J. Appl. Environ. Biol. Sci., 7(1)69-73, 2017

ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

Application of Analytic Hierarchy Process for Selecting Best Student

Nur Afriza Baki[1], Nur Idalisa Norddin[2], Wan Azrina Wan Azaman[3]

[1]Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Bukit Besi, Dungun, Terengganu, Malaysia
[2]Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Dungun, Terengganu, Malaysia
[3]Academy of Language Studies, Universiti Teknologi MARA, Bukit Besi, Bukit Besi, Dungun, Terengganu, Malaysia

Received: August 16, 2016
Accepted: November 23, 2016

ABSTRACT

The implementation of reward management in any academic institutionaims at rewarding students rightfully and consistently to appreciate their significance to the organisation. It could inspire the students to work harder, but often some conflicts arose during the nomination and selection process. Thus, the purpose of this study is to suggest a model that could assist in selecting the best student by using Analytic Hierarchy Process, one of the methods in Multi Criteria Decision Making. The students were ranked based on the criteria and their value. The overall priority value of the students was calculated by considering the priority of each criteria. The student with the highest priority value was regarded as the best student.
KEYWORDS: Hierarchical Framework, Selection Process, Multi Criteria Decision Making (MCDM), Pair-Wise Comparison, Best Student.

INTRODUCTION

Rewarding oneself in regards of his achievements or success could be a motivating factor to always keep him positive and industrious. It sets the goals and the establishment of rules clearly so people will be aware of their job, could monitor their progress and be alert of their accomplishments. In Universiti Teknologi MARA (Terengganu) particularly, this rewarding management has been implemented to motivate the students to excel in their studies and be well-rounded. These students will be selected and awarded as the best students amongst all. Award selection is normally carried out through surveys or evaluation process by the faculty or the management of the campus. This process however, is less efficient since the process of evaluating and nominating the students for the awards are executed without any specific measurement or rubrics. They are chosen based on the panel of top management's instinct which involves personal judgement and highly affected by the emotional condition of these people. The deterministic scale or crisp values might lead to ambiguous results even though some initiatives have been done to prevent biasness such as listing down the criteria of the award [1].

Since the selection process of the best student award involves multiple criteria, there will be some difficulties in the selection process. One study regarding student selection for All Round Excellence Award has considered a few criteria such as academics, extracurricular activities, cultural activities, general behaviour and department activities in the selection process [2]. It was done by using Multi Criteria Decision Making (MCDM). Overall, the MCDM method can be classified into two; based on the type of data used in the study or the number of decision makers involved in the decision process [3].

Analytic Hierarchy Process (AHP) is one of the MCDM method that is commonly used nowadays. It involves in building up a hierarchical framework which allows inclusive criteria, sub-criteria and other alternatives and the data is derived by using a set of pair-wise comparisons. This method benefits the most when some important elements in making the decision are difficult to measure or compare or agreement between the decision makers is obstructed due to the differences of their expertise and preferences [4]. In addition, the AHP method is simpler than other methods; it is easy to use, has great flexibility and can be integrated with many other methods [5].

The AHP has been introduced by [4, 6] which is mostly used in selection process of many sectors such as manufacturing, personnel, social, engineering, education and even politics [7]. This method has also been improved or integrated with a few other methods in solving many MCDM problems such as in a study [8] that combined AHP and Preference Ranking Organisation (PROMETHEE) method, AHP and Fuzzy in [9], AHP and WeightedGoal Programming (WGP) [10], AHP and Multi-Objective Possibilistic Linear Programming (MOPLP)[11].

AHP matrix can be considered as reasonably consistent if its Consistency Ratio (CR) is not more than 0.1 [12]. However, if it is greater, the judgment needs to be retested. Because of its flexibility and simplicity, this

Corresponding Author: Nur Afriza Baki, Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Bukit Besi, Bukit Besi, Dungun, Terengganu, Malaysia, Email: nurafriza@tganu.uitm.edu.my

method has been chosen in order to find out the best student who is excellent in academic and extracurricular activity.

METHODOLOGY

The AHP method is used as a framework of this study to find the best student of the academic semester. This study aimed to suggest a model to select the most outstanding student. During the selection process, all listed criteria which are used to build the model, are fairly evaluated. The data obtained in this study was from 25 mechanical engineering students whom have gone through an interview and a questionnaire.

This model is split into two phases [13], which are to determine the weigh of each criterion and to calculate the overall priority and finally the ranking of all students.

Phase 1: Determine the Weight of Each Criterion

There are five steps involved in determining the weight of each criterion.

Step 1: Identify the criteria, sub-criteria and students for evaluation and put them into theAHP hierarchy

A hierarchy model is a system that ranks people one above the other based on their status. The overall goal will be narrowed down to certain criteria and levelled down further to sub-criteria, in which later will provide some choices to be selected as the best [6]. In this study, the hierarchical model is as Figure 1.

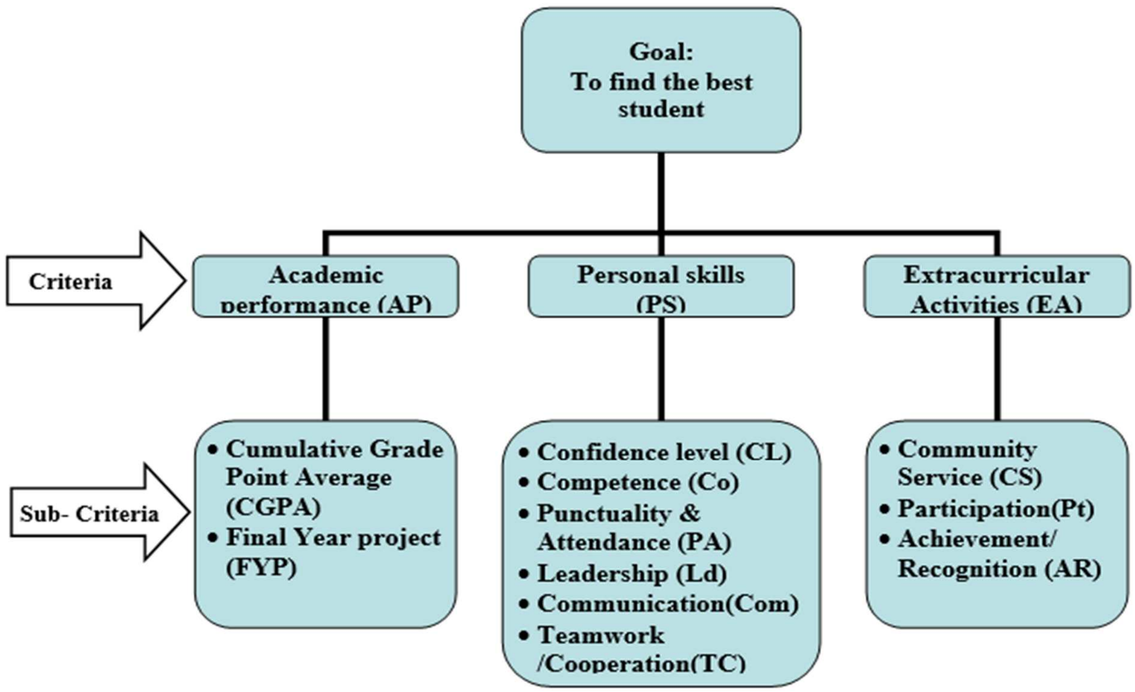

Figure 1: Hierarchical model of the criteria and the sub-criteria

Step 2: Assign score for each criterion

The individual score given to the students for each sub-criteria is based on 1-9 preferences scale as Table 1 [12].

Table 1: 1-9 preferences scale

Intensity of Importance on an Absolute Scale	Definition
1	Equal importance
3	Slight more importance
5	Strong more importance
7	Very strong importance
9	Extremely more importance
2, 4, 6, 8	Intermediate scores between the two judgements

The evaluation for the students has been shortlisted from the whole class of 25 to 5 potential students as Table 2.

Table 2: Score of all sub-criteria for 5 potential students

	AP			PS							EA		
	CGPA	FYP		CL	Co	PA	Ld	Com	TC		CS	Pt	AR
S1	7	5	S1	4	6	7	4	6	7	S1	2	2	3
S2	8	6	S2	5	7	8	5	5	7	S2	4	6	5
S3	3	7	S3	6	4	5	6	4	5	S3	5	5	4
S4	5	6	S4	7	5	7	7	5	6	S4	6	6	5
S5	4	5	S5	5	6	6	4	3	5	S5	4	4	2

Step 3: Construct pair-wise comparison matrix

First, the pair-wise comparison matrix is used to compute the weightage of each criteria and the sub-criteria involved in the selection process. The formula to construct the pair-wise comparison matrix is based on the paper by [13]. Table 3 shows the comparison of all the criteria and Table 4 shows the comparison of sub-criteria for EA.

Table 3: Pair-wise comparison matrix for criteria

	AP	PS	EA
AP	1	2	3
PS	1/2	1	2
EA	1/3	1/2	1

Table 4: Pair-wise comparison matrix of sub criteria for activities

	CS	Pt	AR
CS	1	1/4	1/3
Pt	4	1	2
AR	3	1/2	1

Next, the pair-wise comparison matrix will also be used to evaluate the five potential students by calculating their score for all of the sub-criteria. Table 5 shows the pair-wise comparison matrix with respect to Cumulative Grade Point Average (CGPA).

Table 5: Pair-wise comparison matrix of CGPA

CGPA	S1	S2	S3	S4	S5
S1	1	1/2	5	3	4
S2	2	1	6	4	5
S3	1/5	1/6	1	1/3	1/2
S4	1/3	1/4	3	1	2
S5	1/4	1/5	2	1/2	1

Step 4: Normalizing the pair-wise comparison

In order to proceed with the calculation, the pair-wise matrices need to be normalized to ensure the total of each column is equal to 1. The entry of the original pair-wise matrix has to be divided with the total of respective column. Consequently, the priority value of each item in the hierarchy is obtained by calculating the average of the each row in the normalized pair-wise matrices. Table 6 to Table 8 illustrate the normalized pair-wise matrix and the priority value of Table 3 to Table 5 respectively.

Table 6: Normalized pair-wise matrix for criteria

	AP	PS	EA	Priority
AP	0.545455	0.571429	0.5	0.538961
PS	0.272727	0.285714	0.333333	0.297258
EA	0.181818	0.142857	0.166667	0.163781

Table 7: Normalized pair-wise matrix of sub criteria for extracurricular activities

	CS	Pt	AR	Priority
CS	0.125	0.142857	0.1	0.122619
Pt	0.5	0.571429	0.6	0.557143
AR	0.375	0.285714	0.3	0.320238

Table 8: Normalized Pair-wise matrix of CGPA

CGPA	S1	S2	S3	S4	S5	Priority
S1	0.264317	0.23622	0.294118	0.339623	0.32	0.290856
S2	0.528634	0.472441	0.352941	0.45283	0.4	0.441369
S3	0.052863	0.07874	0.058824	0.037736	0.04	0.053633
S4	0.088106	0.11811	0.176471	0.113208	0.16	0.131179
S5	0.066079	0.094488	0.117647	0.056604	0.08	0.082964

Step 5: Consistency validation

The beauty of AHP method is that it can provide the verification on the evaluation that have been made by the judges or the evaluator. The consistency validation is based on the value of consistency ratio and commonly, the ratio is considered consistent if the value is below 0.1 [14].

The calculation of consistency ratio involves the following sequence of steps:

i. Calculate the weighted sum vector; this vector is obtained by summation of the multiplication of entry in each row of pair-wise matrix, a_{ij} with the priority, c. The mathematical formula as follows:

$$w_{i1} = \sum_{j=1}^{n} a_{ij} c_{j1}$$

ii. Consistency vector is then calculated by dividing the weighted sum vector with the priority value.
iii. Lamda, λ is determined by average of consistency vector.
iv. Consistency index is calculated by the following, provided that n is the number of items in each pair-wise comparison matrix.

$$CI = \frac{\lambda - n}{n - 1}$$

v. Finally, the consistency ratio is the division of CI and random index,RI. The Random index is the standard index as Table 9 [15].

Table 9: Standard index

N	RI	n	RI	n	RI
1	0	5	1.12	9	1.45
2	0	6	1.24	10	1.49
3	0.58	7	1.32	11	1.51
4	0.9	8	1.41	12	1.58

Phase 2: Calculate the overall priority and ranking of all students

The hierarchy of the proposed best student selection model consists of four levels with five candidates. The ranking can be done by calculating the priority vector for each candidate from lower to the upper level of the hierarchy in order reach the goal. This simple calculation is done by summing up the product of the priority values of each candidate with respect to the accessed criteria.

RESULTS AND DISCUSSION

Table 10 shows the priority value for all thecriteria of each student. The highest priority value is considered as the best result.

Table 10: Priority value for all criteria of each student

	AP	PS	A
S1	0.245502802	0.216422526	0.072215297
S2	0.382624223	0.281925148	0.298650066
S3	0.132307779	0.129711828	0.194171994
S4	0.149981337	0.231940565	0.330655743
S5	0.089583859	0.139999934	0.1043069

Based on Table 10, the student S2 has the highest priority for 2 from 3 criteria. They are Academic Performances (AP) and Personal Skills (PS). As for the criteria, Activities (A), the highest priority value is belong to student S4.

Based on these priority values from Table 10, the overall priority value of the students is calculated, by taking into consideration the priority of each criteria. The priority for the criteria AP, PS and EA are 0.538961039, 0.297258297 and 0.163780664 respectively. Table 11 shows the ranking of all 5 students for the best student award.

Table 11: Ranking of student

	Priority	Ranking
S1	0.208477306	2
S2	0.338937244	1
S3	0.141668273	4
S4	0.203935372	3
S5	0.106981805	5

The decision on the best student is made by comparing the priority value obtain from Table 11. The student with the highest priority, which is student S2 value is ranked as the best student.

CONCLUSION

In conclusion, in this study, a model of the best student for a semester was developed by using AHP. The result is computed by using an Excel Spreadsheet. The ranking can assist the management community in decision process to choose the best student by considering all the required criteria.

REFERENCES

1. Kousalya, P. and G.M. Reddy, 2011. Selection of a Student for All Round Excellence Award using Fuzzy AHP and TOPSIS Methods. International Journal of Engineering Research and Applications, 1 (4): 1993-2002.
2. Kousalya, P.,G.M. Reddy,S. Supraja and V.S. Prasad, 2012. Analytical Hierarchy Process Approach-An Application of Engineering Education. Mathematica Aeterna,2 (10): 861-878.
3. Triantaphyllou, E., B. Shu, S.N. Sanchezand T. Ray, 1998. Multi-Criteria Decision Making: An Operations Research Approach. Encyclopaedia of Electrical and Electronics Engineering, 5: 175-186.
4. Zhang, L., 2010. Comparison of classical analytic hierarchy process (AHP) approach and fuzzy AHP approach in multiple-criteria decision making for commercial vehicle information systems and networks (cvisn) project, M. S. thesis, University of Nebraska, Lincoln.
5. Ho, W., 2008. Integrated Analytic Hierarchy Process and its Applications-A Literature Review. European Journal of Operational Research, 186 (1): 211-228.
6. Frangos, C.C., K.C.Fragkos, I. Sotiropoulos, I. Manolopoulos and E. Gkika, 2014. Student Preferences of Teachers and Course Importance Using the Analytic Hierarchy Process Model. In the Proceedings of the 2014 World Congress on Engineering, pp: 1-5.
7. Vaidya, O.S. and S. Kumar, 2006. Analytic Hierarchy Process: An Overview of Applications. European Journal of Operational Research, 169 (1): 1-29.
8. Bogdanovic, D., D. Nikolic and I. Ilic, 2011. Mining Method Selection by Integrated AHP and PROMETHEE Method. Annals of the Brazilian Academy of Sciences, 84(1): 219-233.
9. Moayeri, M., A. Shahvarani, M. H. Behzadi and F.H. Lofti, 2015. Comparison of Fuzzy AHP and Fuzzy TOPSIS Methods for Math Teachers Selection. Indian Journal of Science and Technology, 8(13): 1-10.
10. Memarian H., S.K.Balasundram, K.C. Abbaspour, J. Talib, C.B.S. Teh and A.M. Sood, 2014. Integration of Analytic Hierarchy Process and Weighted Goal Programming for Land Use Optimization at the Watershed Scale. Turkish Journal of Engineering and Environmental Sciences, 38 (2):139-158.
11. Ozgen, D., S. Onut, B. Gulsun, U.R. Tuzkaya and G. Tuzkaya, 2008. A Two-Phase Possibilistic Linear Programming Methodology for Multi-Objective Supplier Evaluation and Order Allocation Problems. Information Sciences, 178 (2): 485-500.
12. Saaty, R.W., 1987. The Analytic Hierarchy Process-What it is and How it is Used. Mathematical Modelling, 9(3-5): 161-176.
13. Norddin, N.I., N. Ahmad andZ.M. Yusof, 2015. Selecting Best Employee of the Year Using Analytical Hierarchy Process. Journal of Basic and Applied Scientific Research, 5(11): 72-76.
14. Thomas L. Saaty, 1980. The analytic hierarchy process: Planning, priority setting, resource allocation. McGraw-Hill.
15. Hambali, A., S.M.Sapuan and N. Ismail, 2007. Evaluation of Design Concepts at Conceptual Design Stage Using Analytical Hierarchy Process, Product and Design. In the Proceedings of the 2007 Conference on Design, Simulation, Product Development and Optimization.