Evaluation of open-source e-Learning platforms based on the Qualitative Weight and Sum approach and Analytic Hierarchy Process

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ABSTRACT

E-learning is now playing a very important role in learning processes and the major concern in all education institutions and universities. Open source e-learning platforms are one of the latest e-learning management systems used to deliver e-learning courses in most of the universities and higher educational institutions in the entire world, also in Jordan. There is a need to compare and evaluate these platforms to assess their weaknesses and strengths. It is currently not clear what the best method to evaluate these platforms. A number of studies have been carried out in this field already, but there is still a need for further analysis to choose the best platforms [1]. This paper presents an evaluation of open source e-learning platforms. Based on the functionality of these platforms and the main characteristics provided of each platform we combined the Qualitative Weight and Sum (QWS) and the Analytic Hierarchy Process (AHP) approaches for the evaluation process of these open source e-learning platforms. For our research we used all open source e-learning platforms that are implemented and used at all Jordan Universities. The result for the evaluation in Jordan shows that all Jordanian universities use open source e-learning platforms and that the Moodle platform is the most widely used. However, Intelligent Web Teacher (IWT) obtained the highest evaluation results according to the QWS and ASP approach. Claroline comes in the second place. Both IWT and Claroline are highly recommended to be used. The results of this research paper will be very useful for higher institutions in Jordan and all over the world to decide which open source platforms will be more reliable and beneficial in their institutions and which features of these e-learning platforms are the most important to be activated when implementing the open source platform. This research also helps the open-source e-learning platform software developer to decide which features are more important for learners based on the scores in the evaluation

Keywords: e-learning systems, open source software, evaluation approach, qualitative weight and sum, analytic hierarchy process, Jordan universities.

1. INTRODUCTION

E-learning makes knowledge transfer possible in a way that can have definite economic and educational value. E-learning has become a fundamental and decisive aspect of professions related to the new economy [2, 3]. E-learning is a complement to and sometimes overtaking conventional classroom teaching methods. Various organizations and institutions across the world are moving toward adopting e-learning as their principal teaching and training method [4, 5].

E-learning open source platforms are now playing a major role in changing the existing ways of teaching and learning methods in higher educational institutions. The demands on higher education require a fundamental change towards new technologies and to choose the best of them [6, 7]. Open source E-learning platforms can be thought of as the main solution to provide e-learning courses to students. There are several open-source E-learning systems which support different capabilities and it is very important to choose the best platform that fits the E-learning needs of each institution. Although Blackboard is still a big player, various institutions are moving toward adopting open-source platforms because open-source platforms provide the opportunity to add specific features to such systems according to the university's needs. In addition, since these kinds of systems are maintained by a very large group of programmers, they are regularly updated and in each release technical problems are resolved and upgraded. All these open-source programs are freely available to general public [8, 9], although sometimes there are charges and fees for support.

Because there are many different open source platforms and most of the world's universities and higher education institutions use different platforms, this variety makes the evaluation of this kind of platforms difficult [10]. There are multiple criteria and methods to evaluate them, and frameworks and models are required to drive this evaluation. So the goal of this paper is to show a model for selecting the most suitable E-learning solution taking into

account its technological and pedagogical aspects. In literature there are many approaches to evaluating E-learning platform [14].

Britain & Liber proposed a "Framework for Pedagogical Evaluation of Virtual Learning Environments" [11]. This framework considers two models upon which an evaluation strategy may be based. The first one comes from the Conversation Framework [12] that addresses several ways the learning process is produced in an e-learning platform. Another model for the evaluation is based on the Viable Systems Model (VSM) and was proposed by Britain & Liber themselves. Based on each model, Britain & Liber propose different criteria to evaluate how e-learning platforms address the model's learning characteristics. Subjective methods such as filling questionnaires or elaborating comparison grids are used to decide if a learning platform meets the selected criteria. Another basic framework is proposed [13] to distinguish between the many ways in which Virtual Learning Environments (VLEs) can be evaluated. Félix Buendía García [10] provided a framework that is based on the use of the SCORM standard specifications that allow instructors to employ benchmark tests to evaluate e-learning platforms. The framework includes the purpose of the evaluation, the type of methods that might be used and the measures employed. The authors described the different roles for evaluation, the types of experiments to be performed and criteria to evaluate the usability or the learning effectiveness. Their proposed evaluation methods range from interpreting results and identifying processes and outcomes, to detecting the type of data or participants. Additionally, several measures (e.g. usability heuristics, frequency of interactions or learning outcomes) are included in their framework [10].

2. MATERIALS AND METHOD

In this paper we have used the Qualitative weight and sum (QWS) approach as in [15] and the Analytic Hierarchy Process (AHP) used in [14] for evaluating new and additional characteristics in addition to the characteristics studied in previous literature about these e-learning platforms for different open source platforms. For this purpose a questionnaire was designed and given to students in Systems Analysis course at Jordan University. Those students have experience in using the e-learning platform that is implemented and used at Jordan University.

The qualitative weight and sum (QWS) approach is a well-established approach for the evaluation of software products. It establishes and weights a list of criteria. QWS is based on the use of symbols. There are six qualitative levels of importance for the weights, frequently symbols are used: E = essential, * = extremely valuable, # = very valuable, + = valuable, | = marginally valuable and 0 = not valuable. The weight of a criterion determines the range of values that can be used to measure a product's performance.

The AHP which was developed by Thomas Saaty is an effective means of dealing with complex decision-making. AHP helps capture both subjective and objective evaluation measures, providing a useful mechanism for checking their consistency relative to considered alternatives, thus reducing bias in decision making [17]. The AHP approach allows not only to evaluate the platforms but also to test the application that's why we used both the QWS and the AHP approaches.

We have summarized all the symbols in Table [1] below with their weights. Ranking for each platform are subjective.

	QWS	Weight in AHP
essential	**E**	**5**
extremely valuable	*****	**4**
very valuable	**#**	**3**
valuable	**+**	**2**
marginally valuable	**|**	**1**
not valuable.	**0**	**0**

Table [1] A summary of all the symbols with their weights according to QWS and AHP

3. DISCUSSION AND RESULTS

We used the QWS approach for evaluation of e-learning open source platforms, because it is a well-established and known approach for the evaluation of software products. The differentiated results highlight the strengths and limitations of the platforms. We applied the evaluation approach with QWS in a way where the essential criteria are assessed in a pre-evaluation phase, similar to Baumgartner [15] and [16]. The minimum criteria that we have chosen which cover the major general requirements of each platform are: Social Networking Tools, Productivity Tools & Software Installation, Administration Tools & Security, Presentation Tools and Material Distribution, and Management Features.

For the evaluation, we have selected the nine most well-known open source e-learning platforms and evaluated these according to the minimum criteria that were mentioned in the previous paragraph. The nine platforms are : Dokeos (version 1.8.6) [17], Claroline (version 1.11) [18], IWT (version 1.1) [19], ILIAS (version 4.2.1) [20], Moodle (version 2.0) [21], Atutor (version 2.0.3) [22], LON-CAPA (version 2.10.0) [23], OpenUSS (version 1.1) [24]. ADA (version 1.7.1) [25]. Next, these nine platforms were tested in detail with real life examples from universities in Jordan. Almost all of the universities here implement the open source platforms we have studied and analyzed. These platforms were tested according to the following features provided by each platform : On-Line User Registration, Course List, Course Indexing, New Course Creation, Contents Import, Contents Sharing Contents Insertion, Multi Course Management, Multi-User Management, Assessment Management, Report, Student's Group, Management, Progress Tracking, Virtual Classroom, Application Sharing Contents, Download, Organization of course objects, Assessment of tests, Administration of courses, Security, Authorization

management, User management, Installation of the platform, Assistance, Documentation, Conferences, Announcements, Learning material, Exercises, Assignment & Quizzes, Whiteboard, Chat, Forum, E-Mail.

We classified the characteristics to the nine minimum criteria and categories as discussed above. These criteria and categories have several subcategories as described in Table [1, 2, 3, 4, and 5] below. Several attributes measure the characteristics of each subcategory. Only the subcategories are weighted and evaluated and then we have calculated the weighted sum and divided by the total weighted sum for the subcategory in other words we calculated the weighted average. After that we calculated the percentages of these categories as in equation (1,2).

Subcategory weight =

$$\sum_{k=0}^{n}(\text{feature weight}) \quad \text{.....eq(1)}$$

Here n is the number of features and feature weight is the weight of the QWS symbol weighted in AHP approach.

Sub category percentage =

$$\frac{\text{Minimum criteria weight}}{\text{Total weight of all symbols}} * 100\% \quad \text{.....eq(2)}$$

Here "total weight of all symbols" is the total symbol weight of in the QWS approach as shown in table 1 for a specific subcategory.

The features in each subcategory are weighted and calculated from the questionnaire's answers. According to the QWS approach, these values are summarized for each category by using the number of each symbol. The evaluation value of the platform is calculated equivalently and after that we used the Analytic Hierarchy Process (AHP) to calculate the weight for each subcategory. The final evaluation of each platform is calculated by the total summation of all sub categories according to equation (3)

Platform Final Evaluation =

$$\sum_{k=0}^{n}\left(\frac{\text{Platform category weight}}{\text{no of sub categories}}\right) * 100\% \quad \text{.....eq(3)}$$

Here n is the number of categories in the same platform.

	Feature	Calculated Percentage
social networking Tools	Chat	1.2%
	Forum	0.98%
	E-Mail	4.9%
	Contents Sharing	3.2%
	Conferences	2.1%
Subcategory weight:		12.38

Table [2] Subcategory for Social Networking Tools

	Feature	Calculated Percentage
Productivity Tools & software Installation	Application, Download	2.8%
	Objects	2.4%
	Installation of the platform	4.7%
	Assistance	0.97%
	Documentation	3.1%
	Virtual Classroom	1.8%
Subcategory weight:		15.77

Table [3] Subcategory for productivity tools

	feature	Calculated Percentage
Administration Tools & security	Administration of courses	4.5%
	Progress Tracking	1.9%
	On-Line User Registration	2.2%
	New Course Creation	5.1%
	Report	2.8%
	Organization of course	0.87%
	Assessment of tests	5.8%
	Security	4.3%
Subcategory weight:		27.47%

Table [4] Subcategory for Administration Tools

	feature	Calculated Percentage
Presentation Tools and Material Distribution	Announcements	2.7%
	Learning material	4.8%
	Exercises	4.1%
	Assignment & Quizzes	3.9%
	Whiteboard	3.2%
	Course List	5.1%
	Course Indexing	1.9%
	Contents Import	3.7%
	Contents Insertion & download	3.2%
Subcategory weight:		28.5%

Table [5] Subcategory for Presentation Tools

	feature	Calculated Percentage
Management Features	MultiCourse Management	2.7%
	Multi-User Management	2.1%
	Assessment Management	3.5%
	Student's Group	2.8%
	Management	4.1%
	User management	2.7%
	Authorization management	3.4%
Subcategory weight:		21.2%

Table [6] Subcategory for Management Features

	Assessment of tests	Organization of course objects	Application Sharing	Virtual Classroom	Progress Tracking	Student's Group Management	Report	Assessment Management	Multi-User Management	Multi Course Management	Contents Insertion	Contents Sharing	Contents Import	New Course Creation	Course Indexing	Course List	On-Line User Registration
Dokeos	1.7	1.7	0.8	0.93	1.7	1.4	1.7	1.4	1.4	1.4	2.1	0.8	2.1	1.7	2.1	2.1	1.7
Claroline	1.7	1.7	0.0	0.0	1.7	1.4	1.7	1.4	1.4	1.4	2.1	0.8	2.1	1.7	2.1	2.1	1.7
IWT	1.7	1.7	0.8	0.93	1.7	0.0	1.7	1.4	1.4	1.4	2.1	0.8	2.1	1.7	2.1	2.1	1.7
ILIAS	1.7	1.7	0.0	0.0	1.7	1.4	0.0	1.4	1.4	1.4	2.1	0.8	2.1	1.7	2.1	2.1	1.7
Moodle	1.7	1.7	0.0	0.0	1.7	1.4	1.7	1.4	1.4	1.4	2.1	0.8	2.1	1.7	2.1	2.1	1.7
Atutor	1.7	1.7	0.0	0.0	1.7	1.4	1.7	1.4	1.4	1.4	2.1	0.8	2.1	1.7	2.1	2.1	1.7
LON-CAPA	1.7	1.7	0.0	0.0	1.7	1.4	1.7	1.4	1.4	1.4	2.1	0.8	2.1	1.7	2.1	2.1	1.7
OpenUSS	1.7	1.7	0.0	0.0	1.7	1.4	1.7	1.4	1.4	1.4	2.1	0.8	2.1	1.7	2.1	2.1	1.7
ADA	1.7	1.7	0.0	0.0	0.0	1.4	1.7	1.4	1.4	1.4	2.1	0.8	2.1	1.7	2.1	2.1	1.7

Table[7] Platform final evaluation. It continues below. Note Numbers are given in percentages.

	E-mail	Forum	Chat	Whiteboard	Assignment & Quizzes	Exercises	Learning Material	Announcements	Conferences	Documentation	Assistance	Platform Installation	User Management	Authorization Mangmt.	Security	Administration of courses
Dokeos	0.8	0.8	0.8	2.1	2.1	0.0	2.1	2.1	0.8	0.93	0.93	0.93	1.4	0.0	0.0	1.7
Claroline	0.8	0.8	0.8	2.1	2.1	2.1	2.1	2.1	0.0	0.93	0.93	0.93	1.4	1.4	1.7	1.7
IWT	0.8	0.8	0.8	2.1	2.1	2.1	2.1	2.1	0.0	0.93	0.93	0.93	1.4	1.4	1.7	1.7
ILIAS	0.8	0.8	0.8	2.1	2.1	0.0	2.1	0.0	0.0	0.93	0.93	0.93	1.4	1.4	1.7	1.7
Moodle	0.8	0.8	0.8	2.1	2.1	2.1	2.1	2.1	0.0	0.93	0.93	0.93	1.4	1.4	1.7	1.7
Atutor	0.8	0.8	0.8	2.1	2.1	0.0	2.1	2.1	0.0	0.93	0.93	0.93	0.0	1.4	0.0	1.7
LON-CAPA	0.8	0.8	0.8	2.1	2.1	2.1	2.1	2.1	0.0	0.93	0.93	0.93	1.4	1.4	1.7	1.7
OpenUSS	0.8	0.8	0.8	2.1	2.1	0.0	2.1	2.1	0.0	0.93	0.93	0.0	0.0	0.0	1.7	0.0
ADA	0.8	0.8	0.8	2.1	2.1	2.1	2.1	2.1	0.0	0.93	0.93	0.93	1.4	1.4	1.7	1.7

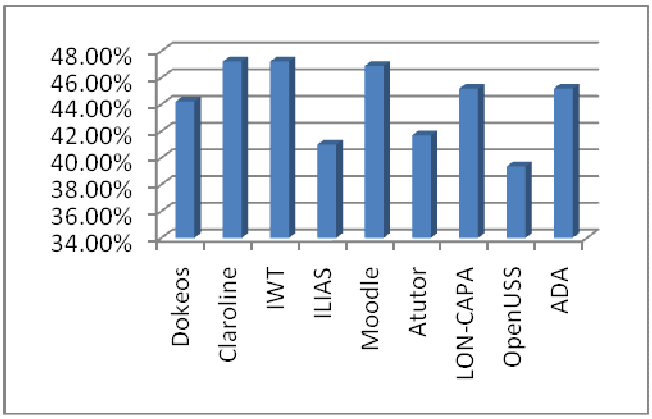

Figure [1] chart for the final results of the open source e-learning platform evaluation

The IWT platform gave a good result when we tested it according to the chosen minimum categories. The overall evaluation result shows the results for each platform and each subcategory, classified by categories. If such a category is considered important, then our method can suggest a better platform that has a high weight in most categories such as IWT and Claroline (see Table [7] below). The best results of each category are highlighted.

However, and as shown in Figure 1, it can be seen that the Intelligent Web Teacher (IWT) achieved a high evaluation values. Claroline, which is used by two Jordanian universities, also dominate the evaluation by achieving the best value in the total summation of the sub categories. The strengths of Claroline are the high scores for the criteria of Social Networking, Productivity Tools, Software Installation, Administration Tools and Security. Additional strengths of Claroline are the Management Features, Presentation Tools and Material Distribution. Furthermore, the outstanding usability of Calroline leads to the maximum evaluation value in the usability category.
The third place goes to Moodle. This platform has been used in six Jordanian Universities (University of Jordan, Hashemite University, Mutah University, Jordan University of Science and Technology, Balqa Applied University , German-Jordanian University) . The LON-CAPA, and ADA platforms are ranked equally at the fourth position, ILIAS and Atutor are ranked at the fifth position and the sixth position, whereas OpenUSS is ranked last. The reason for the low ranking of OpenUSS is that so far only the basic features are realized. However, the quality of these features is very good.

Open source e-learning platforms in Jordanian Universities:

University and educational organizations have different strategies in deploying E-learning systems. All universities in Jordan use open source E-learning platforms which are integrated into the university portals. Integration is considered desirable as it generally improve the content quality of e-learning system. This most frequently used open system system in Jordan universities is, according to this research Moodle.

We have studied all universities in Jordan accredited by the Ministry of Higher Education in Jordan and almost all of them are adopting open source e-learning platforms, as shown in Table [8].

PLATFORM / UNIVERSITY	Dokeos	IWT	ILIAS	Moodle	Atutor	LON-CAPA	OpenUSS	ADA	Dokeos	Claroline	Blackboard
University of Jordan				√							
Yarmouk University										√	
Al-Hussein Bin Talal University										√	
Hashemite University				√							
Al al-Bayt University											√
Mutah University				√							
Jordan University of Science and Technology				√							
Balqa Applied University				√							
German-Jordanian University				√							

Table [8] shows the platforms adopted in all of the Jordanian Universities.

To investigate the implementation of open source elearning systems in the Jordanian Universities and to conduct the study, the following research questions were studied:

- What is the most frequently used open source e-learning platform implemented in Jordanian Universities?
- What percentages of the Jordanian universities in Jordan implement e-learning in their learning process?
- What percentage of Jordanian Universities in Jordan use open source software as e-learning platform?
- What percentage of Jordanian Universities in Jordan developed there own e-learning platform?

The numbers about the open source implementation in Jordanian universities are shown in table [9]. The data in this table shows how many universities and the percentage provide an open source E-learning platform, the percentage of every type of open source E-learning platform, and the most frequently used platform (compare figure [2])

E Learning	**All Universities in Jordan (No.=9)**	
	Number	percentage
Open source E-learning platform	8	88%
Commercial E-learning platform	1	12%
Own developed E-learning platform	0	0%
Most frequently used E-learning platform: Moodle	6	66%
The E-learning platform is part of the university website	9	100 %

Table[9] Open-Source implementation in Jordanian Universities

It is seen from table 9 shows that the majority of the software implemented in E-learning systems in Jordan is based on open source E-learning platforms, 8 out of 9 for universities (88%). The most frequently used open source platform is Moodle, almost 66% use this platform. All E-learning systems are integrated with the website of the university. This is desirable as integration will improve the ease of access of the E-learning system.

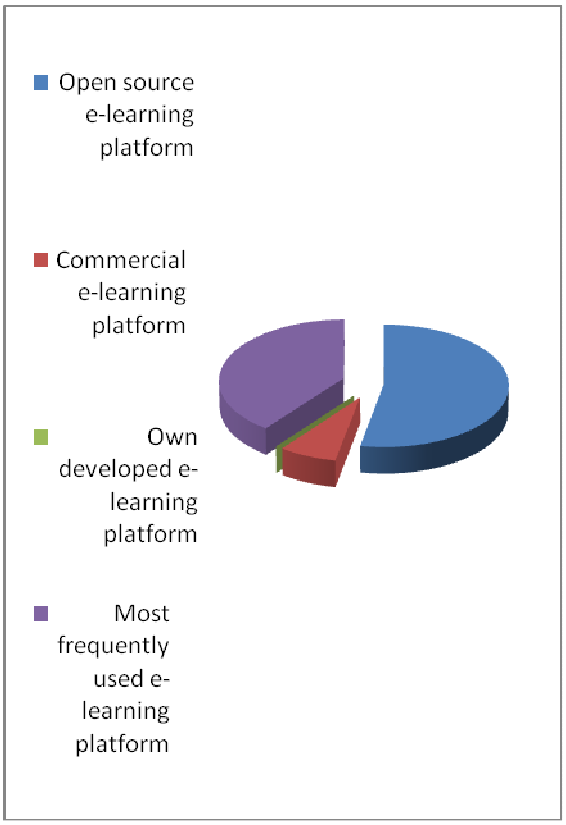

Figure [2] percentage of Jordanian universities using open source E-learning platforms.

4. CONCLUSION

Although Commercial E-learning platforms like Blackboard is still a big player, various organizations and educational institutions all over the world are moving toward adopting open-source E-learning platforms because open-source platforms provide the opportunity to add specific features to such systems according to the university's needs. These platforms occupy an ever increasing and preeminent role in the teaching and learning process in these institutions. This research paper will help higher educational institutions to decide what the best open source E-learning platform is for their purposes, based on the results of a thorough evaluation of these platforms.

This evaluation of open source E-learning platforms was done by combining both QWS and AHP approaches. This combination of the two approaches for this purpose is new. The evaluation was carried out by evaluating the open source e-learning at all Jordanian universities. The research showed that the highest evaluated e-learning platform is Intelligent Web Teacher (IWT), followed by claroline and in third place the Moodle E-learning platform. The most frequently used open source system in Jordan universities is Moodle.

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