Recommendations of the Best Lecturers Selection Method Using Simple Additive Weighting (SAW) and the Analytical Hierarchy Process (AHP)

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Abstract:

Colleges in this case was a working parent lecturers, very interested parties maintain the quality of the professors in the teaching and learning process. The selection process of the best lecturers have been regulated by the KEMENTRIS TEK of HIGHER EDUCATION including lecturer required to have the Superior achievements of Work i.e. covers, learning, research and community service. At this time in maintaining the quality of professors, Faculty of social and political sciences of the University of Sultan AgengTirtayasa recently did an assessment of teaching and learning (Learning) with assessment of students toward professors about four (4) competencies assessed, namely Pedagogic Competence (1), (2) Professional Competence, (3) the competence of personality, (4) Social Competence. The assessment process takes a long time and where judgment objectiveness is still not following the standard KEMENTRISTEK of HIGHER EDUCATION, then the need to resolve the matter with the designed a system of information presented by building a support system decision method using Simple Additive Weighting (SAW) as a method to process data learning and Analytical Hierarchy Process (AHP) as a method that can process data research and outreach because of the penilaaianya based on the the criteria, after doing its automatic data, then the value of the method of AHP SAW and would do the merging value so that the system will provide recommendations to the ranking of the best lecturers FROM Untirta with the method of calculation based on SAW and AHP.

Keywords — SAW, AHP, decision support system, the determination of the best Professors, SAW-AHP

1. Introduction

1.1 Background

The position of lecturer is as professional educators and scientists with the main task of transforming, developing, and disseminating knowledge, technology, and art, as well as the community it serves to improve the quality of national education. The main task in connection and function as agents of learning lecturer, developer of the science, technology, and art, then the lecturer has a duty staple in learning, namely: planning, implementing, and assessing learning processes and evaluating learning outcomes [17].

Faculty of social and political science UNIRITA every 2 times a year to evaluate the process of teaching and learning at the end of the semester that aims to enhance the professionalism of lecturers in carrying out tasks, improve processes and results education, assessing accountability, improving the atmosphere of academic professors in the classroom and give awards for the best professors.

1.2 The purpose of the research:

1. The purpose of this research is to design a system of decision making for choosing just the right best lecturer based on assessment of students with scoring value that is already in the specified by the cluster Penajaminan UNIRITA EXTENSION method using Quality SAW and scoring papers as well as the public service has been done by a lecturer within one year, the process of this scoring method using AHP.

2. Help recommend in terms of taking decisions against the best professors to the leadership of the EXTENSION UNIRITA.
2. The cornerstone of the theory

2.1 Decision support system (SPK)

An interactive computer-based systems, which help decision makers through the use of data and decision models for solving problems which is semi structured and unstructured, which essentially heightens the effectiveness decision makers.

2.2 Simple Additive Weighting (SAW)

A method of Simple Additive Weighting (SAW) is often also known the term weighted summation method. The basic concept of the method Simple Additive Weighting (SAW) is looking for a weighted summation of rating performance on any alternative on all attributes [5]. A method of Simple Additive Weighting (SAW) requires a process of normalization of the matrix (X) to a scale that can be compared to all alternatives, this method is a method that is best known and most widely used in the face of the situation Multiple Attribute Decision Making (MADM). MADM is a suatu method that is used to find the optimal alternatif of a number of alternatives with certain criteria.

As for step completion in method using SAW [4] are:

1. Determine alternate (Candidate), namely Ai (i.e. the process of determining the value of alternatives), example: A1, A2, .... An
2. Determine the criteria that will be used as reference in decision-making, i.e. Cj (i.e. the process of determining the value of criteria), example: C1, C2, ... CN
3. Provide value rating the suitability of each alternative on every criteria example: A1 with C1 = value
4. Determine the weighting of preference or importance (W) any criteria example: C1: ...%, C2: ....%, ... ... ... ... CN: .....%
5. Create a table rating the suitability of any of the alternatives on each criterion. At this stage of the settlement process in point/number 2 (two) above was made based on suitability rating table, Example Table 1. Match rating:

<table>
<thead>
<tr>
<th>Alternatif</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C1</td>
</tr>
<tr>
<td>A1</td>
<td>Nilai A1C1</td>
</tr>
<tr>
<td>A2</td>
<td>Nilai A2C1</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>An</td>
<td>Nilai AnCn</td>
</tr>
</tbody>
</table>

6. Make a decision matrix X formed from a table rating the suitability of any of the alternatives on each criterion. The value of X each alternative (Ai) on each criterion (Cj) already determined. Example: Then the result:

\[
X = \begin{bmatrix}
X_{11} \times \text{Maxi} & X_{12} \times \text{Maxi} & \ldots & X_{ij} \times \text{Maxi} \\
X_{21} \times \text{Mini} & X_{22} \times \text{Mini} & \ldots & X_{2j} \times \text{Mini} \\
\vdots & \vdots & \ddots & \vdots \\
X_{i1} \times \text{Maxi} & X_{i2} \times \text{Maxi} & \ldots & X_{ij} \times \text{Maxi}
\end{bmatrix}
\]

7. Perform normalization decision matrix X by calculating the value of rating the performance of ternormalisasi (rij) from alternative Ai on the criteria of Cj.

\[
\frac{X_{ij}}{\text{Maxi} (X_{ij})}
\]

Description:
rij = ternormalisasi performance rating
Maximum value = Maxi from each row and column
Minij = the minimum value of each row and column
Xij = rows and columns of a matrix

8. The final outcome (Vi) preference value is obtained from the sum of the line element matrix multiplication ternormalisasi (R) with weighted preferences (W) a corresponding element in the column matrix (W).

\[
V_i = \sum W_j \times r_{ij}
\]

Description:
Vi = final value of alternative
Wj = Weights that have been specified
Rij = Normasisasi matrix

Then it can be exemplified as follows:

Table 2. Calculation Of Prefensi:

<table>
<thead>
<tr>
<th>Alternatif</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C1</td>
</tr>
<tr>
<td>A1</td>
<td>X11 \times W</td>
</tr>
<tr>
<td>A2</td>
<td>X21 \times W</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>An</td>
<td>Xn1 \times W</td>
</tr>
</tbody>
</table>

The value is obtained from the sum of the perkolomVi.

\[
V_1 = (x_1 \times W) + (X_12 \times W) + \ldots + (X_1j \times W) = V_2 = (W \times X_21) + (X_22 \times W) + \ldots + (W \times X_2j)
\]

And so on

The results of the calculation of values Vi larger indicates that alternative Ai is the best alternative.

2.3 Analytic Hierarchy Process (SAW)

The method of Analytic Hierarchy Process (AHP) is a general theory about the measurements. Four different measurement scales that are usually used in a sequence is a nominal scale, ordinal, interval and ratio. The higher the scale...
can be categorized into the lower scale, but not vice versa. Revenue per month ratio scale can be categorized into the ordinal scale of income level or category (high, medium, low) a nominal scale. Conversely, if the measurement is done at the time the data obtained are ordinal or categories, the higher scale data cannot be retrieved. AHP overcome most of the problems were. [1]

In resolving the problems of AHP there are some principles that must be understood as follows [5]:
1. Create a hierarchy
Complex systems can be understood with the break it down into elements – elements of supporters, putting together elements hierarchically combined or mensistesinya.

2. Assessment criteria and alternatives
Alternative criteria and conducted by comparison in pairs. For a variety of issues, a scale of 1 to 9 is the best scale to express opinions. The value of qualitative opinion and definition of comparative scale Saaty can be measured using the table analysis as shown in table 1 below:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A just as important (Equal) with B</td>
</tr>
<tr>
<td>3</td>
<td>A slightly more important (Moderate) of B</td>
</tr>
<tr>
<td>5</td>
<td>A clearly important (Strong) of B</td>
</tr>
<tr>
<td>7</td>
<td>A very clearly important (Very Strong) from B</td>
</tr>
<tr>
<td>9</td>
<td>A more important absolute (Extreme) of B</td>
</tr>
<tr>
<td>2,4,6,8</td>
<td>If in doubt between two adjacent values</td>
</tr>
<tr>
<td>1/(1-9)</td>
<td>The inverse value of the importance of scale 1-9</td>
</tr>
</tbody>
</table>

3. Synthesis of Priority (the determination of priority)
For each criteria and alternatives, paired comparisons need to be made (Pairwise Comparison). Weight and priority calculated by manipulating the matrix or through the completion of a mathematical equation.

4. Logical Consistency (Logical Consistency)
Consistency has two meanings. First, objects – objects that are similar can be grouped in accordance with the uniformity and relevance. Second, regarding the level of relationships between objects based on certain criteria. The logical consistency of calculations done by following steps-steps as follows:
   a. multiply the matrix with the corresponding priorities.
   b. sum up the results of multiplication perbaris.
   c. the summation of Results each line divided the priorities in question and the results are summed up.
   d. results of c divided the number of elements, will be \( \pi \text{maks} \).
   e. Consistency Index (CI) = \( (\pi \text{maks} - n)/(n-1) \).
   f. consistency Ratio = CI/RI, where RI is the random index consistency. If the ratio of consistency \( \leq 0.1 \), the calculation result data can be justified.

Table 4. The Index Value Of The Random

<table>
<thead>
<tr>
<th>n</th>
<th>RI</th>
<th>n</th>
<th>RI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00</td>
<td>9</td>
<td>1.45</td>
</tr>
<tr>
<td>2</td>
<td>0.00</td>
<td>10</td>
<td>1.49</td>
</tr>
<tr>
<td>3</td>
<td>0.58</td>
<td>11</td>
<td>1.51</td>
</tr>
<tr>
<td>4</td>
<td>0.90</td>
<td>12</td>
<td>1.48</td>
</tr>
<tr>
<td>5</td>
<td>1.12</td>
<td>13</td>
<td>1.56</td>
</tr>
<tr>
<td>6</td>
<td>1.24</td>
<td>14</td>
<td>1.57</td>
</tr>
<tr>
<td>7</td>
<td>1.32</td>
<td>15</td>
<td>1.59</td>
</tr>
</tbody>
</table>

2.4 performance assessment of Lecturers
Performance assessment of lecturers is comprised of several stages. performance assessment consists of three steps: define, assess the performance of the work and give feedback. [16]

2.5 performance assessment criteria for Lecturers
a. Assessment Criteria lecturer with the method the SAW:
   Referring to law No. 14 Of 2005 teachers and professors that the competence of teachers and professors include competence, the competence of personality pedagogy, social competence, social competence.

b. criteria for the assessment of lecturers with AHP method:
   Referring to the guidelines for the selection of an accomplished lecturer, published by KEMENRISTEKDIKTI that the requirements of the best professors for research is intellectual property, publication, Impact Pulikasi, Speaker seminars, and for the devotion to the the community is the appropriate technology, the concept of an environmental Setup, model development, model of development partnerships, institutional setup models, involvement in making public policy texts.

2.6 Review Research
Table 5. The chart review study
3. Research methods
The research is applied research (Applied Research). In this study, the sample data used, namely data and research results and student pengebdian to people. Data collection data collection methods do primary or secondary. On the method of primary data collection by way of doing data collection directly to the data source which is owned [2] UNTIRTA, the collection of data is done by the method of observation, interview and questionnaire for the secondary data pengumpuan method do by way of reading, observing and studying the data from a source that is associated with this research.

3.1 determination of the best Lecturers Performance Model with AHP method

3.2 Engineering Testing Data
1. Black Box Testing: by knowing the function has been determined, so the testing done to find fault in every function.
2. User Acceptance Test (UAT) is a verification process that the solutions created in the system already according to the user. This process is different from testing system (ensuring software does not crash and in accordance with the request of the user), but rather ensure that solutions in the system will work for users (i.e., tests that the user accepts the solution in the system).

4. RESULTS and DISCUSSION
In this study discusses the results of the calculation of the student's assessment against the SAW professors and method of AHP as assessment of scientific works and pengebdian society that was conducted by professors, from the results of the data processing using 2 methods above, then it will be done the combination of the value so that it can produce the best lecturer rank.

4.1 The calculation Process SAW
Calculation method of stages SAW:
1. Determine the criteria that will be used as reference in decision-making, that Ci.
2. Determine the suitability of each alternative rating on each criterion.
3. Normaslisasi Matrix
Do the normalization of the matrix X searched for Rmax value with the formula:

\[
CnAn = \frac{C1A1, C1A2, \ldots, C1An}{Rmax = \max (C1A1, C1A2, \ldots, C1An)}
\]

a. attribute Normalization of C1 (a lecturer explain publicly lecture contract)
And do against all the criteria which amounted to 20 criteria.

Then the result of normalization are:

\[
R = \begin{bmatrix}
0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2 & 0.2
\end{bmatrix}
\]

b. the process of peringkangan by use of weights:

\[W = [5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5]\]

Then the results obtained are:

\[V_1 = (5)(1)-(5)(0.33)-(5)(1)-(5)(1.25)-(5)(1)-(5)(1)
\]
\[+(5)(0.75)-(5)(0.5)-(5)(1)-(5)(3)-(5)(0.5)-(5)(0.5)
\]
\[+(5)(1)-(5)(0.25)-(5)(0.5)-(5)(0.75)-(5)(1)+(5)
\]
\[+(5)(0.5)-(5)(0.75)-(5)(0.75)
\]
\[= 5+1.65+5+1.25+5+3.75+2.5+5+2.5+3.75+5
\]
\[+1.25+2.5+3.75+5+3.75+2.5+3.75 = 72.9
\]

And do all the process until the V5

Then the result of the process of peringkangan using rengking weights the following professors:

<table>
<thead>
<tr>
<th>No</th>
<th>Id Dosen</th>
<th>Peringkat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dosen 1</td>
<td>72.91</td>
</tr>
<tr>
<td>2</td>
<td>Dosen 2</td>
<td>71.66</td>
</tr>
<tr>
<td>3</td>
<td>Dosen 3</td>
<td>71.66</td>
</tr>
<tr>
<td>4</td>
<td>Dosen 4</td>
<td>79.58</td>
</tr>
<tr>
<td>5</td>
<td>Dosen 5</td>
<td>83.75</td>
</tr>
</tbody>
</table>

4.2 the process of calculation of AHP

Stages of calculation method of AHP:

a. Specify comparison criteria

Table 9. Rating The Suitability

b. Make a comparative matrix pairs

Table 12 Comparative Matrix Pairs Research Criteria

c. create a matrix of values criteria (normalization of the matrix)

Table 14 the normalization Criteria Research

d. the normalization Criteria Community

Table 15 community services
Calculation of a ratio consistency criteria research
T (number) = number of Eigen value/number of criteria = 6.373
Ci = (t-sum of the criteria)/(number of criteria-1) = 0.3433
IR5 = seen from table Index value Random Consistency = 1.12
Then his consistency value is = Ci/IR5 = 0.3065
Criteria for research result consistency because < = 0.1
Calculation of the ratio of Community criteria consistency
T (number) = number of Eigen value/number of criteria = 5.763
Ci = (t-sum of the criteria)/(number of criteria-1) = 0.1908
IR5 = seen from table Index value Random Consistency = 1.12
Then his consistency value is = Ci/IR5 = 0.1704
Criteria for research result consistency because < = 0.1

4.3 combination SAW and AHP
To do a merger of the two methods of SAW and AHP to do phase calculations based on criteria and alternatives, then the following process perhitunganya:

Next is the summation of the line divided the number of professors, then the result is:

Decision:
The greatest value is Dosen5 so Dosen5 was elected as the best alternative calculation result of the merger of the 2 (two) methods SAW and AHP.

4.4 Prototype
The making of prototype made with web-based. Following is the display of the form--the form that is used on applications to help determine the calculation method of the SAW and AHP. As for the database that will be used is using MySQL, so that later the system has history which is useful as a reference for the selection of the best lecturers by providing assessment of the conclusions from the data that has ever been examined previously.
a. Use case
Use case is used to describe user interaction of the process against the prototype to be made sequentially and can also order against the operation of the prototype. Use case in this research is like the image below:
4.5 the design Prototype

a. the Prototype SAW

Prototype SAW a draft prototype assessment that housed students toward professors is form-a form that serves to input the value given by the students to professors, the professors judgment based on assessment of students during the interact one semester:

b. Prototype AHP

Prototype Admin/Staff Staffing method of AHP, Prototype was built for input values, an analysis of alternative criteria, criterion, criteria and analysis rank:

5. Conclusions and suggestions

a. Conclusions

In the research above, then it can be inferred about the method of AHP SAW and as one of the alternate methods used in the case of this study, because:

1. Using a Simple Additive Weighting (SAW) has managed to build decision support systems with an accomplished lecturer lecturers penilaianya ranking results derived from students against professors who have made the learning process teaching for a semester.

2. Using Analythical Hierarchy Process (AHP) has provided an assessment regarding the weighting of each of the existing criteria, namely research and devotion to society which there are sub-criteria.

3. with the incorporation of the calculation method of AHP SAW and default value for each lecturer can be known by results of rating acquisition values that have been processed, then the decision making can be made into a solution or recommendation to the Chairman [2] Untirta.

b. Suggestions

Suggestions in this study are:

1. This research is still in the prototype stage in the development of the application, may further research could apply this prototype into an application system that is more than just a prototype.

2. The study also has limitations that have been described above as in terms of case studies that is only in the environment of the school of social and political sciences of the University of Sultan AgengTirtayasa or more, hopefully the next research can expand the restrictions that exist today.
Bibliography: