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SELECTION PARTICIPANTS OF SCIENCE OLYMPIC IN ELEMENTARY SCHOOL USING FUZZY – PROFILE MATCHING METHOD

Science ability is one of the students' potentials that can be developed and can be competed. Every student's potential in the field of science can be excelled and directed to become ability. Science Olympiad is a forum to show students' abilities so that every elementary school is expected to participate. Schools must, of course, determine prospective participants for the science olympiad, with the selection of potential students with predetermined assessment criteria. In this study, implementing decision support with fuzzy logic for the conversion of criteria values and the Profile Matching method in determining the ideal profile of prospective Olympic participants, each student's alternative value on the criteria is obtained by the difference in value with the ideal profile, the smaller the value of the GAP difference, it indicates the best alternative. The results showed that the results of fuzzy and profile decisions were the three best alternatives for students who participated in the science Olympics.

Keywords:
Fuzzy, Profile Matching, Decision Support, Selection Parcticipants, Science Olympic

1. Introduction

Freedom of learning and education 4.0 is the type of learning needed by today's students. Students must be able to think analytically and collaboratively, and educators must face technological developments that change very quickly. One of the efforts to master and create technology in the future requires a strong mastery of Mathematics and Science from an early age as a long-term investment for students to achieve success in the future. Therefore, the quality of education must continue to be improved by following the times [1][2]. Efforts to improve the quality of education in the fields of Mathematics and Science and the implementation of the National Elementary School Science Olympic (OSN SD). OSN SD is an Olympic science field event for students throughout Indonesia. This activity is a strategic forum to improve the quality of the Mathematics and Science learning process so that students become more creative and innovative, as well as a vehicle for elementary/MI and equivalent students to develop talents in Mathematics and Science[3] so that students can be creative, skilled, solve problems, and be able to develop all aspects of his personality [4].

The State Elementary School (SDN) 2 in the Ubung area is among the many elementary schools that are very supportive and encourage their students to participate in the Mathematics and Natural Sciences Olympiad. Every year the selection process is carried out to obtain prospective Olympic participants who have the best scores to be proposed to participate in the Mathematics and Natural Sciences Olympiad activities. Schools and teachers determine criteria according to conditions, such as math skills and science abilities [5]. The process of selecting the best students to be prospective participants contains a subjective element. This is due to the lack of tools or methods to become a fundamental benchmark for assessing the suitability between the assessment criteria[6][7] or requirements with alternative Olympic participants with value specifications. The school will choose three students with the best grades to participate in the Mathematics and Natural Sciences Olympiade. Some of the best students from their schools will be selected before participating in the competition. Of course, in determining the best alternative from a series of alternatives based on multi-

criteria, a process is needed to generate decisions [8]. A choice back framework is utilized to back decision-makers in deciding choices [9][10].

The decision support system is part of the information system [11][12][13] so that it can process alternative student data based on criteria assessment to produce the best alternative for MIPA Olympiad participants.

Several studies have successfully implemented a decision support system in the selection of participants in the science olympiad for elementary school students [14] using the Promethee II method, [15] for high school students using the Electre method, and research using a combination of fuzzy-profile matching[16][17]The use of fuzzy logic in calculating attribute weight values objectively by ignoring the subjectivity of decision-makers [18][19] as well as the profile matching method used to match the ideal alternative profile with selected alternative candidates based on criteria values[20][21][22]This study aims to assist schools in conducting the initial selection of MIPA Olympiad candidates with the criteria of student ranking in class and the average value of Mathematics and Natural Sciences lessons so that the three best alternatives for students are using fuzzy logic and profile matching, to produce the best decisions.

2. Method

2.1 Decision Support System

A decision support system (DSS) is characterized as an data framework to help middle-level supervisors an with semi-structured decision-making processes[23]to be more viable by using analytical models and available data[7]

2.2 Fuzzy Logic

The fuzzy method is considered appropriate to determine the gap from fuzzy data and find a solution in the form of the right decision by analyzing the criteria set in the form of a definite number (crisp) which is converted into fuzzy (fuzzy) to get the degree of membership (fuzzification) [24][25]. The degree of membership function greatly influences fuzzy set theory. The membership function represents and explains the degree of proximity and membership of an object(x) to attributes [26]. The fuzzy set theory uses crisp numbers, a classical set theory. Crisp numbers are used to indicate the presence of an element in a set(A), where this element has the possibility of membership, namely being a member of A or not being a member of A[27]. This study aims to combine methods between fuzzy logic, and profile matching aims to process fuzzy data in the form of sets using a ascending linear curve fuzzy[28] shown in Figure 1 and descending linear curve fuzzy[24] shown in Figure 2 then can be processed using the profile matching method.

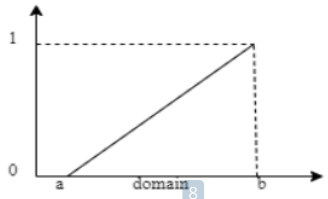

Figure 1. Ascending Linear Curve Representation

Membership Function:

$$\mu(x) = \begin{cases} 0; & x \le a \\ \frac{x-a}{b-a}; & a \le x \le b \\ 1; & x \ge b \end{cases} \quad (1)$$

Figure 2. Descending Linear Curve Representation

Membership Function:

$$\mu(x) = \begin{cases} \frac{b-x}{b-a}; & a \le x \le b \\ 0; & x \ge b \end{cases} \quad (2)$$

2.3 Profile Matching

Profile Matching Model is a fundamental process in HR management where the competencies (ability) needed are determined to obtain maximum results from several criteria [29]. These competencies or abilities must be fulfilled to the maximum or closest to the prospective Olympic participants. In general, the profile matching process compares student profiles to the required criteria so that differences can be known (also called GAP). The smaller the value of the resulting difference, the greater the alternative value on each criterion[30]. The steps in solving multi-criteria problems using the Profile Matching method are[31][32]:

1. Competency GAP Calculation

After determining the student to be assessed, then determining the calculation of competency gap mapping where what is implied by crevice here is the distinction between understudy profiles and perfect profile or can be shown by Equation (3) below:

$$\text{GAP} = \text{Student Profile} - \text{Ideal Profile} \quad (3)$$

2. Determine GAP Calculation

After obtaining the Gap for each customer, each customer profile is given a weighted value according to the provisions in the GAP value weight table[18][21].

TABLE 1
GAP VALUE WEIGHT

Number	GAP Difference	Value Weight	Description
1	0	11	Competence as required
2	0,1	10,5	Individual competence excess 0,1
3	-0,1	10	Individual competence deficiency 0,1
4	0,2	9,5	Individual competence excess 0,2
5	-0,2	9	Individual competence deficiency 0,2
6	0,3	8,5	Individual competence excess 0,3
7	-0,3	8	Individual competence deficiency 0,3
8	0,4	7,5	Individual competence excess 0,4
9	-0,4	7	Individual competence deficiency 0,4
10	0,5	6,5	Individual competence excess 0,5
11	-0,5	6	Individual competence deficiency 0,5

3. Calculation and Grouping of Core Factors and Secondary Factors

The next process is to calculate the GAP weight value by means of which each aspect is grouped into two groups, namely Core Factor and Secondary Factor as follows.

Core Factor Calculation:

$$\text{NCF} = \frac{\sum NC}{\sum IC} \quad (4)$$

Information :
NCF : Average of Core Factor
NC : Total number of Core Factor scores
IC : Number of items

Secondary Factor Calculation:

$$NSF = \frac{\sum NS}{\sum IC} \quad (5)$$

Information :
NSF : Average of Secondary Factor
NC : Total number of Secondary Factor scores
IC : Number of items

4. Calculation of Total Values

The final result of the profile matching calculation process is the ranking of students who are entitled to be proposed as participants in the science olympiad. The calculation of the rating value refers to the results of certain calculations. The total score is calculated based on the percentage of core factors and secondary factors that greatly affect student profiles. The calculation is shown in Equation (6) below:

$$(x)\%\ NCF + (x)\%\ NSF = N \quad (6)$$

Keterangan :
NCF : Average value of core factor
NSF : Average secondary factor
N : Total Values
(x)% : Percentage of value input

First, determine the percent value, namely the core factor of 60% and the second factor of 40%. Then the value of the core and secondary factors is added according to the formula.

3. Result and Discussion

3.1 Flowchart Metode Fuzzy – Profile Macthing

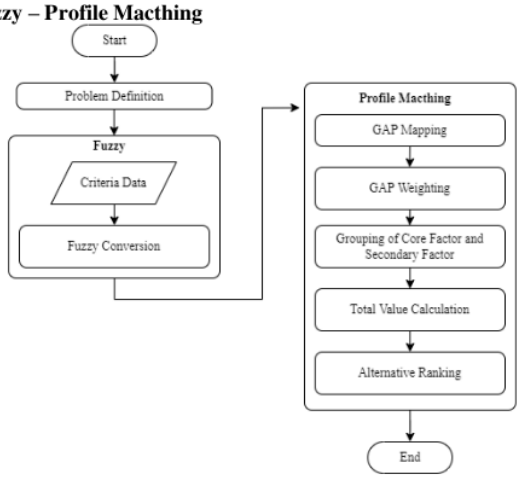

Figure 3. Flowchart Subsystem Fuzzy-Profile Matching

In Figure 3, it can be explained the stages starting with defining the problem, namely the selection of candidates for science olympiad participants, then continuing with the process using the fuzzy method, namely the assessment criteria data converted using a fuzzy membership function in the form of a linear

ascending curve representation and a descending linear curve [24]. The converted criteria data is then used in the calculation phase of the Profile Matching method to produce the best alternative ranking for the science olympiad participants

3.2 Criteria and Alternative Data Analysis

The alternative data used five data from fifth and sixth-grade students of SD N 2 Ubung. The criteria data in the study consisted of two aspects, namely aspects of academic intelligence and other aspects . Aspects of academic intelligence consist of Class Rank (K1), Average Value of Mathematics Subjects (K2), Average Value of Physics Subjects (K3), Average Value of Chemistry Subjects (K4), and Average Subject Value of Biology(K5). Other Aspects consist of Attitudes and Skills (K6). Aspects of Academic Intelligence are already inputted with numbers, so there is no need to score. In contrast, the Other Aspects are scored using a value scale of 1-5 and then converted into an ascending linear fuzzy membership set using Equation(1). Scoring other aspects can be seen in Table 2 below:

TABLE 2
SCORING ASPECT VALUES

Aspect	Criteria	Description	Value Scale	Convertion Fuzzy Value
Other Aspect	Attitude and Skills	Very Good	5	1
		Good	4	0,75
		Enough	3	0,5
		Not Enough	2	0,25
		Very Less	1	0

3.3 Determining the Ideal Profil Value Criteria

The ideal profile value was obtained from the results of interviews with decision-makers. The ideal profile is determined in advance to produce GAP scores with student alternative scores. The ideal profile value for each K1 criterion is based on grades 1 to 5, then the ideal profile value for the K2 to K5 criteria is based on a value of 0 to 100, while the ideal profile value for the K6 criteria is based on Table (2) above. After the ideal profile value is determined, then convert the fuzzy value using an ascending linear curve and a descending linear curve.

Calculation of fuzzy value conversion for K1 criteria using descending linear curve

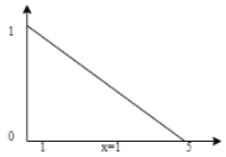

Figure 4. Fuzzy Graph for K1

$$\mu c_{\text{lass rank}}(1) = \frac{5-1}{5-1} = 1$$

Calculation of fuzzy value conversion for K2 criteria using ascending linear curve

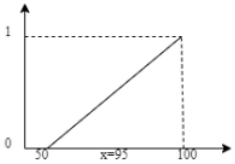

Figure 5. Fuzzy Graph for K2

$$\mu_{\text{average value math}}(95) = \frac{95-50}{100-50} = \frac{45}{50} = 0{,}9$$

TABLE 3
IDEAL VALUE PROFIL OF CRITERIA

Criteria	Criteria Name	Ideal Profile	Convertion Fuzzy Values
K1	Class Rank	1	1
K2	Average Value of Mathematics Subjects	95	0,9
K3	Average Value of Physics Subjects	95	0,9
K4	Average Value of Chemistry Subjects	95	0,9
K5	Average Subject Value of Biology	95	0,9
K6	Attitudes and Skills	Very Good	1

3.4 Alternative Value

The following are the alternative values of students who are prospective participants in the science olympiad on each of the assessment criteria, which can be seen in Table 4 below:

TABLE 4
ALTERNATIVE VALUES

Alternative	Aspects of Academic Intelligence					Other Aspect
	K1	K2	K3	K4	K5	K6
A1	1	98	88	98	88	Very Good
A2	2	85	90	88	87	Good
A3	2	87	94	84	85	Good
A4	1	95	86	91	97	Very Good
A5	3	88	92	92	87	Good

The alternative values for each criterion are then converted to fuzzy values using Equations (1) and Equation (2). Criteria K1, K2, K3, K4, and K5 use an ascending linear curve. While the K6 criteria use a descending linear curve. The results of the fuzzy conversion can be seen in Table 5 below:

TABLE 5
FUZZY CONVERTION RESULTS

Alternative	Aspects of Academic Intelligence					Other Aspect
	K1	K2	K3	K4	K5	K6
A1	1	0,96	0,76	0,96	0,76	1
A2	0,75	0,7	0,8	0,76	0,74	0,75
A3	0,75	0,74	0,88	0,68	0,7	0,75
A4	1	0,9	0,72	0,82	0,94	1
A5	0,5	0,76	0,84	0,84	0,74	0,75

3.5 Calculation GAP Competency

The Competency Gap is calculated by Equation (3), with the benchmark ideal profile value in Table (3) and alternative values in Table (5). Then the difference in GAP values is calculated which can be seen in Table 6 below:

TABLE 6
COMPETENCY GAP SCORE

Alternative	Aspects of Academic Intelligence					Other Aspect
	K1	K2	K3	K4	K5	K6
A1	1	0,96	0,76	0,96	0,76	1
A2	0,75	0,7	0,8	0,76	0,74	0,75
A3	0,75	0,74	0,8	0,68	0,7	0,75
A4	1	0,9	0,72	0,8	0,94	1
A5	0,5	0,76	0,8	0,8	0,74	0,75
Ideal Values	**1**	**0,9**	**0,9**	**0,9**	**0,9**	**1**
A1	0	0.06	-0.14	0.06	-0.14	0
A2	-0.25	-0.2	-0.1	-0.14	-0.16	-0.25
A3	-0.25	-0.16	-0.1	-0.22	-0.2	-0.25
A4	0	0	-0.18	-0.1	0.04	0
A5	-0.5	-0.14	-0.1	-0.1	-0.16	-0.25

3.6 Calculation of Core Factor and Secondary Factor

To calculate the value of the core factor (NFC) and the second factor (NSC) according to equations 4 and equation 5, it is first determined that the Core Factor group is the criteria K1, K2, K3, K4, K5, and the Secondary Factor is the criteria K6. The results of the NFC and NSC values can be seen in Table 7 below:

TABLE 7
CORE FACTOR AND SECONDARY FACTOR OF COMPETENCE

Alternative	K1	K2	K3	K4	K5	K6	NFC	NSC
A1	11	11	10	11	10	11	10.6	11
A2	9,5	9,5	10	10	10	9	9.8	9
A3	9,5	10	10	9,5	9	9	9.6	9
A4	11	11	10	10	11	11	10.6	11
A5	6	10	10	10	10	9	9.2	9

3.7 Calculation Final Score and Ranking

The NFC and NSC values of each alternative are then calculated by equation 6 to obtain the final alternative value, namely the Ni value, the core factor weight value is 70% and the secondary factor weight value is 30%. The results of the alternative final scores can be seen in table 8 below:

TABLE 8
TOTAL VALUE OF COMPETENCE

Alternatif	NFC (70%)	NSC(30%)	Ni
A1	7.42	3.3	**10,72**
A2	6.86	2.7	**9,56**
A3	6.72	2.7	9,42
A4	7.42	3.3	**10,72**
A5	6.44	2.7	9,14

From table 8 obtained the final value of each alternative, then followed by ranking based on the value of Ni from the largest to the smallest. The final result is that the three best alternatives are chosen, namely A1 and A2 with a value of 10,72, and A2 with a value of 9,56 so that these three selected alternatives will become participants in the science olympic.

4. Conclusion

Determination of the best alternative from multiple assessment criteria into a decision process that can be completed using decision support analysis, in the problem of selecting candidates for science olympiad participants, the use of fuzzy logic in value conversion and the profile matching method to determine the ideal profile of decision making can be implemented and produce three student alternatives best. further research can develop techniques for scoring scores using linear interpolation and comparing results.

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