**Evaluation**

Like many other software applications and tools, the Learning Management Systems (LMS) are appearing in two streams: Proprietary and Open-source. The proprietary applications are usually priced and run on the cloud server of the proprietor. The right to modify the features and functionalities of such applications rests with the proprietor. The open-source applications on the other hand are freely available, modifiable and upgradable. Thus, they are significantly beneficial in terms of cost and functionality over the proprietary applications. Hence, many organizations are adopting open-source Learning Management Systems as their e-learning platforms.

As discussed already, the fundamental aim of the project was to develop an e-learning platform for the All-India Institute of Speech and Hearing using a suitable Open-Source Software Learning Management System (OSS-LMS) to conduct its long-term and short-term academic programmes in a blended manner. Hence, we had to

A survey of literature was conducted to find out the available OSS-LMS. The literature databases, PubMed, J-gate and ERIC as well as the leading commercial publishers’ websites Science Direct, SprinkerLink, Wiley Online were used for the literature search. Various combination of keywords such as ‘Opensource software AND E-learning’, ‘Opensource e-learning’, ‘Opensource software AND Learning Management System’, ‘OSS and E-learning’, ‘Integrated Learning Management System AND Opensource software’ were used for retrieving the relevant literature.

 There was mentioning of 12 OSS-LMS in the literature published in the last 10 years. These are: ATutor, Canvas, Claroline, Chamilo, Dot Learn, Forma, Ilias, Moodle, Open edX, Open eLMS, Open OLAT and Sakai.

A preliminary review of these 12 e-learning platforms, carried out by visiting their official websites is given below.

1. **ATutor**: ATutor is one of the oldest web-based open-source learning management systems. The focus of the ATutor LMS is ‘Accessibility for all’. It was initially developed by Greg Gay as his graduate school project at the end of 1990’s. Later, Adaptive Technology Resource Centre of the University of Toronto, Canada took over the project and developed ATutor as an adaptive and accessible learning management platform. The official release of the platform was at the end of 2002. Presently, the ATutor LMS is hosted on the SourceForge and maintained by Greg Gay, along with Cindy Qi Li and Harris Wong with the support of developer community. It is possible for the organizations to freely download and self-host the ATutor lms. The ATutor LMS supports all types of learning environments. It is governed by GNU General Public License.
2. **Canvas**: The Canvas, published by M/s Instructure from the year 2011, is one of the most leading LMS today. It is used in more than 4,000 institutions around the world as of 2020. The Canvas is published as open-source and paid versions. The paid version is available as a cloud-hosted solution by the Instructure. However, the paid version has extra features and functionalities which are not available in open-source version. In other words, open-source release of Canvas is not a replica of its paid version. The LMS is suitable for schools, higher education institutions and business organizations.
3. **Claroline**: Prof. Marcel Lebrun and Thomas De Praetere of the Catholic University of Louvain, Belgium initiated the Claroline project in late 1990s. Claroline stands for Classroom Online. The developers of the Claroline LMS consider it as the first real-time open-source LMS dedicated to the learning process rather than teaching process. Claroline was known for its ease of use when compared to its contemporaries like moodle, WebCT and Ilias LMS. However, from 2015, the versions of open-source based claroline are published for testing purpose only, not for production. Instead, a paid version called Claroline Connect started publishing. The Claroline Connect has additional featured and functionalities.
4. **Dot Learn**: The ‘Dot Learn’ written as ‘.LRN’ is an open-source e-learning solution supported by .LRN consortium, an international non-profit organization promoting open-source educational technology based on USA. It was originally developed at the The Dot Learn is developed on a software framework for building scalable, community-oriented web applications called Open Architecture Community System (OpenACS). It is suitable for deploying e-learning solution in schools, higher education institutions, non-profit and government organizations. However, the Dot Learn is not active since 2010 and many of the links on the official website of the solution are non-functional.
5. **Chamilo**: The Chamilo is a completely open-source LMS published by Chamilo Association, Spain. It was originated from another LMS called Dokeos in 2010 whereas the Dokeos was forked from the Claroline LMS project in 2004. Chamilo is a collaborative product of various organizations, establishments and individuals. The LMS is mainly used in Spanish-speaking countries. The latest version of Chamilo is 1.11.16 published in 2021. The Chamilo 2.0, which is currently under development, hopefully will bring more features and functionalities to the software.
6. **Forma**: Forma is a relatively new open-source learning management system released in 2012. The Forma lms is basically designed for corporate learning , but suitable for other learning environments also. It was originated from Docebo, another e-learning software freely released under a GPL V. 2.0 license. In 2011, Docebo decided to shift its operation from open-source to commercial mode. In consequence, the old Docebo users formed a new community and worked in collaboration with a group of partnering companies on the open-source code ‘abandoned’ by Docebo. They fixed the bugs, developed patches and added new features to the old, Docebo open-source software and created the Forma lms . The founders of Forma lms established a company to look after the software in 2017 known as Forma.association. Currently, Forma.association is responsible for maintaining, developing and promoting the lms. The latest version of the software is available for downloading only for the association members and contributors. The membership in Forma.association is payment-based. However, the previously released stable versions of the Forma lms are available for everyone to download.
7. **Ilias:** The Ilias lms started as an e-learning project at the University of Cologne, Germany in 1998. Since 2009, it is published as an open-source LMS under GPL by ILIAS Open-Source E-learning Society.It is very active online learning platform across the world, especially in european countries. The latest version of the ILIAS is 7.2 published in June 2021.The name ILIAS is an acronym for the German phrase, ‘Integriertes Lern-, Informations- und Arbeits kooperations System’ meaning ‘integrated learning, information and work-cooperation system’.
8. **Moodle:** Moodle is the world’s most famous open-source learning published since 2002.The word ‘Moodle’ stands for Modular Object-Oriented Dynamic Learning Environment.It is originally developed byMartin Dougiamas, a computer engineer from Australia. Currently Moodle is published by Moodle Pty Ltd, Australia headed by Martin Dougiamas. The latest version of Moodle is 3.11, published in 2021. Moodle is used by schools, colleges, universities and business organizations across the world. In addition to the completely open-source version, the Moodle is also available as a cloud-hosted solution by Moodle Pty. Also, there are professional moodle service providers certified by the Moodle functioning across the world to assist the installation and customization of the LMS on payment basis.
9. **Open edX**: The Open edX is an open-source learning software developed by the edX Incorporation, one of the popular MOOCs (Massive Open Online Courses) providers. edX is a non-profit organization jointly established by the Massachusetts Institute of Technology (MIT) and Harvard University, the two world famous universities in Cambridge, USA. The edX released Open edX in 2013 and it is supported by a huge community of users. The Open edX is completely free and organizations can download and install in their local servers and create own institutional learning management system.
10. **Open eLMS**: A UK based e-learning company by name eLearning WMB started the Open eLMS software in 2005. The company released the software under open-source model in late 2006 and made available as SourceForge project in 2007. However, from 2018, the company made the software as proprietary and it is available for schools, colleges, universities and business organizations on payment basis.
11. **Open OLAT**: Formerly known as OLAT which stands for Online Learning And Training. The Department of Computer Science, University of Zurich, Switzerland developed the OLAT learning management platform in 1999. In 2011, M/s frentix, GmbH, Zurich, Switzerland initiated an open-source project based on the version 7.1 of the OLAT and named it as OpenOLAT. It is available for free download as open-source under Apache license. Unlike many other open-source LMS, OpenOLAT has no developer community. However, it is available as a cloud-hosted learning platform with frentix on payment basis for schools, companies, universities and other institutions.
12. **Sakai:** Sakai is another well-known open-source LMS developed as a collaborative project by five US-based Universities, namely**,** Indiana University, University of California, [Massachusetts Institute of Technology](https://en.wikipedia.org/wiki/Massachusetts_Institute_of_Technology), [Stanford University](https://en.wikipedia.org/wiki/Stanford_University), and University of Michigan. The Sakai project was started in 2005 with an objective of developing a collaborative learning environment from the existing e-learning tools of each of the participating organizations. Currently, the project is managed by Apereo Foundation, USA, and there is a 16-member Sakai Management Committee for taking strategic decisions. The Sakai LMS is completely open-source which can be deployed locally. Also, there are ‘commercial affiliates’ providing fee-based support to install, customize and host the Sakai LMS. The leading commercial affiliates of the Sakai project are Learning Experiences, Michigan, USA, Entornos de Formación (EDF), Valencia, Spain, Unicon, Arizona, United States, and Longsight , Ohio, United States**. Sakai** is availablein two versions:

Of the 12 learning management systems, Claroline, Canvas, Dot Learn, Open eLMS and Forma were excluded from further study due to the following reasons:

1. The Claroline is not available as open-source version for production environment since 2015.
2. The Canvas lms released as open-source versions is not the exact replica of its fee-based cloud-hosted solution. The cloud-hosted platform provides extra features and functionalities.
3. The Dot Learn is not updating since 2010
4. The Open eLMS is no longer available as open-source lms.
5. The latest version of the Form lms is not available for free download. Also, it is developed keeping in mind the corporate training.

The remaining seven OSS-LMS were either installed locally or created free accounts on the demo sites for further evaluation and testing.

**Development of Evaluation Criteria**

We reviewed a number of previous studies on common OSS evaluation and LMS OSS evaluation. A compiled list of criteria used in these studies along with the software applications evaluated is given in table 1.

We found none of these evaluation criteria set as appropriate to adopt in our study. Hence, we developed our own set of evaluation criteria by re-grouping and re-naming already reported criteria.

Our criteria for evaluating the OSS LMS werebroadly categorized under two headings:

**Common OSS functionalities**

The ‘*Common OSS Functionalities*’ criterion was further divided into ‘*System Requirements*’, ‘*Software Age / Seniority*’ ‘*Release Frequency’, ‘License Type’* and ‘*Support’*.

***System Requirements****:* EachOSS is developed to work in a specific technical environment backed by a set of supporting applications and tools. Compatibility of the supporting applications is an important determinant of the smooth functioning OSS. OR Understanding the specific supporting software applications required for the smooth functioning of an OSS is crucial. The major supporting applications for the functioning of an OSS in web environment are Operating System, Programming Language, Database and Web Server Application. They are broadly mentioned under the criterion, ‘*System Requirements’*.

***Software Age / Seniority***: The successful existence of a software application over a period of time is referred by the terms ‘Age’ and ‘Seniority’. It is an important determinant in selecting an open-source software application.

**Software Release Frequency**: An open-source software releasing its updates and upgrades at regular intervals is considered as stable and reliable. In other words, increased frequency of release is an indication of improvement in its features and functionalities. Normally, there are two types of releases, major version and minor version. During major version change, the software gets updated with new features or key changes in the existing features whereas minor releases include mainly include fixing bugs and security issues.

***Support***: Technical support is a must for the smooth functioning of a software system, especially that is functioning in a network environment. Proprietors of commercial applications guarantee default support upon purchase of their products. However, the case is not so for an open-source software. We have to analyse the nature of support for an open-source software before its adoption. The level of support for an open-source application ranges from documentation to video tutorial and demo site. In addition, the presence of an active user community needs to be ensured.

 Table 2: CommonOSS Functionalities

|  |  |
| --- | --- |
| **Sl. No.** | **Main Criterion** |
| 1 | Software Age / Seniority  |
| 2 | Major Version Release Frequency |
| 3 | Minor Version Release Frequency |
| 4 | Support1. Active community
2. Demo site
3. Regional Service Providers
4. Updated User manuals
5. Video tutorial
 |

**OSS LMS Functionalities**

The *OSS LMS Functionalities* are further divided broadly into ‘*Teaching-Learning Functionalities*’ and ‘*LMS Management Functionalities*’.

**Teaching-Learning Functionalities***:* The important learning resources like audio, lessons, text, videos and web links, communication tools like chat, discussion forum, announcements, email and video conferencing support, and learning assessment tools like assignment, quiz, polls and surveys are included under ‘*Teaching-Learning Functionalities*’.

**LMS Management Functionalities**: The e-learning management tools and functionalities at administrator, teacher and learner levels such as Attendance, Bulk user enrolment, Calendar, Certificate, Course back up, Course creation, Gradebook, Learning activity statistics, Learning path, Personal profile creation, Self-enrolment, Student grouping, Study progress tracking, User role., are included under a common criterion named ‘LMS Management Functionalities’. The two important e-learning standards, SCORM and LTI are also included here.

 **Table 2: Teaching-Learning Functionalities**

|  |
| --- |
|  **Teaching-Learning Functionalities** |
| 1 | Audio  |
| 2 | Chat  |
| 3 | Dictionary/ Glossary  |
| 4 | External links |
| 5 | Files |
| 6 | Folder  |
| 7 | Forum  |
| 8 | Lesson  |
| 9 | Quiz  |
| 10 | Survey/Poll |
| 11 | Video |
| 12 | Videoconferencing (support)  |
| 13 | Wiki |
| **LMS Management Functionalities** |
| 1 | Attendance  |
| 2 | Bulk enrolment  |
| 3 | Calendar |
| 4 | Certificate  |
| 5 | Course back up |
| 6 | Course creation |
| 7 | Gradebook |
| 8 | Learning activity statistics |
| 9 | Learning path |
| 10 | LTI standard  |
| 11 | Personal profile creation |
| 12 | SCORM standard |
| 13 | Self-enrolment |
| 14 | Student grouping |
| 15 | Study progress tracking |
| 16 | User role |

**Development of Rating Scale**

A dichotomous scale with ‘1’ indicating the availability of a functionality, and ‘0’ indicating non-availability was used for checking each of the identified criterion, except ‘Software Age / Seniority’, ‘Major Version Release Frequency’, and ‘Minor Version Release Frequency’. For these features, a four-point scale as detailed in table 4 are used for evaluation.

Table 4: Four-point Evaluation Criteria

|  |  |  |  |
| --- | --- | --- | --- |
| Sl.No. | Criterion | Sub-criteria | Scale Point  |
| 1 | Software Age / Seniority | 1. Less than 5 years
 | 1 |
| 1. 5 to 10 years
 | 2 |
| 1. 10 to 15 years
 | 3 |
| 1. More than 15 years
 | 4 |
| 2 | Major Version Release Frequency | 1. Once in two years
 | 1 |
| 1. Between 1 and two years
 | 2 |
| 1. Between 1 year and six months
 | 3 |
| 1. Below six months
 | 4 |
| 3 | Minor Version Release Frequency | 1. Once in six months
 | 1 |
| 1. Between 3 and 6 months
 | 2 |
| 1. Between 1 and 3 months
 | 3 |
| 1. Below 1 month
 | 4 |

An evaluation matrix / grid/ checklist has been developed to evaluate the selected OSS LMS against the set of features and functionalities detailed in table 2 & 3.

The evaluation matrix with scores obtained for each of the lms is given in table 5.

**All those platforms often provide similar features and users can hardly choose the most appropriate for them.**

**Researchers proposes different approaches and criteria for evaluations of LMS platforms.**

**In most studied articles, scientists have proposed evaluation models for LMS platforms, but they have analysed with them only to 3 applications**

**The present study shows that there is a lot of e-learning software, and most of them have similar characteristics.** [[An Analysis of Some Learning Management Systems

Radoslava Kraleva#1, Mehrudin Sabani#2, Velin Kralev// International Journal on Advanced Science, Engineering and Information Technology,// Vol.9 (2019) No. 4]]

From our research of technical literature, we combined and classified a collection of criteria suitable for OSS-LMS evaluation. We also defined the meaning of each evaluation criterion. The criteria are categorized into several groups such as functionality, reliability, usability, efficiency, maintainability, and portability.

These minimum criteria cover three general usage requirements: an active community, a stable development status, and a good documentation of the platform.

The official websites of the above OSS LMS were visited and

They were further assessed by visiting the individual websites of these applications.

Only the OSS LMS which are available as 100% open-source have been selected so that we need not worry about it will be acquired and altered.

* A thorough and multi-faceted comparison and evaluation was conducted
* Combined criteria from several evaluation studies ( )
* Software have been evaluated by being members of websites, using demo programs and in accordance to the features of given at the internet website
* Some of the studies reported the evaluation carried out by the end-users themselves based on . In some of the studies, the end-users themselves carried out the comparison based on their experience of two (in most cases) or more LMSs. (e.g. A Comparison of Two Online Learning Systems//Mark Nichols**)**

and their functional features, modules, standards, hardware and software requirements

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The selection and adoption of a CMS by a teaching institution or a corporate training system follows the analysis of some basic parameters, usually including technical features (e.g., program-ming language used or required hardware infrastructure, etc.), available functions (e.g., discus-sion forums, integrated streaming services, etc.), supported formats (e.g., HTML, PDF, different video encoding, etc.) and learning technology standards compliance (e.g., SCORM). Such analy-ses are mostly system-oriented, i.e., measure a definite set of features independent from the users, and only a very limited number of comparative studies on CMS actually consider other parame-ters including usability concerns (Inversini, Botturi, & Triacca, 2006; Nguyen, Chang, Chang, Jacob & Turk, 2008).

[[[**Evaluating and Comparing the Usability of Web-based Course Management Systems**]]]

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The Open University (OU) is Europe’s largest higher education provider one of a handful of mega-universities across the world. In 2004, planning began for the development and roll-out of an integrated LMS across the university. The project framework rates open source software according to seven weighted criteria, Functionality: 25%, Usability 20%, Documentation 15%, Community 12%, Security 10% Support 10%, Adoption 8%. In 2005 the OU selected Moodle as the basis for its LMS, which enabled the Open University to develop an effective online learning platform for its 180,000 distance learners (Sclater, 2008) [[[Sclater, N., 2008. Large-Scale Open Source E-Learning Systems at the Open University UK., Center for Applied Research. Research Bulletin. Volume 2008, Issue 12. 2008. <http://www.educause.edu/ecar>]]]

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Evaluating aspects

• Technical flexibility: Hardware and software requirements, Support, Cost/License, Authentication • Learning tools: Forums, Materials, Messenger, Chat, Exercises, Group work, Student tracking. • Usability: Technical knowledge/installation, Course templates, Standards, Languages.

[[[Research on open source e-learning tools and agricultural applications R. Szilágyi, P. Lengyel and M. Herdon]]]

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**Nichols reported the comparison of ‘iQualify’ and inhouse developed LMs with Moodle by students of** Open Polytechnic, the largest distance learning provider in New Zealand, **based on the following criteria:** **Usability, Accessibility, Instructions for use, Navigational facilities and content.**

**[[A Comparison of Two Online Learning Systems/Mark Nichols//***Journal of Open, Flexible and Distance Learning]]]*

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**Özdamlı** evaluate eight, most demanded software, were chosen: Atutor, Bazaar, Bodington, Claroline, Coursemanager, ILIAS, Moodle and Sakai current existing Open Source Learning Management Systems based on their Administration tool and Curriculum Design features, namely, Authentication, Course Authorization, Hosted Services, Registration Integration, Course Management, Instructor Helpdesk, Student Tracking, Course Templates, and Customized Look. Evaluation scale was derived from edutools.org web site and with the approval of experts.

[[**An Evaluation of Open Source Learning Management Systems According to Administration Tools and Curriculum Design //** Ozdamli, Fezile]]

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In another paper based on same research reported by Ozdamli **, Uzunboylu reported the evaluation of the same eight software applications** based on their features of the Communication Tools, Productivity Tools, Student Involvement Tools.

[[ **An Evaluation of Open Source Learning Management Systems According to Learners Tools]]**

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In an effort to select a suitable LMS for Athabasca University, the Open University of Canada, Stewart and others evaluated three software, WebCt, LotusNotes. And Moodie. The evaluation was based on a set of weighted criteria representing the needs of the University such as the university's mandate as an open distance learning institution, system administration, costs, features of instructional design

and the availability of teaching-learning tools.

[[**Choosing MOODLE: An Evaluation of Learning Management Systems at Athabasca University**]]

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Momani compared two LMS, Moodle and Blackboard, based on fifty two comprehensive features classified to six main factors, namely, Pedagogical Factor, Learner Environment, Instructor Tools, Course and Curriculum Design, Administrator Tools, and Technical Specification.

 [[[**Comparison between two Learning Management Systems: Moodle and blackboard]]]**

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*Lengyel, Herdon,& Szilágyi* evaluated Moodle and ATutor LMS based on their functional features, modules, standards, hardware and software requirements.

**[[Comparison of Moodle and ATutor LMSs]]**

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Rafi, Samsudin & Hanafi compared the perceived benefits, use and learner satisfaction of OSS LMS and proprietary LMS by conducting a survey among undergraduates from two groups of undergraduate students in two Malaysian universities. Of the two groups, one was using only the OSS LMS and other group, proprietary LMS. The study found that the perceived benefits, use and learner satisfaction were significantly higher among the group of undergraduates using OSS LMS.

[[[**Differences in Perceived Benefit, Use, and Learner Satisfaction between Open Source LMS and Proprietary LMS]]]**

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Unal and Unal presented a comparison of Moodle and Blackboard LMSs based on students’s experience. The participating students compared the two LMS based on course format / layout, *Announcements / News, Lessons / Course Documents, Discussion Board,* Assignment Modules, Collaboration and Communication Tools, *Gradebook,*

[[ **Evaluating and Comparing the Usability of Web-based Course Management Systems]]**

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Awang & Darus conducted a case study evaluation of Claroline, the Open Source LMS. Evaluate “Routing Protocols and Concepts” course using Open Source LMS at the Faculty of Computer and Mathematical Sciences (FSKM). The “Routing Protocols and Concepts” is a course offered for semester four (4) Bachelor of Science (Hons) (Data Communication & Networking) students at FSKM. focus on the implementation of this online course based on the Open Source LMS, with Claroline as our case study **[[[Evaluation of An Open Source Learning Management System: Claroline]]]**

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Valencia, Enríquez and Tigreros evaluated the effectiveness of three virtual learning spaces, Moodle, Blackboard and Jimdo based on four broad criteria: technical design and materials, instruction design, tutorial action and virtual class. The applications were deployed in three universities.

**[[[Innovative Scenarios in the Teaching and Learning Process: A View From the Implementation of Virtual Platforms]]**

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 Ülkerand *Yılmaz compared the OSS LMS with commercial LMS based on* *F*ee, Technical support , Hardware and Scalability , Development , Security and Integration

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Konstantinidis and others set organizational / departmental requirements for selecting an LMS as easy access for instructors and students, motivation of the instructors to adopt the new LMS, support of communication (peer / student - instructor), increase of student attendance and participation, integration of additional systems, and adoption of a single system solution. This single system would focus mainly on the ease of use. This would include simple maintenance, control, and usability (i.e., one account per user).

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* Following up with a detailed comparison of potential LMS would be ideal to various internationally popular LMS including Edmodo, Google Apps for Education, MOOC, Moodle, OLAT, and Sakai.These popular software offer easy access to demonstration and provide details of tool functionality.
* The instrument used in the study of Chua and Montalbo (2014) was slightly modified by the authors to fit with the characteristics of the respondents of the study. Specifically, the items regarding the profile of the respondents and a non-mandatory portion for comments and suggestions regarding the VC were added in the questionnaire.

CMSs consist of software packages that allow educators to construct online learning sites for uploading content materials, facilitating student-student/student-tutor communication via discussion forums, e-mail, and chat functions, setting up online quizzes and questionnaires, and managing multiple student groups. These features can help educators to organize their course materials, efficiently distribute learning materials, and introduce creative methods of teaching. CMSs can also be used to implement ongoing course evaluation (2), facilitate collaborative learning (1), and enhance student learning (19). A good CMS platform should be easy to use, readily available, stable, flexible, and able to be integrated with other platforms (15)

The major players in

Moodle is stable and well-supported, with extensive user and developer groups. The Moodle open source developer community is actively developing new modules and utilities, and the program, and regular improvements can be expected. Similarly, educators using Moodle frequently share their creative uses for the program in online forums.

Canvas, unlike many projects hosted by GitHub, is commercially dual-licensed. We license Canvas via the AGPLv3 to the open source community, but we also offer Canvas via a subscription to many of our clients. For this to work, Instructure needs to retain copyright over the Canvas project.

Canvas runs on the exact same code as we release to GitHub, and as of this writing the code that we deploy to our production environment is pushed the same day to GitHub. The plugins and extensions that we don't open source right now include:New Quizzes, MasteryPaths, Plagiarism Platform, Proprietary SIS integrations, Migration tools for commercial LMSs, Chat tool, SCORM import tool, Catalog, Canvas Data,DocViewer, New Analytics, QR Login Code generation, Other minor customizations that only apply to a hosted environment

Uribe-Tirado A, Melgar-Estrada LM, Bornacelly-Castro JA. Moodle learning management system as a tool for information, documentation, and knowledge management by research groups. Prof Inform 16: 468 – 474, 2007. 36.

Wheeler B. The open source parade. EDUCAUSE Rev 39: 68 – 69, 2004.