**EVALUATION CRITERIA OF THE LMS**

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|  | **Study**  | **LMS** **evaluated** | **Main & Sub Criteria**  | **Remarks** |
| **1** | **Open Source LMS Comparison: Moodle vs OpenEdX vs Canvas LMS/** Michał Macura | MoodleOpenEdxCanvas | * **Deployment type**: Cloud hosted Vs Self-hosted
* **CMS & branding** (i.e. Content management & branding the LMS as per the requirement of an organization)
* **Integrations** ( Not all LMS comes with everything right out of the box so to speak. There should be the ability to increase the power of your open-source learning management system even further through a range of LMS integrations that can make designing and delivering e-learning even easier and more fun)
* **Learning modes**: Adaptive learning, Social learning, Blended/Hybrid learning (Different institutions, classes or even teachers have varying methods of teaching and a one size fits all solution to learning doesn't work for everyone. This is where learning modes such as Adaptive learning, Social learning, Blended/Hybrid learning come into play)
* **Ecommerce** (One of the key features of any LMS is the ability to monetize its content and courses. So a decent learning management system should include the ability to generate revenue)
* **mLearning** (Not all students will be able to access courses from a pc but would still wish to learn even in transit or on the go. This is where mLearning comes into play, allowing for access on mobile devices and smartphones.
* **Learning Paths** (The ability to dictate a strategic pathway in which content is systematically disseminated gives the students a simple progression by which to pick up content relating to the overall goals)
* **Certificates** (Once a course is complete or at certain defined stages, the LMS should have the ability to give out certification of completion as a reward to the student)
* **Gamification/ Simulations technologies** (One of the key ways to increase engagement and promote completion of various tasks and activities is by adding gamification such as puzzles or quizzes to the course study. Teachers can even go one step further by integrating simulations to express certain ideas and scenarios to improve comprehension)
* **Assessment and Testing technologies** (Both the ability to progress to the next stage of a course or to graduate from a course depends on the comprehension of the subject matter. Hence a good LMS should include the ability to carry out assessments and test as needed)
* **Audio/Video Conferencing tools** (Distance learning is usually impersonal and "distant" but with the inclusion of conferencing tools into an LMS you take the learning experience to another level by allowing one-on-one or one-on-many video class sessions)
* **Learning outcomes technologies/ Grading functionality** (At the end of every learning experience, there is usually a Grade to determine how a student has performed or the degree to which they comprehend the subject matter. Having a grading system gives a direct visual representation of this)
* **Social & collaboration technologies/ chat tools** (A learning environment is always made better when the students are able to have social interactions with the instructor either on an individual basis or in a group setting and one of the ways of achieving this is through instant chat or messaging services within the LMS)
* **Functionality Customization**
* **Ease of Use**
* **Community Support**
* **Content Authoring tools**
* **Multilingual**
* **Offline learning**
* **Custom user interface**
* **SCORM Compliance**
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| **2** | **Comparing and Evaluating Open Source E-learning Platforms// Fakhreldeen Abbas Saeed// International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-3, Issue-3, July 2013** |  **Moodle 1.9,** **Claroline 1.8.1,** **Mambo 4.6.1,** **Atutor 1.5.4,** **+CMS 2.0.0** **Dokeos 1.6.4** Openacs 5.1.2 **Drupal 5.3** **Ilias 3.8.3** **Lon-capa 2.5.2** **My source matrix** 3.14.0  **Olat 5.2** **Plone 3.0** **Sakai 2.3** **Anaxagora**  | **Security:** Audit Trail, Email Verification, Granular Privileges, Login History, Some Authentication Problem Notification, Sandbox, Session Command Management, Versioning, Advanced Caching**Performances:** Database Replication, Load Balancing, Page Caching, Static Content Export**Support:** Code Skeleton, Manual/Supp/Training, Develop Community, Online Help, Pluggable Api, Public Forum Public Mailing List, Users Conference**Interoperability:** Content syndic.rss, Ftp support, Ical calendar, Wai compliant, Webdav support, Xhtml compliant, Instrstandard compliant**Flexibility:** Cgi-mode support, Content reuse, Extens.user profiles, Metadata support, Multi-lingual content Multi-site deployement**Easy of using:** Roxio™ drag&drop content, Email to discussion groups, Image resizing, Macro language, Mass upload, Server page lang, Site setup wizard, Spell checker, Style wizard, Subscriptions, Template language, Ui throttling, Undo, Wysiwyg editor, Zip archives**Management:** Advertising manag, Asset management, Clipboard button located at Content scheduling, Inline administration, Online administration, Package deployment, Themes (skins), Trash, Web statistics, Webstyle/template**Communication tools:** Blog, Chat, Discussion groups (forum ), Mail form , Mypage (dashboard), File distribution Groupware**Administration tools:** Contact management, Data entry, Database reports, Helpdesk organizes bug report, Http proxy, Guest book, In/out board**Course delivery tools:** Document management, Events, Events management, Faq management, Newsletter , Product management, Project tracking, Search engine, Tests / quizzes, Time tracking, User contributions, Link management**Content development:** Graphs and charts, Job postings, Photo gallery, Search engine, Site map, Syndic.content rss |  |
| **3** | **Learning Management System User Requirements for the National Nuclear Security Administration's International Nuclear Safeguards Engagement Program// C. Carroll/2021** |  | **Communication Tools**: White Board, Stream Video, Discussion Forums, Social / Experiential Learning – Communities, File Exchange, Communication Support**Administration Tools:** Authentication, Course Authorization, Registration Integration, Student ProfilesReport Generation**Curriculum Design:** Course Templates, Course categories and subcategories, Ability to allow students to pick courses from a course catalog, Ability to allow students to rate courses, Curriculum Management, Customization of Look-and-Feel, Instructional Design/Content Development Tools, Automated Testing and Scoring, Content Sharing and Reuse**Course Delivery Tools:** Course Management, Instructor Support, Online Grading Tools, Student Tracking, Archives**Student Involvement:** Group Work, Student Community Building, Self-assessment, Student PortfoliosAbility to share ePortfolio outside of the LMS **Productivity Tools:** Bookmarks, Searching Within a Course, Calendar/Progress Review, Ability to Work Offline and then Synchronize, Orientation/Help, **Pricing/Licensing:**License Structure, Payment Methods, Free Trial Available**System:** Hosting Location, Server OS, Client Hosting, Software Support**Integration:** Content Standards, Embedded Support for Third Party Tools**Portal Organization and customization:** Ability to create independent sub-portals (branches)Ability to create groups of students, in order to assign common courses (groups), Ability to customize and brand your portal and sub-portal(s), Ability to add your own login domain, Ability to create automated events based on triggers, Ability to customize automated notifications based on triggers Ability to configure user permissions**Security:**  Allow IP control and filtering?, Support double username access lockability?Support secure password management?, Support encryption and user password per authentication?Encrypt data during transmission?, Include an advanced antivirus check on all uploaded content?Is the system compliant with ISO 27001 Certification?, Is there a protocol for conducting penetration test assessments?**Logging and Security Response:**Log security events on networking, security device, or on server equipment?, Does the system's logging practices enable the identification of the IP Address of theremote system in the event of an attack?, Maintain all security logs? If yes, indicate retention period.Have documented and implemented security incident response procedures?, Have incident response processes in place to investigate potential security incidents in real-time? If no, specify time frame, Have processes in place to report security incidents to the customer? If yes, indicateTimeframe, Send logs to a centralized log collection server?, Monitor logs for security events and intrusion attempts in real time?, Perform an automated correlation of security logs between the various device types, Enable the identification of internal personnel (specific user) in the event of an internal attack?**Network/Service Architecture:**Deploy firewalls?,Deploy network Intrusion Prevention System (IPS) sensors? If yes, are all IPS sensors, updated within 24 hours of new signatures released?,Support the firewalls, IPS sensors, routers and switches on software and hardware, levels?, Patch all critical security issues on firewalls, IPS sensors, routers and switches within 1 month of release?, Encrypt data in transit on public or shared networks?**Secure Server:** Have antivirus software installed and running optimally in the server?, Have measures in place to protect data from exposure when the service is executed on shared servers?, Have measures in place to protect from performance degradation when the service is executed on shared servers?, Have policies in place to ensure the integrity of any software prior to installation?, Have its servers built off a general network or on an isolated network?,Have security patches installed prior to the server being put onto the general network?**Backups:** Are the servers backed up to external media (e.g. tape) on a daily basis or all data, replicated in near real-time to a secondary site?, Are backups tested regularly? If yes, please specify the frequency, If data is backed up to external media, how often are full backups performed?, If data is backed up to external media, are the backups encrypted?, If data is backed up to external media, are the backups stored offsite? | *The research team conducted a review on online resources to identify attributes that the team could use to describe LMSs.* |
| **4** | **A Comparison of Two Online Learning Systems****Mark Nichols//Journal of Open, Flexible and Distance Learning, 20(1)** | **iQualify****Moodle** | 1. Usability
2. Accessibility
3. Instructions for use
4. Navigational facilities
5. Content
 | **Mark Nichols compared** **Moodle with iQualify, an indigenously developed lms for Open Polytechnic, the a single-mode provider of distance education in New Zealand. The comparison was based on student outcomes, high-level course evaluations, and student perceptions of the two lms. The student experience was based on .**  |
| **5** | An Analysis of Some Learning Management SystemsRadoslava Kraleva#1, Mehrudin Sabani#2, Velin Kralev// International Journal on AdvancedScience, Engineering and Information Technology,// Vol.9 (2019) No. 4 | Adobe Captivate Prime , Atutor, BizLibrary , BlackBoard, Brightspace, Chamilo, Cornerstone OnDemand, Docebo, Edmodo, Edsby, Educadium, eFront, Instructure, iSpringLearn, Latitude Learning, LearnLinq, LearnUpon, Lessonly, Litmos, Mindflash, Moodle, NEO LMS, Open edX, Saba Software, Sakai, SAP SuccessFactors, Schoology, SkillSoft, SkyPrep, ProProfs, SumTotal, TalentLMS, Tortal Training LMS, Thinkific, WizIQ WorkWize  | **Learning Skills Tools***(* Creating activities and learning Tools): SCORM Compliant , Lectures as web pages, documents, presentations, video etc. , Examples and tasks, as web pages, documents, presentations, video etc. , Assignments and exercises as web pages, documents, quizzes , Gamification, Evaluation ,  **Communication Tools (**Allows interaction between lecturers and students) : Chat , Forums , Email messages ,  **Productivity Tools:** *(* The software functionalities provided by LMS systems) : Uploading/downloading various documents types , Add, edit, delete data for students , Analysis of students' achievements and outcomes, Multiplatform support , Security and protection of users’ data, Creating a data backup , Need for a system administrator that can manage allthe user roles in the LMS , Web-based technology of software development, Need for installation, Self-Registration | Kraleva, Sabani and Kralev developed a set of criteria for analysing the LMS platforms in terms of their software specifications and functionalities under three categories based on a survey of the state-of-art science research.  |
| **6** | An evaluation and selection problemsof OSS‑LMS packages//Belal Najeh Abdullateef, Nur Fazidah Elias, Hazura Mohamed, A. A. Zaidan2 and B. B. Zaidan//SpringerPlus (2016) 5:248 |  | **Functionality:** Course development, Activity tracking, Assessment**Reliability:** Error prone, Correctness, Backup and recovery**Usability***:* Error reporting, User interface, Learnability, User types, Efficiency, Satisfaction**Portability***:* Middleware standards, DBMS standards, Communication stds, OS compatibility**E‑learning standards***:* ADL-SCORM, IMS-QTI, IMS-LIP, AICC-CMI, **Learner’s communication**: Communication synchronous, Communication asynchronous**Security & privacy***:* Authentication, Authorization, Validation of input, Audit, data/ docu. encryption**Vendor***:* User manual, Tutorial, Troubleshooting guide, Training, Maintenance and upgrading, Communication | Abdullateef and others reviewed the OSS LMS evaluation criteria reported in the literature. They re-defined the criteria by combining and classifying them under eight groups: Functionality, Reliability, Usability, Portability, E‑learning standards, Security & privacy, **Learner’s communication** and Vendor.  |
| **7** | **An Evaluation of Open Source E-Learning Platforms Stressing****Adaptation Issues//**Sabine Graf & Beate List// Proceedings of the Fifth IEEE International Conference on Advanced Learning Technologies (ICALT’05)0-7695-2338-2/05 $20.00 © 2005 IEEE | ATutor 1.4.1, Dokeos 1.5.5, dotLRN 2.0.3, ,ILIAS 3.2.4, LON-CAPA 1.1.3, Moodle 1.4.1,OpenUSS 1.4, Sakai 1.0, and Spaghettilearning 1.1  | **Communication tools**: Forum, Chat, Mail/Messages, Announcements, Conferences, Collaboration, Synchronous & asynch. tools**Learning objects:** Tests, Learning material, Exercises, Other creatable Los, Importable LOs**Management of user data:** Tracking Statistics, Identification of online users, Personal user profile**Usability**: User-friendliness, Support, Documentation, Assistance**Adaptation:** Adaptability, Personalization, Extensibility, Adaptivity**Technical aspects:** Standards, System requirements, Security, Scalability**Administration:** User management, Authorization management, Installation of the platform**Course management:** Administration of courses, Assessment of tests, Organization of course objects | Graf & List conducted an evaluation of OSS LMS focussing on adaptive issues. There were 8 categories and several subcategories for evaluation.  |
| **8** |  An Evaluation of Open Source Learning Management Systems According to Learners Tools//  Hüseyin Uzunboylu, Ph.D\*, Fezile Özdamlı\*\* and Zehra Özçınar, PhD// |  | **Communication Tools**: Discussion forums, File Sharing, E-Mail, Chat**Productivity** **Tools**: Bookmarks, Help, **Student Involvement Tools**: Group work, Student Community Building, Student Portfolios | Uzunboylu, Özdamlı & Özçınar carried out a general evaluation of 72 OSS LMS. Eight, most demanding among them were further investigated based on features of communication tools, production tools, and student involvement tools available with the selected software.  |
| **9** | **An evaluation of open source learning management systems****According to administration tools and curriculum design//****Fezile Özdamlı** |  | **Administration Tools**: Authentication, Course Authorization, Hosted Services, Registration Integration, Course Management, Instructor Helpdesk, Student Tracking, **Curriculum Design**: Course Templates, Customized Look and Feel, Instructional Design Tools,  | **Özdamlı evaluated the 8 OSS LMS** based on features of of the Administration Tools and Curriculum Design |
| **10** | Finding Open optionsAn Open Source software evaluation modelwith a case study onCourse Management Systems//Karin van den BergTilburg//Tilburg University, August 2005//Master Thesis// |  | **Community** – the driving force behind an Open Source project**Release Activity** – showing the progress made by the developers**Longevity** – how long the product has been around**License** – is one of the general Open Source licenses used**Support** – from the community as well as paid support options**Documentation** – user manuals and tutorials, developer documentation**Security** – responding to vulnerabilities**Functionality** – testing against functional requirements**Integration** – standards, modularity and collaboration with other products**Goal and Origin** – why was the project started and what is the current goal | Berg (2005) developed an open-source softwareevaluation model, using 10 criteria found in the literature and the model was tested by evaluating OSS course management systems.  |
| 11 | Choosing MOODLE:An Evaluation of Learning ManagementSystems at Athabasca University// International Journal of Distance Education Technologies, Volume 5, Issue 3//2007 | Moodle, Lotus Note and WebCT | **Systems Administration:** Integration with current registration procedures, Single sign on capabilities and compatibility with current authentication systems, Flexible administration across centres andPrograms, Secure access, authorization, and virusProtection, Interoperability using SCORM, IEEELOM, and CanCore**Cost:** Licensing fees, hardware and software costs, Costs related to integration with the Banner registration system, Cost of ongoing support, Staff training costs**Instructional Design:** Granularity, Templates and modularization, Student Experience**Teaching and Learning Tools:** Workable assignment drop box, accommodate XML and mobile device delivery, course authoring tools | The users of Moodle, Lotus Note and WebCT LMS in Athabasca University, Canada made a comparative evaluation through rating system based on a set of criteria.  |
| 12 | **Learning Management Systems for the Rest of Us**An assessment of open source learning management systems//Corporate University Enterprise Inc. (CUE), white aper//2003 | **Moodle****Claroline****Ilias****Ganesha** **Manhattan Virtual Classroom** | **Features****Strength****Weakness****Current User Community** | In a white paper, the Corporate University Enterprise evaluated the OSS LMS  |
| 13 | **Hamtini, T.M. & Fakhouri, H.N. (2012).** Evaluation of open-source e-Learning platformsbased on the Qualitative Weight and Sumapproach and Analytic Hierarchy Process. In: Clark, R.C. & Mayer, R.E. (eds) Proceedings of the International multi-Conference Society, Cybernetics and Informatics, pp.1-7. E-learning and the Science of Instruction, Jossye-Bass, San Francisco  | Dokeos, Claroline, IWT, ILIAS, Moodle, Atutor LON-CAPA , OpenUSS ,ADA  | **Social Networking Tools**: Chat, Forum, E-Mail, Contents Sharing, Conferences**Productivity Tools & Software Installation**: Application Download, Objects Installation of the platform, Assistance, Documentation, Virtual Classroom**Administration Tools & Security**: Administration of courses, Progress Tracking, On-Line User, Registration, New Course Creation,Report, organization of course Assessment of tests, Security**Presentation Tools and Material Distribution:** Announcements, Learning material ,Exercises ,Assignment & Quizzes ,Whiteboard ,Course List ,Course Indexing ,Contents Import ,Contents Insertion & download**Management Features:** MultiCourse Management ,Multi-User Management ,Assessment Management ,Student’s Group,Management ,User management, Authorization management | Based on the functionality of nine open-source e-learning platforms used in different Jordanian universities and the maincharacteristics provided of each platform we combined theQualitative Weight and Sum (QWS) and the AnalyticHierarchy Process (AHP) approaches for the evaluation |
| 14 |  E-Learning Management System for community schools during COVID-19 pandemic and beyond a review of some open source LMS software// Yogendra Singh Parihar, Anand Srivastava, Inder Pal Singh Sethi// International Journal of Scientific & Engineering Research Volume 12, Issue 3, March-2021 | **Chamilo****Moodle****ATutor****Ilias** | **Technical Overview:** First release, Latest version and release date, Programming language, Supported Database, Interoperability, Accessibility**Features and Functionality Overview**  ***Tools for distribution***: Resource, Announcements, RSS Feeds,  Content Sharing ***Tools for communication***: Internal Email, Calendar, Student  Profile, Video Conference ***Tools for interaction:*** Forum, Quiz or Test, Assignments,  Online Discussions ***Tools for course administration:*** Group Management, Grade  Book, Survey/Polls, Reports | Parihar, Srivastava & Sethi carried out a comparative analysis of four OSS LMS |
| 15 | Analysis of web platforms of learning management systemsfor distance education in the face of social isolation// Alexi Delgado1, Enrique Lee Huamani2, Hugo Obispo-Mego3, Daniel Justo-L6pez4// Volume 9, No.5, September - October 2020International Journal of Advanced Trends in Computer Science and Engineering | Chamilo,Moodie Google Classroom | **Technical Characteristics****Personalization of the learning proposal:** Discussion forums, File sharingInternal mail, Diary *I* Notes Online, Chat online, Work progress calendar**User support:** Authorization to courses, It has an installation manualWorkgroup**Student Tools**: Workgroup, Constant self-evaluation, Briefcase**Promotion of collaborative learning**: Allows teachers to attach complementary academic material | Delgado and others compared the usefulness of three LMS using Analytic Hierarchy Process  |
| 16 | Evaluation of An Open Source Learning ManagementSystem: Claroline//Norkhushaini Bt Awanga and Mohamad Yusof B Darusa//The 3rd International Conference on e-LearningICEL2011, 23-24 November 2011, Bandung, Indonesia | ClarolineDoceboMoodleDokeosAtutorIliasSumtotalSabaBlackboardGiunti labsPlateau | **Server facilities and multimedia aspects** Licence Target [audience] Type of Target Multimedia Learning Object Production Server Facilities**E-learning tools**Scorm  Forum  Wiki  Video Con. Model of Learning | Awanga & Darusa compared the features of Cllaroline LMS with 10 other LMS.  |
| 17 |  Comparative Evaluation of Accessibility and Learnability of Learning Management Systems: Case of Fronter and Canvas// Faizan Ahmad, Wondwossen Beyene, and George Anthony Giannoumis | Canvas Fronter | Features **Toolbar** **Dashboard** **Rooms/Courses** **Profile/ Account** **User Guide** **Accessibility**Functions **Search** **Upload/ download** | Ahmad, Beyene & Giannoumis compared the learnability and accessibility features of the Canvas and Fronter LMS from the user’s perspective.  |
| 18 | Innovative Scenarios in the Teaching and Learning Process: A ViewFrom the Implementation of Virtual Platforms// Heriberto González Valencia, Jakeline Amparo Villota Enríquez1 & María Eufemia Freire Tigreros1// English Language Teaching; Vol. 11, No. 7; 2018 | Moodle, Blackboard and Jimdo | **Technical and material design** ***Esthetic design***  ***Quantity and quality of the icons*** ***Ease to find the tools*** ***Presentation of contents*** ***General services*** Administrative management General information News Activity agenda Recreational activities**Instructional design** ***Presentation of the objectives*** Guides Course information ***Flexibility of the didactic contents*** Possibility of use in another environment ***Activities*** Individual Collaborative ***Communication*** Synchronous Asynchronous ***Evaluation*** ***Constructivist*** ***Communication*****Tutorial action**  ***Virtual community development*** ***Personalization of the tutorial*** ***Professor´s role*****Virtual class** ***Learning path*** ***Video or written communication*** | Valencia, Enríquez & Tigreros compared the featues of Moodle, Blackboard and Jimdo LMS based on four criteria |
| 19 | **Learning management system: Integration models of conventional and distance education of students// Irina Gladilina 1\*, Lyudmila Pankova 1, Svetlana Sergeeva 2, Natalia Bulochnikova 1, Sergey Baldin//** EurAsian Journal of BioSciences // 14, 6153-6159 (2020) | Moodle, Sakai, ATutor,Blackboard Learn, DoceboClaroline | **Software programming language****Platform****Multilanguage interface****Structure****Interactive communications** Forums Graphic chats Virtual classes Trainings**Possibility of creating interactive courses using audio & video****Video conferences****Knowledge assessment system****Adoption for mobile devices****Cost** | **Gladilina and others (2020) compared the features of six LMSs used in distance education in Russia based on survey among 40 experts in the education field.**  |
| 20 | Open source learning management systems in distanceLearning**//** Cansu Cigdem Aydin & Guzin Tirkes// The Turkish Online Journal of Educational Technology – April 2010, volume 9 Issue 2 | Moodle Atutor Dokeos Olat | **General aspects*** Support and compatibility to Standards
* Including content development and content authoring /editing tools, modularity
* Backup Tools
* User Authentication

**Didactic functionality*** Follow-up of student’s learning processes
* Online Exam
* Multiple Input Supports (Multimedia etc.)
* Video Conference Support

**Productivity tools*** Online Help and Documentation
* Calendar

**Communication tools*** Survey and forum support
* Chat and Group work

**Technical flexibility*** XML support
* System Requirements

**Usability*** Multiple Language Support
* User Interface and ease of usage
* Frequency of Usage
 | Aydin & Tirkes analysed the general features required for an OSS LMS required in an e-learning environment and then tested and compared these features in four selected LMS.  |
|  |  |  |  | analysed and compared interoperability features of Moodle and Blackboard, the two leading LMS in OSS and commercial strames, respectively.  |