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An Evaluation of Open Source Learning Management System Software in e-Learning

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Abstract: The use of e-learning is increasing in the educational sector. New tools and technologies are being introduced to blend the technology within educational boundaries. The most important tools used to implement e-learning is the Learning Management System. There are large number of LMS available which are being used by the universities, colleges and schools. The selection of LMS is critical for the success of any e-learning system. This paper compares seven open source LMS i.e. Moodle, ATutor, Chamilo, Claroline, Efront, Docebo and Dokeos. The comparison is made on the basis of technical parameters and the communication tools. It has been made through practical installation and literature review. The results show that all the LMS are cross platform and based on PHP technology. All of the them have My Sql as the backend database. MOODLE and Atutor have additional support for Microsoft and Oracle. Both of them also provide the maximum communication sub tools. The specifications of e-learning standards were found to be more diversely described in different LMS. The comparison will help the administrators and educators to set a criterion according to their needs and adopt LMS which is suitable for their requirements.

Keywords: LMS, Open Source, E-learning, Communication Tools, Online Interaction

1. INTRODUCTION

The evolution in Information and Communication Technology has revolutionized the teaching and learning environment (Makokha 2017). ICT has augmented the availability and accessibility by revamping the services with the usage of online delivery of courses (Tan 2018). As a result the e-learning has come up with new tools and technologies to supplement the online activities for the learners of 21st century (Anshari 2017). It has the potential to support remote learners anywhere and anytime by using dynamic web-based applications (Yılmaz 2012). One of the important dynamic web based tool of e-learning is the Learning Management System (LMS) software.

LMS is an application program that is used to store, deliver and manage e-learning activities. The activities are governed by digital contents, student support services and communication between the students and the teachers (Ulker 2016). It facilitates the students to download the contents and participate in course discussions through synchronous and asynchronous mode. The teachers use LMS to upload the contents and schedule synchronous and asynchronous discussions. Majority of the LMSs are web-enabled and facilitate "*anytime*", "*anywhere*" e-learning" (Khalkhali 2014). Such LMSs have diversified functionalities and features in their different versions that are available in the market. These diversified systems belong to two broad classes of LMS: Open Source and Proprietary (Pankaja 2013).

Open source LMS enables the users' freedom to download and configure it without any cost. The users can modify the source code and can also redistribute its copies to an individual or a group of clients (Cavus 2014). These LMS are customizable which can be configured according to localized setting and parameters to suit the needs of learners in a specified domain (Aydin 2010).The proprietary LMS have failed to achieve user satisfaction due to high purchasing and maintenance cost and as a result open source LMSs are evolving. However, there are large number of open source LMS, available in the e-learning industry. It is difficult to evaluate and analyze the features due to large number of functionalities available (Elabnody 2015).The objective of this paper is to present a criteria for the comparison of technical features of open source LMS.

2. Learning Management System

Generally, the e-learning system consists of a set of tasks that range from content development; its presentation and distribution to a group of learners through online collaboration. LMS provide a platform where these components are configured and integrated using certain tools available under the umbrella of one software application (Dobre 2015). It also manages the student records and course registration modules which enables the organizations and companies to offer their courses online. There are three important stakeholders of the LMS i.e. student, teacher and administrator

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(**Fig. 1**) who uses category based features according to their roles and privileges **(Table-1)**. Students download the digital contents and submit the assignments by using student involvement tools. They also participate in online discussions by using communication tools (Zaitseva 2013). Teachers prepare and upload the contents by using teacher involvement tools. (Ryann 2009). They use collaborative tools to interact with the learners. They also conduct quizzes and assignments using the assessment tools. Administrator is the technical person who manages the e-learning system, user accounts & their roles, associated courses and event scheduling within the LMS. The whole LMS is organized by the administrator (Min 2012). With the

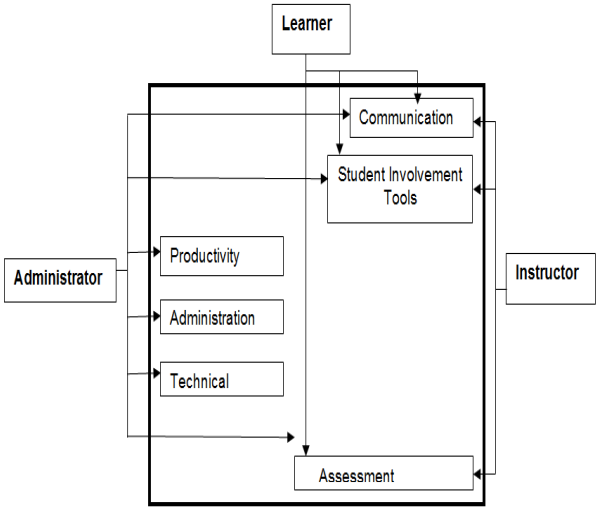

Fig. 1 Functional view of LMS

Table-1 Category based Features of LMS

No.	Categories	Description/Sub Modules
1.	Communication	Discussion Forum, File Exchange, Email, Online Journal, Chat and Whiteboard
2.	Student Involvement Tools	Group assignments, Social Networking, Student Profiles
3.	Productivity	Search, Help Module, Calendar
4.	Administration	Course Design, Development and Integration of Course Modules, User Roles, Hosting
5.	Technical Aspects	Usability, E-learning Standards, Security, Scalability, System Configuration
6.	Assessment	Quizzes and Assignments
7.	Database	Storage of Students' Profiles, Student Tracking,

passage of time more LMS were introduced with new and innovative features and this competition led towards LMS industry (Dahlstrom 2014). The present LMS industry has a size of over $ 3 billion with hundreds of platforms available as open source and proprietary. Due to large number of LMS available in the e-learning industry (Bakhouyi 2016) it is important to have a criterion that can help users to make decision while selecting LMs for online use. It is important to make a right selection especially from the open source where LMS is free of cost and allows customization as per institutional needs (Berking 2016).

3. MATERIALS AND METHODS

The vendors are developing and upgrading their LMS with standard set of features. They are also adding new and advance features to attract the stakeholders. Therefore, the selection of right LMS for an institution is a challenging task. It requires information about important features, modules, software and hardware requirements. The purpose of this research is to provide a method to compare the features of LMS. The research can help the academia and corporate organizations to establish criteria for the selection of LMS for their organization. By using the exploratory research method the 30 LMS were explored and 08 popular one were selected for further comparison. The comparison was made on two important criterions: technical features using the criteria of (Hussain 2011) and communication tools following the research of Al-Ajlan (2012) and Cavus (2014). Further research was done by exploring the websites of 08 open source LMS: Moodle, ATutor, Chamilo, Claroline, Efront, Docebo, and Dokeos. We also installed the LMS and compared the important communication tools. Data was collected from the individual websites and by exploring the communication tools of the installed LMS.

4. RESULTS

The Clarolineis the oldest among the chosen LMS (Claroline 2017). Since 2000 the development team of Claroline is working on stability of source code and operational features (**Table-2**). The Moodle and ATutor were released in the year 2002. Both Moodle and ATutor were developed as a result of research studies in the learning technologies (Moodle 2017, ATutor 2017). Dokeos was released in 2004 (Dokeos 2017) followed by Docebe 2005 (Docebo 2017) and Efront 2007 (Efront2017). Chamilo is the latest LMS (Chamilo 2017) among the chosen list that was launched in the year 2010. All the listed LMS are based on Open Source technologies like Apache Web server, My Sol. Database and PHP Server Side Scripting. There is additional support for Oracle in Moodle, ATutor and Claoroline. The cross platform is also compliance for most versions of Windows, Linus and Macintosh in all the listed LMS. The compatibility with e-learning standards is also present as all the listed LMS are conformed to Shareable Content Reference Model (SCORM) which allows developers to create reusable content that can be exchanged between different e-learning systems. All the seven LMS are available under General Public License (GPL).

Table-2 Technical Features of LMS

LMS	Release Date	Technology	Database Support	Operating System Support	Standard Specification	License
Moodle	2002	PHP	MY SQL, Oracle, Microsoft SQL, Post Gre SQL	Cross Plat-form	AICC, SCORM, IMS	GNU, GPL
ATutor	2002	PHP	My SQL, Oracle, Microsoft SQL, Post Gre SQL	Cross Plat-form	AICC, SCORM, IMS	GNU, GPL
Chamilo	2010	PHP	My SQL	Cross Plat-form	SCORM, QTI	GNU, GPL
Claroline	2000	PHP	My SQL	Cross Plat-form	SCORM, IMS, QTI	GNU, GPL
Efront	2007	PHP	My SQL	Cross Plat-form	IMS, SCORM	CPAL
Docebo	2005	PHP	My SQL	Cross Plat-form	AICC, SCORM, TIN CAN	GPL
Dokeos	2004	PHP	My SQL	Cross Plat-form	IMS, SCORM, TIN CAN	GPL

The communication tools provide a platform of interaction between teachers and students. It is an essential part of LMS which should provide different ways and means for peer to peer and group level communications. Keeping in view the importance of online communication the comparison of communication tools of the selected LMS is evaluated **(Table-3)**. The discussion forum is available in all the listed LMS. It allows students and teachers to send and receive discussion threads. File exchange is available in five LMS except Claroline and Dekos in the mentioned versions. Internal email feature is provided by Moodle, ATutor and Chamilo. Internal messages are available in all the listed LMS. Finally the online chat and whiteboard is also provided by all LMS except the Claroline.

Table-3 Comparisons of Communication Tools

Sr. No.	Features	Moodle 3.2.2	ATutor 2.2.2	Chamilo 1.11.2	Claroline 1.11.10	Efront 3.6.15	Docebo 4.0.5	Dokeos 2.1.1
1	Discussion Forums	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	File Exchange	Yes	Yes	Yes	No	Yes	Yes	No
3	Internal Email	Yes	Yes	Yes	No	No	No	No
4	Internal Messages	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	Online Journal & Notes	Yes	Yes	No	Yes	Yes	Yes	Yes
6	Online Chat	Yes	Yes	Yes	Yes	No	Yes	Yes
7	Whiteboard	Yes	Yes	Yes	No	Yes	Yes	Yes

5. DISCUSSION

The released dates of above-mentioned LMS vary from 2000 to 2010. All were found cross platform, based on PHP technology with MySQL as backend database. The reason for the use of PHP may be due to its flexibility of using with different operating systems. This technology is also supported by different web servers and can be integrated with heterogenous databases. That is why MOODLE and ATutor were found with additional integration support for Microsoft and Oracle databases. While examining the standards, it was found that MOODLE and ATutorare in compliance with AICC, SCORM and IMS. Efront mentioned IMS and SCORM specifications. These are international e-learning standards that deal with organization and architecture of e-learning courses and digital contents inside the LMS. QTI was specified in Chamilo and Claroline which deals with Question and Test Interoperability of assessment objects. TIN CAN was itemized in Docebo and Dokeos which provide additional support for learning analytics. The analysis of communication tools shows that MOODLE and ATutor have maximum sub communication tools available in their respective versions. All the communication tools are not always desirable in different electronic learning scenarios. However, the availability of maximum sub tools gives us an opportunity to customize the desired application module. Therefore, the selection of right LMS for right stakeholders can be made keeping in view the most available features as mentioned in table2 and table 3. The confirmation of most desired features provides a comprehensive base for further evaluation and final selection.

6. CONCLUSION

The adoption of emerging tools is the need of today's modern era. The use of e-learning is penetrating in the information industry and the LMS is the most important system of e-learning. LMS provides a variety of tools for the delivery of online courses. Due to large

number of LMS available in the market it has become necessary to evaluate and compare important feature.

This paper provides a comparative study of seven open source LMS software. The comparison was made on technical parameters and communication tools. The evaluation gives a way out to select an open source LMS. It can help policy makers while promoting and adopting new tools and technologies. The future work will deal with more detailed analysis of individual features. The higher versions of respective LMS may also be analyzed with the technical and communication subcategories. The mobile learning features in purview of next generation e-learning may also be looked into.

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