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Implementation of Hybrid Recommendations in the Standardized Student Internship Assessment System At ITPLN

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Abstract

Student internship assessment is an important aspect of higher education, requiring objective and accurate standards. This research examines implementing a hybrid recommendation system to improve the internship assessment process at ITPLN. The hybrid recommendation method combines content-based and collaborative approaches so that it can provide more relevant and personalized recommendations. Through analysis of previous assessment data and feedback from students and supervisors, this system is designed to assess student performance more comprehensively. The research results show that the use of a hybrid recommendation system can increase accuracy and fairness in assessments, as well as provide additional insight for supervisors in providing evaluations. Thus, this research contributes to the development of better assessment systems in the context of professional education, especially in the fields of engineering and technology. It is hoped that the implementation of this system can become a model for other institutions in optimizing the student internship assessment process.

Keywords: *Recommendation System, Hybrid Recommendation, Internship Assessment, ITPLN*

Abstrak

Penilaian magang mahasiswa merupakan aspek penting dalam pendidikan tinggi, yang memerlukan standar yang objektif dan akurat. Penelitian ini mengkaji implementasi sistem rekomendasi hibrida untuk meningkatkan proses penilaian magang di ITPLN. Metode hybrid recomendation menggabungkan pendekatan berbasis konten dan kolaboratif, sehingga dapat memberikan rekomendasi yang lebih relevan dan personal. Melalui analisis data penilaian sebelumnya dan umpan balik dari mahasiswa serta pembimbing, sistem ini dirancang untuk menilai kinerja mahasiswa secara lebih komprehensif. Hasil penelitian menunjukkan bahwa penggunaan sistem rekomendasi hibrida dapat meningkatkan akurasi dan keadilan dalam penilaian, serta memberikan wawasan tambahan bagi pembimbing dalam memberikan evaluasi. Dengan demikian, penelitian ini berkontribusi pada pengembangan sistem penilaian yang lebih baik dalam konteks pendidikan profesional, khususnya di bidang teknik dan teknologi. Implementasi sistem ini diharapkan dapat menjadi model bagi institusi lain dalam mengoptimalkan proses penilaian magang mahasiswa.

Kata-kata kunci: *Sistem Rekomendasi, Hybrid Recommendation, Penilaian Magang, ITPLN*

1. Introduction

Student internship assessment is an important component of higher education that evaluates students' competency and preparation to enter the professional sector [1]. Internships offer essential practical experience, but student performance evaluations are frequently subjective, relying on individual opinions from supervisors. This can lead to inconsistency, discontent, and conflict among students and supervisors [2]. As a result, a more objective and standardized assessment mechanism is required to ensure fair evaluation.

In today's digital age, information technology, and recommendation systems have arisen as powerful instruments for enhancing the evaluation process. Recommendation systems, which are extensively utilized in e-commerce and social media, can help in academic assessments. The hybrid recommendation technique, which combines content-based and collaborative approaches [3], has the potential to increase assessment accuracy and relevance. The content-based method examines student characteristics and performance, whereas the collaborative approach seeks feedback from various sources, including supervisors, internship supervisors in the field, and examiners. This combination of approaches is likely to yield more exact suggestions [4]. This work focuses on the deployment of a hybrid recommendation system for evaluating student internships at ITPLN. This approach is intended to give a more thorough and equitable evaluation by analyzing past data and soliciting comments from students and supervisors. The author expects that by using this technology, he would be able to better identify students' strengths and limitations, as well as give valuable information for curriculum creation and internship programs. It is intended that the findings of this study will not only help to improve the assessment system at ITPLN but will also serve as a resource for other educational institutions looking to implement a technology-based evaluation system. Thus, this study has the potential to aid in the creation of a more equitable, transparent, and quality-oriented evaluation system for higher education in Indonesia.

2. Method

This study employs qualitative methods, including observation and documentation. Qualitative procedures are real and practical research methods that involve data collecting and statistical analysis.

2. 1 Location and Time of Research

Data were collected at the PLN Institute of Technology. This research was conducted at the PLN Institute of Technology on September 2, 2024, at the PLN Tower, Jl. Lkr. Luar Barat, RT.1/RW.1, Duri Kosambi, Cengkareng District, West Jakarta City, Special Capital Region of Jakarta 11750.

2. 2 Data Collection

Data for this study were gathered using a variety of techniques. The overall findings of the research will be impacted by these closely related approaches. These methods are as follows:

a) Observation: This method of gathering data involves watching and documenting environments and circumstances that are pertinent to the study. Direct observations were made at the PLN Institute of Technology for this study.

b) Literature study: To learn more about internships at ITPLN, a literature study was carried out. A list of internship values, samples of student internship documentation, and other reliable sources are all included in the literature evaluation.

2. 3 Model Analysis

The analysis process is conducted in phases, beginning with the first step and concluding with the creation of a model for a recommendation system that can offer useful suggestions based on the internship activities of the students. The two primary phases of this modeling process are data collecting and hybrid recommendation implementation [5]. A flowchart of the procedures used in this investigation is shown in Figure 1. The PHP programming language was used for all modeling processes in this study, with web-based implementation, particularly when the hybrid recommendation strategy was being implemented [6].

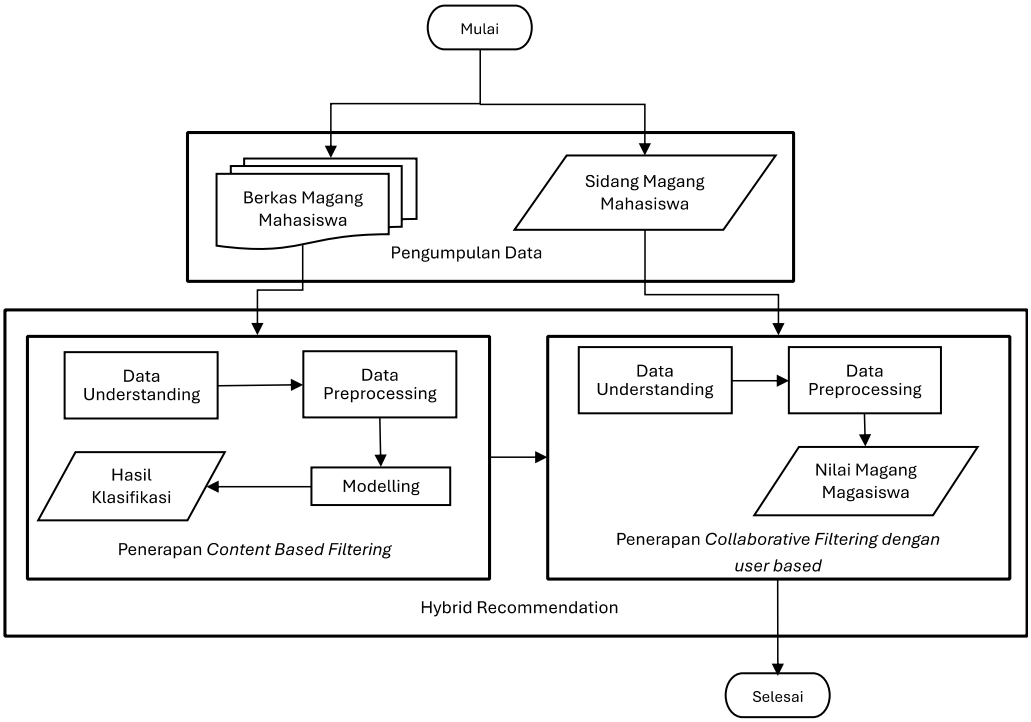

Figure 1. Hybrid Recommendation Model Design

3. Results and Discussion

This internship assessment recommendation system is website-based. This system was developed to help students and lecturers in assessing internships and obtaining grade recommendations according to the student's abilities and what the student has done during the internship. The result of this study is a product of an internship assessment recommendation system at ITPLN in the form of a website.

3. 1 Data Analysis

The data used comes from students who participated in internships in the previous semester. The dataset will be processed first and separated into two types, namely classification dataset and recommendation dataset. For the classification dataset, the Naïve Bayes method will be used, while for the recommendation dataset, the user-based collaborative filtering method will be used **[7].** The classification dataset is divided into 12 internship assessment compartments, namely: Integrity (ethics and morals), Scientific Expertise (Professionalism), Work Ethic, Responsibility, Teamwork Ability, Initiative, Creativity, Use of Information Technology, Communication, Self-Development, Attendance, and Internship Report. The dataset for this recommendation is determined using the ITPLN internship assessment

guidelines. This information will be filled in by the Field Supervisor, Internship Supervisor, and Internship Examiner. The dataset consists of 99 student data with 12 assessment attributes. Further information regarding the dataset properties can be seen in **Table 1.**

Table 1. Classification Attribute

Attribute	Explanation
integrity	Integrity (ethics and morals)
professionalism	Scientific Expertise (Professionalism)
workethic	Work Ethic
responsibility	Responsibility
teamwork	Teamwork Ability
initiative	Initiative
creativity	Creativity
it	Use of Information Technology
communication	Communication
selfdevelopment	Self-Development
attendance	Attendance
report	Internship Report

Meanwhile, the recommendation data set consists of 10 assessment data in the form of given value data. The list of values displayed can be seen in **Table 2**.

Table 2. Value Table in ITPLN

Letter	Numeric	Min	Max
A	4	81	100
A-	3,75	76	80.99
B+	3,5	72	75.99
B	3	68	71.99
B-	2,75	64	67.99
C+	2,5	60	63.99
C	2	56	59.99
D	1	41	55.99
E	0	0	40.99
T	0	0	0

3. 2 Hybrid Recommendation Implementation

The method used in making the recommendation system is the hybrid recommendation method. The approach method used in hybrid recommendation is content-based filtering with the naïve Bayes method and collaborative filtering with the user-based filtering method. The naïve Bayes method is used to classify student internship grades based on the value of each

attribute and user-based is used to predict the internship grades obtained by students from the internship examiner.

3.2.1. Naïve Bayes Calculation

The naïve Bayes calculation will be run first using the values of each classification attribute. In other words, naïve Bayes is used to classify student grades based on the attributes entered and will produce probability values for each concentration based on the input of student internship grades. The following is a sample of the use of naïve Bayes in the system.

The grades entered by the field supervisor in the application will be automatically converted into letters based on the grade rules in ITPLN according to Table 2. Sample grades entered by the supervisor can be seen in **Table 3.**

Table 3. Sample Input Values

Mahasiswa	integrity	professionalism	workethic	responsibility	teamwork	initiative	creativity
M1	92	78	100	85	67	100	75
M2	80	68	93	72	96	93	63
M3	96	70	74	94	71	70	75
M4	71	99	94	66	69	99	97
M5	80	98	79	65	85	98	90
M6	75	64	71	76	60	93	93
M7	70	100	60	67	81	97	83
M8	65	95	95	82	65	66	70
M9	74	84	72	71	98	86	78
M10	67	70	67	64	79	78	63
M99	81	80	75	79	95	80	75

it	communication	selfdevelopment	attendance	report	Result	Result
69	90	71	64	78	A-	80,75
86	77	68	95	70	A-	80,08333333
78	94	93	93	97	A	83,75
78	70	89	92	70	A	82,83333333
82	60	64	65	89	A-	79,58333333
78	60	94	92	85	A-	78,41666667
61	60	84	83	91	A-	78,08333333
72	86	88	85	92	A-	80,08333333
64	72	93	63	64	A-	76,58333333
94	88	87	78	96	A-	77,58333333
95	90	68	77	78	A	????

After the supervisor enters the value, the system will automatically convert it to letters, this is because the letter value is used in the calculation of the GPA on campus. The converted value can be seen in **Table 4.**

Table 4. Converted Values

Mahasiswa	integrity	professionalism	workethic	responsibility	teamwork	initiative	creativity
M1	A	A-	A	A	B-	A	B+
M2	A-	B	A	B+	A	A	C+
M3	A	B	B+	A	B	B	B+
M4	B	A	A	B-	B	A	A
M5	A-	A	A-	B-	A	A	A
M6	B+	B-	B	A-	C+	A	A
M7	B	A	C+	B-	A	A	A
M8	B-	A	A	A	B-	B-	B
M9	B+	A	B+	B	A	A	A-
M10	B-	B	B-	B-	A-	A-	C+
M99	A	A-	B+	A-	A	A-	B+

it	communication	selfdevelopment	attendance	report	Result
B	A	B	B-	A-	A-
A	A-	B	A	B	A-
A-	A	A	A	A	A
A-	B	A	A	B	A
A	C+	B-	B-	A	A-
A-	C+	A	A	A	A-
C+	C+	A	A	A	A-
B+	A	A	A	A	A-
B-	B+	A	C+	B-	A-
A	A	A	A-	A	A-
A	A	B	A-	A-	???

Based on the table above, the calculation process will be carried out using the naïve Bayes method to determine the value obtained by students with a sample of 99 students. The formula used in the naïve Bayes method is as follows [8] [9]:

$$P(C|X) = \frac{P(x|c)P(c)}{P(x)}$$

Explanation:

x : Data with unknown class

c : Data hypothesis is a specific class

P(c|x) : Hypothesis probability based on conditions (posterior probability)

P(c) : Hypothesis probability (prior probability)

P(x|c) : Probability based on conditions on the hypothesis

P(x) : Probability c

The first step is to calculate the number of training data (n). Based on the data above, the number of training data obtained is 98 data.

Next, calculate the number of specific classes. Based on the data above, the specific classes obtained are A, A- and B+. With the specific number in Table 7.

Table 5. Specific Number of Classes

A	37
A-	48
B+	13

Once the specific number of classes has been obtained, the next step is to calculate the probability of the hypothesis.

Table 6. Hypothesis Probability

P(Ci)	P(Result "A")	0,378
	P(Result "A-")	0,490
	P(Result "B+")	0,133

Next, the hypothesis probability calculation is carried out based on each attribute. Based on the data, the hypothesis probability will be calculated with 12 attributes.

Table 7. Hypothesis Probability Based on Conditions

P(X|Ci)	P(integrity "A" | Result "A")	25	0,676
	P(integrity "A" | Result "A-")	16	0,333
	P(integrity "A" | Result "B+")	2	0,154
	P(professionalism "A-" | Result "A")	6	0,162
	P(professionalism "A-" | Result "A-")	2	0,042
	P(professionalism "A-" | Result "B+")	1	0,077
	P(workethic "B+" | Result "A")	1	0,027
	P(workethic "B+" | Result "A-")	5	0,104
	P(workethic "B+" | Result "B+")	2	0,154
	P(responsibility "A-" | Result "A")	3	0,081
	P(responsibility "A-" | Result "A-")	4	0,083
	P(responsibility "A-" | Result "B+")	2	0,154
	P(teamwork "A" | Result "A")	20	0,541
	P(teamwork "A" | Result "A-")	23	0,479
	P(teamwork "A" | Result "B+")	4	0,308

P(initiative "A-" | Result "A")	3	0,081
P(initiative "A-" | Result "A-")	3	0,063
P(initiative "A-" | Result "B+")	2	0,154
P(creativity "B+" | Result "A")	4	0,108
P(creativity "B+" | Result "A-")	3	0,063
P(creativity "B+" | Result "B+")	1	0,077
P(it "A" | Result "A")	18	0,486
P(it "A" | Result "A-")	15	0,313
P(it "A" | Result "B+")	3	0,231
P(communication "A" | Result "A")	22	0,595
P(communication "A" | Result "A-")	23	0,479
P(communication "A" | Result "B+")	5	0,385
P(selfdevelopment "B" | Result "A")	2	0,054
P(selfdevelopment "B" | Result "A-")	7	0,146
P(selfdevelopment "B" | Result "B+")	1	0,077
P(attendance "A-" | Result "A")	4	0,108
P(attendance "A-" | Result "A-")	3	0,063
P(attendance "A-" | Result "B+")	1	0,077
P(report "A-" | Result "A")	3	0,081
P(report "A-" | Result "A-")	5	0,104
P(report "A-" | Result "B+")	4	0,308
P(X | Result "A")		0,0000000001559
P(X | Result "A-")		0,0000000000321
P(X | Result "B+")		0,0000000001648

Finally, do the clarification process. The clarification result taken is the one with the greatest probability.

Table 8. Clarification Process

P(X(Ci))*P(Ci)	P(X | Result "A") * P(Result "A")	0,0000000000589
	P(X | Result "A-") * P(Result "A-")	0,0000000000157
	P(X | Result "B+") * P(Result "B+")	0,0000000000219

Based on the table above, it can be seen that the probability obtained by M99 is Value A with a similarity value of 0.0000000000589.

3.2.2. User-based Collaborative Filtering Calculation

The calculated data are in the form of values given by the internship supervisor, field supervisor, and internship examiner converted into a rating form. As an example of a user-based calculation, the data used in Table 11 is the data resulting from converting student values into a form based on a Linkert scale of 1-10 with the code and position of the assessor in Table 12.

Table 9. Student Value Rating

Mahasiswa	D1	D2	D3
M1	9	9	10
M2	10	10	10
M3	10	10	9
M4	9	9	10
M5	9	8	10
M6	9	8	8
M7	10	10	10
M8	10	8	10
M9	10	10	10
M10	8	10	9
M11	10	10	10
M12	9	10	10
M13	10	10	10
M14	10	10	10
M15	10	8	10
M99	10	10	???

Table 10. Assessor Code

Kode	Jabatan
D1	Pembimbing Lapangan
D2	Dosen Pembimbing Magang
D3	Dosen Penguji

The example data above will be calculated to see the recommended results from user-based calculations on **M99**, using the following formula [10].

$$Similarity(A,B) = \frac{A \,.\, B}{||A|| \text{ x } ||B||} = \frac{\sum_{i=1}^{n} A_i \text{ x } B_i}{\sqrt{\sum_{i=1}^{n} A_i^2} \text{ x } \sqrt{\sum_{i=1}^{n} B_i^2}}$$

Explanation:

A and B : Two students to be compared. In this context, it is the lecturer who assesses the students.

A_i and B_i : Assessment or rating given by students A and B to the i-th item.

n : Number of items.

Based on this formula, the following are the results of calculating the similarity of values between students.

Table 11. User-based Collaborative Filtering Calculation Results

Mahasiswa	D1	D2	Numerator	Denominaor	Similarity	Ranking
Sim(M99,M1)	9	9	180	180	1	1
Sim(M99,M2)	10	10	200	200	1	1
Sim(M99,M3)	10	10	200	200	1	1
Sim(M99,M4)	9	9	180	180	1	1
Sim(M99,M5)	9	8	170	170,293864	0,998274373	3
Sim(M99,M6)	9	8	170	170,293864	0,998274373	3
Sim(M99,M7)	10	10	200	200	1	1
Sim(M99,M8)	10	8	180	181,107703	0,993883735	4
Sim(M99,M9)	10	10	200	200	1	1
Sim(M99,M10)	8	10	180	181,107703	0,993883735	4
Sim(M99,M11)	10	10	200	200	1	1
Sim(M99,M12)	9	10	190	190,262976	0,998617829	2
Sim(M99,M13)	10	10	200	200	1	1
Sim(M99,M14)	10	10	200	200	1	1

Sim(M99,M15)	10	8	180	181,107703	0,993883735	4

Based on the calculation above, M99 gets a similarity of 1 with several other students, so the recommended value that can be obtained by M99 is a rating of 10, or if in the assessment table it is A by D3 or the Examining Lecturer.

3. 3 Hybrid Recommendation Implementation

The implementation results are based on the system's appearance and algorithm (Naïve Bayes and User-based Collaborative). This section will discuss the appearance of the internship assessment system, including the implementation of the Hybrid Recommendation approach. This system is needed so that respondents can later review the effectiveness of the internship assessment system using the recommended hybrid recommendation technique. Here is the appearance of the system.

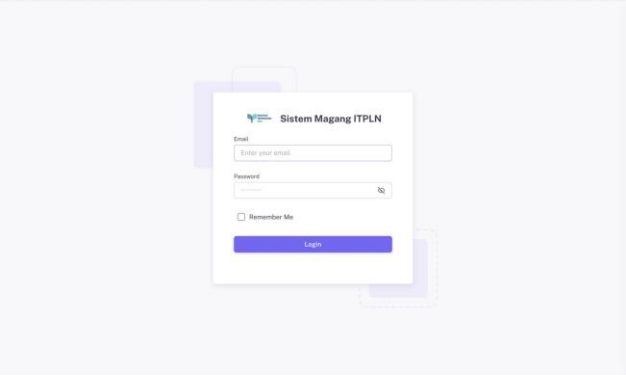

Figure 2. Login Display

Figure 2 is the login display. Users can enter the email and password provided by the study program admin so that the system will immediately read the user logged in as admin, student, internship supervisor, examiner, or field supervisor.

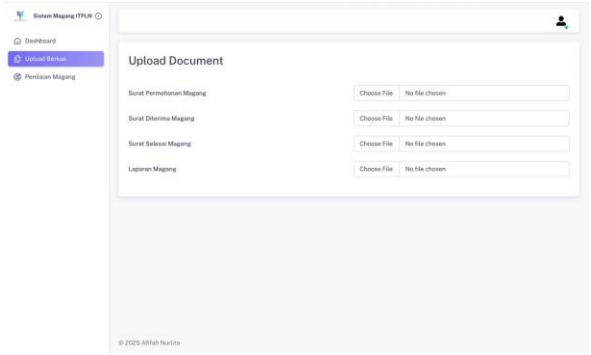

Figure 3. Upload Student Files

Figure 3 is a login image for the following students, students can upload all files that are internship requirements. Files that need to be uploaded by students are internship application letters, internship acceptance letters, internship completion letters, and internship reports.

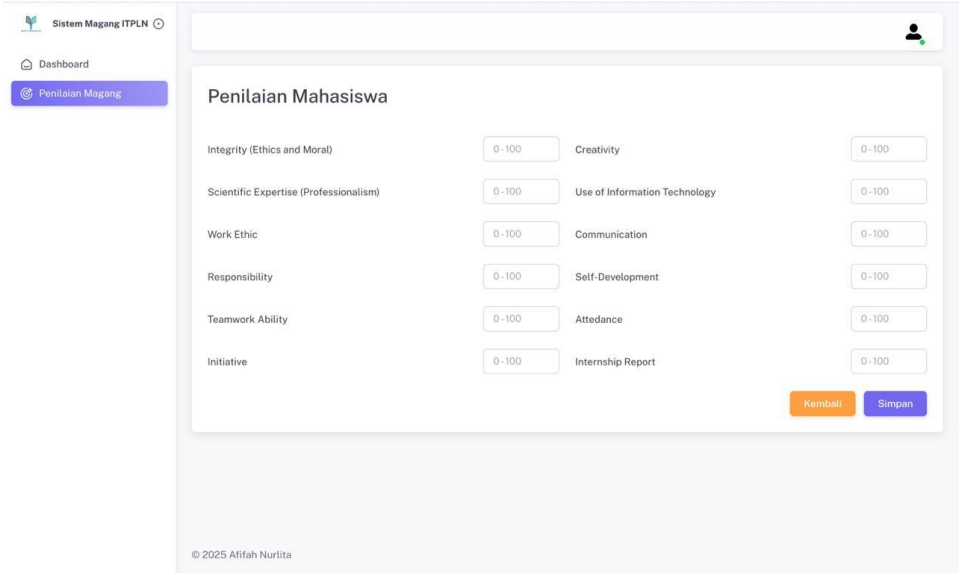

Figure 4. Internship Assessment Form

After students complete their internship according to the period, the internship supervisor and field supervisor will display an internship assessment form based on 12 attributes as shown in **Figure 4.**

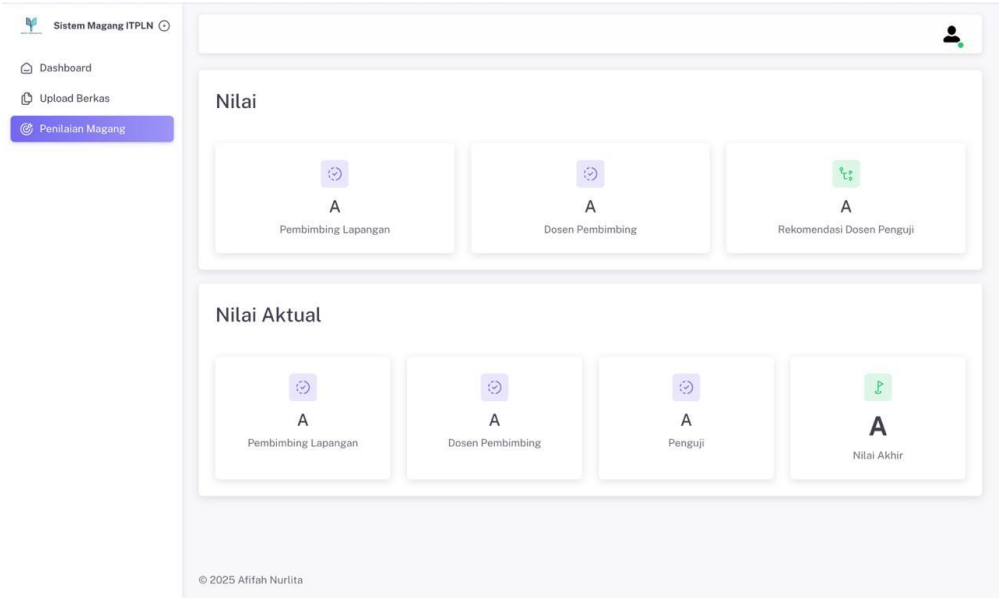

Figure 5. Student Internship Value

Figure 5 above shows the recommendation value and the actual value obtained by students on their student accounts.

4. Conclusion

This study focuses on the implementation of hybrid recommendations in assessing student internships at ITPLN. The applied method combines two main approaches: content-based filtering using the naïve Bayes algorithm and collaborative filtering with the user-based filtering method. By using the naïve Bayes method, this system successfully classifies students' internship scores based on relevant attributes, thus providing more accurate recommendations. Meanwhile, the user-based filtering approach allows the system to predict the internship score that students will get based on the assessment of the examining lecturer, which takes into account the experience and assessment of other users.

The results of the implementation of this hybrid recommendation system show the potential for improvement in the internship assessment process, which not only increases accuracy but also provides more personalized recommendations to students. Thus, this study makes a significant contribution to the development of a more efficient and effective internship assessment system in the academic environment. Overall, the hybrid recommendation implemented in this study can be a model for other educational institutions to improve the process of evaluating and assessing student internships, as well as contribute to the development of more innovative assessment methods in the field of education.

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