SOLVING NEW STUDENT ALLOCATION PROBLEM (NSAP) WITH ANALYTICAL HIERARCHY PROCESS (AHP)

[1]Wan Haniza Wan Hassim, [2]Abdul Samad Shibghatullah, Faaizah Shahbodin[3]

[1,2]Optimization, Modelling, Analysis, Simulation and Scheduling (OptiMASS) Research Group, FakultiTeknologiMaklumat&Komunikasi, UniversitiTeknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal Melaka, Malaysia.

Email: onehoneyza@gmail.com, samad@utem.edu.my

ABSTRACT: *There are many approaches used to solve New Student Allocation Problem (NSAP). Many researchers use application of Genetic Algorithm (GA). However, the study presented in this paper applies an Analytical Hierarchy Process (AHP)technique in solving New Student Allocation Problem (NSAP) handled by Registration Unit at Ungku Omar Polytechnic. The problem is the students are allocated to their class randomly, just by using their registration number and by all means without referring to their intelligence level, knowledge, skills and also their performance. So, in this paper the researcher's focus is on solving NSAP by using AHP to allocate students into their respective classes with minimum intelligence gap in each class and the number of students in each class does not exceed its maximum capacity. The proposed solution will be tested using real data from the Politeknik Ungku Omar to see the result.*

KEYWORDS: Analytical Hierarchy Process (AHP), New Student Allocation Problem (NSAP)

1.0 INTRODUCTION

The New Student Allocation Problem (NSAP) is one of clustering problems to allocate students into some classes with minimum intelligence gap and skills per class with its maximum capacity. This topic is essential as it is a great challenge to provide best educational service for large number of students with wide diversity in their achievements and skills. Implementing discriminating policies to these groups can be done easily by allocating the students into the groups [1]. It is hard to measure students' intelligence. University or school only has limited time to know their real intelligence level and the educational process must be done in a specific time after the fresh student is registered. It is fairly acceptable if their level of intelligence assessed during their entry requirement for example by using SPM grade but then they will usually be allocated into classes with sorting method: a class of new students who has similar ranking.

Although this method has no suitable concept of students' similarity, many educational organizations still utilize it. For example, there is a case study in California USA which implements this method. The case study looked after a research resulted on how similar students get different results in hundreds of school in this area [1]. Since students with same ranking assumed as similar, it is very reasonable that they get different results. Same total scores can be accumulated from various marks combinations because the same sum up scores does not always show students' similarity. According to clustering method, among the various scores combination, the combination score with completely similar objects shows high level of students' similarity.

Hence, in this paper, the researchers will focus on solving New Students Allocation Problem (NSAP) to minimize the gap of intelligence in each class by using AHP as students' allocation system by ranking them. It is important because the management needs to apply specific approach to provide quality education to its students and to improve the quality of managerial decisions.

2.0 NEW STUDENT ALLOCATION PROBLEM (NSAP)

Currently, in polytechnic system, the students are allocated to each class randomly by using their registration number. It is normal practice to assign students from certain subjects into different classes based on their registration number [2]. Usually, when each student receives the result of their application to the polytechnic from the UPU Online system, they must make a confirmation to receive the offer by log in into e-portal of specific polytechnic that they are offered by using their IC number. From the e-registration portal, the details about the registration process such as the course offered, the fees and registration number are given. The registration number is generated automatically based on ascending order based on first come first serve concept. This means, the first student who registered will get the first registration number. After that, Students Affair Department Officer will give the student's name list to Registration Unit for each Academic Department to allocate the students into their classes. Registration Unit Officer will allocate them randomly to each class and she/he will make sure that it does not exceed its maximum capacity, which is 40 students per class. The limit is set due to computer lab capacity, where it can support only 40 students for each time.

The problem is the students are allocated randomly, not referring to the real intelligence level, knowledge, skills and also their performance. This topic is essential, because it is very difficult to provide optimum educational service for large number of students with diversity of achievements and skills [1]. Based on the Literature Survey and interview session with the lecturers, daily learning process is quite difficult when the gap between each student in each class is high. It will affect the motivational level of students. Sometimes, excellent students will feel bored and de-motivated when they have to wait for the weak students to understand about the certain topics. Same like a weak students. They feel uncomfortable to give some ideas or sharing knowledge with others. Besides, lecturer also needs to choose suitable techniques and activities in teaching and learning process to make sure that it suits the student's requirement with different intelligence level and skills to

understand and master about the topic. This is important to improve the effectiveness of teaching and learning process so that the probability of weak students to fail is low.

3.0 THE CURRENT NEW STUDENTS ALLOCATION APPROACHES

There are many approaches used to solve NSAP. Many researches use application of GA [3]. For example, [1] stated that the researchers explore the applicability of GAs to the New Student Allocation Problem (NSAP), which allocates new students into some classes which consist of similar students and the headcounts of students per class does not go beyond its maximum capacity. This topic is Essential as it is difficult to provide good educational service for large number of students with high diversity of achievements or skills. It concerns on similar objects, hence NSAP is a clustering problem but there is no clustering method that clusters objects (students) with the number of objects in each cluster (class) which has been defined previously. As a matter of fact, ranking method that commonly used does not have an appropriate concept on students' similarity. It is an unsolved problem. So, they propose two approaches based on the chromosomal representation: Partition Based Approach (PBA) and Centre Based Approach (CBA). Some computational experiments have been done to analyze the effects of the different chromosomal representations. Based on the results, they find out that CBA is better than PBA, since it is easy for CBA to minimize the gap in each class. However, this paper only use one combination of GAs operators with CBA, the future researches should try to improve the ability of GAs by joining more than one operators. They can also hybrid GAs with another Artificial Intelligence approach to improve its ability.

Susanto used Fuzzy C-Means algorithm (FCM) to solve NSAP. The fuzzy clustering algorithm [2] is based on student's achievement in the pre-requisite subjects. Utilizing this method, students with similar achievements are combined into the same class. So that students with lesser different in levels of achievement will be in a different class. The proposed approach is used for student allocation to have better quality of the daily learning process. There has been a significant standard to change from a lecturer centered approach towards a learner centered learning process which is call as Outcome Based Education (OBE). However, by using this method, some points need to be considered, which the socialization process among students, socialization among lecturers and socialization among the administrative staff especially those dealing with timetabling.

Otherwise, K-Means Clustering Algorithm also can use to solve this problem. K-means clustering [4] is a well-known partitioning method. K-means is one of the most widely used and simple clustering algorithms. It was first introduced in 1955 [5]. [4] stated that, the objects are categorized as belonging to one of K- groups. As a result of separating method, a set of K clusters was produced; one cluster referred to each object of data set. In every cluster, the representative would be either a centroid or a cluster. A proper representative was provided by the arithmetic mean of the attribute vectors for all objects within a cluster by considering a real-valued data; in other cases, it may requires the alternative types of centroid. However, in this paper, Query redirection is not used. If using the Query redirection approach, a large amount of data from different databases can be easily clustered. So if this approach is measured, then the performance of K-means clustering algorithm is better-quality for huge samples of data set that are also distributed in nature.

The current method that researcher use to solve this problem is by using Bayesian Approach [3].The smartest/intelligent students may be clustered with the least intelligent in a same class. This problem may be solved by the use of Bayesian classification technique which considers the academic achievements of the students. In present research an attempt has been made to explore Bayesian classification to solve the allocation problem of new students. Based on the present study it notice that techniques of Subtractive clustering technique, Genetic Algorithm and Artificial Neural Network techniques (i.e. hybrid Fuzzy Expert system) are required urgently in relation to evaluation of both students and teachers academic performance to improve its ability.

However, there are some researchers who combine two techniques such as Analytical Hierarchy Process (AHP) and k-Means Clustering to get the best result in solving resource allocation such as [6],[7] and [8]. [6] stated that, the researchers select two algorithms, AHP (Analytical Hierarchy Process) for indicator optimization and K-means for clustering. It can be seen from the clustering results that the importance of all the indictors from the streamlined index system are greater than or equal to 0.95.It has been verified that AHP is excellent to determine the results of the index system in this paper. The differences between the three clusters are significant, which is in line with the results of qualitative analysis and provides a reliable basis for the following strategic analysis. From this paper, the result shows that clustering analysis is a good tool for segmentation.

[7] stated that, the combination of AHP and K-means clustering algorithm by the researcher lead to the splitting of Chinese weekly newspaper office's customers into platinum, golden, iron and lead customers by choosing suitable indicators according to current value and potential of the customer. Lastly, this paper proposes to management office some strategic proposals according to type of customers, which can improve the efficiency of the offices' resources for each customer.

In addition, [8] stated that, problem of clustering and ranking university majors in Iran was also considered by the author. As a solution, the procedure was clarified by presenting a model. The comparison was made by identifying eight different criteria from 177 existing university majors. Firstly, university majors are grouped based on its similarities and differences by implementing K-means algorithm. After that, by using AHP algorithm, majors of the university are ranked.

4.0 ANALYTICAL HIERARCHY PROCESS (AHP) APPROACH AND RELATED WORKS

The AHP method, which was introduced by Saaty (1980), gives direction on how to determine the priority in choosing

few alternatives and the relative importance of attributes in a multiple criteria decision-making problem, and has been widely discussed in various aspects [9]. The first example is in ERP System Selection [9] where a comprehensive ERP system selection framework is proposed by constructing the objective hierarchy and specify the appropriate attributes to provide detailed guidance for evaluation of ERP system. The proposed methodology also ensures that the evaluation process is ranged with the competitive strategies and goals of the enterprise. The uncertainties involved in the assessment of ERP alternatives and relative importance weightings of attributes are handled by applying analytical hierarchy process (AHP) technique. In order to demonstrate the practical feasibility of the proposed method, an experimental case in Taiwan is described.

Second example is in Project Management [10] in which the Analytical Hierarchy Process (AHP) is presented as a possible decision making technique to be used in project management. The problem of pre-qualification of the contractor is used as an example. A pre-qualification criterion for a project is constructed in a hierarchical structure. By applying the AHP, the pre-qualification criterion is ranked in descending-order list of contractors which can be used in deciding the best contractors to perform the project. The sensitivity of the final decisions to minor changes in judgments can be assessed and checked by performing a sensitivity analysis. The AHP apply steps which are simplified by using the `Expert Choice' professional software which is available commercially and designed for implementing AHP. Thus, this will inspire the application of the AHP by project management professionals.

The third example is in Instruction response system (IRS). [11] stated that, the influential factors of selecting an IRS are summarized and an Analytical Hierarchy Process method model is established. This is used to rank the various available IRS products, where price, transmission distance, battery capacity, and additional functions, are carefully chosen as the criterion layer factors. Based on the investigation of five available IRS, the AHP model is organized to assist in the decision making process of the most suitable system. Two chief decision-makers are asked to construct the judgment matrix, and the least costly system is found to be the most desirable one.

Besides, AHP is also used in Selection of Appropriate Schedule Delay Analysis Method. [12] that states the five commonly used schedule delay analysis methods in the construction industry are taken. Then, the one suited is being chosen by using analytical hierarchy process (AHP) technique. The decision is made by assuming all the data are one and then highest number in the ranking is said to be the most appropriate method.

However, the Prioritizing Features in the Selection of Web Service, [13] do propose analytical hierarchy process (AHP) technique to be used in order to prioritize the web service features. Then, the decision making process is aided via a quantitative way. The AHP technique provides pairwise comparison of elements with consistency in result which acts as a solution in solving problems.

5.0 OVERVIEW OF THE PROPOSED NEW STUDENTS' ALLOCATION SYSTEM

A systematic AHP technique is proposed to help Registration Unit Officers in making decisions relating to cluster/allocate the new students into their classes. The intention is to help them in selecting the new students into their classes in a manner and fair way to make sure that the new students can perform in their study continuously. The main process of registration students is still remaining but the approach to cluster/allocate the new students is revised due to increase the quality of students and also teaching and learning process. The proposed approach aims to keep the capacity of students in each class optimum in the sense of minimizing the intelligent gap and skills between the students and being quick in providing solutions to officers dealing with such problems.

This study will involve two processes of an interview where current data on how allocation/clustering the new students into their classes' are implemented in the ICT Department collected. The second process is to analyze interview data using AHP techniques to produce effective procedure in ranking the new students into their classes' for use in ICT Department especially in Registration Unit.

To test or evaluate the approach, the researcher will conducted a test for Control and Experimental Group to see a comparison of overall mean score for students' achievement. SPSS is used to calculate the mean score. If the mean score for Experimental Group is higher than Control Group so that the approach is considered suitable to solve NSAP. Besides, SPSS also used to evaluate the motivational level in both group to see wether it can increase students' motivational level. The motivational level is measured by comparing mean score between the groups.

6.0 MODELLING WITH ANALYTICAL HIERARCHY PROCESS (AHP) APPROACH

This section presents the detailed model of AHP method to solve NSAP. The main steps of this approach are as follows:

Step 1: The problem is decomposed into a hierarchy structure consist of goal, criteria, sub-criteria and alternatives. Figure 1 shows the illustrative of Hierarchy Structure.

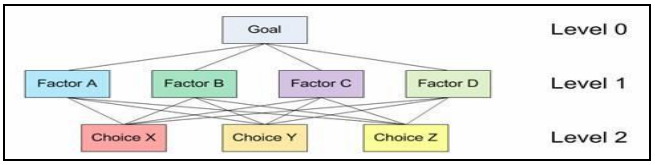

Figure 1 : Illustrative a simple AHP Model

Step 2: Then, to produce a hierarchic structure, data are collected from expert's persons or decision-makers in the pairwise comparison of alternatives on a qualitative scale as described below. The comparisons are rated as equal, marginally strong, strong, very strong, and extremely strong by the experts. The opinion was illustrated in a special designed format as shown in Figure 2. The comparisons are made for each criterion and converted into quantitative numbers as shown in Figure 3.

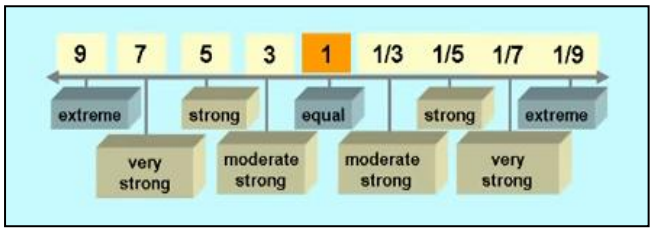

Figure 2 : Format for pair wise comparisons

Option	*Numerical value(s)*
Equal	1
Marginally strong	3
Strong	5
Very strong	7
Extremely strong	9
Intermediate values to reflect fuzzy inputs	2, 4, 6, 8
Reflecting dominance of second alternative compared with the first	Reciprocals

Figure 3 : Gradation scale for quantitative comparison of alternatives.

Step 3: After that the comparisons in pair of various criteria produced in step 2 are organized into a square matrix.

Step 4: Thus, compare the principal eigenvalue and the corresponding normalized right eigenvector of the comparison matrix to give the relative importance of the various criteria. The elements of the normalized eigenvector are termed weights with respect to the criteria or sub-criteria and ratings with respect to the alternatives.

Step 5: After the matrix is normalized, the consistency of the matrix of order n is evaluated. Comparisons made by this method are subjective and the AHP tolerates inconsistency through the amount of redundancy in the approach.

Step 6: Lastly, choose the highest weight of the criteria and sub-criteria to calculate the total score for each alternatives and get the average. Then ranking the alternatives based on descending order which is from highest average to lowest. Thus, the alternatives are clustered based on the rating of each alternative by referring to the grading scale to cluster the students.

7.0 CONCLUSION

From this research, the researcher will solve the Registration Unit of Information and Communication (ICT) Department problem to allocate the new students into their class by ranking the new students by using an Analytical Hierarchy Process (AHP) technique. It is important to minimum the intelligent gap and skills between each student and at the same time can helps the management or lecturer to plan or manage the class/students in a good way. It will improve the efficiency of education environment and also the management part.

REFERENCES

[1] Zainudin Zukhri & Khairuddin Omar, "Solving New Student Allocation Problem with Genetic Algorithms: A Hard Problem for Partition Based Approach." 2008.

[2] R. S. Yadav, "Implementation of Data Mining Techniques to Classify New Students into Their Classes : A Bayesian Approach," vol. 85, no. 11, pp. 16–19, 2014.

[3] I. S. & P. S. Sani Susanto, "Using the fuzzy clustering algorithm for the allocation of students," *World Trans. Eng. Technol. Educ.*, 2002.

[4] N. K. Navjot Kaur, Jaspreet Kaur Sahiwal, "Efficient K-Means Clustering Algorithm Using Ranking Method In Data Mining." 2012.

[5] L. Ying and W. Yuanyuan, "Application of Clustering on Credit Card Customer Segmentation Based on," pp. 1869–1873, 2010.

[6] J. Han, L. Mei, and T. A. O. Wang, "Customer Value Management Based On Ahp And K-Means Clustering Method," no. July, pp. 11–14, 2010.

[7] D. T. Abbas Rad, Abolfazl Kazzazi, Mohammad Soltani, "Clustering and Ranking University Majors using Data Mining and AHP algorithms: A case study in Iran," vol. 5, no. 17, pp. 113–134, 2010.

[8] C.-C. Wei, C.-F. Chien, and M.-J. J. Wang, "An AHP-based approach to ERP system selection," *Int. J. Prod. Econ.*, vol. 96, no. 1, pp. 47–62, Apr. 2005.

[9] K. M. A.-S. Al-Harbi, "Application of the AHP in project management," *Int. J. Proj. Manag.*, vol. 19, no. 1, pp. 19–27, Jan. 2001.

[10] J. Zhang, D. Xue, and X. Han, "Selection of an instruction response system with Analytical Hierarchy Process method," *2012 IEEE Int. Conf. Inf. Sci. Technol.*, pp. 758–760, Mar. 2012.

[11] I. Adhikaril, S. Kim, and Y. Lee, "Selection of Appropriate Schedule Delay Analysis Method : Analytical Hierarchy Process (AHP)," no. c, pp. 9–13, 2006.

[12] M. Godse, R. Sonar, and S. Mulik, "The Analytical Hierarchy Process Approach for Prioritizing Features in the Selection of Web Service," *2008 Sixth Eur. Conf. Web Serv.*, pp. 41–50, Nov. 2008.