Learning Management System Selection with Analytic Hierarchy Process

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Abstract:

Dramatic increase in both the variety and the complexity of e-learning tools causes difficulties of choosing the most appropriate technology for such learning applications and tools embedded in a learning system. Today, there are many available learning management systems as alternative products. Choosing the best one of them that meets the needs is an optimization problem of decision making. In this paper, the analytic hierarchy process was applied for solution of this optimization problem.

1 Introduction

“The Web revolution, the popularity of on-line learning, and the broad availability of computers in schools, colleges, universities, workplaces and in other social settings has caused a qualitative change in the field of learning technologies. Both the variety and the complexity of e-learning tools have increased dramatically over the last 10 years.” This is a known fact by the most of the people involved in learning and technology area and quoted from a call for paper section published at http://www.computer.org/portal/web/tlt/cfp by IEEE Transactions on Learning Technologies. However, dramatic increase in both the variety and the complexity of e-learning tools on the other hand, causes difficulties of choosing the most appropriate technology for such learning applications and tools embedded in a learning system. For instance, there are more than twenty learning course management systems available as alternative products. So, how does or will an organization select its learning course management system? Does an organization follow a methodology to select a product that meets the best of its interests? This situation is classified under the optimization problem of decision making. In this paper, an analytic hierarchy process (AHP) for the selection of learning course management system where will be used in web based training of biomedical specialists: Application to biomedical device technology teachers of Vocational High Schools connected to Ministry of National Education project (WEBD) is presented.

2 Materials and Methods

Decision support system (DSS) is considered as a solution to optimization problem. Analytic Hierarchy Process (AHP) was developed by Saaty [1] and described by him in [2] as a theory of measurement through pair-wise comparisons and relies on the judgments of experts to derive priority scales. AHP is one of the widely used methodologies to solve optimization problem in multi-criteria decision making. It has been used in a variety of decisions including Firms’ Overall Performance Evaluation [3], in Vendor Selection problem [4,5], in identification of the critical factors associated with the implementation of World-Class Manufacturing (WCM) techniques [6], equipment purchasing [7], in project planning and project management [8].
In LMS selection, choosing the right alternative that fits our needs requires an analytic evaluation not just by picking a product based on intuition. This evaluation involves a formal process, with defined aim and definition of objectives with a specific quantifiable set of criteria. A quantitative approach with spreadsheet might have been a solution to this problem [9]. However, with the increasing alternatives and criteria and with the consideration of time required for implementation of methodology and the project timeline a quick and easily applicable methodology is needed.

AHP which is a structured technique for dealing with complex decisions is used for selection of the appropriate learning course management system selection due to its success in helping decision making. The decision hierarchy is structured starting from the top with the goal of the decision, then, the objectives from a broad perspective through the intermediate levels (criteria and sub-criteria) to the lowest level (alternatives) as seen in Figure 1. Readers can find detailed information about AHP in references 1 and 2.

AHP Based Learning Course Management System Selection

In WEBD project, first the technical working group conducted needs analysis according to work packages and outputs described in the project. With use of a web based AHP software developed with author’s supervisory [10], modeling of decision hierarchy, pairwise comparison and evaluation of results were achieved. WEBD project consists of seven work packages namely, Management and Coordination, Developing Database for Team Members of Target Sectors and Groups, Development of Common Curriculum, Content development for WEBD, Production of WEBD, Testing of WEBD and Dissemination and Exploitation of results. Each work package includes its aim, definition of activities, description of methodological/ pedagogical framework and description of outputs. Working team defined the decision hierarchy according to the needs and aims of the project and came up with nine main criteria and total sixteen sub criteria belonging to total five main criteria.

Modeling of decision hierarchy was obtained with definition of the goal as to select the most appropriate LMS software or technology for the project WEBD. Multi-language Support, The cost, Evaluative tools, Compatibility, Support, Sustainability, Reliability, Source Code and Management were defined as main criteria. The e-portfolio, exam pool, student tracking and statistical tools were defined as sub-criteria of “evaluative tools”. Comply with international e-learning standards, content development tools, software and platform compatibility were defined as sub-criteria of “compatibility”. Documentation, technical and online update support were defined as sub-criteria of “support”. Open source and proprietary source codes were defined as sub-criteria of “source code”. System management, user management and security were defined as sub-criteria of “management”. There were ten LMS chosen as alternatives (Atutor, Black Board, Dokeos, E-nocta, HotChalk, Illas, JoomLA,
Moodle, Sakai Project, Sumtotal Systems). Figure 2 shows the decision hierarchy model of the LMS.

![Decision Hierarchy Model of the LMS](image)

Figure 2. Decision hierarchy model of the LMS.

There are 26 pair-wise comparison matrices in total: One for the criteria with respect to the goal which is shown in Figure 3, 5 for sub-criteria the first of which for the sub-criteria under evaluative tools: e-portfolio, exam pool, student tracking and statistical tools that is shown in Figure 4. The other four pair-wise matrices for the sub-criteria under compatibility, support, source code and management are not shown here. In Figure 3, the criteria listed on the left are compared one by one with each criterion listed on top as to which one is more important with respect to the goal of selecting a best job.

![Pairwise Comparison Matrix](image)

Figure 3. Pairwise comparison matrix with respect to goal.
Figure 4. Pairwise comparison matrix for the sub-criteria under evaluative tools.

Then, there are twenty comparison matrices for the ten alternatives with respect to all the covering criteria, the lowest level criteria or sub-criteria connected to the alternatives which are not shown here due to space limit of the paper. In Figure 4, the sub-criteria on the left are compared with the subcriteria on top as to their importance with respect to flexibility. It should be noted here that pair-wise comparison matrices are inverse-symmetric and therefore there is no need to fill out those cells. In web based AHP program, those cells are automatically filled out for the user by default at background for sake of simplicity and to prevent from typing mistakes. The derived scale based on the judgments in comparison matrix with respect to goal is shown in Figure 5.

Figure 5. Derived scale based on the judgments.

During the achievement of comparisons inconsistency check was made for both alternatives and criteria. Inconsistency ratio measures how far all pairwise judgments deviate from perfect consistency among all comparisons. Inconsistency ratio (here is TO) of greater than about 0.1 are generally viewed as worthy of concern and it is advised to redo pairwise comparisons. Ratios smaller than 0.1 reflect a pretty coherent set of evaluations. As seen from Figure 5, all TOs less than 0.1 mean that all judgments were consistent. Details of results are given with support of graphics. Figure 6 shows the bar graph of the results from scale based on the judgments.

Figure 6. Graph of the results from scale based on the judgments.
The final results are presented with the overall scores of each alternative as seen in Figure 7. According to Figure 7, Moodle is the most suitable alternative for the project. All readers should be aware that the methodology used in this paper does not evaluate a software product. It shows how AHP can be used for an optimal decision. It also should be noted that results or scores can differ with the change of priorities and objectives. Therefore, saying that the Moodle is the best one among the other platforms might be misleading. It would be better to say that according to the given priorities Moodle is the best candidate for this work. If the priorities change, then scores will change.

![Figure 7. The overall scores of alternatives](image)

Before implementing the selected alternative AHP conducts a sensitivity analysis to determine whether small changes in judgments affect the final weights and rankings of the alternatives. This may lead decision maker to reconsider the judgments or sufficiency of the chosen alternative.

4 Conclusion

The use of AHP as a decision support system for selection of the most appropriate LMS for given priorities and criteria is presented. AHP gives reliable results with the collaboration of expertise and structural methodology. Although AHP relies on expertise for the best solution, the inconsistency check during the pair-wise comparisons makes the AHP reliable as a decision support system even for people who are less experienced in decision making. AHP is a powerful tool but cannot evaluate products by itself. The results of this study cannot be generalized to a specific product or technology for a similar application.

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