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Decision Support System for Final Assignment with Analytical Hierarchy Process (AHP) Method. Case Study: Informatics Engineering Faculty of Engineering, Pancasila University

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Abstract

In human life always faced with several choices. The right decision making will affect our lives in the future. In the bachelor degree program education Final Project is the closing course to get a Bachelor's degree. Many things need to be considered in determining the appropriate TA topic. Many people have a view, choose the topic of Final Assignment that is easy so easy, regardless of suitability with interests and talents. Actually this view needs to be reviewed because choosing the topic of Final Assignment has a significant impact on the lives of these students in the future. To determine the topic of Final Assignment in the Informatics Engineering Faculty of Engineering, the Pancasila University required mastering criteria, mastering memorization, mastering the count, mastering the design, value, and areas of interest. And has an alternative, namely Information Systems, Decision Support Systems using methods, Intelligent Systems/Expert Systems, Networks, Mobile Programming (Games), Mobile Programming (Applications), Use of Algorithms in Support Systems / Applications of this Decree using Analytic Hierarchy Process method for determine the exact topic of Final Assignment according to the ability of students. The AHP method refers to taking selected elective courses.

I. PREFACE

In human life always faced with several choices. The right decision making will affect our lives in the future. In the education process there are three stages: the study plan, the Teaching and Learning Process (PBM) and evaluation. Evaluation consists of evaluation of courses, and final evaluation of studies. Evaluation of courses can be done with examinations, assignments, and observations. Study final evaluation is a process of assessing student achievement to determine their graduation in a study program.

In the bachelor degree program education Final Project is the closing course to get a Bachelor's degree. Therefore every student must take Final Assignment courses. Students often experience difficulties or obstacles in determining Final Assignment topics. Final Assignment is an independent task to make scientific work done by students under the guidance of a supervisor. Many things need to be considered in determining the appropriate Final Assignment topic. Many people have a view, choose the topic of Final Assignment that is easy so easy, regardless of suitability with interests and talents. Actually this view needs to be reviewed because choosing the topic of Final Assignment has a significant impact on the lives of these students in the future.

To determine the topic of Final Assignment in the Informatics Engineering Faculty of Engineering, the Pancasila University required mastering criteria, mastering memorization, mastering the count, mastering the design, value, and areas of interest. And has alternatives, namely Information Systems, Decision Support Systems, Intelligent

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Systems/Expert Systems, Networks, Mobile Programming (Games), Mobile Programming (Applications), Use of Algorithms in Systems / Applications

II. ANALYTICAL HIERARCHY PROCESS (AHP)

AHP is a functional hierarchy with the main input of human perception. The existence of hierarchies allows the breakdown of complex or unstructured problems in sub-problems and compile them into a hierarchical form. AHP has many advantages in explaining the decision making process. One of them is that it can be described graphically so that it is easily understood by all parties involved in decision making.

Analitycal Hierarchy Process (AHP) is one of the decision-making methods developed by [1], a mathematician from the University of Pittsburg, USA in the early 1970s. AHP is one model of decision making that can help the human frame of mind. Basic thinking AHP method is the process of forming numerical scores to compile a ranking of each decision alternative based on how the alternative should be matched with the criteria of the decision maker [2]. The AHP method takes into account the level of validity up to the tolerance limit for inconsistencies of various criteria and alternatives chosen by decision makers.

Stages of Decision Making

The decision-making stages are [3] [4] [5]:

1. Identify the problem
2. Selection of problem solving methods
3. Collection of data needed to implement the decision model.
4. Implement the model
5. Evaluate the positive side of each alternative
6. Implement selected solutions

AHP Method Procedure

The AHP Method procedure is as follows:

1. Define the problem and determine the desired solution, then compile a hierarchy of the problems faced. The hierarchy is to set goals that are the overall system goals at the highest level. Then create a hierarchical structure that begins with general objectives, followed by criteria and alternatives at the lowest level.
2. Determine the priority of elements.
    a. make a comparison of pairs, that is comparing elements in pairs according to the criteria given
    b. Pairwise comparison matrices are filled using numbers to represent the relative importance of an element to other elements
    c. Create a pairwise comparison matrix that describes the relative contribution or influence of each element on each criterion with another criterion scale 1 to 9 is the best scale in comparing elements.
    The Comparison Rating Scale is as follows:

Table 1. Scoring Scale

1	Both elements are equally important
3	One element is slightly more important than the other element
5	One element is more important than the other
7	One element is clearly more important than other elements
9	One element is absolutely important than other elements
2,4,6,8	Values between two close consideration values

Table 2. List of Random Index Values

UKURAN MATRIKS	**NILAI IR**
1,2	0,00
3	0,58
4	0,90
5	1,12

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

The steps to determine the decision support system using the AHP method are:

1. Determine the criteria priority
   Make a pairwise comparison matrix. Comparative assessment is carried out between one criterion and another.
2. Create a criteria value matrix. This matrix is obtained by the formula:
   New column row value = Old row - column value / total number of old columns.
   a. Create an addition matrix for each row.
   b. Calculation of consistency ratio
   c. Used to ensure that the consistency ratio (CR) value <= 0.1. If it turns out that the CR value is greater than 0.1then the pairwise comparison matrix must be corrected.
3. Determine subcriteria priority. Performed on sub-sub-criteria of all criteria. Calculates sub-criteria priorities and criteria, namely:
   a. Create a pairwise comparison matrix.
   b. Create a criteria value matrix
   c. Determine the addition matrix of each row
   d. Calculation of consistency ratio
4. Calculate results. Priority of calculation results in steps 1 and 2 is then stated in the results matrix.

III. RESULTS AND DISCUSSION

The results and discussion of the support system using the AHP Method are

1. The names of elective courses can be assumed to be alternative namely Distributed Data Processing courses, Intranet Development, Decision Support Systems, Intelligent Systems, Cryptography, Multimedia Information Systems, Executive Information Systems, Wireless Computer Networks, E-Commerce, Mobile Programming, E-Goverment [6], XML.
2. There are data on 12 elective courses before simplifying, which is taken from the resume of the results of direct interviews with the Head of the Department which is used as a reference in Final Assignment decision making. These references are Information Systems, Decision Support Systems, Intelligent Systems, Networks, Use of Algorithms in Systems or Applications, Mobile Programming Games and Mobile Application Programming. The hierarchical structure can be drawn as below

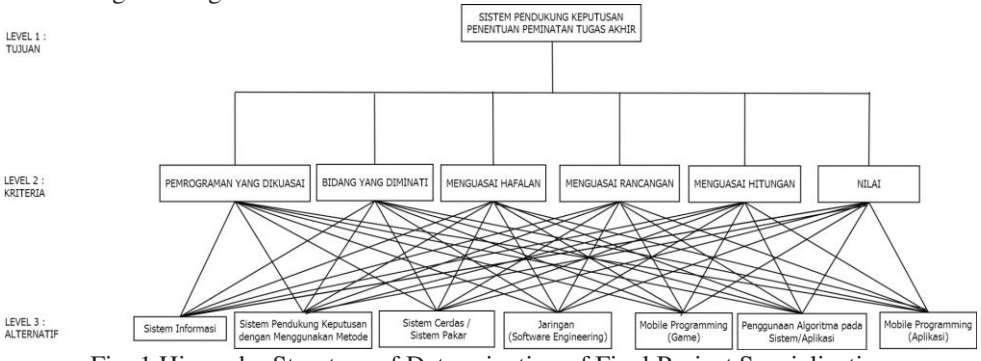

Fig. 1 Hierarchy Structure of Determination of Final Project Specialization

3. Creating a Hierarchy Weighting Factor Matrix for All Criteria

Table 3. Weighting Factor Matrix

Criteria	Mastered programming	Areas of interest	Mastering memorization	Master the design	Mastering the count	Value
Mastered programming	1	1/5	1/3	1/4	1/2	1/7
Areas of interest	5	1	4	2	2	1/2
Mastering memorization	3	1/4	1	1/3	2	1/5
Master the design	4	1/2	3	1	5	1/3
Mastering the count	2	1/2	1/2	1/5	1	1/4
Value	7	2	5	3	4	1

There are 6 criteria in the decision support system for determining valuation. Explain about mastered or not the comparison of criteria, the value is 1/5, 1/3, 1/4, 1/2, 1/7 which means that it is inversely proportional, the value 1 means the same is controlled, the value of 2.4 means that it is sufficiently controlled, the value of 5 means more mastered and value 7 means very mastered.

4. Create a hierarchy weighting factor matrix for all simplified criteria such as the table below:

Table 4. Simplified Hierarchy Weighting Factor Matrix for All Criteria

Criteria	Mastered programming	Areas of interest	Mastering memorization	Master the design	Mastering the count	Value
Mastered programming	1.00	0.20	0.33	0.25	0.50	0.14
Areas of interest	5.00	1.00	4.00	2.00	2.00	0.50
Mastering memorization	3.00	0.25	1.00	0.33	2.00	0.20
Master the design	4.00	0.50	3.00	1.00	5.00	0.33
Mastering the count	2.00	0.50	0.50	0.20	1.00	0.25
Value	7.00	2.00	0.50	3.00	4.00	1.00

The priority weight value is generated from the average relative weights for each row. After the comparison matrix is formed, we can see the priority weights for the comparison of criteria. By dividing the contents of the comparison matrix with the appropriate number of columns, then adding up the line after that the sum of the results is divided by the number of criteria so that the priority weights are found.

5. Create a hierarchy weighting factor matrix for all normalized criteria such as the table below:

Table 5. Hierarchy Weighting Factor Matrix for All Normalized Criteria

Criteria	Mastered programming	Areas of interest	Mastering memorization	Master the design	Mastering the count	Value	Priority weight
Mastered programming	0.05	0.04	0.02	0.04	0.03	0.06	0.04
Areas of interest	0.23	0.22	0.29	0.29	0.14	0.21	0.23
Mastering memorization	0.14	0.06	0.07	0.05	0.14	0.08	0.09
Master the design	0.18	0.11	0.22	0.15	0.34	0.14	0.19
Mastering the count	0.09	0.11	0.04	0.03	0.07	0.10	0.07

Value	0.32	0.45	0.36	0.44	0.28	0.41	0.38

6. Determine the highest priority weight of all the criteria contained in the 0.38 value criteria

0.04	= 0.05 + 0.04 + 0.02 + 0.04 + 0.03 + 0.06 / 6
0.23	= 0.23 + 0.22 + 0.29 + 0.29 + 0.14 + 0.21 / 6
0.09	= 0.14 + 0.06 + 0.07 + 0.05 + 0.14 + 0.08 / 6
0.19	= 0.18 + 0.11 + 0.22 + 0.15 + 0.34 + 0.14 / 6
0.07	= 0.09 + 0.11 + 0.04 + 0.03 + 0.07 + 0.10 / 6
0.38	= 0.32 + 0.45 + 0.36 + 0.44 + 0.28 + 0.41 / 6

7. The maximum eigenvalue (maximum λ) is

0.254547636	= (1.00*0.04) + (0.20*0.23) + (0.33*0.09) + (0.25*0.19) + (0.50*0.07) + (0.14*0.38)
1.50566985	= (5.00*0.04) + (1.00*0.23) + (4.00*0.09) + (2.00*0.19) + (2.00*0.07) + (0.50*0.38)
0.554599912	= (3.00*0.04) + (0.25*0.23) + (1.00*0.09) + (0.33*0.19) + (2.00*0.07) + (0.20*0.38)
1.228398688	= (4.00*0.04) + (0.50*0.23) + (3.00*0.09) + (1.00*0.19) + (5.00*0.07) + (0.33*0.38)
0.446771985	= (2.00*0.04) + (0.50*0.23) + (0.50*0.09) + (0.20*0.19) + (1.00*0.07) + (0.25*0.38)

Table 6. Eigenvalue

Amount of Multiplication between Multiplication Factors with priority weights	Priority Weight	**λ max**
0.254547636	0.04	6.238912644
1.50566985	0.23	6.546390653
0.554599912	0.09	6.227960827
1.228398688	0.19	6.382397065
0.446771985	0.07	6.079909073
2.431679775	0.38	6.457501395
Σ		**37.93307166**

8. Calculating the consistency index value, 6-order matrix (which consists of 6 criteria), the consistency index values obtained are:

$$CI = \frac{\lambda\, maks - n}{n-1} = \frac{6.32217861 - 6}{6-1} = 0.064435722$$

9. Determine the Consistency Ratio (CR) by entering the value of Consistency Index (CI) divided by Random Index (RI), Random Index is a function of the number of criteria or systems being considered

$$CR = \frac{\text{CI}}{RI} = \frac{0.064435722}{1.249} = 0.051964292$$

Because CR 0.05 <0.100 means the preference of respondents is consistent.
From the results of the calculation above shows that: the value criteria is the most important criterion for students who want to determine their specialization in the final project with a weight of 0.38 or 38%, the next is the criteria of the field of interest with a weight value of 0.23 or 23%, then criteria for mastering the design with the weight value is 0.19 or 19%, the criteria master memorization with a weight value of 0.09 or 9%. Criteria take the count with a weight value of 0.07 or 7% and the programming criteria that are mastered with a weight value of 0.04 or 4%

10. Determination of alternatives in the decision support system for determining specialization of Final Assignment.

Table 7. Alternative

No	Alternative	Code
1	Information System	A
2	Decision Support System	B
3	Expert System	C
4	Network	D
5	Mobile Programming (Game)	E
6	Use of Algorithms in Systems / Applications	F
7	Mobile Programming (Application)	G

11. Calculating the determination factor of specialization Final Assignment for the programming criteria that are mastered. Below is an alternative pairwise comparison matrix against the programming criteria mastered

Table 8. Comparison Matrix

	A	B	C	D	E	F	G
A	1.00	5.00	1.00	7.00	3.00	3.00	2.00
B	0.20	1.00	0.33	1.00	0.50	1.00	0.33
C	1.00	3.00	1.00	6.00	2.00	2.00	1.00
D	0.14	1.00	0.17	1.00	0.50	0.50	0.25
E	0.33	2.00	0.50	2.00	1.00	3.00	1.00
F	0.33	1.00	0.50	2.00	0.33	1.00	0.25
G	0.50	3.00	1.00	4.00	1.00	4.00	1.00
Σ	3.51	16	4.50	23	8.33	14.50	5.83

12. Calculate priority weights based on the results of the addition of alternatives

Table 9. Priority Weight

	A	B	C	D	E	F	G	Weight
A	0.28	0.31	0.22	0.30	0.36	0.21	0.34	0.29
B	0.06	0.06	0.07	0.04	0.06	0.07	0.06	0.06
C	0.28	0.19	0.22	0.26	0.24	0.14	0.17	0.21
D	0.04	0.06	0.04	0.04	0.06	0.03	0.04	0.04
E	0.09	0.13	0.11	0.09	0.12	0.21	0.17	0.13
F	0.09	0.06	0.11	0.09	0.04	0.07	0.04	0.07
G	0.14	0.19	0.22	0.17	0.12	0.28	0.17	0.18

13. Calculate the highest priority weight of all alternatives contained in the Alternative Information System 0.296886733

0.296886733	= 0.28+0.31+0.27+0.3+0.36+0.21+0.34/7
0.062566187	= 0.06+0.06+0.09+0.04+0.06+0.07+0.06/7
0.22133354	= 0.28+0.19+0.27+0.26+0.24+0.14+0.17/7
0.046924024	= 0.04+0.06+0.04+0.04+0.06+0.03+0.04/7
0.134084946	= 0.09+0.13+0.13+0.09+0.12+0.21+0.17/7
0.075656023	= 0.19+0.06+0.13+0.09+0.04+0.07+0.04/7
0.162548546	= 0.14+0.19+0.07+0.17+ 0.12+0.28+0.17/7

14. Calculate vector consistency

Table 10. Consistency Vector

Consistency Vector				
A	2.11	7.26	0.22	Lamda max - n
B	0.44	7.21	0.04	n - 1 = 7-1 = 6
C	1.55	7.23	0.03	Index Random = 1.32
D	0.33	7.23		
E	0.95	7.26		
F	0.52	7.16		
G	1.33	7.20		
Total		**50.54**		
λmaks		**7.22**		

15. Calculate the maximum eigenvalues obtained **λmaks =** 7.26 + 7.21 + 7.23 + 7.23 + 7.26 +7.16 + 7.20 / 7 = **7.22**
16. Calculating the consistency index value, 7-ordered matrix (which consists of 7 alternatives), the consistency index values obtained are:

$$CI = \frac{\lambda\, maks - n}{n-1} = \frac{7.22 - 7}{7-1} = 0.04$$

17. Determine the Ratio Consistency (CR) with the value of n = 7 and the RI value = 1.32, then

$$CR = \frac{\mathrm{CI}}{RI} = \frac{0.04}{1.32} = 0.03$$

Because CR 0.03 <0.100 means the preference of respondents is consistent.

18. The results of the weighting of all priority criteria such as the table below:

Table 11. Priority Criteria

P.V All Criteria	Criteria
0.04	mastered programming
0.23	areas of interest
0.09	master memorization
0.19	master the design
0.07	master the count
0.38	Value

19. The calculation of the results of the determination of Final Assignment in the Information Engineering Faculty of the Pancasila University is as follows:

Table 12. Result

Alternative	Weight
Information System	**0.24**
Decision Support System	0.06
Expert System	0.16
Network	0.09
Mobile Programming (Game)	0.15
Use of Algorithms in Systems / Applications	0.10
Mobile Programming (Application)	0.19

Then the result of the Information System Final Assignment topic is the best Final Assignment priority with a weight value of 0.24

IV. CONCLUSION

After being analyzed using the Analytic Hierarchy method, it can be concluded as follows:

1. Analytic Hierarchy Process or AHP can finally provide answers to the process of determining Final Assignment by students which consists of six criteria, namely mastered programming, areas of interest, mastering the calculation, mastering the design, mastering memorization and values
2. Information System Final Assignment topic is the best Final Assignment priority with a weight value of 0.24, followed by mobile programming (application) with a weight value of 0.19, Intelligent System / Expert System with a weight value of 0.16, mobile programming (game) with a weight value of 0.15, the use of algorithms in system / application with a weight value of 0.10, a network with a weight value of 0.09 and the last having a weight value of 0.06

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