TOPSIS Method for Decision Support Systems in Determining the Interests of Medical Student

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Abstract. Learning modules selected at Medical Education Study Program of Gadjah Mada University is not accordance with the student’s interests and abilities. Some modules does not give a detailed information. Student tend to choose the recommended modules with highly subjective consideration, following recommendation from classmates or senior. This study uses the TOPSIS method. it is used in decision support systems. The system developed is not a decision making tool, but a system that helps decision makers with information from data that has been processed. Results of implementing decision support system using TOPSIS method are module chosen according to student’s interest. Through interest test, the student completes the questions that are available in each module block. Student not need to read the entire module overview. Decision support system display an appropriate module overview through ranking result from the prediction analysis of student interest and abilities.

1. Introduction

Decision support systems (DSS) have an important role to assist decision makers in understanding information, when processes are needed, and in what form decisions are made [1]. DSS can be used to help make decisions based on data and models to solve problems[2]. DSS is built to solve various managerial problems and corporate organizations. DSS increases the effectiveness and productivity of managers to solve problems with the help of computer technology[3].

University of Gadjah Mada University Medical Study Program applies a block system to its learning. Learning blocks have themes in accordance with the curriculum using problem based on learning strategies. Block module is chosen by students in the fourth year, block module discusses subjects related to medicine that have not been discussed intensively in other blocks. Block module consists of elective courses. Block module contains topics outside the core curriculum. The purpose of the block module is to enrich the knowledge, skills and behaviors that support career development. Each student must choose two modules.

Selection of the Block module is done freely with a quota system. Students in selecting modules use subjective considerations such as friends in choosing modules, references from seniors about the modules selected, and lecturers who teach modules. Study program has provided a guideline book which contains the Terms of Reference (TOR) regarding information on each module offered. Number
of modules offered causes students not to receive detailed information about the contents of each module. To get the results of the prediction analysis of medical students' interest, a decision support system application is needed using the TOPSIS method. Method is based on the concept that the best chosen alternative not only has the shortest distance from the positive ideal solution but also has the longest distance from the negative ideal solution [4]. Using DSS students get module recommendations according to their interests and abilities. Students get detailed information on the chosen modules to be chosen more quickly and accurately.

2. Current Research

Several kinds of research use the TOPSIS method to produce recommendations. It is used to select the best employees. The criteria used in the selection of the best employees are work discipline, behavior, work quality and job responsibilities. The final results of the best prospective employees are used as the best employee selection decision making tool by top management [5].

Likewise, research of Khosravi [6], also uses the TOPSIS method for selecting rice milling systems. The Criteria used to make decisions include the percentage of rice damage, market attractiveness, energy requirements, capacity and cost of rice milling.

Whereas Habibi [7] conducts research using the TOPSIS method, Moora and the combination of those methods to determine hospital ranking. The study was conducted based on six criteria, namely Registration, Payment, Outpatient, Inpatient, Emergency and Pharmacy. The results showed that the combination method, MOORA, and TOPSIS determined the same hospital for rank 1 to rank 7. Then, for ranking 8 to rank 10, the TOPSIS method got different results from other methods. The results of the final analysis in this study can be used as recommendations for hospital managers and the government to improve the quality of public health services.

In contrast to Listyaningsih [8], she combines the TOPSIS and the methods of building a decision support system that determines the performance of village governments. The AHP method is used for weighting while the TOPSIS method is used for ranking the performance of the village government. The system has a dynamic nature for the required evaluation criteria. Assessment criteria can be adjusted to the regulations or requirements needed. From the test results, it was found that 86.67% of users agreed that the prototype could be implemented and used to evaluate the performance of the village government in the Secang sub-district.

3. Methodology

3.1 Analysis of Medical Students Interest with the TOPSIS Method

Case studies: Medical students choose modules to be studied in the block module to enrich knowledge, skills and behaviors that support career development. Alternative modules consist of:

1) A1 = Advance Anthropometry
2) A2 = Lifestyle Nutrition
3) A3 = The Management Of Chronic Disease
4) A4 = Sport Science

Three criteria are used as a reference in decision making, namely:

1) C1 = Not interested
2) C2 = Pretty interested
3) C3 = Very interested

The importance of each criteria, assessed from 1 to 3, namely:

1) C1 = Not Important
2) C2 = Quite Important
3) C3 = Very important
Decision support systems give preference weights to each criteria:
\[ W = (1, 2, 3) \]

3.2 Application of Steps in TOPSIS

1) Determine criteria that will be used as a reference for decision making, namely C_i and nature of each criteria.

| Criteria Name       | Nature of Criteria                                                                 | Weight |
|---------------------|-------------------------------------------------------------------------------------|--------|
| C1 = Not interested | Positive, Reason: inappropriate statement describing Student's self.                | 1      |
| C2 = Pretty interested | Negative, Reason: statement describing self-doubting Student                      | 2      |
| C3 = Very interested | Positive, Reason: appropriate statement describing Student self                    | 3      |

2) Determine the suitability rating of each alternative on each criterion. Criteria value on all alternatives is obtained from the accumulation of student answers.

Table 2 show list of question statement to determine students interest in choosing modules as alternatives.

| ID | Question Statement                                                                 | A1 | A2 | A3 | A4 |
|----|-----------------------------------------------------------------------------------|----|----|----|----|
| P01| I am interest to know basic anthropometry                                          | v  | v  | v  |
| P02| I am interest understanding health issue related to anthropometry                  | v  | v  |    |
| P03| I am interest understanding health diagnosis using anthropometry.                  | v  |    |    |
| P04| I am interest understanding benefit using anthropology in health diagnosis         | v  |    |    |
| P05| I am interest having expertise to apply anthropology in health diagnostics         | v  | v  |    |
| P06| I am interest learning correct use tools of anthropometrics                         | v  | v  | v  |
| P07| I am interest using an evidence based approach to assess the nutritional status     | v  | v  | v  |
| P08| I am interest understanding role of family doctors in primary care                  |    | v  |    |
| P09| I am interest understanding the Chronic Disease Program in primary care.            |    |    | v  |
| P10| I am interest understanding the natural history of disease, five levels of prevention and environmental problem that can contribute to an individual's health. | v  |    |    |
| P11| I am interest in effective communication with family and community about patient condition, therapy, diet, and prevention of chronic diseases. |    | v  | v  |
| P12| I am interest understanding interprofessional collaboration in managing chronic disease patient. | v  | v  |    |
| P13| I am interest understanding application of family practices Indonesia health care system. |    |    | v  |
| P14| I am interest writing good recipe                                                  | v  | v  |    |
| P15| I am interested in the application of sports anthropology                           | v  | v  |    |
| P16| I am interest knowing anthropometric assessment on athlete.                         | v  |    | v  |
| P17| I am interest knowing the application of sports nutrition.                          | v  | v  |    |
| P18| I am interest knowing differences in performance in anthropology, biomechanics, aerobic capacity, oxidative stress parameters in serum and nutrition between endurance, endurance athlete and non athlete. | v  | v  | v  |

TOTAL 8 8 8 8
3) Make a normalized decision matrix. TOPSIS requires a performance rating of each Ai alternative on each normalized Cj criterion.

\[
 r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{n} x_{ij}^2}} \tag{1}
\]

| Alternatif | Criteria | C1 | C2 | C3 |
|------------|----------|----|----|----|
| A1         |          | 3  | 3  | 2  |
| A2         |          | 2  | 4  | 2  |
| A3         |          | 1  | 5  | 2  |
| A4         |          | 2  | 4  | 2  |

4) The multiplication between the weights and the value of each attribute to form the Y matrix can be determined based on the normalized weight ranking \((y_{ij})\).

\[
y_{ij} = w_i r_{ij} \tag{2}
\]

| Matrik A | Matrik R (Normalisasi) |
|----------|-------------------------|
| 3        | 3                       | 0.7071 | 0.3693 | 0.5000 |
| 2        | 4                       | 0.4714 | 0.4924 | 0.5000 |
| 1        | 5                       | 0.2357 | 0.6155 | 0.5000 |
| 2        | 4                       | 0.4714 | 0.4924 | 0.5000 |

5) Determine the matrix of a negative ideal solution and a positive ideal solution

\[
Y_j^+ = \begin{cases} 
\max_i y_{ij}^+ & \text{if } j \text{ is the profit attribute} \\
\min_i y_{ij}^+ & \text{if } j \text{ is the cost attribute} 
\end{cases} \tag{3}
\]

\[
Y_j^- = \begin{cases} 
\min_i y_{ij}^- & \text{if } j \text{ is the profit attribute} \\
\max_i y_{ij}^- & \text{if } j \text{ is the cost attribute} 
\end{cases} \tag{3}
\]
Table 6. Y+ and Y- matrix values

| Criteria Name | Nature of the criteria | Y+ | Y- |
|---------------|------------------------|----|----|
| C1 = Not interested | Positif | Max (0.7971;0.4714;0.2357;0.0471) = 0.7071 | Min (0.7971;0.4714;0.2357;0.0471) = 0.2357 |
| C2 = Pretty interested | Negatif | Min {0.7385; 0.9847; 1.2309; 0.9847} =0.7385 | Max {0.7385; 0.9847; 1.2309; 0.9847} =1.2309 |
| C3 = Very interested | Positif | Max {1.5000; 1.5000; 1.5000; 1.5000} =1.5000 | Min {1.5000; 1.5000; 1.5000; 1.5000} =1.5000 |

Can be concluded

A+ = {0.7071;0.7385;1.5000}
A- = {0.2357;1.2309;15000}

6) Determine the distance between the value of each alternative and the positive and negative ideal solution matrices.

The formula for the value of D+ positive solution distance:

\[ D_{i+} = \sqrt{\sum_{j=1}^{n} (y_{ij}^+ - y_{ij})^2} \] ............................ (4)

The formula the D-distance value of the negative ideal solution:

\[ D_{i-} = \sqrt{\sum_{j=1}^{n} (y_{ij}^- - y_{ij})^2} \] ............................ (5)

The distance between the value weights from each alternative to the positive ideal solution \( S_i^+ \) can be calculated by:

\[ D_{i+} = \sqrt{(y_{i1}^+ - y_{1+})^2 + (y_{i2}^+ - y_{2+})^2 + (y_{i3}^+ - y_{3+})^2} \]

\[ D_{1+} = \sqrt{(0.7071 - 0.7071)^2 + (0.7385 + 0.7385)^2 + (15000 - 15000)^2} = 0.0000 \]

\[ D_{2+} = \sqrt{(0.4714 - 0.7071)^2 + (0.9847 + 0.7385)^2 + (15000 - 15000)^2} = 0.5406 \]

\[ D_{3+} = \sqrt{(0.2357 - 0.7071)^2 + (1.2309 + 0.7385)^2 + (15000 - 15000)^2} = 0.6816 \]

\[ D_{4+} = \sqrt{(0.4714 - 0.7071)^2 + (0.9847 + 0.7385)^2 + (15000 - 15000)^2} = 0.5406 \]

The distance between the weighted values of each alternative to \( S_i^- \) negative ideal solutions can be calculated with

\[ D_{i-} = \sqrt{(y_{i1}^- - y_{1-})^2 + (y_{i2}^- - y_{2-})^2 + (y_{i3}^- - y_{3-})^2} \]

\[ D_{1-} = \sqrt{(0.7071 - 0.2357)^2 + (0.7385 + 1.2309)^2 + (15000 - 15000)^2} = 0.6816 \]

\[ D_{2-} = \sqrt{(0.4714 - 0.2357)^2 + (0.9847 + 1.2309)^2 + (15000 - 15000)^2} = 0.5406 \]

\[ D_{3-} = \sqrt{(0.2357 - 0.2357)^2 + (1.2309 + 1.2309)^2 + (15000 - 15000)^2} = 0.0000 \]

\[ D_{4-} = \sqrt{(0.4714 - 0.2357)^2 + (0.9847 + 1.2309)^2 + (15000 - 15000)^2} = 0.5406 \]

7) Determine the preference value for each alternative. A greater \( V_i \) value indicates the alternative \( A_i \) that is preferred.

\[ V_i = \frac{D_{i+}}{D_{i+} + D_{i-}} \] ............................ (6)
Table 7. Calculation result of TOPSIS method

|   |   |     |
|---|---|-----|
| 1 | A1 | 1.0000 Advance Anthropometry |
| 2 | A2 | 0.5000 Lifestyle Nutrition |
| 3 | A4 | 0.5000 Sport Science |
| 4 | A3 | 0.0000 The Management Of Chronic Disease |

4. Conclusion

TOPSIS method can be applied to the Medical Education Student Interest Decision Support System to find out which module recommendations are offered. The recommended module blocks are in accordance with the interests and abilities of the Student. weight value uses a three criteria scale that is not interested, quite interested and very interested in answering questions related to the module offered.

5. References

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