

Decision Making for Acceptance of Physics Teachers with the Fuzzy TOPSIS Method

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Abstract

Teachers are the most important human resource in educating students. At SMP Negeri 3 Palembang there is still a great need for teaching staff, namely professional physics teachers. The professional physics teachers selected are those who really have good potential in educating. Teacher selection has not been represented quantitatively so that it is still based on subjective views and thoughts. This study aims to provide a quantitative employee selection decision-making technique through the Fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method. Data obtained through interviews with teachers and HRD to get the weight of the criteria at each stage and implemented in teacher candidates. The results obtained were teacher candidate rankings for each stage of selection, so that the teacher was declared to have passed to the next stage or did not pass and could not continue to the next stage. The value with the lowest ranking and does not meet the special criteria will result in the candidate not passing. From the research results, the use of the fuzzy method can make it easier in subjective assessment, and the TOPSIS fuzzy calculation until the final stage results in 3 passing candidates.

Keywords—Teacher Selection Decision Making, Fuzzy TOPSIS, Knockout System in Selection Stages

1. INTRODUCTION

DIn an effort to improve the quality of education for students, teachers who are competent in providing education to students are needed. Teachers are professional educators who have important duties, functions and roles in the intellectual life of the nation. An outstanding teacher is a teacher who has the ability to carry out tasks, has a personality that is in accordance with the teaching profession and has educational insights so that it can actually improve the quality of the process and learning outcomes or guidance that exceeds that achieved by other teachers so that they can be used as role models for students, peers, and the community surroundings [1]

Professional teachers are expected to be able to participate in national development, excel in science and technology, have an aesthetic, ethical, noble character and personality [2]. Therefore, the teaching profession needs to be developed continuously and proportionally according to the functional position of the teacher.

Junior High School (SMP) Negeri 3 Palembang opens acceptance of physics teacher positions that match the criteria required by the school. After the candidates are selected through the first selection that has been made by the school. Furthermore, several other stages will be carried out, where if the candidate does not pass it will fail and cannot continue to the next stage, the consideration of decisions made is still based on money data obtained directly, there is no quantitative consideration that can determine the best candidate in the selection process and the candidate who is can be declared passed or

not passed. Therefore we need a decision-making technique in selecting teachers that can be used as a decision making for choosing a physics teacher appropriately and quickly. Based on this background, it is necessary to develop a physics teacher selection by implementing the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) fuzzy method. Fuzzy TOPSIS was chosen for this problem because of its fuzzy logic in making structured preference maker decisions [3].

Fuzzy theory helps in measuring the concept of obscurity related to subjective humans. For that, the evaluation must be carried out in one environment. In this case, fuzzy is able to help fix failures that occur when only using the TOPSIS method. Fuzzy TOPSIS was chosen for this problem because of its fuzzy logic in making structured preference maker decisions [3].

Fuzzy theory helps in measuring the concept of obscurity related to subjective humans. For that, the evaluation must be carried out in one environment. In this case, fuzzy is able to help fix failures that occur when only using the TOPSIS method. Fuzzy TOPSIS was chosen for this problem because of its fuzzy logic in making structured preference maker decisions [3]. Fuzzy theory helps in measuring the concept of obscurity related to subjective humans. For that, the evaluation must be carried out in one environment. In this case, fuzzy is able to help fix failures that occur when only using the TOPSIS method.

Fuzzy logic is an appropriate way to map an input space into an output space [4]. Fuzzy logic uses language expressions to describe variable values. Fuzzy logic works by using the degree of membership of a value which is then used to determine the results to be generated based on predetermined specifications. It was mentioned earlier that fuzzy logic maps the input space to the output space. Between input and output there is a black box which must map input to output accordingly [5].

TOPSIS (Technique For Order Preference By Similarity To Ideal Solution) is a multi-criteria decision-making method that has a concept where the chosen alternative is the best alternative that has the shortest distance from the positive ideal solution and the longest distance from the negative ideal solution. This method is widely used to solve practical decision making. This is because the concept is simple and easy to understand, computationally efficient and has the ability to measure the relative performance of decision alternatives in a simple thematic form [6]

The principle of the TOPSIS method is simple, where the alternative is chosen besides being close to the positive ideal solution and far from the negative ideal solution [7]. This concept is widely used in several MADM models to solve practical decision problems [8]. The TOPSIS method is a method that can help the optimal decision-making process to solve practical decision problems [9]. This is because the concept is simple and easy to understand, computationally efficient and has the ability to measure the relative performance of decision alternatives in a simple mathematical form [10].

A decision support system / Decision Support System (DSS) is an interactive information system that provides information, modeling, and data manipulation. The system is used to help decision makers in semi-structured and unstructured situations, where no one knows exactly how decisions should be made. Decision support systems are usually created to support a solution to a problem or to evaluate an opportunity. The DSS application uses a flexible, interactive and adaptable CBIS (Computer Based Information System) developed to support solutions to specific unstructured management problems [11].

Unlike several other studies, this research was conducted by ranking each selection stage, then each stage obtained results that could pass to the next stage until being elected as a Physics Teacher. The scope of this research is only aimed at SMP Negeri 3 Palembang. By referring to the solutions provided by the TOPSIS method in helping to make decisions, a decision maker can make decisions about choosing a physics teacher according to the required criteria.

2. RESEARCH METHOD

In this study, the Fuzzy TOPSIS method was used to produce teacher candidate rankings for each selection stage, so that the candidates passed to the next stage or did not pass so that they could not continue to the next stage. The framework for thinking in this study is as shown in the following figure:

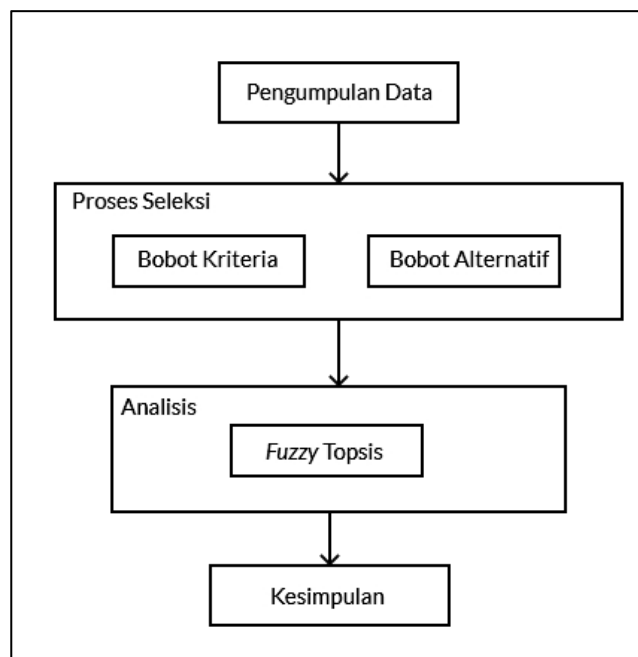


Figure 1. Thinking Framework

2.1 Data Collection

The data was collected through interviews with the school (HRD, Principal of SMP Negeri 1 Palembang). The data obtained is a data that contains the provisions needed by the school in carrying out the process of admitting physics teachers.

2.2 The selection process

Process selection is the first step taken after collecting all the necessary data in the research process. The purpose of this process is to make it easier to proceed to the next stage and reduce the risk that will occur at each stage of the process. In this selection process itself is divided into two, namely the weighting process based on criteria and weighting based on alternatives.

2.3 Analysis

After going through the selection process, the results of the data will be processed immediately to the analysis stage. At this stage the data will be processed using *fuzzy* TOPSIS where the weight assessment of the Fuzzy TOPSIS is carried out by the School Principal in stage 1, and HRD in stage 2.

2.3.1 Fuzzy Logic

Logic *fuzzy* is an appropriate way to map an input space into an output space [4]. Fuzzy logic uses language expressions to describe variable values.

2.3.2 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

The TOPSIS method is a method that can help the optimal decision-making process to solve practical decision problems[8]. This is because the concept is simple and easy to understand, computationally efficient and has the ability to measure the relative performance of decision alternatives in a simple mathematical form [12].

2.4 Conclusion

The next stage is the conclusion, this stage is the final stage in the research process. At this stage the researcher will present the results obtained from the research that has been done.

3. RESULTS AND DISCUSSION

In this section, the researcher will explain the process carried out in this research. This research itself uses the TOPSIS fuzzy method. There are several stages carried out in this study such as data collection, processing and analysis.

3.1 Data collection

Data collection collected in this study is the result data from the applicant selection stage consisting of 3 stages. First stage is the biodata stage where candidates send their CV biodata to schools. If the biodata meets the criteria, the candidate passes, and if there is still information that you want to explore in general, the candidate will be given a validation test (containing basic questions related to the physics teacher profession).

Then the next stage is the interview stage. At the interview stage, candidates will be given a test code. In this research, the calculation and analysis of the validation test and test code are not carried out because the validation test and test code act as complementary data in the 2 main stages of employee selection. The validation test is not the basis for aborting employees, while the test code can be used as an assessment for candidates who do not pass, but it is a final and personal assessment for the school. The employee selection stages can be seen in Figure 2.

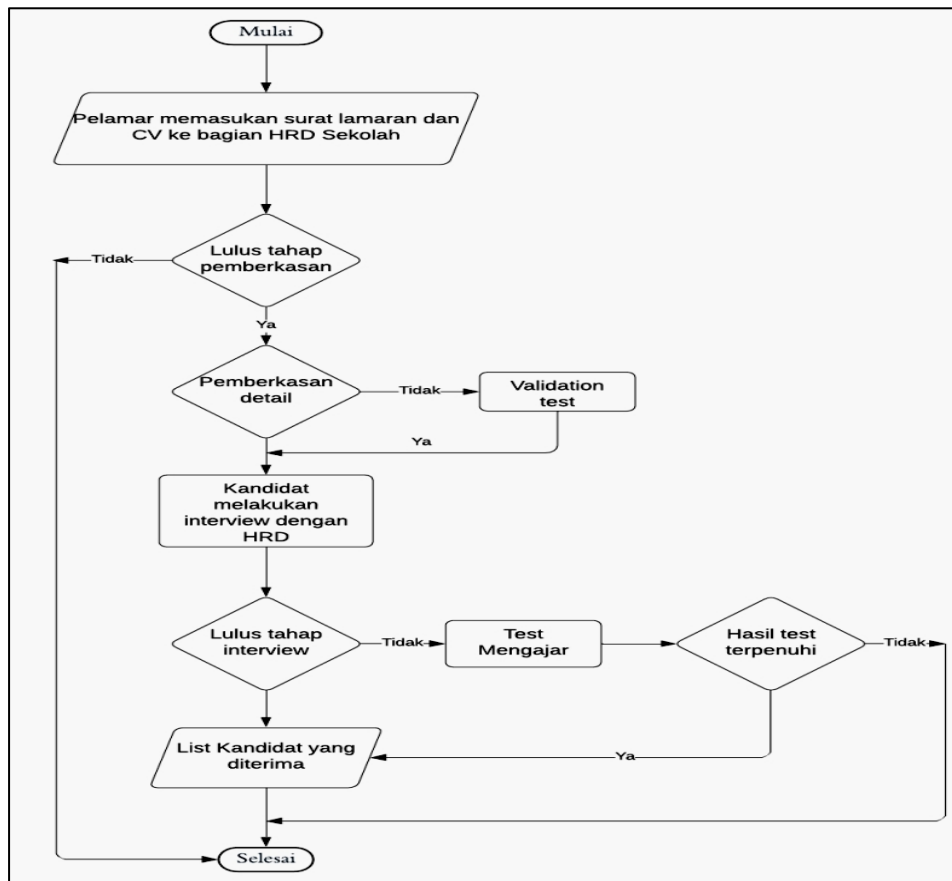


Figure 2. Flowchart of the Process of Selection for Physics Teachers at SMP Negeri 3 Palembang

There are special criteria that must be met. Special criteria are used as the maximum requirements for each stage, if the candidate does not meet the special criteria then the candidate can be declared a failure. Specific criteria for each selection stage can be presented in Table 1. While the criteria weight data and alternative weights obtained from the results of interviews with school principals and HRD are presented in Table 2.

Table 1. Specific Criteria for Each Selection Stage

No.	Stages	Criteria that must be met
1	Application file	Physics teacher-based educational background
		Have skills related to the physics teacher position
2	<i>Interview</i>	Good conflict management
		<i>Skill</i> and experiences are conveyed in a credible and clear manner

Table 2. Weight Assessment of Selection Stages Criteria

No.	Stages	Criteria	Weight
1	Application file	Work experience	Moderate
		<i>Skill</i>	High
2	Interview	Candidate Information	Low
		Personality	Low
		Leadership	Low
		Teamwork	Low
		Motivation	Low
		Work under Pressure	Moderate
		Problem Management	High
		Time Management	High
		Teaching Ability	High
<i>Finishing</i>	Moderate		

3.2 Processing

Processing The data in this study were carried out by providing alternative weight values / ratings and criteria weights based on fuzzy logic. The scale used is 1 to 9. Pairwise comparisons are carried out using a scale of 1-9 values before the scale is converted into a triangular fuzzy number / TFN value [10]. Fuzzy Rating can be seen in Table 3.

Table 3. Fuzzy Rating

<i>Fuzzy Number</i>	Alternative Weights / Ratings	Criterion Weights
(1,1,3)	Very Ugly (SJ)	Very Low (SR)
(1,3,5)	Ugly (J)	Low (R)
(3,5,7)	Enough (C)	Medium (S)
(5,7,9)	Good (B)	Height (T)
(7,9,9)	Very Good (SB)	Very High (ST)

The first stage of the alternative weight assessment was carried out by the principal, then the TOPSIS fuzzy calculation was carried out. The alternative weighting stages for each candidate can be presented in Table 4.

Table 4. Alternative Weights of Application File Stages

Criteria	A1	A2	A3	A4	A5	A6
C1 (Work Experience)	C	B	SJ	B	J	SJ
C2 (skill)	B	J	J	B	J	SJ

Second stage namely the interview, the alternative weight is given by the HRD then the TOPSIS fuzzy calculation is carried out. Alternative weights of candidates who pass stage one can be presented in Table 5.

Table 5. Alternative Weights for the Interview Stage

Criteria	A1	A2	A3	A4
C3 (Candidate Information)	B	C	B	J
C4 (Personality)	B	B	C	B
C5 (Leadership)	B	C	B	C
C6 (Teamwork)	B	B	B	C
C7 (Motivation)	C	B	B	C
C8 (Working under Pressure)	B	B	B	B
C9 (Problem Management)	C	C	B	SJ
C10 (Time Management)	B	B	B	C
C11 (Teaching Ability)	B	B	B	B
C12 (Finishing)	B	B	B	C

In the calculation of the fuzzy TOPSIS stages in this study, each stage of the selection consists of passing candidates and failing candidates. Candidates are declared to have passed seen not from their value but the results of the candidate's ranking, if the candidate is in the lower rank and does not meet special criteria then the candidate is declared a failure. Specific criteria and ranking positions state that candidates can pass to the next stage or not.

3.3 Analysis

After the data goes through the process *processing* The next step is to calculate the results using the TOPSIS fuzzy method. This calculation itself is carried out in accordance with the stages in the previous process, namely the application file stage and the interview stage.

3.3.1 Application File Stage

Tahap application file for physics teacher position consists of 10 candidates. At this stage, the main special criterion and the main requirement is that candidates have a physics teacher educational background based on their studies or based on their experience. The results of the data obtained at the application file stage by processing the processing can be presented in Table 6.

Table 6. Results of Application File Stages

Rank	Alternative	Preference Value	Status
1	A6	0.550	GRADUATED
2	A3	0.423	GRADUATED
3	A1	0.330	GRADUATED
4	A5	0.254	GRADUATED
5	A7	0.101	GRADUATED
6	A4	0.98	GRADUATED
7	A10	0.65	NOT PASS
8	A9	0.47	NOT PASS
9	A8	0.16	NOT PASS
10	A2	0.09	NOT PASS

Candidates A6, A3, A2, A5, A7 and A4 are declared to have passed because they meet the main requirements of the physics teacher education background and are not in the lowest rank, meaning that the other criteria have a high weight value. Meanwhile, candidates A10, A9, A8 and A2 were declared not to have passed the application file stage because they were in the lowest ranking and did not meet special criteria, namely that the candidate did not have a physics teacher educational background both from experience and study.

Candidates who pass the application file stage then fill out a validation test which contains general data to explore the candidate's knowledge and experience regarding the position of a physics teacher. Henceforth, candidates will be scheduled to carry out the next stage, namely the interview stage.

3.3.2 Interview Stage

At stages *interview* candidates will conduct interviews with HRD at school. Specific criteria that are the main thing to consider at this stage are the ways of conflict management and teaching methods. The results of this interview stage can be presented in table 7.

Table 7. Results of the Interview Stage

Rank	Alternative	Preference Value	Status
1	A6	0812	GRADUATED
2	A3	0.709	GRADUATED
3	A2	0.673	GRADUATED
4	A5	0.540	NOT PASS
5	A7	0.323	NOT PASS
6	A4	0.201	NOT PASS

Candidates A6, A3 and A2 passed because they met the main criteria and were not in the lowest ranking. Candidates A5, A7 and A4 are declared not passed because they cannot meet the main interview criteria and are ranked the lowest in this assessment. When conducting interviews for candidates who are deemed inadequate, they will be taken to the teaching test and in the test the results can be determined whether the candidate will pass or fail.

4. CONCLUSION

The conclusion in this study is that the weighted triangle function used provides an increase in the objectivity of the assessment of the physics teacher selection, with the scale used 1-9 whose notation groups are (1; 1; 3), (1; 3; 5), (3; 5; 7), (5; 7; 9), (7; 9; 9) consist of criterion weights (very low, low, medium, high, and very high) and alternative weights / ratings (very bad, ugly, sufficient, well, very well). From the results of calculations carried out using the TOPSIS fuzzy method, the results in the first stage of the candidates who pass are A6, A3, A2, A5, A7 and A4, while in the last stage the candidates who pass are A6, A3, and A4. Specific criteria and the lowest ranking at each stage are the main things to consider passing or failing candidates.

5. SUGGESTIONS

The suggestions for further research are:

1. Using fuzzy logic functions for the calculation of criteria and criteria weights to test more data.
2. Multiple types of criteria and alternatives to compare results.

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