E-LEARNING PLATFORM EVALUATION THROUGH MULTICRITERIA ANALYSIS

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ABSTRACT
In this paper we present a multicriteria methodology for supporting institutes' decisions on eLearning platform evaluation. Based on previous research, we define a set of evaluation criteria, define appropriate weights in collaboration with experts and utilize an outranking approach for the multicriteria model. In order to demonstrate the model we apply the method in evaluating a number of open source platforms and present the decision outcome. This methodology can support institutes' decision makers not only by providing a solution to the selection problem, but in understanding the factors that are involved in the selection decision through their involvement in the decision process as well.

KEYWORDS
Multicriteria decision making, eLearning

INTRODUCTION

Educational institutes worldwide planning to offer to their students either online classes or hybrid ones, mixing traditional and online methods, come to decisions regarding eLearning platform selection. This decision in not trivial, since a number of significant criteria has to be considered.

On the one hand, following the development of Internet technologies, the number of eLearning platforms available is increasing, ranging from fully commercial to open source ones. In addition, major differences between available platforms regarding functionality exist, which impact user acceptance and overall performance accordingly. On the other hand, financial investment in setup and operation cost varies between platforms and impacts institutes' finances. Finally, end user adoption may be negatively affected in the case of an inappropriate platform selection.

For the reasons stated above, eLearning platform selection can be modelled as a multicriteria decision problem, considering that institutes' decision makers evaluate alternative platforms available based on a number of relevant criteria.

In this paper we present a multicriteria methodology for supporting institutes' decisions on eLearning platform evaluation. Based on previous research, we define a set of evaluation criteria, define appropriate weights in collaboration with experts and utilize an outranking approach for the multicriteria model. In order to demonstrate the model we apply the method in evaluating a number of open source platforms and present the decision outcome. This methodology can support institutes' decision makers not only by providing a solution to the selection problem, but in understanding the factors that are involved in the selection decision through their involvement in the decision process as well.

MULTICRITERIA DECISION ANALYSIS (MCDA)

The study of decision problems has a long history, and in the last decades has been one of the major research fields in decision sciences. The mathematical modelisation of these decision making problems started in the 19th century with economists and applied mathematicians like Pareto, VonNeumann, and Morgenstern. The first approaches considered monocriterion decision problems. Later, research teams introduced multicriteria problems. That is, the problem of finding the best alternative (or a ranking of all of them) considering multiple conflicting criteria or goals. The main difficulty in MCDA problems lies in the fact that usually there is no objective or optimal solution for all the criteria. Thus, some trade-off must be done among the different points of view to determine an acceptable solution. Therefore, it is not an easy problem at all, which explains the large amount of publications in the area in the last decades.

In the MCDA field, three kinds of problems are distinguished (Vincke, 1992): choice problems, ranking problems and sorting problems. The goal of the decision maker in each type of problem is different: in choice problems the aim is to find the best alternative, in ranking problems we want to know the goodness of all alternatives, which is usually presented as a ranking from the best to the worst, and in sorting problems we want to know which alternatives belong to each class of a predefined set of classes.

A typical multicriteria problem formulation is the following:

Having a defined set A of actions and a consistent family G of criteria on A, a multiple criteria decision problem is the one that, with respect to G, either aims to find:

- a subset of A that contains the best actions,
- an assignment of the actions into predefined categories, or
- a rank of the actions in A from best to worst.

Outranking methods

The outranking approach was introduced in the 60s by Roy based on his work on real-world applications. The intention was to overcome some of the difficulties of the aggregation approaches of those days, such as the use of qualitative criteria. This approach focuses the attention to the fact that in MCDA problems one tries to establish preference orderings of alternatives (Roy, 1991), (Perny&Roy, 1992). As each criterion usually leads to different ranking of the alternatives, the problem is to find a consensued ranking. The outranking methods perform pairwise comparisons of alternatives to determine the preferability of each alternative over the other ones for each particular criterion. Then, a concordance relation is established by aggregating the relative preferences. Moreover, a discordance relation is also established, which is used to determine veto values against the dominance of one alternative over the others. Finally the aggregation of the concordance relation yields the final dominance relation.

The basis of these methods is the definition of an outranking relation S. By definition, S is a binary relation: a'Sa holds if we can find sufficiently strong reasons for considering the following statement as being true in the decision maker's model of preferences:

" a' is at least as good as a "

Two conditions must be fulfilled in order to accept that a'Sa holds:

- A concordance condition: a majority of criteria must support a'Sa (classical majority principle)
- A non discordance condition: among the non concordant criteria, none of them strongly refutes a'Sa (respect of minorities principle)

Different methods implement this process using different algorithms. Some of the most well-known outranking models are ELECTRE, PROMETHEE, MAPPAC and PRAGMA (Bana e Costa, 1990).

Electre Tri method

The ELECTRE TRI method belongs to a group of methods called ELECTRE ("Élimination Et Choix Traduisant la Realité") and was specifically designed for the problem of classification of a set of actions according to pre-defined, ordered categories based on multiple criteria. These categories are characterized by a structure of order for the entire set and by pre-defined rules, called reference actions, which are fictitious and are used only to mark limits for them both in the lower and upper parts, where the allocation of each action of the structure of order stems from the result of its comparison with these profiles that define those limits.

In general, we have a set A of actions (a_1,..., a_n) evaluated by m criteria (g_1,..., a_m), and C is a set (C_1,..., C_k) of k categories by order of preference, being C_1 the worst and C_k the best. Each category C_h (h=1,...,k) is defined by two reference actions, being b_h their upper limit and b_{h-1} their lower limit. The reference actions (b_0,..., b_k) must be defined such that, by carrying out the first and the last, each makes up, simultaneously, the upper limit of a category and the lower limit of the next category, that is, b_h is the upper limit for category C_h and the lower limit for category C_{h-1}.

In the diagram below (Figure 1) we depict the main stages of the ELECTRE TRI method (Mousseau et al., 2000).

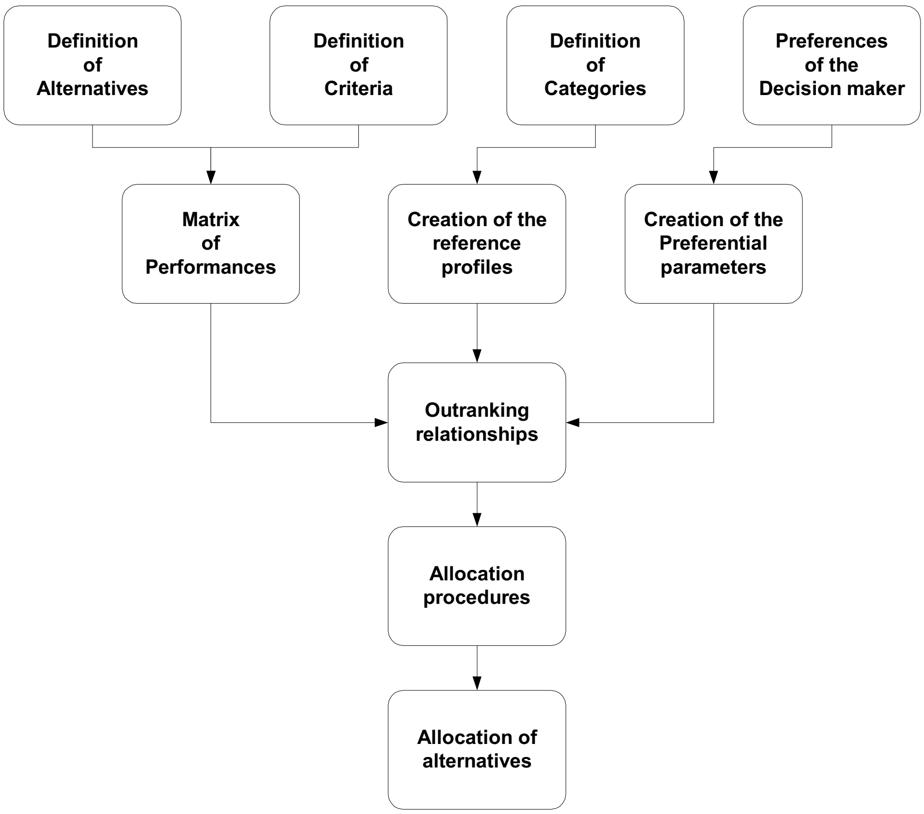

Figure 1. ELECTRE TRI main stages

ELEARNING PLATFORM EVALUATION

Model

Evaluation of eLearning platforms is not only a financial issue, but requires considering the software, and additional features such as the supported teaching and delivering schema, the provided QOS and so on. With respect to this question, both pedagogical and technological aspects must be carefully evaluated. There exist a few e-learning platform evaluations available in the literature focusing mostly on both commercial products and open source ones, and apply mostly simple evaluation approaches (Colace, 2004).

As stated above, the main objective of this study is to support institutes' decisions on eLearning platform evaluation. We propose an evaluation model, which is based on Multicriteria Analysis and aims to assist decision makers on the entire process in a more structured way, so we utilize ELECTRE TRI method, which classifies the alternatives into ordered categories, rather than a choice method. The model is then applied to a number of open source platforms for illustrative purposes.

Based on ELECTRE TRI method, we propose the following model for elarning platform evaluation:

- *Identify the alternatives set A:* The alternative platforms should be identified.
- *Define the categories C and the evaluation criteria G:* The categories should be defined in an ordered way, from less to more preferred ones.
- *Express the DM's preferences:* Determine the DM's alternative preferences (values) and preferences on criteria (weights) for each category.
- *Evaluate alternatives' performance:* Performance on the criteria should be evaluated for each alternative platform.
- *Classification:* Derive classification results.
- *Results assessment*: The DM should assess the results, and modify the parameters accordingly.

Case study

In order to demonstrate the proposed model we present a case study, which refers to the elearning platform decision process of a department of TEI of Athens. The objective was to acquire an elearning platform in order to host the academic material for all the classes and provide students a user friendly environment. Since several elearning platforms exist, they needed a structured way for evaluation, based on existing decision support methodologies. For this reason we proposed the above stated methodology, for both helping them to understand all the aspects involved in the decision process and provide them with an evaluation result.

Following the steps of the methodology, a team of decision makers was formed, including both academics and technical experts from the department, since adoption of an elearning platform relies on both aspects. The required values of the model were based on experts' estimations, reflecting their decision preferences.

- Initially, the team selected a number of existing platforms as alternatives for evaluation (Table 1). Although the number of available platforms is large, the decision was to evaluate a short list of the most widely used. A list of six platforms was then formed for evaluation, excluding the less common ones.

Table 1. Alternative platforms

Alternative	Platform	URL
A1	Claroline	http://www.claroline.net
A2	Ilias	http://www.ilias.de
A3	Moodle	http://www.moodle.com
A4	LRN	http://dotlrn.org
A5	SAKAI	http://www.sakaiproject.org
A6	Manhattan	http://manhattan.sourceforge.net

- Next, the team defined the number and the order of the categories for the classification of the platforms. Since the objective was not to provide a single platform as the most preferable, but classify to a category as a first step, the experts defined three categories, reflecting three levels of evaluation. The categories were Low, Medium and High (Table 2) and according to the decision result, only platforms assigned to High category would be candidates for selection in a second round of evaluation.

Table 2. Classification categories

	Category		
	High	*Medium*	*Low*
Definition	Platforms of high importance, candidate for selection.	Platforms of medium importance, to be further evaluated.	Platforms excluded from further investigation

- The next step was to define a set of evaluation criteria, which represent the most important aspects of an elearning platform, and were considered for the final decision. In collaboration with the team, eight criteria were defined covering both academic and technical aspects, as well as financial ones. For simplicity, criteria scales were defined in a 10 degree scale (Table 3). This scale means for example that a platform with not efficient communication tools would receive a low value in this criterion e.g. 2, while a platform with efficient communication tools would receive a high value in this criterion e.g. 8.

Table 3. Evaluation criteria

Criterion	Description	Scale
G1	Communication tools	1-10
G2	Assessment tools	1-10
G3	Collaboration tools	1-10
G4	Administrative tools	1-10
G5	Course delivery tools	1-10
G6	Course design tools	1-10
G7	Software / Hardware	1-10
G8	License	1-10

- Next, according to the multicriteria methodology, the team should define the limits of the categories, which were defined above. Since the categories are ordered, two limits have to be defined, the limit of the Low category, and the limit of the Medium one. These limits are called category profiles, and are defined by the expert by setting appropriate values for each criterion in the scale defined previously. For example, for the communication tools criterion the team defines that in order a platform to be classified to Medium category has to get a value in this criterion greater than 3, while to be classified to High category has to get a value in this criterion greater than 7. So the profiles are set to 3 and 7 values. In addition to the profiles, the relevant importance of the criteria to the final evaluation has to be defined. This is done by setting the weights of each criterion according to the team's preferences. Based on the above, the team defined the categories profiles, and the criteria weights according to their preferences (Table 4).

Table 4. Criteria weights

	Criteria							
	G1	G2	G3	G4	G5	G6	G7	G8
Profile 1	3	4	3	2	6	4	6	5
Preference	0	0	0	0	0	0	0	0
Indifference	0	0	0	0	0	0	0	0
Profile 2	7	8	6	7	8	6	8	9
Preference	0	0	0	0	0	0	0	0
Indifference	0	0	0	0	0	0	0	0
Weight	0.5	1	0.5	1	0.5	0.5	3.5	2.5

- As a final step before the model execution, the performance of the previously defined alternatives to each criterion has to be defined. This procedure requires the team to evaluate the performance of each platform to each criterion. For example Claronline in terms of communication tools gets a medium value, while in terms of license gets a high value. These values are based on decision makers' estimation. Based on the above, the expert's team evaluated the performance of the six platforms to the eight criteria the according their preferences (Table 5).

Table 5. Alternatives' performance

	Criteria							
Alternatives	G1	G2	G3	G4	G5	G6	G7	G8
A1	4	7	6	8	6	8	9	8
A2	5	4	6	2	4	5	6	8
A3	6	7	6	7	8	8	6	8
A4	3	3	4	3	4	6	4	6
A5	5	5	6	7	2	3	4	5
A6	4	6	7	4	5	7	6	8

- Finally, the model was executed with the appropriate software tool, and the classification results were derived for pessimistic and optimistic assignments according to ELECTRE TRI method (Table 6). According to this classification only one platform is candidate for further examination.

Table 6. Classification results

Alternative	**Platform**	**Category (pessimistic)**	**Category (optimistic)**
A1	Claroline	Medium	High
A2	Ilias	Medium	Medium
A3	Moodle	Medium	Medium
A4	LRN	Low	Medium
A5	SAKAI	Low	Medium
A6	Manhattan	Medium	Medium

CONCLUSION

In this paper we presented a multicriteria model for elearning platform evaluation. We also demonstrated a case study, where a team of experts from a department of TEI of Athens evaluated a number of existing open source platforms. The objective of this study is not to evaluate existing platforms, but rather to provide a tool to decision makers in order to structure their decision problem. Moreover, to prove the applicability of multicriteria analysis to such decision problems. Since every institute has specific needs, problem formulation may be customized with respect to them.

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