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## MULTI-CRITERIA EVALUATION OF E-LEARNING APPROACHES

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**ABSTRACT.** E-learning is a type of learning supported by information communication technology that improves the quality of teaching and learning. This paper explores how a group of 95 respondents consisted of administrative and academic staff, and post graduate students evaluated five e-learning approaches by using multi-criteria methods. They were asked to assess the relative importance of five e-learning evaluation criteria by using direct point allocation method. Furthermore, they also rated the performance of five identified e-learning approaches under each of the criteria. The overall performance of each e-learning approach was computed by using simple arithmetic average method. The results suggested that flipped classroom is the most suitable e-learning approach, while ‘human resource’ found to be the most important criterion. The paper is suggesting a quantitative evaluation method for decision makers who are strategizing modern technologies in higher educational settings.

**Keywords:** e-learning, evaluation, multi-criteria, weight

### INTRODUCTION

Universities in Malaysia are in the move of implementing information communication technologies (ICT) in their teaching and learning activities. The current methods such as traditional learning have become unsuitable for development operations of the educational process because of the rapid development in IT. Therefore, the educational process needs to reform to keep up with the ICT evolution, especially in universities of Malaysia. Modern learning strategy concentrates on the direct interaction between students and positive learning techniques with guidance from the teacher including the student’s ability to participating and researching. In addition, there is a need to develop teaching methods, strategies and the use of modern teaching strategies based on the employment of modern technologies in the development of the educational process (Strayer, 2007).

E-learning or electronic learning is a popular term used that refers to the delivery of a learning, training or education program by electronic means. E-learning involves the use of a computer or electronic device such as a mobile phone in some way to provide training, educational or learning material. (Stockley, 2003). Therefore, Malaysian universities should apply e-learning techniques because of many functional benefits that e-learning brings since e-learning can serve as a catalyst for change in teaching and learning. It supports skills needed

in knowledge-based society, such as collecting, analysing and applying information appropriately and includes different teaching methods, for example, information management, creative thinking, critical thinking, problem-solving and collaborative learning (Osman, Jamaludin, & Mokhtar, 2014).

As a developing country, Malaysia is still having problems to keep up with the ICT evolution due to lack of resources, infrastructure and readiness. A study is required to evaluate potential e-learning approaches to be implemented in universities. Therefore, the paper discusses a study on the evaluation of five e-learning approaches based on five identified criteria by using multi-criteria methods. The survey was conducted in the university's community by sending the questionnaire to more than 700 people through emails, but only a total of 95 respondents answered the survey. The respondents consisted of 38 lecturers, 22 administrative staff and 35 post graduates students who evaluated the importance of the criteria and performances of the five e-learning approaches under each of the five criteria. Two multi-criteria (MC) methods were used to analyze the relative importance of the criteria and to aggregate the overall performance of each e-learning approach. In order to achieve the objective of the paper, this paper is organized as follows. The next section provides an overview of each e-learning approach. It is followed by sections on MC methods, methodology, results and discussions, and conclusions of the study.

## E-LEARNING APPROACHES AND CRITERIA

Five e-learning approaches were selected as the potential e-learning approaches to be implemented in the selected public university, which were ICT supported face to face teaching, flipped classroom, blended learning, synchronous learning and asynchronous learning. The flipped classroom has taken place in education as a modern teaching method (Osman et al., 2014). It is a shift in the process from teacher-centred learning to student-centred learning (Bergmann & Sams, 2012), and it is a concept for active learning where students are provided with study materials like video lectures or online textbooks before they attend the class (Bishop & Verleger, 2013). One more method of modern teaching methods is the blended-learning. It blends together processes of traditional learning and e-learning (Dos, 2014). The e-learning is usually defined as a distance learning includes synchronous learning and asynchronous learning, and sometimes, it is also defined as a type of learning supported by ICT (Begičević et al., 2007; Chao & Chen, 2009). The five e-learning approaches under study and the five evaluation criteria ((Begičević et al., 2007) are as summarized in the following table.

**Table 1. E-Learning Approaches and Evaluation Criteria**

No.	Criteria	No.	Alternatives
1	Human resources	1	Blended learning
2	Specific ICT infrastructure for e-learning	2	Flipped classroom
3	Basic ICT infrastructure for e-learning	3	ICT supported face to face learning
4	Strategic readiness for e-learning implementation	4	Synchronous learning
5	Legal and formal readiness for e-learning implementation	5	Asynchronous learning

## METHODOLOGY

The methodology consists of two main parts. The first part focused on the weights of e-learning criteria, while the second part was about the selection of suitable e-learning approach to be implemented in the selected university. The data were collected from a public university in Malaysia in 2016 through two sets of questionnaires which had been established by using Google Drive and then sent to participants through email. A total of 95 participants took part in the survey. The first set is about the importance of criteria towards implementation of e-learning. Here, the Direct Point Allocation (DPA) was used as weighting method for the criteria where the respondents had to give points between zero and one to each of the five identified criteria, and the sum of points had to be one. The 95 evaluations were aggregated by using geometric average method. The second set of the questionnaire concerns about the rating of the performance of each of the e-learning approaches under every criterion. The scale of rating is 0 to 100, where the higher the rating means the higher the performance of the approach under the evaluation criteria. The geometric average method was used once again to aggregate the 95 performances of each approach under each criterion. The Simple Weighted Average (SWA) method was used to aggregate the weights of criteria and the performances of the e-learning approaches to determine the overall performance of the e-learning approaches.

### Direct Point Allocation Method

The direct point allocation (DPA) method is an easy method for an evaluator or a decision maker (DM) to weigh criteria, where the DM has a 'budget' of points to assign weights to the criteria directly to reflect their relative importance. The total of all criteria weights must be sum up to 1 or 10 or 100. Clearly, in DPA there is no need to normalise the weights since the sum of 100 is already prescribed (Roberts & Goodwin, 2002). In DPA method, the decision not to give any direction on what numbers to use was ready on purpose to see how the DMs choose the numbers without a given reference and the ranges of attributes were described to the subjects (Pöyhönen & Hämäläinen, 2001). In this study, the total points is 1. So the evaluators were asked to give points between zero and one to every evaluation criteria.

### Simple Weighted Average Method

The Simple Weighted Average (SWA) method is basically the same as the normal average method. However instead of having the same weights for each criteria as in the normal arithmetic average method, the criteria now are having different values of weights and the weights were found by using DPA method as explained in the previous subsection. The mathematical representation of SWA is as follows. Let  $EL_i$ , be the overall performance of e-learning approach  $i$ ,  $i = 2, \dots, 5$ ,  $w_j$  be the weight of criteria  $j = 2, \dots, 5$ , and  $x_{ij}$  be the performance of e-learning  $i$  under criteria  $j$ .

$$EL_i = w_1x_{i1} + \dots + w_5x_{i5} \quad (1)$$

## RESULTS AND DISCUSSIONS

Table 2 displays the final results of the study. Columns 2 to 6 show the final performances of each e-learning approach under each evaluation criterion. The overall score for e-learning approaches and their corresponding ranks of implementation are in column 7 and 8 respectively. The weights of criteria are in brackets in row one which positioned C1, 'human re-

source' as the most important criterion, while C4, 'strategic readiness for e-learning implementation' as the second most important criterion. The criterion, C5, 'legal and formal readiness for e-learning implementation' is at the third ranking of importance, followed by C3, basic ICT structure for e-learning and, C2, 'specific ICT infrastructure for e-learning'. In term of the best of e-learning approach to be implemented in the selected public university, Flipped classroom is found to have the highest score which suggested that the evaluators preferred this approach as compared to the other four approaches. The second best e-learning approach is Blended learning approach.

**Table 2. E-Learning**

E-learning approaches	C1 (0.2788)	C2 (0.1525)	C3 (0.1276)	C4 (0.2586)	C5 (0.1824)	Overall Score	Rank
Flipped	85	85	80	85	85	82.24	1
Blended	75	80	80	75	75	74.40	2
ICT & F-to-F	65	60	60	60	60	59.89	3
Synchronous	40	40	40	40	40	39.00	4
Asynchronous	30	25	30	25	30	27.32	5

## CONCLUSIONS

This paper shows the utilization of multi-criteria methods in evaluating e-learning approaches under five identified criteria. The use of this type of quantitative method is very practical for evaluation purposes. Besides, the evaluation was carried out by those who were really involved whether directly or indirectly in the implementation of e-learning in a university. The results of the evaluation show that the human resource found to be the most important basis of criterion from the perspective of the respondents from a public university in Malaysia. This finding has to be taken seriously since no matter how magnificent the technology is, the humans still play the main role as operators as well as the users. Furthermore, the flipped classroom is the most preferred e-learning approach out of five approaches under study. The results of this study would give idea to the management of the university in their process of implementing modern technologies in the teaching and learning process.

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