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Fuzzy topsis optimization on expert systems for core competency detection and Islamic religious education student learning achievement at Perguruan Tinggi Keagamaan Islam Negeri (PTKIN)

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Abstract. The research aims to assess the development and implementation of Fuzzy Topsis optimization on core competency detection expert systems and student learning achievement majoring in Islamic religious education at PTKIN. In the learning process of KKNI based curriculum designed to detect the level of development of core competencies and achievements Study students at the faculty or PAI study Program at PTKIN. The main product development of this research is expert system application With the Fuzzy Topsis method of measuring the indicator Development of Core Competencies (Hard skills and soft skills) and Learning factors that have an effect on student learning achievements. The results of this expert system can help students and lecturers independently to detect how the level of development student core complications, detecting internal learning factors and external influences and measures how they influence to student learning achievements. Optimizing Results of Fuzzy TOPSIS shows optimal results better.

1. Introduction

Perguruan Tinggi Keagamaan Islam Negeri (PTKIN) is a strategic unit of education in preparing outstanding human resources and excellence. Global competition demands that universities should be able to deliver their students to compete globally both nationally and internationally. The quality of higher education graduates including the state Islamic religious college can be measured from how the level of achievement of student learning and the level of graduates in the field of employment as well as their field of expertise. Because of that, the quality of the college can be measured one of them is from how the state Islamic religious college prepares students to be able to master the core competencies and produce graduates who achieve the best. Student learning achievement is demonstrated through the performance of academic, intellectual, skill, and moral skills, personality attitudes.

Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) is a well-known method Multiple Criteria Decision Making (MCDM) problem. Some fuzzy criteria in decision making have an important role in solving problems in the decision-making process. Among the popular methods used in

solving such problems is the Fuzzy TOPSIS where solutions are produced based on the shortest distance from the ideal positive solution and the farthest distance from the ideal solution that is negative [1]. The implementation of Fuzzy TOPSIS on research on the evaluation and selection of projects that propose a new methodology to provide a simple approach to assessment of a project and assist in the decision-making process in choosing the wrong One of the best results for a national oil company in Iran [2]. The research uses six criteria to compare alternative investments as criteria in the utilization of AHP methods and Fuzzy TOPSIS methods. The AHP method is used to analyze the problem structure of the project selection and to determine the weight of a criterion, while the Fuzzy TOPSIS method is used to perform the final rating. The final results of the study were conducted to illustrate the use of models in project selection issues. The research shows the result of calculating the weight of criteria in the implementation using the Fuzzy TOPSIS method by changing the criterion rating. Decision making can use a combination of different weights according to the criteria rating priority. Fuzzy TOPSIS can be used to solve decision making problems by doing a summation of multiplication operations on the triangular fuzzy number (TFN).

Based on the background discussion, the following studies have conducted research on the development of the Neural Network-based Fuzzy Topsis optimization applied to an expert system in detecting student learning in measuring Instrument indicators development of core competencies and internal and external factors affecting the success of learning achievement achieved by students. The implementation of expert systems in detecting student learning can help students and lecturers in decision making to support the improvement of student learning achievement. This development was done to produce expert system applications by optimizing the Fuzzy Topsis method on the expert system of detection of core competencies and learning factors affecting student learning achievement. The research is integrated with the use of Fuzzy TOPSIS based on neural networks (NN) because it is very effective for the digging process. Fuzzy logic is often used to solve complex problems. The Neural Network is a representation of a human brain performance that seeks to mimic the way the human brain works so as to solve existing problems.

2. Literature review

Core competencies are defined as a set of hard and soft-skills that are built and developed through the learning and teaching process so that students are ready for lifelong learning, becoming a good citizen and able to work as challenges. Related research is the implementation of the method of evasion is able to make student development good. The research performs identification for the study is a type of publication, sample group, school subject, data Collection tool, year of study and culture, which samples group, school subject, data collection tools and year of study were found to be a core variable [1]. The final ranking step in the implementation of the Fuzzy TOPSIS method, by calculating the closest coefficient of spacing based on separation from Negative Ideal Solution (NIS) and proximity to Positive Ideal Solution (PIS). Experiments show that with the same focus on PIS and NIS distances, the proposed ratings are identical to the application of TOPSIS, and also work very well when varying the distance weight. The application of proposed methods in related research is demonstrated by the relevant examples of technology and material selection in the context of manufacturing additives. Sensitivity analysis, based on the subjective weight of criteria, level of optimism, weight evaluator in group decision making, and distance weight, is presented to assist the manager in making a more precise, accurate and efficient decision [3]. Related research performs stages of weighting on the application of Fuzzy TOPSIS method by way of determining weight value calculated with matrix normalization value requiring relatively better technique to obtain optimal results [4]. In the research related to the determination of optimal value by conducting a weighted stage using the SMARTER (Simple Multi-Attribute Rating Technique Exploiting Ranks) method. The research is able to recommend that SMARTER is able to optimize the value of the weight that has been done processing before proceeding to the next stage. A Fuzzy TOPSIS implementation among scholarship selection process [5]. Research related to implementing the Hybrid fuzzy Analytic Hierarchy Process (AHP) and the Fuzzy TOPSIS technical to prioritize the effective qualifications of a teacher on medical programs at Tehran University

[6]. Other research by conducting a Multi-Criteria-Decision-Analysis (MCDA) approach by integrating a DINESERV model to evaluate the quality in the context of Campus Restaurant Services (CRS) [7]. In the selection of the best employees can be done by way of the Fuzzy TOPSIS approach by evaluating how well the employee's performance is tailored to the standards set by the company and usually done by the highest level of management such as General Manager or director [8]. In the research related to determining the criteria used in the selection of the best employees include the responsibilities of work, work discipline, quality of work, and behavior. Related research on conducting evaluation and selection of mobile health applications (mHealth) using AHP method and fuzzy TOPSIS [9].

Another issue that implements the fuzzy TOPSIS is to select some of the best alternatives based on some of the attributes (criteria) used. In order to make decisions on a fuzzy issue can be used Fuzzy Multiple Attribute Decision Making (FMADM). In this research, modelling using Unified Modelling Language (UML) in FMADM is a method of TOPSIS and Weighted Product to select the candidate for the academic and non-academic scholarship at Sunan Kalijaga State Islamic University. The data used is fuzzy and crisp data. The results showed that the TOPSIS and Weighted Product method of FMADM can be used for scholarship selection. The selection results recommend students who have the highest level of eligibility to get a scholarship based on the value of preference [10]. Related research is to perform equipment selection using the Fuzzy method TOPSIS by applying data mining in the process of making a decision [11].

3. Methodology

The flowchart from Fuzzy TOPSIS Algorithm is a troubleshooting solution with process sequencing to get preference values from users as the final value to get a rating of all the alternatives and criteria that have been calculated. There are several working steps of Fuzzy TOPSIS including:

- Create a normalized decision matrix
- Create an ideal positive solution matrix and an ideal negative solution
- Determine the matrix of the ideal positive solution and the ideal negative solution
- Determines the distance between the values of each alternative with the matrix of the ideal positive solution and the ideal negative matrix solution
- Specifying the preference value for each alternative

The Output generated from this system is the highest order of the alternative to the lowest. The best alternative will be chosen to be the competency standard to choose from. In the research method there are the weights and criteria needed to determine the appropriate competency standards for students of Islamic religious education at PTKIN.

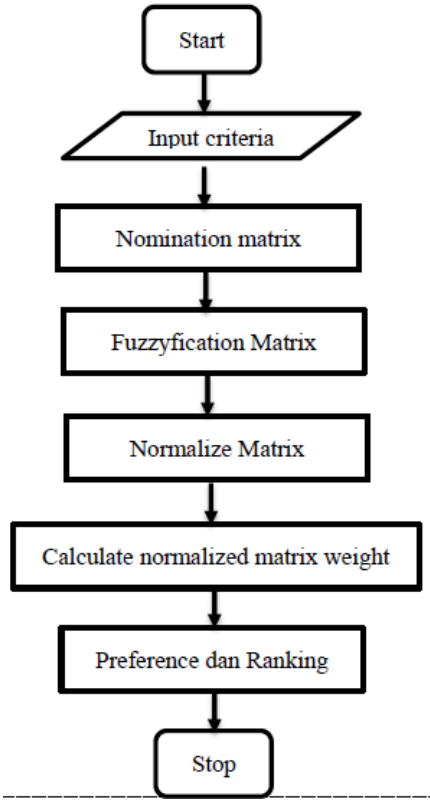

Figure 1. Flowchart of Fuzzy TOPSIS.

Fuzzy TOPSIS requires a number of procedures in making a decision among them is to form the normalization of matrices with formulas such as the following:

$$\sum \boldsymbol{x_{ij}} = ((\boldsymbol{x_{11}})^2 + (\boldsymbol{x_{12}})^2 + (\boldsymbol{x_{13}})^2 + \cdots + (\boldsymbol{x_{11}})^2) \quad (1)$$

After that it is normalized with a formula like the following.

$$\boldsymbol{r_{ij}} = \frac{\boldsymbol{x_{ij}}}{\sqrt{\sum_{i-1}^{m} \boldsymbol{X_{ij}^2}}} \quad (2)$$

Where:
x = decision matrix i = 1,2, ..., m
j = 1,2, ..., n

4. Result and discussion

Fuzzy TOPSIS is one of the methods of making multi-criteria decision making and considering both, the distance to the ideal solution positively and the distance to the ideal negative solution by taking the proximity relative to the ideal positive solution. Based on comparisons to their relative distances, alternative priority arrangements can be achieved.

Table 1. Weighted criteria.

	Description
C1	Academic achievement
C2	Scientific works
C3	Memorization of the Quran
C4	Memorization of Hadith
C5	Learning Facilities
C6	National Championship Achievement

Table 2. Weighted value.

	Description	**Value**
VL	Very less	0,2
L	Less	0,4
E	Enough	0,6
G	Good	0,8
Ex	Excellent	1,0

The next step is to determine the rules of the weighted filter as in table 2 then followed by the Fuzzy matrix decision as in table 3.

Table 3. Fuzzy matrix decision.

	Description	**Results 1**	**Results 2**	**Results 3**
C1	Academic achievement	4,0	6,0	8,0
C2	Scientific works	4,0	6,0	8,0
C3	Memorization of the Quran	2,0	4,0	6,0
C4	Memorization of Hadith	2,0	4,0	6,0
C5	Learning Facilities	4,0	6,0	8,0
C6	National Championship Achievement	2,0	4,0	6,0

5. Conclusion

Based on the discussion and test results application can be concluded. The Fuzzy TOPSIS method can be used as an option to solve the problem of decision-making uncertainty and the process for optimization can produce the best results with the weighted normalization done in the testing TOPSIS Fuzzy method in detecting student achievement and core competencies of Islamic religious education students at PTKIN.

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