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Application of Fuzzy Analytic Hierarchy Process (FAHP) for the Selection of Best Student Award

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HIGHLIGHTS

- The Fuzzy Analytic Hierarchy Process (FAHP) has been used to determine ranking factors.
- The primary data was collected by distributing Google Forms to six experts.
- This study identifies the most influential factor contributing to students' selection of outstanding students.

ABSTRACT

The Best Student Award is an award that students, particularly those who perform best, look forward to receiving. It recognized students who have achieved success in both academic and extra-curricular activities during their undergraduate years. However, there are other challenges in the student selection decision such as having trouble in selecting the student with what characteristic features should be considered and prioritized. Hence, the management needs to take the initiative to make students more satisfied with the new process and result. This study aims to determine the important factors and sub-factors needed to select the student for the best student award and rank them according to the most important influence level. To achieve the objective, the Fuzzy Analytic Hierarchy Process (FAHP) has been used to determine ranking factors including Cumulative Grade Point Average (CGPA), soft skills that students possess, discipline, and participation in extra-curricular activities. Each factor comprises three sub-factors. The primary data was collected by distributing questionnaires to six experts, consisting of three (3) academic administrators and three (3) student administrators using Google Forms. Discipline, with a normalized weight of 0.363, is the most important factor in students' selection of excellent students. With a normalized weight of 0.485, the sub-factor teaching and learning process is the most essential for CGPA. With a normalized weight of 0.445, self-confidence is the most important sub-factor under soft skills. Subfactors free from disciplinary action (normalized weight 0.414) are significant for the factor of discipline and committing (normalized weight 0.482) is significant for the factor of extra-curricular activities. Based on this outcome, it shows that Fuzzy AHP is a method that can assist experts to decide under complicated situations and precisely rank all factors and sub-factors. High satisfaction among students with selection decisions will most likely lead to their high and extraordinary fighting spirit.

Keywords: *Fuzzy Analytic Hierarchy Process, best student award, students' selection.*

INTRODUCTION

The Best Student Award is one initiative established to award students who achieve not only in academics but also in developing important soft skills such as leadership, discipline, teamwork, and communication (Ajoi et al., 2021). Being selected as the best student is a significant thing when studying, but in terms of what is assigned to the student is one of the critical things to focus on. The standard approach in evaluating students' performance at university is based on academic achievement only. Nevertheless, in real-life situations, some students have other characteristics to be the best students, such as soft skills, discipline, co-curricular participation, and many more. Evaluating a student's achievement usually comprises many components, each of which involves many judgments, many of which are based on inaccurate data (Yadav and Singh, 2011). Therefore, the institution needs to ensure that the selected students are students who meet the main criteria that have been set. They should know the factors or criteria that contribute to the student selection for the best student award. Some students find it difficult to be selected as the best student as they cannot afford to get a 4.0 pointer every semester, making them feel unmotivated. Because of that, other criteria need to be looked at and considered fairer, which will make students more motivated during their studies.

The AHP is an effective method for addressing complicated selection issues. Any complicated problem may be decomposed into numerous sub-problems using hierarchical levels, with each level reflecting a set of criteria or qualities relevant to each sub-problem (Sun, 2010). Laarhoven and Pedrycz created the FAHP in 1983, according to Othman et al. (2020), which is a technique of analysis that blends fuzzy theory and AHP. In this technique, the fuzzy theory's membership functions, such as fuzzy triangular numbers, are given as paired comparisons of matrices, which shifts expert views from previously definite values in the traditional AHP to fuzzy numbers.

Due to the essential and specialty of the best student award to the students, we need to identify the most influential factor contributing to students' selection of outstanding students. The objective of this study is to determine the important factors (characteristics) needed to select the student for the best student award, determine the important sub-factors (sub-characteristics) needed to select the best student for the best student award and rank the factors and sub-factors needed to select the best student for the best student award using Fuzzy AHP. Chen et al. (2015) found that the hierarchical structure should be developed based on the selected factors and subfactors. The main framework to evaluate the factors is summarized in a hierarchical structure shown in Figure 1:

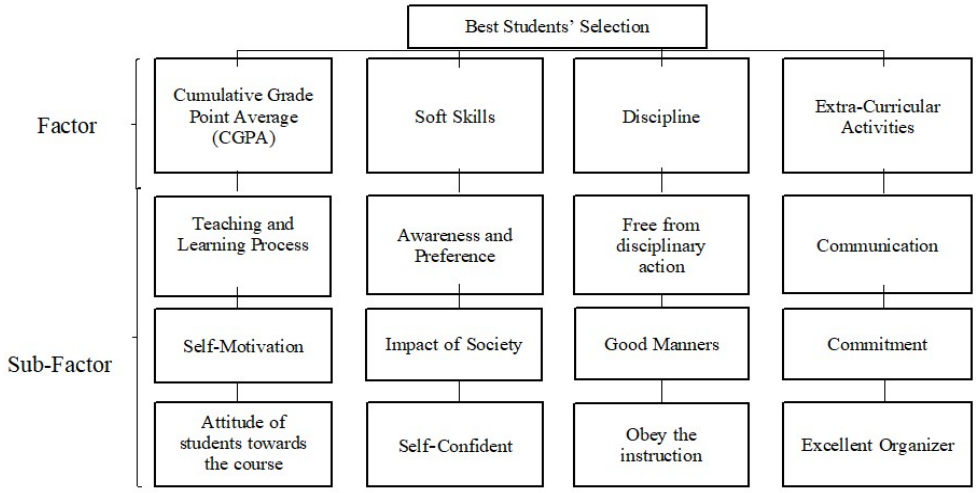

Figure 1: Hierarchical Structure of Best Students' Selection

METHODOLOGY

A survey was performed to assess the important factors influencing students' selection decisions for the best student award. The questionnaires will be distributed to six experts, consisting of three (3) academic administrators and three (3) student administrators using Google Forms. The questionnaire comprises four (4) factors and twelve (12) sub-factors. The questionnaire has two (2) sections: part A and part B, where each piece uses the classic Saaty's scale. Part A evaluates the factors, while Part B evaluates the sub-factors of this research. Figure 2 shows the FAHP phase process in this study.

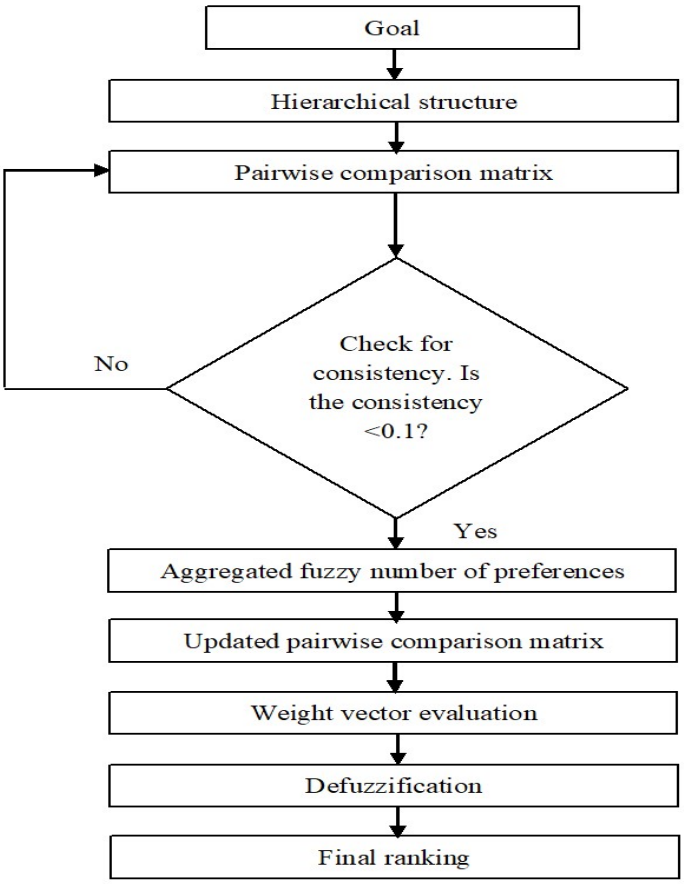

Figure 2: Hierarchical Structure of Best Students' Selection

Step 1: A triangle fuzzy number (TFN) represented by (*l, m, u*) is used to identify a fuzzy set, where *l* is the smallest possible value, *m* is the most promising value, and *u* is the greatest possible value. Othman et al. (2020) found that the triangular fuzzy number correlates significantly with the preferred ratio scale shown in Table 1.

Table 1: Linguistic Term with Triangular Fuzzy Number

Classic Saaty's Scale	Triangular Fuzzy Number	Linguistic Term	Triangular Fuzzy Reciprocal Number	Linguistic Term
1	(1,1,1)	Equally important	(1,1,1)	Equally important
3	(2,3,4)	Moderate Important	$\left(\frac{1}{4},\frac{1}{3},\frac{1}{2}\right)$	Moderate Important
5	(4,5,6)	Strong Important	$\left(\frac{1}{6},\frac{1}{5},\frac{1}{4}\right)$	Strong Important
7	(6,7,8)	Very Strong Important	$\left(\frac{1}{8},\frac{1}{7},\frac{1}{6}\right)$	Very Strong Important
9	(9,9,9)	Extremely Strong Important	$\left(\frac{1}{9},\frac{1}{9},\frac{1}{9}\right)$	Extremely Strong Important
2	(1,2,3)	Values designed for the evaluation of the so-called interphase	$\left(\frac{1}{3},\frac{1}{2},1\right)$	Values designed for the evaluation of the so-called interphase
4	(3,4,5)		$\left(\frac{1}{5},\frac{1}{4},\frac{1}{3}\right)$	
6	(5,6,7)		$\left(\frac{1}{7},\frac{1}{6},\frac{1}{5}\right)$	
8	(7,8,9)		$\left(\frac{1}{9},\frac{1}{8},\frac{1}{7}\right)$	

Step 2: To achieve the results, substitute the fuzzy triangular scale into the pair-wise comparison matrices for each criterion and sub-criterion. The experts' fuzzy triangular scale for pair-wise comparison matrices is created using the following equation:

$$P_k = P_{ij}^k = \begin{array}{c} i/j \\ P_1 \\ P_2 \\ P_3 \\ P_4 \end{array} \begin{bmatrix} P_1 & P_2 & \dots & P_n \\ \left(l_{11}^k, m_{11}^k, u_{11}^k\right) & \left(l_{12}^k, m_{12}^k, u_{12}^k\right) & \dots & \left(l_{1n}^k, m_{1n}^k, u_{1n}^k\right) \\ \left(l_{21}^k, m_{21}^k, u_{21}^k\right) & \left(l_{22}^k, m_{22}^k, u_{22}^k\right) & \dots & \left(l_{2n}^k, m_{2n}^k, u_{2n}^k\right) \\ \dots & \dots & \dots & \dots \\ \left(l_{n1}^k, m_{n1}^k, u_{n1}^k\right) & \left(l_{n2}^k, m_{n2}^k, u_{n2}^k\right) & \dots & \left(l_{nn}^k, m_{nn}^k, u_{nn}^k\right) \end{bmatrix} \quad (1)$$

where k represents the number of experts, and $P_{ij}{}^k$ indicates the k^{th} expert preference of i^{th} criterion over j^{th} criterion using fuzzy triangular number Thus, $P_{ij} = 1 \; and \; P_{ji} = \frac{1}{P_{ij}}$ for $ij = 1, 2, 3, \dots, n$.

Step 3: Check the consistency ratio (CR) of the experts' fuzzy triangular scale for pair-wise comparison matrices**.** Determine whether the input data satisfies a consistency test. If it does not, go back to the previous step and re-do pair-wise comparisons. The consistency ratio (CR) will be computed using the equation below:

$$CR = \frac{CI}{RI}, \quad (2)$$

$$CI = \frac{\lambda_{max} - N}{N - 1}$$

Where *CI* is the consistency index, λ_{max} is the largest eigenvalue of the comparison matrix and *N* is the number of criteria.

Table 2: Random inconsistency indices (RI)

N	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Source:Saaty (1980)

Step 4: Since there are six experts, the preferences of each ($P_{ij}{}^k$) must be of average value, which may be computed using the equation below:

$$Average\left(P_{ij}\right)=\frac{\sum_{k=1}^{k}\left(l_{nn}^{k},m_{nn}^{k},u_{nn}^{k}\right)}{K} \tag{3}$$

where P_{ij} is the preference average value of each expert and *K* is the number of experts.

The pair-wise comparison matrix was updated according to the averaged preference as shown in Equation (4) below.

$$P_{ij}^{k}=\begin{array}{c} i/j \\ P_1 \\ P_2 \\ P_3 \\ P_4 \end{array}\begin{bmatrix} P_1 & P_2 & \cdots & P_n \\ \left(l_{11},m_{11},u_{11}\right) & \left(l_{12},m_{12},u_{12}\right) & \cdots & \left(l_{1n},m_{1n},u_{1n}\right) \\ \left(l_{21},m_{21}^{k},u_{21}^{k}\right) & \left(l_{22},m_{22},u_{22}\right) & \cdots & \left(l_{2n},m_{2n},u_{2n}\right) \\ \cdots & \cdots & \cdots & \cdots \\ \left(l_{n1},m_{n1},u_{n1}\right) & \left(l_{n2},m_{n2},u_{n2}^{k}\right) & \cdots & \left(l_{nn},m_{nn},u_{nn}\right) \end{bmatrix}, \tag{4}$$

Step 5: A geometric mean approach will be used to aggregate the fuzzy judgement matrices collected from all experts once they have been collected and tallied by the system (Othman et al., 2020). The aggregated Triangular Fuzzy Numbers (TFNs) of expert judges will be calculated using equation (5) below:

$$\begin{aligned} t_i &= \left(\prod_{j=1}^{n} p_{ij}\right)^{\frac{1}{n}} \\ &= \left[\left(l_{i1},m_{i1},u_{i1}\right)\times\left(l_{i2},m_{i2},u_{i2}\right)\times\ldots\times\left(l_{in},m_{in},u_{in}\right)\right]^{\frac{1}{n}}, \\ &= \left(l_{ti},m_{ti},u_{ti}\right) \end{aligned} \tag{5}$$

where t_i represents the geometric mean and denoting fuzzy triangular values, $\prod_{j=1}^{n} p_{ij}$ is multiplied by each fuzzy value from the pair-wise comparison matrix. Thus, $i = 1, 2, 3, \ldots, n$

Step 6: To determine the value of vector summation, the aggregated pairwise comparison matrices will be used in conjunction with equation (6):

$$\text{Vector summation} = \sum \tilde{t}_i$$
$$= \left(\sum l_{ti}, \sum m_{ti}, \sum u_{ti} \right) \quad (6)$$

Step 7: The reverse power of vector summation (v^{-1}) will be computed using the equation (7) below, which will be used to arrange the results in ascending order.

$$v^{-1} = \left(\frac{1}{\sum l_{ti}}, \frac{1}{\sum m_{ti}}, \frac{1}{\sum u_{ti}} \right) \quad (7)$$

Step 8: Based on the increasing order of the reverse vector, the fuzzy weight ($\tilde{w}_i$) of the factor will be determined by multiplying (t_i) with (v^{-1}) obtained from step 6. The equation (8) below will be used in this step.

$$\tilde{w}_i = \tilde{t}_i \times q \quad (8)$$
$$= (l_{wi}, m_{wi}, u_{wi})$$

Where l_{wi}, m_{wi}, and u_{wi} are obtained fuzzy triangular numbers.

Step 9: Since the fuzzy weight of the factor is still represented by fuzzy triangular numbers, they must be de-fuzzified using the equation (9) below:

$$E_i = \frac{l_{wi} + m_{wi} + u_{wi}}{3}, \quad (9)$$

where E_i represents a non-fuzzy number.

Step 10: Because the non-fuzzy weight is not normalized, the relevance of the nonfuzzy weight must be normalized using equations (10) below:

$$R_i = \frac{E_i}{\sum_{i=1}^{n} E_i}, \quad (10)$$

where R_i represents the final weight after normalization

Step 11: Since all the steps have been calculated, the factors are then ranked according to the final weight after normalization. The highest normalized weight is determined as the important factor (characteristic) needed to select the student for the best student award.

FINDINGS AND DISCUSSIONS

The relative weight of factors that have been normalized using the FAHP approach is shown in Table 3. From the normalized weight shown in Table 3, Discipline is the key factor that most influences determining the selection of outstanding students with the highest normalized weight of 0.363. According to the academic rules of diploma and bachelor's degree UiTM, one condition for receiving the vice chancellor's award and the dean's award is that the student has never been convicted of disciplinary action while being a student at UiTM (ICEPS, 2021). Next, the important factor is the soft skill of the student, Cumulative Grade Point Average, and Extra-Curricular Activities with normalized weights of 0.333, 0.246 and 0.058, respectively.

Table 3: Non-Fuzzy Weight and Normalized Weight of Factor to Determine the Important Factor

Factor	Non-Fuzzy Weight	Normalized weight
Cumulative Grade Point Average	0.251	0.246
Soft Skills	0.34	0.333
Discipline	0.372	0.363
Extra-Curricular Activities	0.06	0.058

Table 4 shows the weight of the sub-factor of each factor. Based on the result obtained, the important subfactor for the Cumulative Grade Point Average is the teaching and learning process with a normalized weight of 0.485. For soft skills, the self-confidence of students has the highest normalized weight, which is 0.445, and it means that is the most important sub-factor for "Soft Skills". For the discipline factor, the free-from-disciplinary action is more important and needs to be considered with the normalized weight of 0.414. Lastly, for the factor of extra-curricular activities, commitment has the highest normalized weight, which is 0.482.

Table 4: Non-Fuzzy Weight and Normalized Weight of Sub-Factor to Determine the Important Sub-Factor

Factor	Sub- Factor	Non-Fuzzy Weight	Normalized Weight
Cumulative Grade Point Average	Teaching and Learning Process	**0.492**	**0.485**
	Self-Motivation	0.281	0.276
	Attitude of students towards the course	0.243	0.239
Soft Skills	Awareness and Preference	0.201	0.199
	Impact of society	0.36	0.356
	Self-Confident	**0.45**	**0.445**
Discipline	Free from disciplinary action	**0.423**	**0.414**
	Good Manners	0.375	0.367
	Obey the instruction	0.223	0.219
Extra-Curricular Activities	Communication	0.231	0.228
	Commitment	**0.489**	**0.482**
	Excellent Organizer	0.294	0.29

Table 5 shows that the discipline of the students is the most influential factor needed in selecting the best student for the best student award, with a normalized weight of 0.363. It means that students are always taken care of and value their discipline throughout their studies at the university. Discipline refers to the scheme of regulations, penalties, and behavioural tactics suitable to the ruling of university students and the upholding of order in the universities. The next factor that influences the selection of outstanding students is soft skills with a normalized weight of 0.333, followed by Cumulative Grade Point Average with a normalized weight of 0.246, and extra-curricular activities with a normalized weight of 0.058.

Table 5: Ranking of the Factors

Factor	Non-Fuzzy Weight	Normalized weight	Rank
Cumulative Grade Point Average	0.251	0.246	3
Soft Skills	0.340	0.333	2
Discipline	0.372	0.363	1
Extra-Curricular Activities	0.060	0.058	4

After ranking the factors, the next step is to rank the sub-factors that influence the best student selection decision from students' views. From Table 6 the experts indicate that the teaching and learning process is the most important to an excellent CGPA with a normalized weight of 0.485 than self-motivation with a normalized weight of 0.276 and the attitude of students towards the course with a normalized weight of 0.239. That means lecturers should improve their teaching methods to encourage students to actively participate in class. A positive teaching and learning environment could have a significant impact on their CGPA. Next, Table 6 shows that self-confidence in soft skills of students has a higher normalized weight is 0.445 higher than the impact of society and awareness and preference. The experts agree that being self-confident will make students improve their soft skills. Having high self-confidence will make students feel courageous in trying things.

Furthermore, for factor discipline in Table 6, the experts recognize that sub-factors free from disciplinary action play an important part than good manners and obey the instruction with normalized weights 0.414, 0.367 and 0.219 respectively. It shows that the expert agrees that having a satisfactory level of discipline allows students to complete more work in less time, because their attention is focused, and they are not wasting time on distractions such as social media because of the disciplined approach to time management for example. Furthermore, students can finish their work on time, stay involved in their studies, and have more time free to pursue things that are important to them, such as sports, hobbies, youth group, and spending time with friends and family, by managing their time well.

Based on Table 6, committing is particularly important in the involvement of extra-curricular activities than being an excellent organizer and having effective communication with normalized weights 0.482, 0.290 and 0.228, respectively. It shows that the experts prefer students who are fully committed to the responsibilities held as a key sub-factor for extra-curricular activities. Thus, commitment to extra-curricular activities will provide opportunities to demonstrate leadership and character.

Therefore, based on an all ranking of sub-factors, the university needs to consider more the involvement and commitment of students in extra-curricular activities because most of the students are satisfied with the selection decision by the university if they take precedence of student commitment. With regards to students obeying the instruction under the discipline factor, the experts recognize it should be the least sub-factor that affects students' selection for the best student award.

Table 6: Ranking of Sub-Factor

Factor	Sub- Factor	Non-Fuzzy Weight	Normalized Weight	Rank
Cumulative Grade Point Average	Teaching and Learning Process	**0.492**	**0.485**	1
	Self-Motivation	0.281	0.276	2
	Attitude of students towards the course	0.243	0.239	3
Soft Skills	Awareness and Preference	0.201	0.199	3
	Impact of society	0.360	0.356	2
	Self-Confident	**0.450**	**0.445**	1
Discipline	Free from disciplinary action	**0.423**	**0.414**	1
	Good Manners	0.375	0.367	2
	Obey the instruction	0.223	0.219	3
Extra-Curricular Activities	Communication	0.231	0.228	3
	Commitment	**0.489**	**0.482**	1
	Excellent Organizer	0.294	0.290	2

CONCLUSION AND RECOMMENDATIONS

This study aims to determine and rank the factors and sub-factors that influence the selection decision of outstanding students. The selected factors used in this research are Cumulative Grade Average Points (CGPA), soft skills that students have, discipline, and extra-curricular activities. The data used were collected from six experts consisting of 3 academic administrators and 3 student administrators based on UiTM Perlis. The FAHP method which combines the fuzzy theory and AHP has been applied and has successfully achieved the objectives of this study, specifically to determine and rank the important factors and sub-factors that influence the selection decision of outstanding students for the best student award. Hence, based on the results using FAHP, this study concludes that the most important factors are the level of student discipline throughout their studies at the university, followed by soft skills students have factor, CGPA factor, and lastly extra-curricular activities factor. For the sub-factor under discipline, the most important is free from disciplinary action. Furthermore, the important sub-factor for soft skills is self-confidence. As for the CGPA, the teaching and learning process is the important sub-factor that needs to be considered while for Extra-Curricular Activities, the most important sub-factor is the students' commitment.

CONFLICT OF INTEREST DISCLOSURE

The authors declared that they have no conflicts of interest to disclose.

REFERENCES

Amile, M., Sedaghat, M., and Poorhossein, M. (2013). Performance Evaluation of Banks using Fuzzy AHP and TOPSIS, Case study: State-owned Banks, Partially Private and Private Banks in Iran. *Caspian Journal of Applied Sciences Research*, *2*(3), 128–138. http://www.cjasr.com

Ajoi, T. A., Gran, S. S., Kanyan, A., & Lajim, S. F. (2021). An enhanced systematic student performance evaluation based on fuzzy logic approach for selection of best student award. *Asian Journal of University Education*, *16*(4), 10-20. https://doi.org/10.24191/ajue.v16i4.11932

Başaran, S., and Haruna, Y. (2017). Integrating FAHP and TOPSIS to evaluate mobile learning applications for mathematics. *Procedia Computer Science*, *120*, 91–98. https://doi.org/10.1016/j.procs.2017.11.214

Chen, J. F., Hsieh, H. N., & Do, Q. H. (2015). Evaluating teaching performance based on fuzzy AHP and comprehensive evaluation approach. *Applied Soft Computing*, *28*, 100-108. https://doi.org/10.1016/j.asoc.2014.11.050

Fadlina, Sianturi, L. T., Karim, A., Mesran, and Siahaan, A. P. U. (2017). Best Student Selection Using Extended Promethee II Method. *International Journal of Recent Trends in Engineering and Research*, *3*(8), 21-29. https://doi.org/10.23883/ijrter.2017.3382.sk4cv

ICEPS. (2021). *Peraturan Akademik Diploma Dan Sarjana Muda UiTM.* https://iceps.uitm.edu.my/images/iceps/akademik/info/buku_peraturan_akademik_202101102021.pdf

Jovčić, S., Průša, P., Samson, J., and Lazarević, D. (2019). A fuzzy-Ahp approach to evaluate the criteria of third-party logistics (3pl) service providers. *IJTTE: International Journal for Traffic and Transport Engineering, 9(3)*, 26-34. https://doi.org/10.7708/ijtte.2019.9(3).02

Kabir, G., and Hasin, M. A. A. (2011). Comparative analysis of AHP and fuzzy AHP models for multicriteria inventory classification. *International Journal of Fuzzy Logic Systems*, *1*(1), 1-16. https://www.researchgate.net/publication/267237307

Kahraman, C., Cebeci, U., and Ulukan, Z. (2003). Multi-criteria supplier selection using fuzzy AHP. *Logistics Information Management*, *16*(6), 382–394. https://doi.org/10.1108/09576050310503367

Norddin, N. I., Ahmad, N., and Yusof, Z. M. (2015). Selecting the best employee of the year using an analytical hierarchy process. *Journal of Basic and Applied Scientific Research*, *5*(11), 72-76, https://www.researchgate.net/publication/287674087

Othman, M. K., Abdul Rahman, N. S. F., Ismail, A., and Saharuddin, A. H. (2020). Factors contributing to the imbalances of cargo flows in Malaysia's large-scale minor ports using a fuzzy analytical hierarchy process (FAHP) approach. *Asian Journal of Shipping and Logistics*, *36*(3), 113–126. https://doi.org/10.1016/j.ajsl.2019.12.012

Rezaei, M., and Ketabi, S. (2016). Ranking the Banks through Performance Evaluation by Integrating Fuzzy AHP and TOPSIS Methods: A Study of Iranian Private Banks. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, *6*(3), 19–30. https://doi.org/10.6007/ijarafms/v6-i3/2148

Sarahintu, M., Tarmudi, Z., and Lepit, A. (2017). 11 - Selection of the Best Pre-Diploma Science Student Using a Fuzzy Approach. *Prosiding Kolokium Hal Ehwal Akademik (K-HEA)*, *2009*, 34–40. http://ir.uitm.edu.my/id/eprint/26561/1/PRO_ZAMALI TARMUDI S 17.pdf

Sattar, W., Tony Lim Bin Abdullah, M. R., and Mirzaei, F. (2018). A FAHP approach to select students' performance assessment criteria in task-based English language teaching. *SHS Web of Conferences*, *53*, 03005. https://doi.org/10.1051/shsconf/20185303005

Sun, C. C. (2010). A performance evaluation model by integrating fuzzy AHP and fuzzy TOPSIS methods. *Expert Systems with Applications*, *37*(12), 7745–7754. https://doi.org/10.1016/j.eswa.2010.04.066

Yadav, R. S., and Singh, V. P. (2011). Modeling academic performance evaluation using soft computing techniques: A fuzzy logic approach. *International Journal on Computer Science and Engineering*, *3*(2), 676-686. http://www.enggjournals.com/ijcse/doc/IJCSE11-03-02-074.pdf