Comparison of e-Learning Management Systems

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Abstract: - This paper provides comparative analysis of ten types of e-Learning Management Systems (LMS) established on the market. We recognize four LMS types: (1) proprietary LMS, (2) mainly proprietary and partly standard based LMS, (3) mainly standard based LMS and partly proprietary LMS and (4) open architecture LMS. The analysis shows that "standard/proprietary" systems lead e-Learning market at present, which testifies that standards faithfully reflect users' requirements, so even established companies should accept standards as start-point for future LMS development. Open source systems also seem to have perspective, especially those supported by large corporations and well developed communities of users, and they might be respectable competitors to expensive proprietary ones.

Key-Words: Learning Management System, LMS categories, LMS tools and features, e-Learning

1   Introduction

Chaotic development of e-Learning Management Systems (LMS) in the recent decades asserted necessity of regulation in the filed, which resulted with common adoption of the first comprehensive e-Learning standard named Shareable Content Object Reference Model (SCORM). Now that the standard provides main guidelines and requirements, existing LMSs has to undergo thorough changes, and these are not easy for their developers. Majority of companies that produce LMS software have their proprietary products developed far before SCORM was adopted, and they are not willing to discard all the effort they made in the past. Rather they are trying to incorporate SCORM directives into their products gradually, causing diversity on the market that requires careful analysis and comparison before deciding about long-term investments.

Attention has to be paid to open source LMSs as well, because they offer more and more of the functionalities of expensive proprietary systems for free, thus becoming respectable competitors.

In the following sections, we present results of the comparison of four distinctive types of LMSs we recognized on the market: (1) proprietary LMS, (2) mainly proprietary and partly standard based LMS, (3) mainly standard based LMS and partly proprietary LMS and (4) open architecture LMS. Our comparison is based on user feedback on usefulness of the main fifteen tools that are used in LMS systems [1].

2   Basic types of LMS

Here is a brief overview of properties of basic types of LMSs and their most important differences.

2.1   Proprietary LMS

Proprietary Learning Management Systems are in the dieing out stage. This is mainly because they are based entirely on the heritage of Computer Based Training (CBT) systems [15], which were ruling the market before the dawn of the e-Learning standards era, before adoption of SCORM.

Proprietary systems cannot function, in a simple way, with other e-Learning components such as Sharable Content Object components (SCO's) defined by SCORM, neither there is a simple way of establishing their interoperability with other e-Learning systems. For example, there is no an easy way neither for exporting and importing objects of knowledge, nor for exchange of raw materials.

Process of integration of a proprietary LMS system with other LMS components, along with adjustment of the contents can sometimes last as long as 18 months. Companies that produce proprietary LMSs as well as their customers have adopted the rule of 1:3, which means that for every dollar of expense for buying such a system, additional 3 dollars will be needed for maintaining it [3].

2.2   Standard based LMS

Standard based LMSs are currently the fastest growing LMS category. Many companies that were producing the proprietary LMSs so far are now turning towards standards in order to avoid being trapped by their proprietary solution. Conformity with standards, especially with a widely accepted standard like SCORM, guarantees satisfactory level of interoperability not only for LMS, but for the e-Learning material as well.

On the other hand, a system based on the standard can be good only as much as standard is good. Companies mostly adopted SCORM, but the problem is that SCORM is constantly changing [3] due to technological advance and new possibilities, especially in communications.

2.3   Open architecture LMS

Many manufacturers of the LMS systems are claiming that their system is "open", but during implementation many systems show not to be truly open. "Truly open" LMS requires just a little effort for set up, integration with contents and establishment of communication with other systems. Primarily, exchange of the contents with other systems should be easy. Because e-Learning standards are decided about common tasks and expectations from LMSs, truly open systems will need only minor adjustments to fulfil all requirements imposed by those standards [3].

3   Determining the type of LMS

Of the three mentioned LMS types, two are easily recognizable. Which system is an open architecture system and which one is proprietary? This is publicly accessible information and requires no special concern. However, to determine which system is standard based, we need to analyse the system features and compare them with standardized ones.

The main problem is that many proprietary systems have been evolving from being proprietary to being standard based. Even by careful exploration of each of the LMSs that have been passing from proprietary stage to standard based system, it is quite difficult to classify them as being of strictly one or another type. In addition, since there is not only one authoritative standard and taking into account the fact that standards are continually emerging and changing, in this comparison we do not recognize purely "standard LMSs" at all. Another argument for such decision is obvious reality that LMS created and based solely on standard, without having any "proprietary heritage", hardly exists.

Therefore, we distinguish the following four LMS types:

1) proprietary LMS,
2) mainly proprietary and partially standard based LMS, denoted as "proprietary/standard",
3) mainly standard based LMS and partially proprietary LMS, denoted as "standard/proprietary",
4) open architecture LMS.

The first and the last type are easily recognizable. Distinction between "proprietary/standard" and "standard/proprietary" is not that obvious, but it can be made quite objectively. If LMS fulfils only basic requirements of the standard, we consider that system to be a "proprietary/standard" one. If a system is fulfilling majority of the standard requirements, we consider it "standard/proprietary". In both cases, we take SCORM as the reference.

In continuation, we compare ten LMSs in Table 1. These have been chosen because of their popularity and because among them there is as least one representative of each LMS type we recognize. In Table 1, "O" stands for open architecture, "S/P" for "standard/proprietary", "P/S" for "proprietary/ standard" and "P" for proprietary LMS.

Table 1: Types of LMSs used in this analysis.

	Type of LMS			
LMS	O	S/P	P/S	P
ANGEL 6.2		X		
Blackboard Academic Suite		X		
Claroline 1.4	X			
eCollege AU+			X	
Jenzabar Internet Campus Solution 1.03				X
Learnwise		X		
Moodle 1.5.2	X			
Sakai 2.0	X			
Learning Manager Enterprise Edition			X	
WebCT Vista 3.0			X	

As shown in the table, we compare three products from each category, except proprietary. Purely proprietary LMSs are nowadays very rare, and we included one in this research just for completeness. The chosen set encompasses all important LMS architectures and it is quite sufficient for examination of their advantages and disadvantages.

4 Comparative analysis

4.1 Methodology and the grading system

This research has been made by web-based comparison system *EduTools* [2], which allows users to compare LMSs or particular tools by different criteria. For example, users can choose Discussion Forum, Course Management and File Exchange as tools, and Moodle 1.5.2 and Sakai 2.0 as LMSs in order to make comparison between these two LMSs with respect to the chosen tools.

Picking the "right" set and number of tools to make comparison can be a problem, because it is not easy to say which tools are most important and most frequently used. Knowing that there is no absolutely best choice, we have decided to rely on experience of other researchers [1] and statistics. Specifically, we have chosen 15 tools, listed in Table 2, that were most frequently selected by *EduTools* users during comparisons of LMSs at [2].

The users' choice is sometimes surprising. The three most frequently selected tools are Discussion Forum, Course Management and File Exchange. This is expected, because Discussion Forum is place where majority of students pose their questions, exchange experience etc. In addition, practice of usage and administration of LMSs proves that professors also tend to communicate with their students threw Discussion Forum, as the most convenient way of talking to all of them at once. Another reason might be that this tool is certainly the most frequently used in everyday life, after E-mail, and both professors and students are usually familiar with it. Furthermore, new Discussion Forum tools provide abundant set of features, allowing professors to coordinate majority of essential activities directly from Discussion Forum, without need for some other tool at all. Good example is Calendar tool, which is rarely used for simple posting of important dates to the students. Instead, professors prefer opening a new topic on Discussion Forum and putting all dates there or in a single text file on the homepage of the course. Discussion Forum can serve as knowledge management tool as well, because it allows saving and indexing of all threads of discussion of Frequently Asked Questions database, which can be used and upgraded by every new generation. Finally, e-learning literature recognizes Discussion Forum as a great tool for turning students "from passive viewers to active participants." [8].

Somewhat surprising is 7th place of Internal Mail. The probable reason is that professors use discussion forums for all general-purpose questions, and dedicated external mail for communication with individual students. Similarly unexpected might seem high second place by importance of Course Management tools. However, this is logical, because managing students and materials of the course is mostly very time consuming activity, which loads professors, or assistants, with lots of job they usually do not like to do.

All in all, Table 2 lists the tools we use in our analysis, and it also contains the frequencies of the chosen tools, that is, the number of participations of a particular tool in comparisons requested by EduTools users. The rightmost column shows relative frequency (out of 1720 total performed comparisons). For instance, 1076 of 1720 users that used comparison system chose Discussion Forum tool as one of criteria. These frequencies will be weights of the respective tools in our analysis.

Table 2: Top 15 most wanted tools (1720 users sample).

Name of the tool	Frequency	Percentage
Discussion Forum	1076	62,56
Course Management	866	50,35
File Exchange	818	47,56
Student Tracking	802	46,63
Automated Testing and Scoring	751	43,66
Online Grading Tools	743	43,20
Internal Email	741	43,08
Group Work	740	43,02
Real-time Chat	730	42,44
Self-assessment	712	41,40
Course Templates	692	40,23
Authentication	687	39,94
Instructional Design Tools	670	38,95
Calendar/Progress Review	651	37,85
Customized Look and Feel	648	37,67

Of course, in order to make comparison, one must be familiar enough with selected LMSs to be able to evaluate features of their tools. We made such an evaluation for all LMSs we compare and the result is in Table 3, which contains grades for all LMS-tool pairs under consideration. The grade of LMS for each particular tool is the number of features the tool provides. Each tool has many features, but we have limited our research to nine most useful and commonly required ones. Thus, for all LMSs in analysis, we have counted the number of implemented features for each tool and the total is LMS grade for the corresponding tool. For example, if LMS provides 6 of 9 required features in

Discussion Forum tool, its grade for Discussion Forum is 6. The final comparison is based on relative grades, that is, on the ratio of number of implemented features and nine (in Discussion Forum

example, relative grade would be 6/9). Of course, in actual calculations it is not necessary to calculate relative grade for every LMS-tool pair.

Table 3: Grades of compared LMSs for each tool used in analysis. The LMS grade for particular tool is the number of features of particular tool that are implemented in LMS under consideration.

Tool	LMS									
	ANGEL 6.2	Blackboard Academic Suite	Claroline 1.4	eCollege AU+	Jenzabar Internet Campus Solution 1.03	Learnwise	Moodle 1.5.2	Sakai 2.0	The Learning Manager Enterprise Edition	WebCT Vista 3.0
Authentication	9	8	3	1	0	6	5	4	2	7
Automated Testing and Scoring	7	9	1	5	0	2	6	4	3	8
Calendar/Progress Review	9	5	0	7	1	4	3	8	2	6
Course Management	8	5	0	7	3	0	2	1	6	9
Course Templates	7	8	1	4	0	5	6	2	3	9
Customized Look and Feel	9	8	0	4	2	1	6	6	6	6
Discussion Forums	9	7	0	5	3	2	6	4	1	8
File Exchange	8	9	1	7	4	3	2	6	0	5
Groupwork	9	6	0	8	2	1	5	4	3	7
Instructional Design Tools	9	8	0	6	1	0	7	4	1	5
Internal Email	7	2	1	6	4	8	0	5	3	9
Online Grading Tools	7	9	0	5	2	1	6	4	3	8
Real-time Chat	9	7	2	6	1	3	5	4	0	8
Self-assessment	9	7	2	6	1	0	4	5	3	8
Student Tracking	9	3	1	6	2	1	7	0	5	8

Since there is at least one LMS that implements all considered features (grade 9) for each tool, it is sufficient to sum all weighted grades for each LMS and, at the end, to divide this sum with maximal possible weighted sum, which is (sum of frequencies in Table 2) · 9 = 101943. Such comparison yields results that we discuss in the next section.

4.1   Comparison results
Before analysis, once again we have to emphasize that in this research we used only those tools that were most frequently desired by *EduTools* users during comparisons. In addition, this research did not take into account features like importing third party content, SCORM/AICC compliance, database requirements and management, support for different platforms, ease of exporting and importing to/from another system etc.

Having these constraints on mind, let us analyse the obtained results. Calculations explained

in the previous section yield Table 4, which is graphically presented in Figure 1.

Table 4: Total scores of compared LMSs.

LMS	Score %
ANGEL 6.2	92,6
Blackboard Academic Suite	74,5
Claroline 1.4	8,6
eCollege AU+	61,9
Jenzabar Internet Campus Solution 1.03	20,3
Learnwise	26,8
Moodle 1.5.2	51,7
Sakai 2.0	44,2
The Learning Manager Enterprise Edition	30,1
WebCT Vista 3.0	82,8

Table 4 and Figure 1 show total scores for all compared LMSs and we see that Angel 6.2 turned out to be the best among selected LMSs. Looking at the grades in Table 3 for the three best-ranked LMSs,

we see that Angel wins with Discussion Forum tool, and it is the second best with Course Management and File Exchange. WebCT is follows with the best Course Management, second best Discussion Forum and fifth result for File Exchange. Blackboard wins with File Exchange, holds third position with Discussion Forum and it has 5 points for Course Management. It is easy to verify that scores would not significantly change even if all tool weights were equal. Thus, Angel is absolute winner. The probable key of Angel's success is its dedication to the users. Angel is typical commercial LMS focused on accessible environment with well developed set of few most wanted features, which makes it user-friendly system capable to respond to all common requirements. There are, of course, certain weaknesses, but they do not appear to be crucial. For example, if we consider supported platforms, Angel supports only Windows platforms, while Blackboard and WebCT offer support for Windows and Unix based servers and databases. In addition, server software for administration of the LMS server and optional extra applications are much more versatile in Blackboard and WebCT. While these features are an advantage in large systems with hard requirements, ordinary users obviously do not care about them very much.
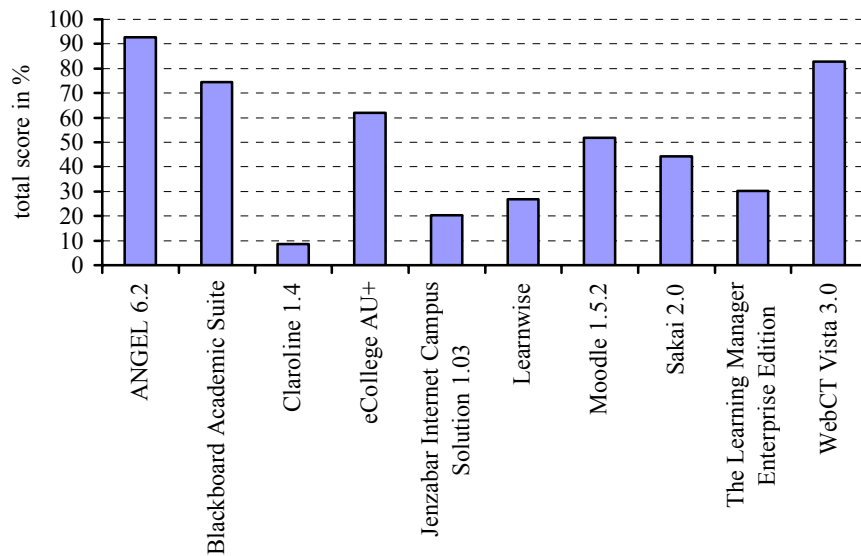

Figure 1: Total scores of compared LMSs (graphical presentation of data in Table 4).

Ranking LMSs (sorting by score) along with specifying their types (see Table 5) reveals another important fact.

Table 5: Ranks of compared LMSs.

Rank	LMS	Type
1	ANGEL 6.2	standard/proprietary
2	WebCT Vista 3.	standard/proprietary
3	Blackboard Academic Suite	standard/proprietary
4	eCollege AU+	proprietary/standard
5	Moodle 1.5.	open
6	Sakai 2.0	open
7	Learnwise	proprietary/standard
8	Learning Manager Enterprise Edition	proprietary/standard
9	Jenzabar Internet Campus Solution 1.03	proprietary
10	Claroline 1.4	open

Namely, we immediately notice that three best-ranked LMSs are exactly the three "standard/proprietary" ones. Conclusion is clear; the more LMS follows the standards, the better rank it achieves. This testifies that standards faithfully reflect users' requirements and that even established companies should accept standards as firm directives for future LMS development if they wish to retain their position on the market.

5 Conclusion

The analysis presented in this paper shows that "standard/proprietary" systems lead e-Learning market at present, and will lead it in the near future as well. This is expected result, but potential investors in LMSs should be careful about the level of conformity of particular LMS with standards.

Many manufacturers claim that their products do respect standards, predominantly SCORM, but there are three levels of conformity:

1. *Compliance* – the lowest level

It is completely in competence of the manufacturer to test its products against the standards. There is no independent control and in the case of incorrect claims, manufacturer can suffer consequences only because of degraded public reputation.

2. *Conformity* – the moderate level

Manufacturer tests its products with authorized tools, but there is still no independent control.

3. *Certification* – the highest level

Testing of conformity is performed by an independent authorized institution.

Almost all manufacturers gladly advertise conformity of their products with standards, but most of them can assert only the first of these levels. Still, things change and yet more manufacturers do notable efforts to achieve complete conformity with standards.

Concerning systems currently on the market, we have already concluded that Angel 6.2 is at present probably the leader. However, software business is extraordinary dynamic activity and situation changes almost monthly. Greatest recent change is that Blackboard overtook WebCT and in that way gained the biggest advantage in e-Learning market so far. Therefore, experts predict rise of the prices of Blackboard's LMS [5]. Other interesting news are that rSmart (rSmart Group supports open source software in education [6]) and IBM offered cooperation on Sakai 2.0 [4] project. This is an open source project with its origins at the University of Michigan and Indiana University, which independently made efforts to replicate and enhance functionality of their existing CMSs. Soon after, MIT and Stanford joined Sakai [7].

On the other hand, Moodle has quite strong community of users, which qualifies it higher than Sakai 2.0. Furthermore, Moodle is still being intensively developed and many universities find it to be an excellent replacement for expensive standard-proprietary based products, like the one offered by Blackboard.

It is clear that open source projects, especially those supported by large corporations and well developed communities of users, will be serious competitors to proprietary standard-based e-Learning systems. This is the old rivalry between ex-proprietary and open source communities, which will certainly continue.

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