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NATIONAL SCIENCE OLYMPIAD PARTICIPANT SELECTION USING COMBINATIONS AHP AND MFEP

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ABSTRACT

In the educational world, many students learn to strive to follow the National Science Olympiad included in the government program. The National Science Olympiad is a competition in science for elementary, middle, and high school students in Indonesia. Students who follow the National science Olympics are students who have passed the county and provincial level selection and are the best students of their respective provinces. At the National Science Olympics, there are 3 different currencies in mathematics, physics, and biology. The research used in this research is a qualitative method of research that uses analysis in a descriptive or narrative to illustrate the phenomenon from the beginning of research to research results. Techniques used in qualitative research in general with interview and observation methods. The final result of the study resulted in a selection system of National Science Olympiad in junior High School 1 range using a combination of AHP and MFEP methods which each writer has a weight of 0.1 mathematics, 0.7 physics and 0.2 of desktop-based biology using Visual Basic .net 2010 Programming language can facilitate the school to determine the students who will be participants in the event.

INTRODUCTION

NSO (National Science Olympiad) is one of the efforts to strengthen the quality of education in the elementary school level because basic education is an excellent foundation and it is important to continue at a higher level. Strengthening the foundation's efforts must be done by changing the orientation of student-oriented education. So that students will be active in the learning process. One of the indicators of quality improvement at a level of education is the increasing ability of students in the ability of critical thinking, logical power, creativity, attitude, and character of the students[1].

Analytical Hierarchy Process (AHP) was developed in the early 1970s by Thomas L. Saaty, a mathematician from Pittsburg University. AHP is essentially designed to rationally capture the perception of people who relate very closely to certain problems

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through procedures designed to arrive at a scale of preference among alternative sets. This analysis is intended to create a model of problems that have no structure, usually set to solve a measured problem (quantitative), problems that require an opinion (judgment) or in a complex or unfixed situation, in situations where statistical data is very minimal or none at all and is only qualitative based on perception, experience or intuition. AHP is also widely used in the decisions for many criteria, planning, allocation of resources, and the determination of priorities of the strategies that players have in conflict situations. Thus, AHP is an analysis used in decision-making with a system approach, where decision-makers are trying to understand a system condition and help to make predictions in making decisions[2] [3][4]

The Multi-Factor Evaluation Process (MFEP) is a quantitative method that uses the System's weighting in decision making. Decision making is done subjectively and intuitively by weighing various factors that have an important influence on their alternative choices. For a strategically influential decision, it is recommended to use a quantitative approach such as MFEP. In the MFEP first of all the criteria that are important factors in making consideration are given the appropriate weighting.[5][6]

The method chosen by the researcher combinations/combines two methods namely AHP and MFEP methods based on the advantages of the amplifier of each method. In this case, the researcher uses the AHP method at the time of determining the criteria, and for Perankingan will use the MFEP method. The combination of these methods utilizes the advantages of each method. The AHP method is selected because it is able to define more consistent criteria. While MFEP is chosen because it is able to choose a superior alternative based on criteria that are processed using the AHP method (Sembiring, 2018).. Through the application of this method, the researcher will combine the AHP method and MFEP in the SNMPTN participants of the National Science Olympiad (NSO). The AHP and MFEP methods are only decision-making to be taken by the headmaster in the SNMPTN participants of the National Science Olympiad (NSO).

Research in the field of decision support systems is also widely discussed with other methods such as SAW[7] and WP[8].

METHOD

The Analytical Hierarchy Process (AHP) method was developed in the early 1970s by Thomas L. Saaty, a mathematician from Pittsburg University. AHP is essentially designed to rationally capture the perception of people who relate very closely to certain problems through procedures designed to arrive at a scale of preference among alternative sets. This analysis is intended to create a model of problems that have no structure, usually set to solve a measured problem (quantitative), problems that require an opinion (judgment) or in a complex or unfixed situation, in situations where statistical data is very minimal or none at all and is only qualitative based on perception, experience or intuition.[3]

Analytical Hierarchy Process is used as a method of solving problems compared to other methods for the following reasons :

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1. The hierarchical structure, as a consequence of the criteria chosen, is up to the most sub-criteria.
2. Calculating validity up to the limit of inconsistency tolerance as criteria and alternatives chosen by decision-makers. Taking into account the output durability of decision-making sensitivity analysis.

MFEP is a quantitative method that uses a weighting system in decision making. Decision making is done subjectively and intuitively by weighing various factors that have an important influence on their choices. For a strategically influential decision, it is recommended to use a quantitative approach such as MFEP. In the MFEP first, all the criteria that are important factors in making consideration are given the appropriate weighting.[9][10]

The same steps are also performed on alternatives that will be selected, which can then be evaluated about those consideration factors. The MFEP method determines that the highest value alternative is the best solution based on the criteria you have selected [5]. Steps MFEP Method :

1. Specifies factors and weights of factors where the total weighting should be equal to one.
2. Filling in value for each factor that affects in decision making from the data to be processed, the value entered in the decision making process of the data to be processed, the value entered in the decision making process is an objective value.
3. The process of calculating weight evaluation is the process of calculating the weight between the weight factor and the evaluation factor by summing the whole results of weight evaluations to obtain the total evaluation result.

   $W = w_1 + w_2 + w_3 + ... + w_n$ .....(1)

   Description :

   W = Total criteria weight

   w = Criteria weight

   W_B **= w.e** .....(2)

   Description :

   W_B = Weight evaluation

   w = Weighing criteria

   e = Evaluation criteria

In multi-factor decision making, the decision-makers are subjective and intuitive to weigh various factors that have an important influence on their choices. For a strategically influential decision, it is recommended to use a quantitative approach such as MFEP. In the MFEP first, all the criteria that are important factors in making consideration are given the appropriate weighting. The same steps are done to the alternatives that will be chosen, which can then be evaluated about those consideration factors. The sum of each criterion weight should be equal to 1 and have the range evaluation criteria value.

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RESULT AND DISCUSSION

In alternative problem solving where AHP helps decision-makers to obtain the best solution by decomposing complex problems into a simpler form to then synthesize the various factors involved in the decision-making problem.
The step to take in determining the priority of the criteria is to create a comparison matrix in pairs. From each of these criteria will be determined the value of the priority of its interests. Each criterion will be determined by the value of its interests based on the following assessments:

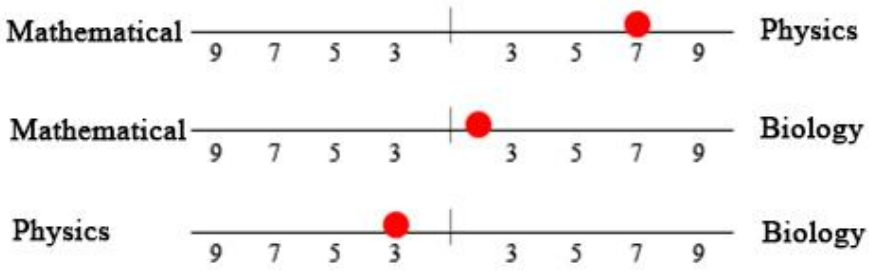

Image 1. The logic of Pairing Comparison Scale Determination

The above value that is a red symbol is the value in the determination of weight in each criterion. If the mathematical criteria compare to Mathematics = 1 which means the two elements are just as important. While Mathematics with Physics = 7 which means that the value between the two elements one element is more absolutely important, then thevalue 7 in the input to the Physics row and 1/7 or 0.143 is entered into the Physics column. The results of the study can be seen from the table below

Table 1. Eigen Value Matrix

Criteria	Mathematical	Physics	Biology	Amount	Average
Mathematical	1/10= **0,1**	0,143/1,476= **0,097**	0,5/4,5= **0,111**	0,30789	0,10263
Physics	7/10= **0,7**	1/1,476= **0,677**	3/4,5= **0,667**	2,04409	0,68136
Biology	2/10= **0,2**	0,333/1,476= **0,226**	1/4,5= **0,222**	0,64803	0,21601
		Amount			1

The next step is to create consistency ratio calculations. This calculation is used to ensure that the value of the consistency ratio (CR) is < = 0.1. If it turns out that the CR value is greater than 0.1 then the paired comparison matrix should be corrected. Previously, the first look for the max value using the number of criteria column times with the average value of each criterion.

λmaks = (Number of math columns * Average Math Scores) + (Number of physics column * Average physics value) + (Number of biological columns * Average biological value)

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= (10 * 0,10263) + (1,476 * 0,68136) + (4,5 * 0,21601)
= 3,004147465

Next look for value Consistency index (CI) with formula:

CI = λmaks – n) / (n-1)
= (3,004147465 – 3) / (3 – 1)
= 0,002073733

Next look for the consistency ratio (CR) Value < = 0.1 with the formula:

CR = CI / IR

To get the IR value can be seen in the table below:

Table 2. Random Consistensy index list (IR)

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48	1,56	1,57	1,59

CR = CI / IR
= 0,002073733 / 0,58
= 0,0035 **CONSISTENT**

The result of a CR value of < = 0.1 is declared consistent.

In the MFEP method the weight value factor where the total weighting should be equal to 1 (∑ weighting = 1) or called the factor weight. And from the calculations using the AHP method the total weight value equals 1, so that the total weight value of the AHP method can be combined into the MFEP method as a weighted value as well.

Table 3. Factors and the weighted

No	Faktor	Bobot
1	Mathematical	0,10263
2	Physics	0,68136
3	Biology	0,21601
	Total ∑	1

Fill the weight value of the factor according to several alternatives that serve as candidates for national Science Olympiads. The value of the factor weights and alternatives can be seen in the table below.

Table 4. Factor and alternative values

Alternative	Faktor		
	Mathematical	**Physics**	**Biology**
A1	6	6	4
A2	7	7	8
A3	8	5	5
A4	6	3	7
A5	8	5	7
A6	3	8	8

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Table 4. Factor and alternative values

Alternative	Faktor		
	Mathematical	**Physics**	**Biology**
A7	6	3	8
A8	8	7	5
A9	4	5	7
A10	6	6	7
A11	7	9	8
A12	4	6	6
A13	9	7	5
A14	7	5	5
A15	6	6	7
A16	8	7	6
A17	9	7	7
A18	6	8	6
A19	6	8	8
A20	8	6	7

Weight evaluation calculation process is a calculation between factor weight and factor evaluation with the summation, from the result of weight evaluation can determine the result of the evaluation. Here is a weight evaluation calculation on some alternatives.

From the calculation, result obtained weight evaluation value. The weight evaluation value can be seen in the table below.

Tabel 5 Weight Evaluation Value

Alternative	Faktor		
	Mathematical	**Physics**	**Biology**
A1	0,6	4,1	0,9
A2	0,7	4,8	1,7
A3	0,8	3,4	1,1
A4	0,6	2,0	1,5
A5	0,8	3,4	1,5
A6	0,3	5,5	1,7
A7	0,6	2,0	1,7
A8	0,8	4,8	1,1
A9	0,4	3,4	1,5
A10	0,6	4,1	1,5
A11	0,7	6,1	1,7
A12	0,4	4,1	1,3
A13	0,9	4,8	1,1

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Tabel 5 Weight Evaluation Value

Alternative	Faktor		
	Mathematical	Physics	Biology
A14	0,7	3,4	1,1
A15	0,6	4,1	1,5
A16	0,8	4,8	1,3
A17	0,9	4,8	1,5
A18	0,6	5,5	1,3
A19	0,6	5,5	1,7
A20	0,8	4,1	1,5

Sum all the weight evaluation results to obtain the total evaluation result.

$$\sum_{i=0}^{n} WEi = WE1 + WE2 + WEn$$

The Total evaluation results can be seen in the table below.

Table 6 Total Evaluation Results

Alternative	Factor			Total *WEi*
	Mathematical	Physics	Biology	
A1	0,6	4,1	0,9	5,6
A2	0,7	4,8	1,7	7,2
A3	0,8	3,4	1,1	5,3
A4	0,6	2,0	1,5	4,2
A5	0,8	3,4	1,5	5,7
A6	0,3	5,5	1,7	7,5
A7	0,6	2,0	1,7	4,4
A8	0,8	4,8	1,1	6,7
A9	0,4	3,4	1,5	5,3
A10	0,6	4,1	1,5	6,2
A11	0,7	6,1	1,7	8,6
A12	0,4	4,1	1,3	5,8
A13	0,9	4,8	1,1	6,8
A14	0,7	3,4	1,1	5,2
A15	0,6	4,1	1,5	6,2
A16	0,8	4,8	1,3	6,9
A17	0,9	4,8	1,5	7,2
A18	0,6	5,5	1,3	7,4
A19	0,6	5,5	1,7	7,8
A20	0,8	4,1	1,5	6,4

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Based on table 6 above, it can be seen that the students who are the choice to follow the National Science Olympiad representing SMP Negeri 1 District level special Asahan range in science subjects are A11 with a value of 8.6.

CONCLUSION

Based on the results of the analysis of the combination of AHP and MFEF methods that have been done, researchers can conclude prospective national science Olympiads are no longer selected by the teacher of the subjects, but students who want to follow the National Science Olympiad can register as a candidate for National Science Olympiad District level representing SMP Negeri 1 range.

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