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Decision Support System For Determining The Best Graduate Students Using The Analytical Hierarchy Process Method At Stmik Neumann

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Abstract

This study discusses determining the best graduate students, the process of determining the best graduate students is a problem that involves many criteria that are assessed, so that a decision support system is needed to solve it. The process of determining the best graduate students at STMIK Neumann is still constrained because there is no effective method yet and the assessment criteria are only based on GPA scores. In designing this system, researchers used the Analytical Hierarchy Process (AHP) method as the weighting method used. The four basic criteria used are GPA, scientific writing, superior achievement/ability and English. The AHP method can display the value of the priority weight of criteria that can be used as an alternative to determine the best graduate students. The decision support system application for determining the best graduate students is made using a desktop-based programming language, namely Visual Basic 2010 and MySQL as the database. The system built is able to provide ranking recommendations from the number of values sorted by the highest weight. With this system, it is hoped that it can provide an alternative for decision makers to determine the best graduate students at STMIK Neumann.

Keywords*: Decision Support System, AHP, the best graduates*

1. Introduction

Determination of the best graduate students at STMIK Neumann still experiences problems in the decision-making process. This is because there is no objective method to decide quickly and involve many assessed criteria or multiple criteria. For this reason, this research tries to use the Analytical Hierarchy Process (AHP) method. The Analytical Hierarchy Process method is one of the methods used to complete the decision-making system.

The process of selecting the best graduate students is a problem that involves many components or criteria that are assessed (multi-criteria), so that a decision support system with multi-criteria is needed to solve it. Students are expected not only to pursue knowledge in their field, but also to do activities to develop their soft skills so that they become graduates who are independent, full of initiative, work carefully, full of responsibility and tough. This ability can be obtained by students through formal debriefing in the learning curriculum, co-curricular and extra-curricular.

Therefore, STMIK Neumann needs to identify those who excel in these two competencies and the best ones need to be awarded as the best graduate students. The selection of the best graduate students refers to the individual performance of students who meet the

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criteria set by DIKTI in 2017, namely the cumulative grade point average (GPA of all courses passed) with an average of at least 3.00, scientific writing, superior achievement/ability, and language English.

2. Methodology

Ngatawi and I. Setyaningsih (2011) in Suci Oktri Viarani and Hilma Raimona Zadry (2015) the steps in the Analytical Hierarchy Process Method are:

1. Determine the types of criteria used
2. Arranging these criteria in a paired matrix
   $a_{ij} = \frac{\mathrm{wi}}{\mathrm{wj}}, \mathrm{i,j} = 1,2,\ldots,\mathrm{n}$ (1)
   Where n represents the number of criteria being compared, wi the weight for the i-th criteria and aij is the comparison of the weights for the i and j criteria.
3. Normalize each column by dividing each value in column i and row j by the total value of each column.
   $a_{ij} = \frac{\mathrm{a_{ij}}}{\sum \mathrm{a_{ij}}}$ (2)
4. Determine the priority weight of each i-th criterion, by dividing the number of each a value by the number of criteria being compared (n).
   $a_{ij} = \frac{\sum \mathrm{a}}{\mathrm{n}}$ (3)
5. Determine WSF (Wieght Single Factor) with the formula
   $a_{ij} = \sum_{\mathrm{i}}^{\mathrm{n}} = 1\ \mathrm{a_{ij}} \times \mathrm{w_i}$ (4)
6. Determine the value of CF (Consistenci Factor) with the formula
   $\mathrm{CF} = \frac{\mathrm{WSF}}{\mathrm{Bobot}}$ (5)
7. Calculating the average lamda max or CF value with a formula
   $\lambda\,\mathrm{max} = \frac{\sum \mathrm{CF}}{\mathrm{n}}$ (6)
8. Calculating the Consistency Index (CI)
   Calculation of the Consistency Index using the equation:
   $\mathrm{CI} = \frac{\lambda\,\mathrm{max}-\mathrm{n}}{\mathrm{n}-1}$ (7)
9. Measuring the entire consistency of the assessment using the consistency ratio (CR) with the formula:
   $\mathrm{CR} = \frac{\mathrm{CI}}{\mathrm{RI}}$ (8)
10. A certain level of consistency is needed in prioritizing to get the best value. The value of CR ≤ 0.10 is a consistency value, otherwise it needs to be revised. Table 2.2 shows the value of the Random Index (RI)

Table 1. Random Index (RI) Value

N	RI
1	0.00

2	0.00
3	0.58
4	0.90
5	2.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49
11	1.51
12	1.48
13	1.56
14	1.57
15	1.59

11. Determining the priority weight value is obtained from the sum of the comparison weight values between criteria multiplied by the alternative comparison weight values with the criteria.
    Priority Weight = Σ(Comparison Weight Between Criteria x Alternative Comparison Weight with Criteria) (9)

3. Results and Discussion

Of the 4 criteria, it will be related to the student who becomes the best graduate. Each student must meet each of the predetermined criteria to become the best graduate student, namely: GPA, Scientific Writing, Achievement/ability that is superior and English.

1. Determine the criteria for determining the best graduate students

In the AHP method there are criteria needed to determine the best graduate students. The criteria given can be seen in the table below.

Table 2. Criteria

Criteria	Information
K1	Cumulative Achievement Index
K2	Scientific papers
K3	Preferred achievement/ability
K4	English language

These four criteria will be taken into account to determine which students are more prioritized to become the best graduates.

a. Define sub-criteria for each criterion

Sub-criteria for GPA score (K1)

Table 3. Parameters measured by GPA value (K1)

GPA Score (K1)	Information
3.51 – 4.00	With compliments
2.76 – 3.50	Very satisfy
2.25 – 2.75	Satisfying

From Table 3. above it can be seen that the measuring parameters are based on the GPA value. For descriptions With Compliments, given for GPA values from 3.51 to 4.00, for Very Satisfactory descriptions, given for GPA values from 2.76 to 3.50. Then for a Satisfactory statement, it is given for a GPA from 2.25 to 2.75.

Subcriteria for the value of Scientific Work (K2)

Table 4. Parameters measured based on the value of Scientific Writing (K2)

Value of Scientific Writing (K2)	Information
86 – 100	Very good
71 - < 86	Well
56 - < 71	Enough
41 - < 56	Not enough

From Table 4 above it can be seen that the measuring parameters are based on the value of scientific writing. For Very Good descriptions, it is given for scientific writing scores from 86 to 100, for Good descriptions, it is given for scientific writing scores from 71 to 85. Then for Fair descriptions, it is given for scientific paper scores from 56 to 70 and for Poor descriptions awarded for the value of scientific writing from 41 to 55.

Sub-criteria for Achievement (K3)

Table 5. Parameters measured based on Achievement (K3)

Achievement (K3)	Information
National	Very good
Province/City	Well
Campus	Enough
There isn't any	Not enough

From Table 5 above it can be seen that the measuring parameters are based on achievement. For Very Good information, it is given for achievement at the national level, for Good information, it is given for achievement at the Provincial/City level. Then for sufficient information, it is given for campus-level achievements and for Insufficient information it is given for students who do not have achievements.

Sub-criteria for English score (K4)

Table 6. Parameters measured based on the value of English (K2)

English Grade (K4)	Information
86 – 100	Very good
71 - < 86	Well
56 - < 71	Enough
41 - < 56	Not enough

From Table 6 above it can be seen that the measuring parameters are based on English scores. For a Very Good description, it is given for an English score from 86 to 100, for a Good description, it is given for an English score from 71 to 85. Then for an Fair description, it is given for an English score from 56 to 70 and for a Poor description it is given for a score scientific works from 41 to 55.

2. Calculation of priority criteria for the best graduate students using the Analytical Hierarchy Process (AHP) method

a. Determine the priority of criteria

The steps that must be taken in determining priority criteria are as follows:

a. Create a pairwise comparison matrix

Table 7. Pairwise Comparison Matrix

Criteria	GPA	Scientific papers	Achievement	English
GPA	1	3	4	4
Scientific papers	0.333	1	3	3
Achievement	0.25	0.333	1	2
English	0.25	0.333	0.5	1
Amount	1,833	4,666	8,5	10

In table 7. is a comparison matrix of the criteria for the best graduating students which determines which criteria are the most important among other criteria. The number 1 in the GPA value column for the GPA line illustrates the same level of importance between the GPA value and the GPA value. While the number 3 in the scientific writing column, the GPA value line indicates that the GPA value is somewhat more important for scientific writing. The number 0.333 in the GPA value column for scientific writing lines is the result of calculating 1/value in the scientific work column GPA value line (1/3). The other numbers are obtained in the same way.

b. Create a matrix value criteria

Value of new row column = Value of old columns/sum of each old column.

Table 8. Criteria Value Matrix

	GPA	T. Scientific works	Achievement	English	Amount	Priority
GPA	0.545	0.643	0.471	0.400	2,059	0.515
T. Scientific works	0.182	0.214	0.353	0.300	1,049	0.262
Achievement	0.136	0.071	0.118	0.200	0.525	0.131
English	0.136	0.071	0.059	0.100	0.367	0.092

The value of 0.545 in the GPA value column, table 3.8, is obtained from the value of the GPA value column, table 8, divided by the number of columns of table 3.6 (1/1.833). The value of the total column in table 3.8 is obtained from the sum of each row. For the first row, the value 2.059 is the sum of 0.545 + 0.643 + 0.471 + 0.400. The value in the priority column is obtained from the value in the total column divided by the number of criteria, in this case 4 (2.059/4 = 0.515).

c. Create a sum matrix for each row

Table 9. The Addition Matrix for Each Row

	GPA	Scientific papers	Achievement	English	Amount

GPA	0.515	0.786	0.524	0.368	2,193
Scientific papers	0.171	0.262	0.393	0.275	1.102
Achievement	0.129	0.087	0.131	0.183	0.531
English	0.129	0.087	0.066	0.092	0.374

The value of 0.515 in the GPA value row in the GPA value column table 3.9 is obtained from the priority of the GPA value row in table 3.7 (0.515) multiplied by the row value of the GPA value column of the GPA value column in table 3.6 (0.515x1 =0.515). Score0.171in the line of scientific writing, the GPA value column table 3.9 is obtained from the priority of the line of scientific writing in table 3.7 (0.515) multiplied by the row value of scientific writing column GPA value in table 3.6 (0.515x0.33 =0.171).

The total column in table 3.9 is obtained by adding up the values in each row in the table. For example, value2,193in the amount column is the sum of the0.515+0.786+0.524+0.368.

d. Consistency ratio calculation

This calculation is used to ensure that the value of the consistency ratio (CR) < = 0.1. If it turns out that the CR value is greater than 0.1, then the pairwise comparison matrix must be corrected.

Table 10 Comparison of Consistency Ratio

	Row Amount	Priority	Results
GPA	2,193	0.515	2,708
Scientific papers	1.102	0.262	1,364
Achievement	0.531	0.131	0.662
English	0.374	0.092	0.466
Amount			5,201

The total column per line is obtained from the total column in table 3.8, while the priority column is obtained from the priority column in table 7. In table 9, the following values are obtained:

Amount (sum of result values) :5,201

n (number of criteria) = 4

$$\lambda \text{ max(amount/n)} = \frac{5,201}{4} = 1,300$$

$$\text{CI } ((\lambda \text{ max} - \text{n})/\text{n}) = \frac{(1,300 - 4)}{4} = -0,675$$

$$\text{CR(CI/IR)} = \frac{-0,675}{0,90} = -0,75$$

The IR value (Random Index) is determined based on the n value (number of criteria). Because the value of n = 4 then the value of IR = 0.90

Determine the priority of sub-criteria

1. Calculating the priority of the sub-criteria from the criteria for the GPA value

Table 11. Comparison of GPA Consistency Ratio

	Row Amount	Priority	Results
With compliments	1,943	0.633	2,576
Very satisfy	0.593	0.195	1,049
Satisfying	0.320	0.106	0.426
Amount			4,051

Amount (sum of result values) :4,051
n (number of criteria) = 3

$$\lambda \max(\text{amount/n}) = \frac{4,051}{3} = 1,350$$

$$\text{CI } ((\lambda \max - n)/n) = \frac{(1,350 - 3)}{3} = -0,550$$

$$\text{CR(CI/IR)} = \frac{-0,550}{0,58} = -0,948$$

Because CR < 0.1, the consistency ratio of the calculation is acceptable.

2. Calculating the priority of the sub-criteria from the criteria for scientific writing

Table 12. Comparison of the Consistency Ratio of Scientific Writing

	Row Amount	Priority	Results
Very good	2,321	0.558	2,882
Well	1,066	0.260	1.326
Enough	0.453	0.112	0.565
Not enough	0.285	0.071	0.356
Amount			5,129

Total (sum of the result values) :5,129
n (number of criteria) = 4

$$\lambda \max(\text{amount/n}) = \frac{5,129}{4} = 1,282$$

$$\text{CI } ((\lambda \max - n)/n) = \frac{(1,282 - 4)}{4} = -0,679$$

$$\text{CR(CI/IR)} = \frac{-0,679}{0,90} = -0,755$$ Because CR < 0.1, the consistency ratio of the calculation is acceptable.

3. Calculating the priority of the sub-criteria from the achievement criteria

Table 13. Comparison of Achievement Consistency Ratio

	Row Amount	Priority	Results

Very good	1,887	0.466	2,353
Well	1,120	0.277	1,397
Enough	0.647	0.161	0.807
Not enough	0.385	0.096	0.480
Amount			5,037

Amount (sum of result values) :5,037
n (number of criteria) = 4

$$\lambda \text{ max(amount/n)} = \frac{5{,}037}{4} = 1{,}259$$

$$\text{CI } ((\lambda \text{ max} - \text{n})/\text{n}) = \frac{(1{,}259 - 4)}{4} = -0{,}685$$

$$\text{CR(CI/IR)} = \frac{-0{,}685}{0{,}90} = -0{,}761$$

Because CR < 0.1, the consistency ratio of the calculation is acceptable.

4. Calculating the priority of the sub-criteria from the English language score criteria

Table 14 Comparison of English Consistency Ratio

	Row Amount	Priority	Results
Very good	2,229	0.542	2,761
Well	0.949	0.234	1.183
Enough	0.563	0.140	0.703
Not enough	0.341	0.085	0.426
Amount			5,083

Amount (sum of result values) :5,083
n (number of criteria) = 4

$$\lambda \text{ max(amount/n)} = \frac{5{,}083}{4} = 1{,}271$$

$$\text{CI } ((\lambda \text{ max} - \text{n})/\text{n}) = \frac{(1{,}271 - 4)}{4} = -0{,}682$$

$$\text{CR(CI/IR)} = \frac{-0{,}682}{0{,}90} = -0{,}758$$

Because CR < 0.1, the consistency ratio of the calculation is acceptable.

5. Create a Results Matrix

Priority calculation results in steps 1 and 2 are then set forth in the results matrix shown in table 3.27. This result matrix will later be used as a reference in determining the student with the highest score who is entitled to be the best graduate student.

Table 15. Result Matrix

GPA	**Scientific papers**	**Achievement**	**English**

0.515	0.262	0.131	0.092
With compliments	Very good	Very good	Very good
1	1	1	1
Very satisfy	Well	Well	Well
0.410	0.465	0.594	0.431
Satisfying	Enough	Enough	Enough
0.167	0.200	0.345	0.258
	Not enough	Not enough	Not enough
	0.127	0.206	0.156

If given data on the scores of 10 students to determine the best graduates, as shown in table 15, the final results can be seen in table 16.

Table 16 Final Value

Name	GPA	Scientific papers	Achievement	English	Total
Tika	0.211	0.122	0.027	0.040	0.400
Aulia	0.211	0.262	0.027	0.092	0.592
Retno	0.211	0.122	0.027	0.092	0.452
Bayu	0.211	0.262	0.027	0.040	0.540
Wise	0.211	0.122	0.027	0.040	0.400
eco	0.211	0.122	0.045	0.040	0.418
André	0.211	0.262	0.045	0.092	0.610
women	0.211	0.262	0.131	0.092	0.696
Nurul	0.211	0.262	0.027	0.040	0.540
Dawn	0.211	0.262	0.027	0.040	0.540

The value of 0.211 in the Tika row GPA column was obtained from the value of a student named Tika for GPA, namely "Very Satisfactory" with a priority of 0.410 in table 15, multiplied by a priority GPA of 0.515 in table 15. Likewise other values. The total column in table 16 is obtained from the sum of each row. This total score is used as the basis for determining the best graduate students. Then the student with the highest score is a student named Annisa, with a total score of 0.696.

4. Conclusion

1. By applying the Analytical Hierarchy Process method, the system built can display decision results that can be used as an alternative in determining the best graduate students.
2. The decision support system built can speed up the process of determining the best graduate students and after an assessment of 10 students, the decision support system application can produce the final result with the highest weight value of 0.696.

References

Anita Diana,. & Dyah Retno Utari. 2016. *Penerapan Metode Analitycal Hierarchi Process (AHP) Dalam Sistem Penunjang Keputusan Pemilihan Vendor Desain Grafis*. TELEMATIKA MKOM, 8(2), 97-106.

Antonius Rachmat C,. & Aditya Wikan M. 2016. *Konsep & implemetasi pemrograman gui* (edisi I). Yogyakarta: Andi.

Eko Darmanto,. Noor Latifah,. & Nanik Susanti. 2014. *Penerapan Metode AHP (Analitycal Hierarchi Process) Untuk Menentukan Kualitas Gula Tumbu*. SIMETRIS, 5(1), 75-82.

Eva Rianti,. & Robby Noval Pratama. 2016. *Perancangan Aplikasi Sistem Pendukung Keputusan Pemilihan Peserta Olimpiade Sains Tingkat Kabupaten SMPN 7 Sijunjung Menggunakan Metode Analytical Hierarchy Process*. SAINS DAN INFORMATIKA, 51-60.

Estining Nur Sejati Purnomo,. Sari Widya Sihwi,. & Rini Anggrainingsih. 2013. *Analisis Perbandingan Menggunakan Metode AHP, TOPSIS, dan AHP-TOPSIS dalam Studi Kasus Sistem Pendukung Keputusan*. ITSMART, 2(1), 16-23.

Harorld Situmorang. 2015. *Sistem Pendukung Keputusan Pemilihan Calon Peserta Olimpiade Sains Tingkat Kabupaten Langkat Pada Madrasah Aliyah Negeri (Man) 2 Tanjung Pura Denganmenggunakan Metode Simple Additive Weighting (Saw)*. TIMES, IV(2), 24-30.

Haviluddin,. 2011. *Memahami Penggunaan UML (Unified Modelling Language)*. Informatika Mulawarman, 6(1), 1-15.

Opik Taupik K,. Mohamad Irfan,. Ai Nurpianti,. 2013. *Pembuatan Aplikasi Anbiyapedia Ensiklopedi Muslim Anak Berbasis Web*. VII(1), 33-52.

RISTEKDIKTI (2017). *Pedoman Pemilihan Mahasiswa Berprestasi (Pilmapres) Program Sarjana*. Ditemukenali 16 Juli 2017, dari http://pilmapres.ristekdikti.go.id/file/pendukung/2017/PEDOMAN_PILMAPRES_SARJANA_2017.pdf

Rosa A.S., M. Shalahudin. 2013. *Modul Pembelajaran Rekayasa Perangkat Lunak (Terstruktur dan Berorientasi Objek)*. Bandung : MODULA

Saefudin,. & Sri Wahyuningsih. 2014. *Sistem Pendukung Keputusan Untuk Penilaian Kinerja Pegawai Menggunakan Metode Analytical Hierarchy Process (AHP) Pada RSUD Serang*. Sistem Informasi, 1(1), 33-37.

Suci Okti Viarani,. & Hilma Raimona Zadry,. 2015. *Analisis Pemilihan Pemasok Dengan Metode Anlitycal Hierarchi Process di Proyek Indarung VI PT Semen Padang*. Optimasi Sistem Industri, 14(1), 55-70.

Syahrani Dhimas Prabowo,. & Eko Budi Setiawan. 2013. *Sistem Pendukung Keputusan Revitalisasi Terhadap Bangunan Dan Kawasan Cagar Budaya Kota Bandung Di Disbudpar Kota Bandung*. Komputer dan Informatika (KOMPUTA), 2(2), 27-34.

Toriqh Rintaka Widya Gusti Kresna,. Haeruddin,. & Edy Budiman. 2017. *Aplikasi Sistem Manajemen Barang Pada Toko Alat Tulis Kantor Di Toko Siswa 13*. Prosiding Seminar Ilmu Komputer dan Teknologi Informasi, 2(1), 274-280.