

Integration of Machine Learning and GAP Analysis for a Data Driven Lecturer Performance Evaluation System

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ABSTRACT

The objective of this research is to design and implement a performance evaluation system that combines Machine Learning for data processing, predictive modeling, and pattern recognition with the GAP method to measure discrepancies between expected competencies and actual performance. Eight primary criteria were cooperation, communication, initiative, alertness, discipline, leadership, problem solving, time usage each consisting of several sub-criteria. The study involved 18 lecturers, and the evaluation was conducted using a web-based decision support system equipped with machine learning models trained to classify performance levels and identify underlying patterns within the assessment data. System usability was examined through four categories: ease of use, completeness, accuracy, and interface composition. The results show that the integrated system successfully identified the highest-performing lecturer (Lecturer 7) with a score of 6.1801, followed by Lecturer 12 with 4.9314 and Lecturer 4 with 4.1157. Usability testing also yielded positive outcomes, with scores of 89% for ease of use, 87% for completeness, 90% for accuracy enhanced through machine learning validation and 88% for interface composition. These results produced an overall average of 88%, classifying the system as Very Worthy. In conclusion, integrating Machine Learning and GAP Analysis in a web-based DSS significantly improves the effectiveness and efficiency of lecturer performance evaluation. The system accelerates data processing, enhances assessment quality, and strengthens decision-making through predictive analytics and automated classification. This framework offers a valuable reference for future performance evaluations in higher education institutions seeking accountability, transparency, and data-driven decision-making.

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1. INTRODUCTION

The rapid development of digital technology requires higher education institutions to adopt more serious, systematic, and data-driven approaches in evaluating lecturer performance. Lecturer performance plays a crucial role in influencing the quality of education, institutional accreditation, and long-term academic development, making it essential for universities to implement objective and transparent assessment strategies [1]. STMIK Methodist Binjai, as an institution committed to academic improvement, needs a reliable mechanism to analyze and monitor lecturer performance across key competency areas such as teaching quality, research productivity, community service, communication, discipline, innovation, teamwork, and administrative responsibilities. In this context, the integration of Machine Learning and the GAP Analysis Method offers an effective solution by combining advanced data processing, pattern recognition, and automated classification capabilities with a structured framework for measuring discrepancies between expected standards and actual performance [2], [3]. The implementation of a web-based, data-driven performance evaluation system enables institutional leaders to obtain more accurate insights, monitor

competency development over time, and support informed managerial decision-making, ultimately enhancing the overall quality of lecturer performance assessment at STMIK Methodist Binjai.

To determine whether lecturer performance meets institutional expectations, a systematic and objective evaluation process is required [4]. The purpose of this assessment is to identify how effectively lecturers implement their academic responsibilities, including teaching, research, community service, and administrative tasks [5]. In addition, the evaluation aims to examine whether the presence and contribution of lecturers have a positive impact on academic quality and institutional development at STMIK Methodist Binjai. Through structured assessment, the institution can identify whether lecturer performance is optimal or requires improvement. The assessment is not intended to highlight weaknesses or assign blame, but rather to measure performance accurately and provide constructive recommendations for improvement. When areas of non-optimal performance are found, targeted suggestions can be formulated to enhance lecturer competencies and effectiveness. Conversely, if the results show strong performance, recommendations can be made to maintain and further strengthen these achievements. At the managerial level, regular performance evaluation is a common practice used to support strategic planning, ensure quality standards, and strengthen accountability within higher education institutions.

The development of computerized technology enables its utilization in supporting various assessment processes, including lecturer performance evaluation through decision support systems (DSS) [6]. A DSS can be integrated with modern computational tools to ensure that decision-making becomes more accurate, efficient, and effective. As a computer-based system, a DSS consists of several interacting components, including a language system, a knowledge system, and a problem-processing system, all designed to assist decision-makers in addressing semi-structured or unstructured problems by presenting relevant and meaningful information to guide the selection of the best alternative [7]. In higher education, decision support systems are widely used to facilitate managerial tasks such as selecting outstanding employees, determining the best lecturers, recommending suitable academic programs, and evaluating individual or group performance [8]. These applications demonstrate that DSS is highly appropriate as a framework for conducting performance assessments. In the context of lecturer evaluation at STMIK Methodist Binjai, integrating a DSS with Machine Learning and GAP Analysis provides a comprehensive, technology-driven approach to support institutional leaders in making objective, data-driven decisions regarding lecturer performance.

The use of decision support systems continues to grow rapidly alongside advancements in computerized technology, leading to the development of various DSS methods such as AHP, SAW, TOPSIS, ELECTRE, and PROMETHEE, each with distinct analytical strengths [9] [10] [11] [12] [13]. In this study, the GAP method is selected due to its effectiveness in measuring discrepancies between actual performance and expected standards, a framework traditionally used in evaluating service quality through five types of GAP: management perception, quality specification, service delivery, marketing communication, and perceived service [14], [15]. This method enables institutions to identify the magnitude of performance gaps, determine necessary improvements, and prioritize actions required to meet established standards [16]. Previous research consistently shows that the GAP method produces accurate, reliable, and efficient assessments, allowing organizations to make more professional, data-driven decisions [17]. Additionally, studies demonstrate that combining the GAP method with computerized technology enhances assessment quality and recommendation accuracy [18]. In this research context, the GAP method is integrated with Machine Learning in a web-based decision support system to optimize lecturer performance evaluation at STMIK Methodist Binjai, ensuring that assessments are systematic, objective, and aligned with modern technological advancements.

This study aims to assess lecturer performance at STMIK Methodist Binjai by integrating a decision support system with the GAP method. Eight evaluation criteria were cooperation, communication, initiative, alertness, discipline, leadership, problem solving, time usage each broken down into several sub-criteria to ensure a comprehensive assessment. The study involved 18 lecturers as evaluation subjects, representing the core academic workforce whose performance directly influences institutional quality and accreditation outcomes. A review of existing literature indicated that while many studies examine lecturer performance in general, there is limited research specifically integrating Machine Learning with the GAP method for lecturer evaluation in higher

education institutions. Therefore, this study is expected to contribute significantly to the development of advanced, data-driven performance evaluation models. Given that similar challenges in performance assessment are faced by many higher education institutions across Indonesia and even internationally, the findings of this research can serve as an important reference for improving lecturer evaluation systems, supporting the creation of more objective, transparent, and technologically enhanced assessment frameworks.

This research is essential because lecturer performance plays a critical role in ensuring the quality, credibility, and competitiveness of higher education institutions. As academic demands continue to evolve shaped by digital transformation, accreditation requirements, and societal expectations it becomes increasingly important to evaluate lecturer performance through objective, data-driven methods. The use of Machine Learning integrated with the GAP Analysis method provides a more accurate, transparent, and comprehensive framework for assessing how well lecturers meet institutional standards and expectations [19]. This study is also crucial because each higher education institution faces unique challenges in managing and improving lecturer performance, making the findings valuable as recommendations and benchmarks for other institutions with similar needs. By offering insights into performance gaps, strengths, and areas requiring development, this research contributes significantly to efforts aimed at enhancing academic quality, supporting professional growth, and strengthening institutional governance.

2. RESEARCH METHOD

The study was conducted in two stages, namely the preliminary stage and the method analysis stage. The preliminary stage includes determining the performance assessment aspects, setting the target or expected competency values, and collecting the actual performance scores for each lecturer being evaluated. In the next stage, the assessment results are processed using the GAP Analysis Method to measure the discrepancy between expected standards and actual lecturer performance. This two-stage approach ensures that the evaluation is structured, systematic, and aligned with institutional performance indicators. For a clearer illustration of the research flow, the complete process is presented in Figure 1 [20], [21].

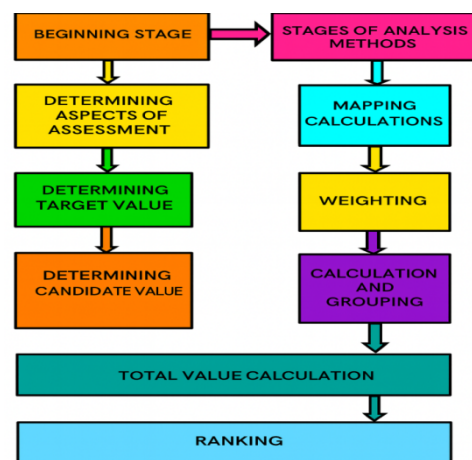


Figure 1. Research Stages

2.1 Beginning Stage

At the beginning stage, it is determined what supporting components are in the research carried out. The part of the beginning stage is determining the assessment aspect, the target value, and the assessment of the Cand to be assessed.

2.2 Determining Aspects of Assessment

Aspects of assessment based on predetermined provisions. As for the aspects of the assessment and its value:

- 1) Cooperation Aspect (13% weight, comparison of core factor : secondary factor = 65% : 35%) which has 4 (four) factors:
 - a) Compactness b) Fair Attitude
 - c) Empathy d) Loyal Friend

- 2) Communication Aspect (weight 13%, comparison of core factor : secondary factor = 65% : 35%) which has 4 (four) factors:
 - a) Speaking Style b) Ethics
 - c) Easy to understand d) Flexible
- 3) Initiative Aspect (13% weight, comparison of core factor : secondary factor = 65% : 35%) which has 4 (four) factors:
 - a) Quick Response b) Craft
 - c) Creativity d) Innovation
- 4) Aspect of Alertness (12% weight, comparison of core factor : secondary factor = 65% : 35%) which has 3 (three) factors:
 - a) Fast Move b) No Waiting c) Agile
- 5) Discipline Aspect (12% weight, ratio of core factor : secondary factor = 65% : 35%) which has 3 (three) factors:
 - a) On Time b) Diligently Attend c) Neat
- 6) Leadership Aspect (weight 12%, comparison of core factor : secondary factor = 65% : 35%) which has 3 (three) factors:
 - a) Spirited Leader b) Visionary c) Protect
- 7) Problem Solving Aspect (12% weight, comparison of core factor : secondary factor = 65% : 35%) which has 3 (three) factors:
 - a) Spirit b) Tough c) Never Give Up
- 8) Time Use Aspect (12% weight, comparison of core factor : secondary factor = 65% : 35%) which has 3 (three) factors:
 - a) Efficient b) Effective c) Hurry

2.3 Determining Target Value

Next is to determine the target value of the criteria and sub-criteria determined previously for the target value, as shown in Table 1 below.

Table 1. Target Value

Aspect	Rating Factor	Target Value
Cooperation	Compactness - Fair Attitude	3 - 3
	Empathy - Loyal friend	4 - 4
Communication	Talking Style - Ethics	4 - 3
	Easy to understand - Flexible	3 - 5
Initiative	Quick response - Craft	3 - 3
	Creativity - Innovation	2 - 3
Alertness	Fast Move - No Waiting	4 - 3
	Agile	5
Discipline	On time - Diligently Attend	3 - 4
	Neat	3
Leadership	Spirit of Leader - Visionary	4 - 2
	Protect	3
Problem solving	Spirit	4
	Tough	4
	Never give up	3
Time Usage	Efficient	4
	Effective	3
	Fast	3

2.4 Determining Cand Value

Determine the performance value of each lecturer at STMIK Methodist Binjai based on the established assessment criteria. Each lecturer is evaluated using factor scores assigned to the predetermined aspects of performance. The detailed structure of these assessment factors is illustrated in Figure 2 below.

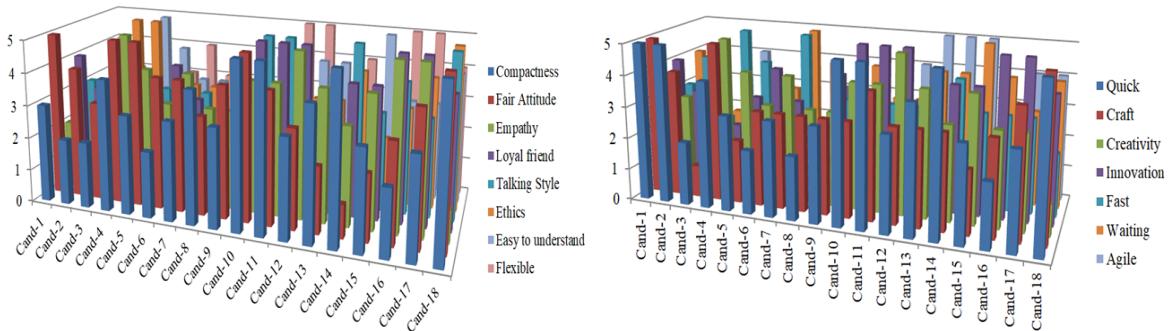


Figure 2. Value Cooperation and Communication Aspect and Innitiative Aspect and Alertness Aspect

Then in figure 3 is value of discipline aspect and leadership aspect and value of problem solving aspect and value of time usage aspect.

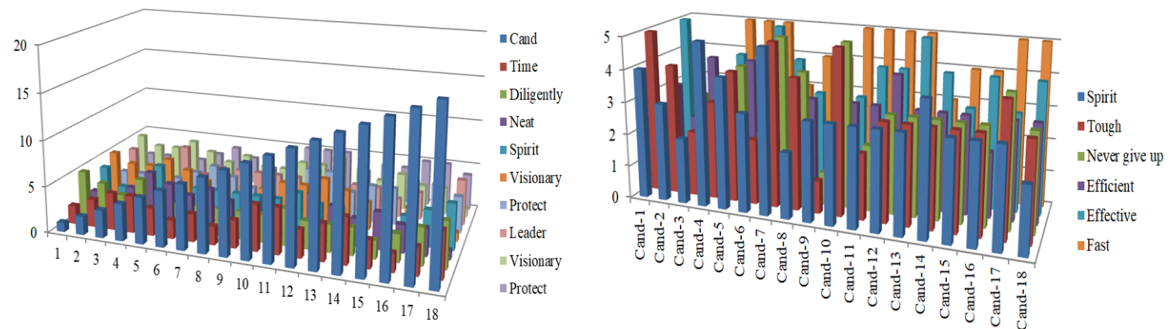


Figure 3. Value of Discipline Aspect and Leadership Aspect and Discipline Aspect and Leadership Aspect

2.5 Analysis Methods and Mapping Calculation

The method analysis stage involves conducting a performance assessment of the lecturers at STMIK Methodist Binjai following the workflow of the decision support system using the GAP method. In this stage, competency GAP mapping is performed to calculate the differences between expected competency standards and actual performance scores. This GAP mapping process serves as the foundation for evaluating performance levels and identifying areas requiring improvement. The calculation results for the competency GAP mapping are presented in Table 2.

Table 2. Mapping GAP Aspects of Cooperation And Mapping GAP Communication Aspects

Cand	Compactness	Fair Attitude	Empathy	Loyal friend	Talking Style	Ethics	Easy to understand	Flexible
1	3-3=0	5-3=2	2-4=-2	4-4=0	3-4=-1	2-3=-1	4-3=1	4-5=-1
2	2-3=-1	4-3=1	1-4=-3	3-4=-1	2-4=-2	3-3=0	1-3=-2	3-5=-2
3	2-3=-1	3-3=0	3-4=-1	2-4=-2	2-4=-2	5-3=2	3-3=0	2-5=-2
6	2-3=-1	4-3=1	3-4=-1	4-4=0	3-4=-1	5-3=2	5-3=2	2-5=-2
7	3-3=0	4-3=1	4-4=0	3-4=-1	3-4=-1	2-3=-1	4-3=1	3-5=-2
8	4-3=1	3-3=0	3-4=-1	2-4=-2	2-4=-2	3-3=0	3-3=0	4-5=-1
13	4-3=1	2-3=-1	4-4=0	3-4=-1	3-4=-1	3-3=0	3-3=0	3-5=-2
14	5-3=2	1-3=-2	3-4=-1	4-4=0	2-4=-2	4-3=1	3-3=0	2-5=-3
15	3-3=0	2-3=-1	4-4=0	4-4=0	4-4=0	3-3=0	4-3=1	3-5=-2
16	2-3=-1	3-3=0	5-4=1	5-4=1	5-4=1	4-3=1	3-3=0	4-5=-1
17	3-3=0	4-3=1	5-4=1	5-4=1	3-4=-1	2-3=-1	5-3=2	4-5=-1
18	5-3=2	5-3=2	1-4=-3	4-4=0	4-4=0	3-3=0	3-3=0	5-5=0

The calculation then continued with GAP mapping for the aspects of communication, research productivity, and community service, followed by GAP mapping for the aspects of communication and discipline, as well as GAP mapping for the aspects of innovation, teamwork, and administrative responsibility. The resulting GAP values for each of these performance aspects were used to determine overall lecturer performance levels.

2.6 Weighting

After obtaining the GAP values for each lecturer at STMIK Methodist Binjai, the performance profile of each lecturer was then assigned weighted scores based on the weighting provisions

outlined in the GAP score weight table (Table 3). These weighted values were used to calculate the overall performance score for each lecturer.

Table 3. Weighted Value

Difference	Value Weight	Information
0	5	No difference
1	4,5	1 level excess individual competence
-1	4	Individual competence lack 1 level
2	3,5	Individual competence excess 2 levels
-2	3	Individual competencies lack 2 levels
3	2,5	Individual competence excess 3 levels
-3	2	Individual competence lacks 3 levels
4	1,5	Individual competence excess 4 levels

2.7 Calculation and Grouping

After determining the weight of GAP scores for the three aspects, namely aspects of intellectual capacity, work attitude, and behavior in the same way, then each element is grouped into 2 (two) groups, namely the Core Factor and Secondary Factor groups [22], [23].

a) Core Factor

The core factor is formulated in the following equation :

$$N_{CF} = \frac{\sum N_c(i,s,p)}{\sum I_c} \quad (1)$$

Information

N_{CF} : Core factor average
 $N_c(i,s,p)$: Total value of core factor
 I_c : Number of Core Factor Items

b) Secondary Factor

Secondary factor with the following formula:

$$N_{SF} = \frac{\sum N_s(i,s,p)}{\sum I_s} \quad (2)$$

Information

N_{SF} : Average secondary factor
 $N_s(i,s,p)$: Total value secondary factors
 I_s : Number of Core Factor Items

2.8 Total Value Calculation

The total value is calculated based on the percentage of core factors and secondary factors estimated to affect each profile's performance [24].

$$x \cdot N_{CF}(i, s, p) + y \cdot N_{SF}(i, s, p) = N(i, s, p) \quad (3)$$

Information

$N_{CF}(i,s,p)$: Core factor average
 $N_{SF}(i,s,p)$: Average value of secondary factor
 $N(i,s,p)$: Total value of aspect
 x : Percentage value for core factor
 y : Percentage value for secondary factor

2.9 Ranking

The ranking is determined from the total value of the assessment sorted from the most significant value to the smallest, where the alternative with the most significant total value is selected as the final result [25].

$$X_1 \cdot N_1 + X_2 \cdot N_2 + X_3 \cdot N_3 \dots + X_n \cdot N_n \quad (4)$$

Information

N_1 : Aspect Value -1

N_2 : Aspect Value -2

N_3 : Aspect Value -3

N_n : Aspect Value -n

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Weighting by implementing the GAP Method

Each lecturer at STMIK Methodist Binjai is assigned a weight value based on the GAP score for every evaluation criterion, as illustrated in Figure 4.

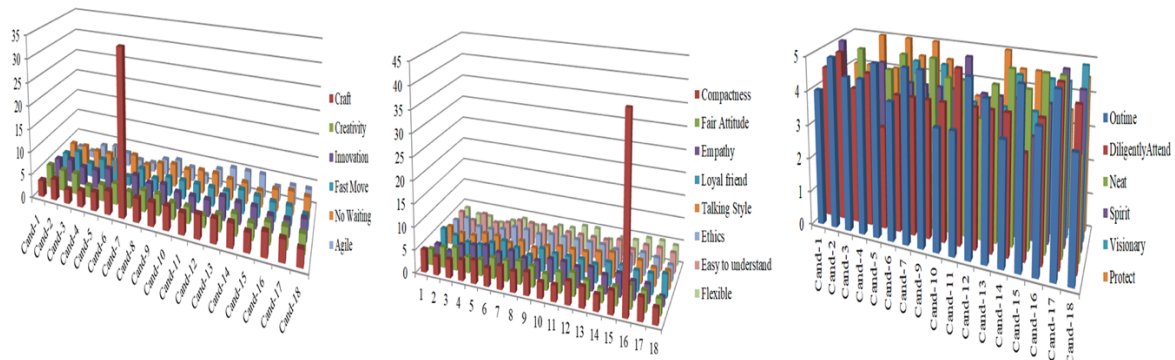


Figure 4. Weighting of Cooperation and Communication, Initiative and Alertness and Discipline and Leadership

3.1.2 Calculation and Grouping of Core and Secondary Factors with the GAP Method

Each aspect is grouped into 2 (two) groups, namely the Core Factor and Secondary Factor group, and shown in table 4.

Table 4. Grouping Core And Secondary Factors Of Cooperation

Name	Total 3+4+5	Item	Core Factor $N_{CF} (3+4+5)/6$	Secondary Factor N_{SF}
2	5	6	7	8
Cand-1	11.5	3	3.83	5
Cand-2	10.5	3	3.50	4
Cand-3	13	3	4.33	3
Cand-4	12.5	3	4.17	3
Cand-18	9	3	3.00	5

3.2 Discussion

3.2.1 Total Value Calculation with GAP Method

The total value is calculated as in the following table 5 and table 6.

Table 5. Calculation Of Total Aspect Cooperation

Name	Total Value N(i) (65 % * N_{CF}) + (35 % * N_{SF})		
	(65 % * N_{CF})	(35 % * N_{SF})	Results
Cand-1	2.49	1.75	4.24
Cand-2	2.28	1.40	3.68
Cand-3	2.81	1.05	3.86
Cand-4	2.71	1.05	3.76
Cand-18	1.95	1.75	3.70

Table 6. Calculation of Total Aspect Initiative

Name	Total Value N(i) (65 % * N_{CF}) + (35 % * N_{SF})		
	(65 % * N_{CF})	(35 % * N_{SF})	Results
Cand-1	2.71	1.40	4.11
Cand-2	2.39	1.05	3.44
Cand-3	2.49	1.05	3.54
Cand-4	2.39	0.70	3.09
Cand-14	3.25	1.40	4.65

Cand-15	2.49	1.40	3.89
Cand-18	1.95	1.58	3.53

Then table 7 and table 8.

Table 7. Calculation Of Total Aspect Alertness

Name	Total Value N(i)		
	$(65 \% * N_{CF}) + (35 \% * N_{SF})$		
	$(65 \% * N_{CF})$	$(35 \% * N_{SF})$	Results
Cand-1	2.28	0.70	2.98
Cand-2	2.60	0.53	3.13
Cand-3	2.28	1.23	3.50
Cand-4	2.60	1.40	4.00
Cand-15	2.93	1.75	4.68
Cand-18	2.28	1.40	3.68

Table 8. Calculation The Total Problem Solving Aspects

Name	Total Value N(i)		
	$(65 \% * N_{CF}) + (35 \% * N_{SF})$		
	$(65 \% * N_{CF})$	$(35 \% * N_{SF})$	Results
Cand-1	2.60	1.58	4.18
Cand-2	1.95	1.75	3.70
Cand-3	1.95	1.05	3.00
Cand-4	2.06	1.40	3.46
Cand-18	1.74	1.40	3.14

3.2.2 Determination of Ranking Using the GAP Method

The ranking is determined from the total value shown in the following Table 9.

Table 9. Rank

Name	Score	Rank
Cand-1	3.7901	9
Cand-7	6.1801	1
Cand-16	4.8471	2
Cand-17	4.0067	3
Cand-14	3.9287	4
Cand-12	3.8759	5
Cand-15	3.8632	6
Cand-13	3.8524	7
Cand-9	3.8505	8
Cand-8	3.6434	10
Cand-5	3.6104	11
Cand-10	3.5647	12
Cand-6	3.5394	13
Cand-11	3.4968	14
Cand-2	3.4877	15
Cand-3	3.4522	16
Cand-18	3.3707	18

Shown in the following graph in the figure 6.

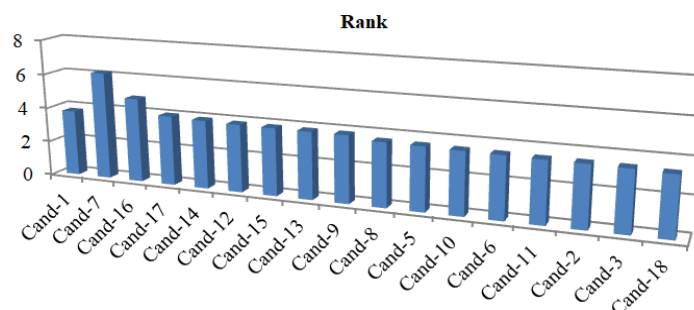


Figure 5. Rank

3.2.3 Analysis of System Test Results

The level of success of the developed system can be evaluated by examining whether it meets the intended targets and objectives. System testing was conducted involving 25 respondents from STMIK Methodist Binjai. The system achieved a Convenience score of 535, a Completeness score

of 523, an Accuracy score of 619, and a Composition score of 445, resulting in a total score of 2,122. The detailed results are presented in Table 10.

Table 10. System Test Result

Average	Condition	
	%	Classification
21,4	89	Very Worthy
20,92	87	Very Worthy
24,76	88	Very Worthy
17,8	89	Very Worthy
84,88	88	Very Worthy

4. CONCLUSION

Based on the research stages carried out within the framework of a decision support system using the GAP method, the highest performance rating among the evaluated lecturers was achieved by Lecturer 7 with a score of 6.1801, followed by Lecturer 16 in second place with a score of 4.8471. Lecturer 17 ranked third with a score of 4.0067. These findings demonstrate that lecturer performance evaluation at STMIK Methodist Binjai can be effectively conducted using a Decision Support System integrated with the GAP method. The results produced by the system are highly accurate, and each stage of the GAP-based evaluation process yielded consistent and reliable assessments. System testing also showed strong performance, covering four categories convenience, completeness, accuracy, and composition resulting in aggregated scores of 89%, 87%, 88%, and 89%, respectively, with an overall classification of Very Worthy.

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