AHP METHOD APPLICATION FOR LECTURER COMPETENCY ASSESSMENT: A STUDY CASE

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Abstract: As a newly established higher education institution in Bukittinggi, Universitas Mohammad Natsir Bukittinggi (UMN Bukittinggi) is chosen as the study location since it required highly qualified and competent teaching staff to support its academic excellence. The competence of lecturers is a fundamental requirement that must be established by universities to enhance the quality of both the institution and its graduates. To determine the required competencies, the university has set specific criteria, including teaching quality, educational background, work ethic, and the quality of teaching materials. This research aims to build a desktop application with Analytic Hierarchy Process (AHP) in assessing lecture competency. Microsoft tools like Visual Studio and Visual Basic programming are used in the development of the application. The application maps the evaluation criteria of lecturer performance into a hierarchy, where each hierarchy will be a pairwise comparison between criteria so that a comparison of the relative importance between the criteria obtained. With the modeling utilizing Unified Modeling Language, this research also designs user interface modeling in the proposed application.
Keywords: Lecturer Competence, Decision Support System, Analytical Hierarchy Process, Technological Competency

A. Introduction

Lecturers act as academic staff who are tasked with implementing the Tridharma of Higher Education, which includes teaching, education, research, development of science and technology, community service, and other supporting activities. Lecturer competence is a crucial factor, because lecturers are the main actors in educational activities that directly affect the quality of graduates and the reputation of the institution as a whole. For this reason, the decision support system (DSS) for determining the lecture competency is essential for ensuring the sustainability and enhancement of the educational quality on campus, contributing to the overall quality of education and the university's reputation.

Performance assessment is an act of measurement carried out on various activities in the value chain in an organization. One way of assessing performance is by using the Analytical Hierarchy Process (AHP) method, which is a decision support system method that aims to assess lecturer performance based on certain criteria. AHP enables decision makers to formulate complex problems into simple forms of hierarchy and to evaluate a large number of qualitative and quantitative factors in a systematic way [1]. AHP method has been implemented in assessing performance of academic staff in various universities. Solihin, H.H et al. utilized AHP method to build DSS model for assessing lecture performance in teaching process [1]. Another study by Mohammed, H.J worked on evaluating flipped classroom learning using Multi-Criteria Decision Making (MCDM) in the Analytic Hierarchy Process (AHP) [2].

Universitas Mohammad Natsir Bukittinggi, established in 2015 under the auspices of YARSI Sumbar, is a private university located in West Sumatra. As a newly established institution, UMN Bukittinggi faces significant challenges in building a strong academic

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foundation, particularly in recruiting highly competent teaching staff. Universities have difficulty managing large amounts of data when using very simple tools that are unable to produce correct information and result in errors in decision making. To address this, this study proposes to build a DSS system which is a desktop application that integrates AHP method for lecture competence assessment [3-13].

B. Research Methods

Research methods are a series of structured or systematic ways used in research to obtain the right answers to the research object. Waterfall methods as follows are implemented in the research stages in completing this study as described in Figure 1.

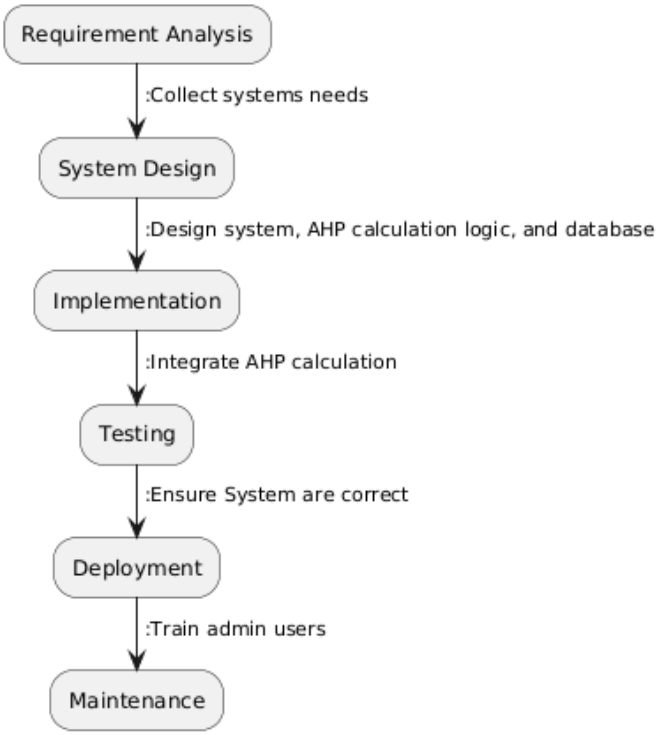

Figure 1. Research Method

2.1 Requirement Analysis:

At this stage, the project objectives and the scope of the DSS system are determined. Additionally, a list of feature requirements for the system and the methods used for the analysis process are also created.

2.2 Analytical Hierarchy Process (AHP):

The In this stage, the design system as whole was created including use case and entity relational diagram (ERD) for the database. AHP logic was then employed to evaluate and rank lecturers based on multiple criteria as follows:

a. Teaching Quality (K1): Evaluates how effectively a lecturer delivers course content and engages with students. This can be rated as Very Good, Good, or Sufficient.
b. Educational Background (K2): Reflects the academic qualifications of the lecturer, categorized as Ph.D. (S3), Master's Degree (S2), or Bachelor's Degree (S1).
c. Work Ethic (K3): Assesses the lecturer's dedication and professionalism, rated similarly to teaching quality.

d.Quality of Teaching Materials (K4): Evaluates the relevance, depth, and clarity of the materials provided by the lecturer.

b.The AHP method is used to solve the multi-criteria decision-making problem by structuring it into a hierarchy. The process involves the following steps:

c.Hierarchy Construction: The hierarchy is constructed with the goal (lecturer competence determination) at the top, followed by the criteria (K1, K2, K3, K4), and then the sub-criteria and alternatives at the lowest level.

d.Pairwise Comparison: Each criterion is compared against the others in a pairwise manner to establish their relative importance. The pairwise comparison matrix (PCM) is created for all criteria and sub-criteria. The consistency of these comparisons is checked using the Consistency Ratio (CR). The general form of the pairwise comparison matrix is:

e.Priority Vector Calculation: The eigenvector corresponding to the largest eigenvalue of the matrix AAA is calculated to obtain the priority vector, which gives the weight of each criterion.

2.3 Implementation:

This development is carried out using Microsoft tools, with Visual Studio serving as the Integrated Development Environment (IDE) and Visual Basic as the programming language. Visual Studio offers a robust platform for coding, debugging, and testing the application, ensuring that it meets the required specifications. For data management and storage, MySQL is employed as the database management system, offering reliability and scalability to handle the application's data needs. phpMyAdmin, a web-based interface for managing MySQL databases, is utilized to simplify database operations such as creating, modifying, and managing the data structure. This combination of tools allows for an efficient development process and a stable, user-friendly application that meets the project's objectives.

2.4 System Testing:

In this phase, the testing system is used to verify that all features work as intended by carrying out both functional and integration testing. The system is tested using historical data to validate its accuracy and consistency. The results are compared with manual assessments to determine the effectiveness of the AHP-based DSS in making lecturer competency evaluations.

2.5 Deployment:

Once the application has successfully passed all necessary testing phases, including functional, integration, and user acceptance tests, it is prepared for deployment. The deployment process involves installing the application on the main campus computer system, which will serve as the primary platform for its operation. This step ensures that the application is fully integrated into the campus's existing IT infrastructure, allowing faculty and administrative staff to utilize the software effectively. Additionally, during deployment, any necessary configurations or customizations are applied to tailor the application to the specific needs of the institution. Comprehensive documentation and user training may also be provided to ensure smooth adoption and optimal use of the application across the campus.

2.6 Maintenance:

Maintenance and repairs are performed on the DSS system if any bugs are identified. Additionally, the system will be upgraded as needed to better meet user requirements.

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C. Results and Discussion

3.1System Testing Results

Interviews were conducted with stakeholders, including decision-makers and system users, to understand the system requirements. Additionally, data and requirement gathering were carried out through a literature review on the AHP method and its application in decision support systems. The results of this review were used in the problem identification process, which led to the following questions:

•R1: How should the criteria needed for the system be determined?

•R2: Who are the users of the system, and what will be the output of the system?

- R3: What features are necessary for effective decision-making using the AHP method, including data visualization, report generation, and multi-criteria analysis?

3.2Use Case

It is crucial to explain the DSS's user interface. Use case is developed initially. Figure 2 displays the compilation of user interaction. In the system, admin is the one and only user that has access. Admin can manage lecturer data, criteria data, do assessment for lecturer, and save the report.

Figure 2. Use Case Diagram

3.3 Entity Relational Database (ERD)

The Entity Relationship Diagram (ERD), which consolidates all findings from the conceptual to the logical database architecture, is shown in Figure 3. The ERD includes tables, attributes, primary keys, entity relationships, optionality, and the relationships between tables in the database. There are several main tables, such as the input_case table for determining evaluation criteria, the input_sample table for lecturer data, and the

master_ir table for AHP matrix calculations. Additionally, there are several supporting tables to ensure the smooth operation of the system.

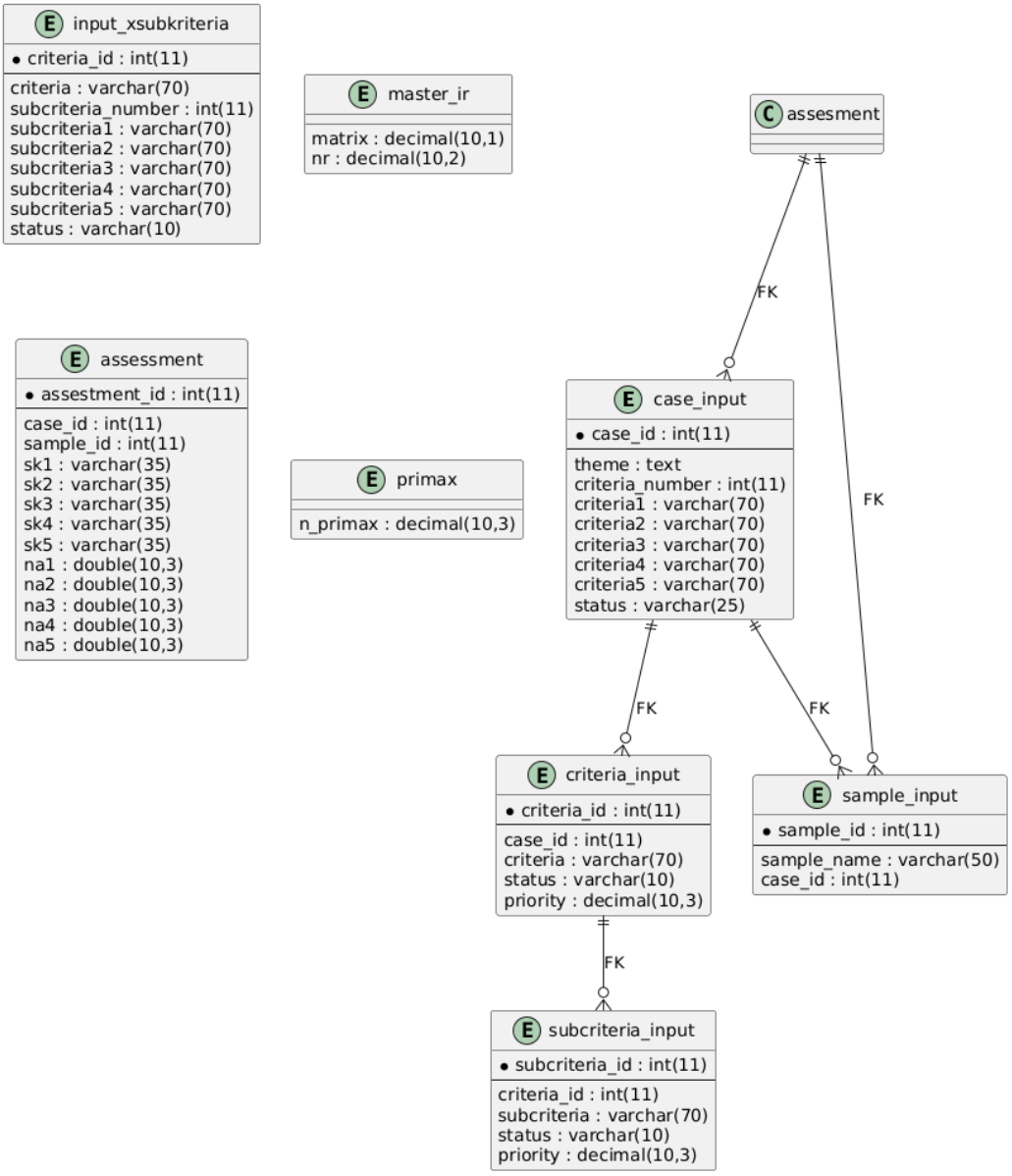

Figure 3. Entity Relational Diagram (ERD)

3.4AHP Calculation

The application was computed using historical data from several lecturers who were assessed based on the established criteria. The results produced by the AHP system were then compared with manual evaluations previously conducted to validate the system's consistency and accuracy. AHP calculations or implementation of the Decision Support System (DSS) are described as follows:

1.Pairwise Comparison Matrix for Criteria

Table 1 presents the pairwise comparison matrix for the subcriteria of teaching quality, which is used to determine the weight of each sub criterion.

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Table 1. Pairwise Comparison Matrix for Teaching Quality Subcriteria

Teaching Quality	Excellent	Good	Sufficient
Excellent	1.000	3.000	5.000
Good	0.333	1.000	5.000
Sufficient	0.200	0.200	1.000
Total	1.533	4.200	11.000

2.Pairwise Comparison Matrix for Teaching Quality Subcriteria

Table 2 explains the pairwise comparison matrix for the subcriteria of teaching quality, which is used to determine the weight of each sub criterion.

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Teaching Quality	Excellent	Good	Sufficient
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Sufficient	0.200	0.200	1.000
Total	1.533	4.200	11.000

3.Pairwise Comparison Matrix for Teaching Quality Subcriteria

Based on the AHP calculations, the system generated rankings of lecturers according to their overall scores across all criteria and subcriteria. The process of determining priorities for each criterion revealed that Teaching Quality had the highest weight, followed by Quality of Teaching Materials, Education, and Work Ethic. Table 3 shows the top 3 ranking of lecturer competence. The results indicate that lecturer 1 has the highest total score, placing them first in the lecturer competence assessment at UMN Bukittinggi

Table 3. Final Lecturer Rankings

	Teaching Quality Score	Education Score	Work Ethic Score	Quality of Teaching Materials Score	Total Score
Lecturer 1	0.482	0.272	0.215	0.231	1.200
Lecturer 2	0.366	0.256	0.195	0.218	1.035
Lecturer 3	0.321	0.198	0.181	0.201	0.901

3.5AHP Calculation

The application is developed based on the use case design. The user interface was created in this stage. Because it offers the initial impression that determines the user experience, the user interface is fundamental. Figures 4 to 8 are the DSS interface for lecturer competence assessment:

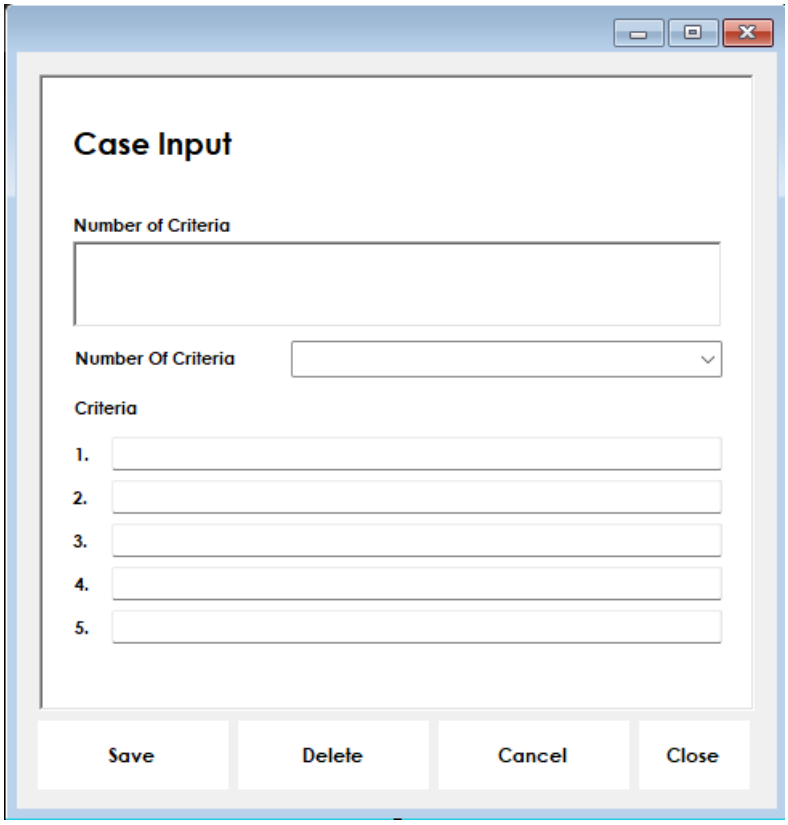

Figure 4. Form of Case Input

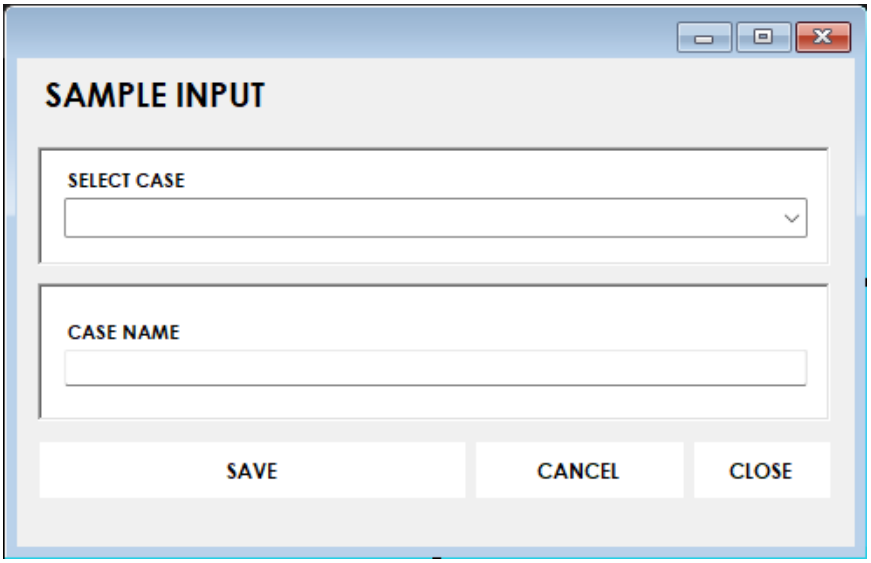

Figure 5. Form of Sample Input

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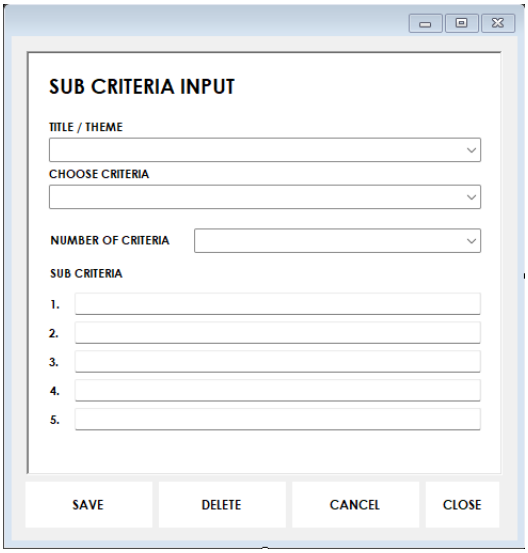

Figure 6. Form of Sub Criteria Input

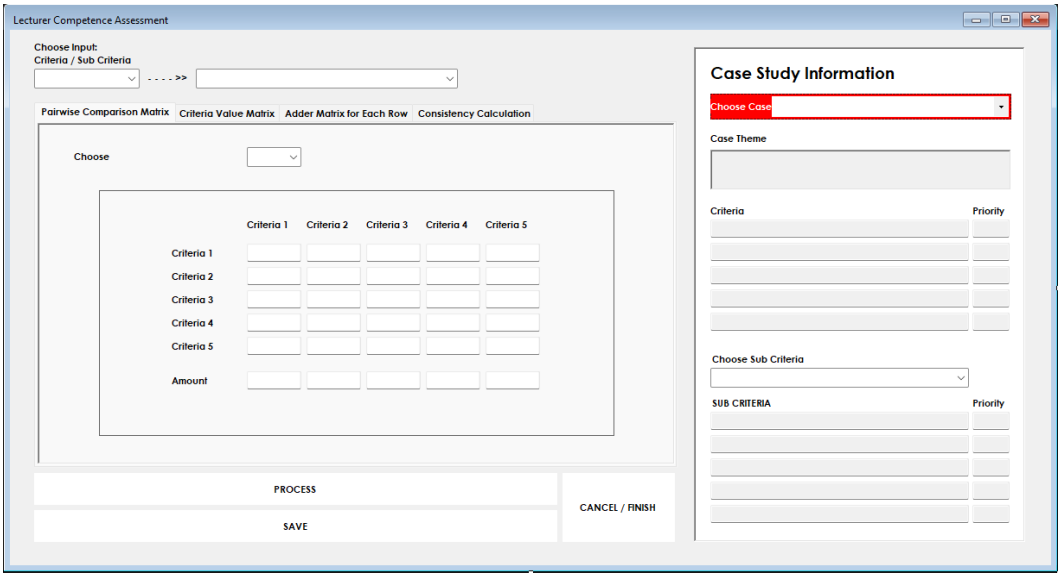

Figure 7. Form of Lecturer Competence Assessment

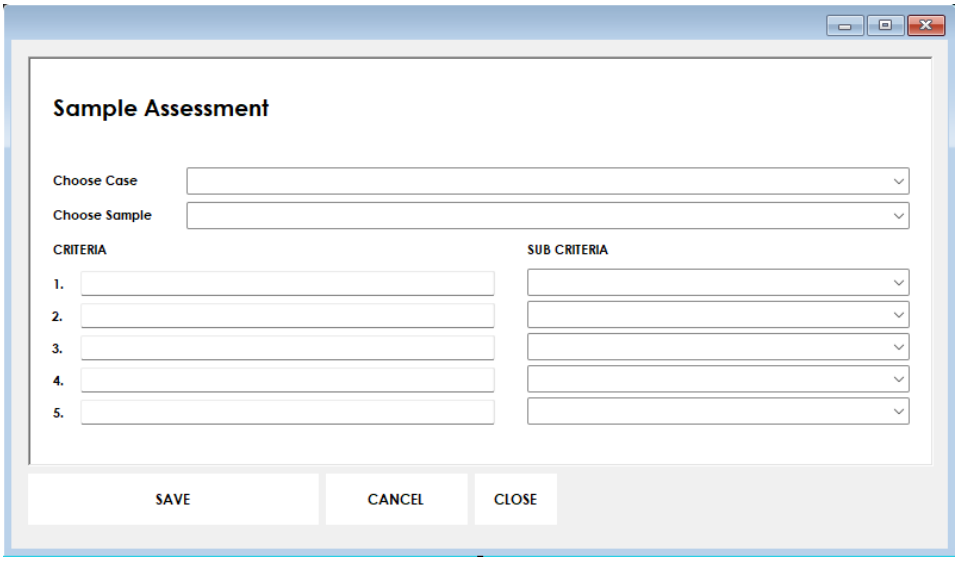

Figure 8. Sample Evaluation

3.6Application Testing

The testing process is carried out to ensure that the system was built in accordance with the needs of the users and can operate properly. Table 4 shows the testing scenario result. Overall, all features were operated properly. The findings compiled in Table 4 are utilized as a guide by the team to execute the testing in order to maintain a neutral perception throughout the testing procedure.

Table 4. Testing Scenario

Features	Status
Lecturer data	Done
Criteria Evaluation	Done
Criteria Score	Done
Assessment lecturer competency	Done
Evaluation result	Done

3.7Discussion

The application of AHP in this lecturer competency assessment system shows several advantages in terms of consistency and objectivity. The results produced by the AHP system are in line with manual assessment, but with a more efficient and systematic process. For example, in the case of lecturer 1, the AHP system provides an assessment that is consistent with manual expectations, but with a more structured and measurable approach.

One of the key advantages of this method is its ability to accommodate various qualitative and quantitative criteria, ensuring that every decision is based on measurable and consistent assessments. Additionally, system testing revealed that the Consistency Ratio (CR) for each pairwise comparison matrix was below 0.1, indicating acceptable consistency. However, some limitations should be noted. The

system's effectiveness still heavily relies on the accuracy of input data and the subjective judgments of users in assigning weights to criteria and subcriteria. Therefore, it is crucial to ensure that data collection processes are conducted meticulously and consistently. Overall, the findings of this research indicate that the AHP method can be effectively employed in the evaluation of lecturer competence at universities. The developed system can be widely adopted by other educational institutions facing similar challenges in evaluating and ranking their academic staff.

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D. Conclusion

In this study, a Decision Support System (DSS) desktop application using the Analytical Hierarchy Process (AHP) is successfully developed to assess lecturer competence at Universitas Mohammad Natsir Bukittinggi. The system is able to objectively evaluate and rank lecturers based on multiple criteria, including Teaching Quality, Education, Work Ethic, and Quality of Teaching Materials. For further research, to make the assessment of college competency easier, other methods such as machine learning should be considered. Machine learning methods can make the assessment process more dynamic by allowing the system to learn from previous evaluations and improve its accuracy over time.

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