggregating all the outcomes of the Square of the Pairwise Matrix, the summation of the results is obtained. The sum of all the elements in the matrix will be divided by the total number of elements in the matrix, in equation (7).

$$\begin{bmatrix} 3.99 & 9.99 & 13.5 & 22 \\ 2.49 & 3.99 & 6 & 10.75 \\ 1.78 & 3.66 & 4 & 7 \\ 0.99 & 2.23 & 2.32 & 3.98 \end{bmatrix} = \begin{bmatrix} 49.48 \\ 23.23 \\ 16.44 \\ 9.52 \end{bmatrix} = 98{,}67 \quad (7)$$

The matrix of multiplication yields the same matrix, and the resulting values are aggregated by row to create the eigenvalue vector. To obtain a meaningful recommendation, the eigenvector values are aggregated, with the objective of identifying a valid value from the criteria set.

6. *Results of Alternative Ranking*
   The resulting alternative ranking can be calculated by dividing the sum of the criteria by the quotient of all criteria, in equation (8).

$$\begin{bmatrix} 49.48 \\ 23.23 \\ 16.44 \\ 9.52 \end{bmatrix} = \begin{bmatrix} 49.48/98.67 \\ 23.23/98.67 \\ 16.44/98.67 \\ 9.52/98.67 \end{bmatrix} = \begin{bmatrix} 0.50 \\ 0.23 \\ 0.16 \\ 0.09 \end{bmatrix} \quad (8)$$

The matrix consisting of 1x1 eigenvectors will be divided by the total sum of all eigenvectors, yielding the eigenvector value for each criterion. The eigenvector value for each criterion will be utilized to determine the most appropriate criteria based on their ranking.

To ascertain the viability of the eigenvectors above as criteria values for evaluating the performance index of doses and to determine the statistical significance of the differences between each value. Subsequently, a separate test is conducted to generate eigenvector 2, with the purpose of comparing it to eigenvector 1 in order to determine if there is a notable distinction.

To assess the suitability of the eigenvector mentioned above as a criterion for determining the performance index of doses and to determine the significance of the differences between each value. Subsequently, a separate test is conducted to generate eigenvector 2, with the purpose of comparing eigenvectors 1 and 2 to determine if there is a notable distinction.

a. Calculating the square of the normalization.
   The result is obtained by squaring eigenvector one after normalizing it, in equation (9).

$$\begin{bmatrix} 3.99 & 9.99 & 13.5 & 22 \\ 2.49 & 3.99 & 6 & 10.75 \\ 1.78 & 3.66 & 4 & 7 \\ 0.99 & 2.23 & 2.32 & 3.98 \end{bmatrix} x \begin{bmatrix} 3.99 & 9.99 & 13.5 & 22 \\ 2.49 & 3.99 & 6 & 10.75 \\ 1.78 & 3.66 & 4 & 7 \\ 0.99 & 2.23 & 2.32 & 3.98 \end{bmatrix} = \begin{bmatrix} 87.03 & 177.66 & 219.04 & 378 \\ 42.43 & 86.57 & 106.69 & 183 \\ 30.24 & 62.21 & 77.87 & 133.8 \\ 17.70 & 26.19 & 45.44 & 78.12 \end{bmatrix} \quad (9)$$

The outcome of the second normalization is the square of the second eigenvector, which will be used to find the result of the second eigenvector.

b. The Eigen Vector 2 process
   This Eigenvector 2 process involves calculating the sum of the squared values of Eigen Vector 1, in equation (10).

$$\begin{bmatrix} 3.99 & 9.99 & 13.5 & 22 \\ 2.49 & 3.99 & 6 & 10.75 \\ 1.78 & 3.66 & 4 & 7 \\ 0.99 & 2.23 & 2.32 & 3.98 \end{bmatrix} = \begin{bmatrix} 861.73 \\ 917.49 \\ 304.18 \\ 177.41 \end{bmatrix} = 1761.01 \quad (10)$$

The eigenvector one process yields a single matrix of size 1x1, resulting in a total value of 1761.01.

c. Eigenvector Result 2

$$\begin{bmatrix} 861.73/1761.01 \\ 917.49/1761.01 \\ 304.18/1761.01 \\ 177.41/1761.01 \end{bmatrix} = \begin{bmatrix} 0.489 \\ 0.237 \\ 0.172 \\ 0.100 \end{bmatrix} \quad (11)$$

Eigenvector 2 will be compared to eigenvector 1 to determine if there is a substantial difference.

$$\begin{bmatrix} 0.489 \\ 0.237 \\ 0.172 \\ 0.100 \end{bmatrix} = \begin{bmatrix} 0.50 \\ 0.23 \\ 0.16 \\ 0.09 \end{bmatrix} \quad (12)$$

Upon examining the matrix provided, it is evident that there is no substantial disparity between eigenvector 2 and eigenvector 1. Consequently, the analysis proceeds to the subsequent phase of ascertaining the rank.

Eigenvector 2 will be compared to eigenvector 1 to determine if there is a substantial difference.

Table 3 demonstrates that Class Attendance is the most effective measure for evaluating the Lecturer Performance Index when selecting exceptional lecturers as a means of ensuring accountability in the execution of the Tri Dharma of Higher Education. Student Feedback, Task Completion, and Working Hours as an employee follow.

Table 3. Order of selection of the best criteria

Value	Criteria	Ranking
0.50	Class Attendance	1
0.23	Student Feedback	2
0.16	Completing Tasks	3
0.09	Working Hours as an Employee	4

This research focuses on the implementation of criteria in several alternatives, specifically in the context of data collecting from students as respondents. Furthermore, it is crucial to address the practical implementation of this research tool in an application, its implications can be immediately communicated to all relevant parties, serving as a means of ensuring accountability (Andrean, 2021).

Once the optimal criteria have been identified, the next step is to integrate these criteria with the available choices in order to select a suitable presenter.

1. Evaluation Standards and Options

Formulating criteria and alternatives based on the facts above. Visual representations for the criteria and options may be seen in Table 4.

Table 4. Criteria and Alternative

Criteria Code	Criteria Name	Alternative Code	Alternative Name
C1	Class Attendance	A1	Aris
C2	Student Feedback	A2	Shinta
C3	Completing Tasks	A3	Novi
C4	Working Hours as an Employee	A4	Teguh

2. Weighting

If the DSS is to be decimal, the sum of the weight must equal 100% of the weighting amount. The weight value will serve as a preference value for determining rankings, as illustrated in Table 3.

Table 5. Weighting

Weight	Value 1	Value 2	Value 3	Value 4
W	0.35	0.25	0.25	0.15

3. Matrix for Decision Making

The process of inputting values into the matrix is performed on a per-educator basis to facilitate grouping. The results of the grouping have been included in the choice matrix in Table 5. As an example, we have taken one educator as a sample.

Table 5. Matrix for Decision Making

Alternative	Criteria C1	C2	C3	C4
A1	3	2	4	4
A2	3	2	3	4
A3	3	3	4	4
A4	4	4	4	4
Max/Min	4	4	4	4

4. Matrix in a standardized form

The use of decision-making for assessing lecturer satisfaction in the hunt for exceptional lecturers in the teaching sector is depicted in Table 6, following the establishment of the decision matrix.

Table 6. Matrix in a standardized from

Alternative	Criteria C1	C2	C3	C4
A1	1	1	1	1
A2	1	0.75	0.75	1
A3	1	0.5	1	1
A4	1	1	1	1

5. Value of Preference

The relative preference value (V) for each alternative is then determined, as shown in Table 7, after the computation of the Euclidean distance between each alternative and the ideal profit and loss solution.

Table 7. Value of Preference

Value	Result	Ranking
V1	1	2
V2	0.88	3
V3	0.87	4
V4	1	1

6. *Classification*

Based on the preference value results, a table is created, the results are averaged, and the top lecturer is determined, as shown in Table 8.

Table 8. Ranking

Lecturer	V1	V2	V3	V4	Average	Rank
P1	1	0.88	0.87	1	0.93	1
P2	0.925	0.95	0.86	0.93	0.91	2
P3	0.8	0.75	0.86	1	0.84	3
P4	0.75	0.82	0.8625	0.875	0.82	4

Table 8 results show that the lecturer with the initials P1 is ranked first (93%), the lecturer with the initials P2 is ranked second (91%), the lecturer with the initials P3 is ranked third (85%), and the lecturer with the initials P4 is ranked fourth (82%).

Upon examining the actual conditions in the field, it becomes apparent that numerous instruments exist that are not readily apparent. Consequently, conducting more comprehensive research is necessary in order to enhance the accuracy and thoroughness of the investigation. Additionally, the application of this decision support system (DSS) serves as a valuable addition to the system implementation. It is advisable to integrate the application of DSS with the development of the system

(Fernandez, Putri, Darmansah, Fathoni, & Wijayanto, 2022).

Furthermore, the issues above will also be addressed through a discourse on the implementation of the IKD system design analysis, which will be included in web programming in accordance with the prescribed principles of DSS. Provided that all of the prerequisites above are satisfied, a system capable of establishing a correlation between artificial intelligence, data, and information will undoubtedly be developed.

II. Conclusion

This study develops a Decision Support System (DSS) to identify the optimal criteria for implementing the system. The conclusive outcome is that Class Attendance is the most optimal criterion as a study instrument for assessing the lecturer performance index, with Student Feedback, Task Completion, and Working Hours as supplementary components. Based on the findings of this study, the lecturer performance index will be utilized to choose professors, serving as a means of ensuring responsibility in the execution of the Tri Dharma of Higher Education.

It is worth noting that this research still needs to improve, particularly in the field of Decision Support Systems (DSS), specifically in determining alternatives and merging criteria and alternatives. In the realm of systems, there needs to be more integration between DSS and the overall system, resulting in each operating independently to generate information. In the future, a website and mobile-based system will be developed that seamlessly combines artificial intelligence, data, and information. This system requires further development and integration with other systems pertaining to the lecturer performance index. It is feasible for this system to be connected to the current system at PD Dikti, thereby enabling reciprocal feedback and fostering synergy to create a system that aligns with expectations.

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