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Decision Making using Neutrosophic and Analytics Hierarchical Process (N-AHP) in Choosing the Qualified Candidate to Enter the Teacher Training Institutions

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ABSTRACT

Education is the key to success in life. It helps individuals and society to develop socially and economically. The quality of education is assessed through the effective teaching of their teachers. There are two important processes to make sure the quality of teachers which are the recruitment process and the selection process [1]. Therefore, the Neutrosophic and Analytics Hierarchical Process (N-AHP) method, a decision-making instrument was constructed in this project focusing on the selection process to calculate and rank the most qualified candidates to enter the teacher's training institutions. In this research, four important main criteria and several sub-criteria have been considered. The main criteria are SPM results, participation in Co-curriculum activities, teacher's qualification tests (UG) and physical fitness test (UF). The weight of each criterion and sub-criteria was calculated using the Neutrosophic and Analytics Hierarchical Process (N-AHP) method. From these evaluated results, the most qualified candidates to enter the teacher's training institution can be identified..

Key words: Analytic hierarchy process (AHP), Decision Making, Neutrosophic set theory.

1. INTRODUCTION

Through globalization, education contributes to a great impact on human society. Teacher has become the important career and not only seen as imparters of knowledge, but also as an encourager towards a better society. Teachers are educators or mentors who contribute to education sectors in the form of education and supporters for the development of national education [3]. In Malaysia, the Institute of Teachers (IPG) has been developed to train the teachers in order to support the national education. After completing the SPM students who are interested to pursue their studies in education lines are required to enter the IPG. To be qualified for IPG, several requirements must be fulfilled which are minimum of 5A's in SPM, active participation in Co-Curriculum activities, and passed both Written Test (UKCG) and Physical Fitness Test (UKF). Due to the high numbers of applicants with the limited quota, the selection process has been so crucial. Therefore, the purpose of this research is to help the decision makers to rank the most qualified students to enter IPG based on criteria calculation using the Neutrosophic set theory and Analytics Hierarchy Process (AHP) method.

1.1 Literature Review

This section discusses the reviews of past-related research. Thomas L.Saaty introduced the Analytic Hierarchy Process in 1980 as one of the methods which was widely used as a decision-making tool and the Neutrosophic set which are the combinations of a fuzzy set, classical set and intuitionist fuzzy set has been employed.

Analytic Hierarchy Process (AHP)

AHP method was widely used as a decision-making tool [4-5]. This method can help decision makers to obtain the solution based on the hierarchy of criteria and sub-criteria in which the goals located at the top and end of the hierarchy were considered as the potential solutions [6], [7]. A new hierarchy was to be developed depending on the changes in the structure of the hierarchies.

Pairwise comparison was the next step after developing the hierarchy in AHP. All the related elements at the end of the hierarchy were compared in pairwise comparison matrices. Next, to produce an overall score for each element, each score of the elements was combined with the criterion weight [8]. Furthermore, the consistency ratio (CR) will be calculated to see the consistency of the decision makers' judgments. The judgments were accepted if the CR <0.1. [7].

Regardless of the wide usage of AHP method, it has been criticized for its lack of ability with uncertainties and imprecision for the decision makers to get the exact number [9-11]. Therefore, the expanded fuzzy AHP method has been developed to overcome the problem.

Neutrosophic Set (NS)

Neutrosophic Logic can distinguish between absolute truth and relative truth that can be effectively represented real world problems. The method of an AHP presented in this research is using neutrosophic set (N-AHP) [12].

2. METHODOLOGY

The proposed research was modeled by using N-AHP method. The integrated criteria and sub-criteria were weighed according to this method.

2.1 Development of the Hierarchical Framework

All criteria used in this research are shown in the table 1 below. Four (4) levels of the hierarchical framework begins with the goal which is to find the qualified candidates based on four (4) main criteria followed by the sub- criteria and ending with candidates ranking [13].

Table 1: List and code of the criteria

Main Criteria	Sub-criteria	Sub-criteria
SPM (S)	• Minimum 5A (A) • Credits subject BM and Sejarah (C) • Pass BI (P)	No sub-criteria
Co-curriculum (K)	• Sport (S) • Unit Uniform (U) • Club & Association (CL)	No sub-criteria
UKCG (UG)	• INSAK Test (IT) • Psychometric Test (PMT)	No sub-criteria
UKF (UF)	• Physical Test (PT) • Interview (I)	Physical Test • Bleep Test (BT) • Reach range (RR) • Push Up (PU) • Rise Up (RU) • Body Mass Index (BMI) Interview • Individual Performance (IP) • Confidence level (CL) • Appearance (AP)

2.2 Triangular Neutrosophic Set Number

In this research the triangular neutrosophic scale and linguistic terms were implemented as shown in Table 2.

Table 2: Corresponding Triangular Neutrosophic scale and Linguistic terms.

Saaty scale	Explanation	Neutrosophic Triangular scale
1	Equally influential	$\tilde{1}$ = <(1,1,1);0.50,0.50,0.50>
3	Slightly influential	$\tilde{3}$ = <(2,3,4);0.30,0.75,0.70>
5	Strongly influential	$\tilde{5}$ = <(4,5,6);0.80,0.15,0.20>
7	Very strongly influential	$\tilde{7}$ = <(6,7,8);0.90,0.10,0.10>
9	Absolutely influential	$\tilde{9}$ = <(9,9,9);1.0,1.00,1.00>
2	Sporadic values between two close scales	$\tilde{2}$ = <(1,2,3);0.40,0.65,0.60>
4		$\tilde{4}$ = <(3,4,5);0.60,0.35,0.40>
6		$\tilde{6}$ = <(5,6,7);0.70,0.25,0.30>
8		$\tilde{8}$ = <(7,8,9);0.85,0.10,0.15>

2.3 Determining Weightsof Criteria

There were 5 steps involved to find the normalized weights of both criteria and sub-criteria.

Step 1: Pairwise comparison based on linguistic terms

The first step was to use a pair-wise comparison to evaluate the weights of each criteria and determine the priority based on expert judgments.

Table 3: The pair-wise comparison of the main criteria

Code Criteria	Equally Influential (1,1,1)	Slightly Influential (2,3,4)	Strongly Influential (4,5,6)	Very Strongly Influential (6,7,8)	Absolutely Influential (9,9,9)	Code Criteria
UF		/				UG
			/			S
				/		K
UG			/			S
				/		K
S		/				K

The importance of each criteria has been evaluated. Table 3 shows UKF is the most important, followed by SPM results, and the least important criterion is co-curriculum.

Step 2: Neutrosophic pair-wise comparison matrix

By applying the neutrosophic triangular scale, the pair-wise comparison of main criteria is tabulated in Table 4:

Table 4: The neutrosophic comparison matrix of main criteria

Criteria	UF	UG	S	K
UF	((1,1,1); 0.5,0.5,0.5)	((2,3,4); 0.3,0.75,0.7)	((4,5,6); 0.8,0.15,0.2)	((6,7,8); 0.9,0.1,0.1)
UG	((1/4,1/3,1/2); 0.3,0.75,0.7)	((1,1,1); 0.5,0.5,0.5)	((4,5,6); 0.8,0.15,0.2)	((6,7,8); 0.9,0.1,0.1)
S	((1/6,1/5,1/4); 0.8,0.15,0.2)	((1/6,1/5,1/4); 0.8,0.15,0.2)	((1,1,1); 0.5,0.5,0.5)	((2,3,4); 0.3,0.75,0.7)
K	((1/8,1/7,1/6); 0.9,0.1,0.1)	((1/8,1/7,1/6); 0.9,0.1,0.1)	((1/4,1/3,1/2); 0.3,0.75,0.7)	((1,1,1); 0.5,0.5,0.5)

Step 3: Consistency of expert's judgements.

The result shows the data is consistent as <0.1

Step 4: The crisp comparison matrix of main criteria and sub-criteria

The crisp matrix is calculated using Equation (2)

$$S(\tilde{a}_{ij}) = \frac{1}{8}[a_1+b_1+c_1]\times\left(2+\alpha_{\tilde{a}}-\theta_{\tilde{a}}-\beta_{\tilde{a}}\right) \quad (2)$$

The crisp matrix of main criteria is tabulated in Table 5:

Table 5: The crisp comparison matrix of main criteria

Criteria	UF	UG	S	K
UF	1	1	4	7
UG	1	1	4	7
S	0.25	0.25	1	1
K	0.142857143	0.142857143	1	1

Step 5: Normalization

The matrix will be normalized as shown in Table 6:

Table 6: The normalized comparison matrix of main criteria

Criteria	UF	UG	S	K
UF	0.417910448	0.417910448	0.4	0.4375
UG	0.417910448	0.417910448	0.4	0.4375
S	0.104477612	0.104477612	0.1	0.0625
K	0.059701493	0.059701493	0.1	0.0625

The weight of main criteria was calculated based on the total of the row averages.

Table 7: Weightage of the main criteria

Criteria	Eigen Vector X
UF	0.418330224
UG	0.418330224
S	0.092863806
K	0.070475746

3. RESULT AND DISCUSSION

This research was conducted to propose an effective method for the selection of qualified candidates to enter teacher's training institutions. The qualification was determined based on four criteria which are SPM results, participation in Co-curriculum activities, teacher's qualification tests (UG) and physical fitness test (UF). The results were calculated using the proposed Neutrosophic AHP method. The final results for the ten (10) candidates are presented in Table 8.

Table 8: The weights of main criteria, sub criteria, candidates and their ranking.

Candidates	Total Final Weightage (Overall)	Rankings
C4	0.108275	1
C7	0.107216	2
C3	0.104364	3
C10	0.101868	4
C2	0.100554	5
C5	0.099595	6
C6	0.096328	7
C9	0.095105	8
C1	0.094138	9
C8	0.092556	10

Based on these results, C4 is the best candidate since he/she had the highest value of UG and UF, which are the two most important criteria. Meanwhile, C8 was the most un-preferred candidate since he/she had the lowest values of SPM result, UG and UF.

5. CONCLUSION

The aim of this research to develop a model based on Neutrosophic AHP method to facilitate as the guidelines for IPG in choosing the most qualified candidates to enter their institution. For future works, researchers are suggested to consider other multi-criteria decision making method such as VIKOR to solve the problem.

REFERENCES

1. Organisation for Economic Co-operation and Development, Santiago, P., &SourceOECD. (2005). *Teachers matter: Attracting, developing and retaining effective teachers*. Organisation for Economic Co-operation and Development.
2. Jamil, H., Razak, N. A., Raju, R., & Mohamed, A. R. (2007). Teacher professional development in Malaysia: Issues and challenges. *Africa-Asia University Dialogue for Educational Development Network*, 85-102.
3. Atkins, D. E., Brown, J. S., & Hammond, A. L. (2007). *A review of the open educational resources (OER) movement: Achievements, challenges, and new opportunities* (pp. 1-84). Mountain View: Creative common.
4. Saaty, T. L. The analytic hierarchy process. New York: McGraw-Hil. (1980) https://doi.org/10.21236/ADA214804

5. Ayhan, M. B. A Fuzzy Ahp Approach for Supplier Selection Problem: A Case Study inAGearmotor Company. *International Journal of Managing Value and Supply Chains*. 2013. 4:11-23. https://doi.org/10.5121/ijmvsc.2013.4302
6. Stević, Ž.,Tanackov, I., Vasiljević, M., Novarlić, B., &Stojić, G. An integrated fuzzy AHP and TOPSIS model for supplier evaluation. *Serbian Journal of Management*. 2016.11(1): 15-27. https://doi.org/10.5937/sjm11-10452
7. Ounkaewi, D., Chalongsuppunyoo, R., Payakpate, J. An application of MCDM on dormitory consideration. *International Journal of Advances in Computer Science and Technology (IJACST).* 2014.11(3):27-29.
8. Vahidnia, M. H., Alesheikh, A., Alimohammadi, A., &Bassiri, A. Fuzzy analytical hierarchy process in GIS application. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences.* 2008. 37(B2): 593-596.
9. Srichetta, P., &Thurachon, W. Applying fuzzy analytic hierarchy process to evaluate and select product of notebook computers. *International Journal of Modeling and Optimization*. 2012. 2(2): 168. https://doi.org/10.7763/IJMO.2012.V2.105
10. Deng, H. Multicriteria analysis with fuzzy pairwise comparison. *International journal of approximate reasoning*. 1999. 21:215-231. https://doi.org/10.1016/S0888-613X(99)00025-0
11. Goyal, R.K.; Kaushal, S.; Sangaiah, A.K. (2017). The utility based non-linear fuzzy AHP optimization model for network selection in heterogeneous wireless networks. *Appl. Soft Comput*. https://doi.org/10.1016/j.asoc.2017.05.026
12. Zhang, C.; Li, D.; Sangaiah, A.K.; Broumi, S. (2017). Merger and Acquisition Target Selection Based on Interval Neutrosophic Multi-granulation Rough Sets overTwo Universes. *Symmetry*, 9, 126. https://doi.org/10.3390/sym9070126
13. Buckley, J.J. (1985). Fuzzy hierarchical analysis. *Fuzzy Sets Syst*. 17, 233–247. https://doi.org/10.1016/0165-0114(85)90090-9