# Current Trends and Challenges of Developing and Evaluating Learning Management Systems

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**Abstract:** Many Universities recognize the necessity of using Learning Management Systems (LMSs) to increase learners' motivation, encourage interaction, provide feedback and provide support during the learning process. There are many proprietary and open source LMSs that can be found as alternative products. With the ever-growing number of LMSs, the task of developing and evaluating LMS becomes even more important. This paper discusses the factors that affect the use of LMS, the developing issues that have an impact on LMS and the evaluation processes that should be taken to select the suitable LMS. Also, it presents challenges that face LMS success, efficiency, assessment, evaluation, selection and usability. Last it shows the current trends to answer a question of how the LMS of the future will look like.

**Key words:** Learning management system, e-learning, LMS success, LMS challenges, LMS trends.

## 1. Introduction

Learning Management Systems (LMSs) are web based applications that are being used today in e-learning. With the improvement of e-learning concept, Learning Management Systems are gaining interest as a delivering and managing teaching or training learners. There has been a sudden increase in using the applications of the learning management systems in higher education. [1]. LMSs contain features that assist in the designing, sharing, delivery, management and evaluation of learning resources to all learners [2]. Effective Elearning comes from spreading more educational opportunities and help learners to develop their skills [3]. In higher education institutions, LMSs provide prosperous learning environment. The investments to LMS continue to increase; there are hundreds of LMS products available in marketplace [4], [5]. Therefore, there is a need to help organizations with tools necessary for developing and evaluating these systems [6].

Then [7]-[10] show that many universities are conscious about using LMS as a tool to help in disseminating materials to the learners. LMS called course management system or learning content management system is software designed to assist instructors and learners with course management. LMS is considered as a useful tool to manage educational resources. It is necessary to have a LMS that can be adapted easily to changing requirements.

The rest of this paper is organized as follows: Section 2 presents the factors that affect the LMS success. In Section 3, the developing of LMS is showed. Then Section 4 is about the evaluation process of LMS. While Section 5 presents a framework that contains challenges and work directions; last Section 6 is a view of the current trends in LMS.

## 2. LMS Success

Management information system is a set of systems that helps managers to take better decisions [11]. LMS is regarded as a management information system [12]. LMS is an information system (IS) that supports teaching and learning activities and the management and communication associated with them [13]. Development of management Information systems is not easy as it needs to visualize the complete information system with functionality [9]. Implementation of specific LMS functionalities depends on specific requirements. As LMS solution is successful for a university it does not mean that will be successful for other universities or organizations. The 99 LMS functionalities are listed in alphabetical order and not in an importance order as seen in Appendix [14], where MIS functionalities are checked.

DeLone and McLean's [15] IS success model includes three components: the creation of a system, the use of the system, and the consequences of the use of the system. Holsapple and Lee-Post adapted DeLone and McLean's model for use in the learning management system to be: system design, system usage, and system outcome. Many studies have used the D&M IS success model in the learning field, but many researchers express their need to propose an IS success model for e- learning purposes and especially for LMS. In [16] system quality, service quality, content quality, learner perspective, instructor attitudes, and supportive issues had a considerable effect on the learners' perceived satisfaction. [13], [17] Showed that learner and instructor involvement improve effectiveness of learning process. Results of [18] reveals six factors including learners' characteristics, instructors' characteristics, extrinsic motivation, service quality, system quality, and information quality that influence the acceptance of e-learning systems in developing countries. Perceived usefulness, perceived ease of use, user satisfaction, learner characteristics, instructor, LMS characteristics and organization characteristics have influence on LMS success [19]. System quality is very important factor in relation to the service quality, information quality and learning community [20] [21]. The following lines identify the critical factors that affect LMS integrated from previous studies that affect LMS success:

1) Personal factors / PF (learner and instructor):
   - User characteristics (UC).
   - User satisfaction (US).
   - Perceived usefulness (PU).
2) System factors / SF (LMS characteristics):
   - System quality (infrastructure).
   - Service quality (organization).
   - Information quality (course).
3) Organizational factors/OrgF:
   - Management support.
   - Training.
4) Supportive factors/SupF :
   - Ethical and legal issues together with privacy.
   - Plagiarism and copyright concepts.
   - Cost.

Table 1 is an integration of different validated e-learning success models from previous studies to illustrate the success factors of LMS symbolized by x, where no model has a complete set of factors.

LMS characteristics play an important role in evaluating LMS [20]. LMS Characteristics as shown in Table 2 which are system quality, service quality and information quality [22]. System quality (SQ) in a LMS, measures the essential features including system performance and user interface. Examples of system quality measures in the LMS are response time, usability, availability, reliability, completeness, and security.

Service quality (SrQ) is concerned with the support given by the service provider of LMS, whether the service is delivered by the university organization or external providers. It has become an important element in research related to information systems [23]. Information Quality (IQ) is concerned quality measures derived from user perspectives [24] is a term to describe the quality of the content of information systems. The criteria for measuring information quality are multidimensional such as speed of access to information, accuracy and clarity [25]. Table 2 illustrates the quality attributes (criteria) for each LMS characteristics (SQ, SrQ, and IQ)

TABLE 1. Reference Models and Success Factors

| | **Success factors of LMS** | | | | | |
|---|---|---|---|---|---|---|
| **Reference, Year** | **PF** | | | **SF** | **OrgF** | **SupF** |
| | *UC* | *US* | *PU* | | | |
| [16], 2009 | x | x | | x | | x |
| [13], 2010 | x | x | x | x | | |
| [17], 2010 | x | | | x | x | x |
| [18], 2012 | x | | x | x | | |
| [19], 2012 | x | x | x | x | x | |
| [20], 2014 | x | x | x | x | | |
| [21], 2014 | x | x | x | x | | |

TABLE 2. LMS Characteristics and Quality Attributes [23]-[25]

| | **LMS Characteristics** | | |
|---|---|---|---|
| **Quality attributes** | **SQ** | **SrQ** | **IQ** |
| Accessibility | | x | x |
| Accuracy | x | | x |
| Assurance | | x | |
| Availability | x | | x |
| Completeness | x | x | x |
| Consistency | | | x |
| Currency | | | x |
| Effectiveness | x | | |
| Efficiency | | x | |
| Empathy | | x | |
| Flexibility | x | | |
| Format | | | x |
| Functionality | x | | |
| Interactivity | x | | |
| Legibility | | | x |
| Relevancy | | | x |
| Reliability | x | x | x |
| Responsiveness | x | x | |
| Sufficiency | | x | x |
| Tangibility | | x | |
| Timeliness | | | x |
| Understandability | | | x |
| Usability | x | | |

## 3. Developing of LMS

LMS provides the university a set of tools that help in managing course catalogues, record data from learners and provide reports to management. Most LMS includes features such as discussion forums, chats, automated testing, assessing tools and student tracking [26].The aim of developing this learning management tool is to provide the users with an attractive, user-friendly, secure, and a comprehensive interactive interface with easy-to-use facility [27].

LMS systems support different features which can be analyzed from different aspects which are: pedagogical aspect, learner environment, instructor tools, course and curriculum design, administrator tools and technical specification [28]. LMS functional requirements include Learners should be able to keep

track of their learning progress while performing the activities of a learning design; instructors should upload, discuss and review assignments; the system should support the creation and delivery of self-assessments; allow the implementation of various pedagogical approaches and course designs for the different target audiences [29].

Currently there is a need of Low cost and adaptable interacting LMS to provide e-learning courses. A study was performed to present the developing, implementation and evaluation of LMS tool. The tool supports the most common features of an e-Learning such as view courses, view texts and videos, manage quizzes, display presentations and editing processes. Where each user account has its own personalized page and appearance and the system generates different kinds of interactive submenu pages that are readily accessible. The study findings is that the keys to deploy a successful LMS are understanding where system is being deployed, who uses it, how it needs to integrate with existing and future systems, and what specific educational tasks should be automated [30].

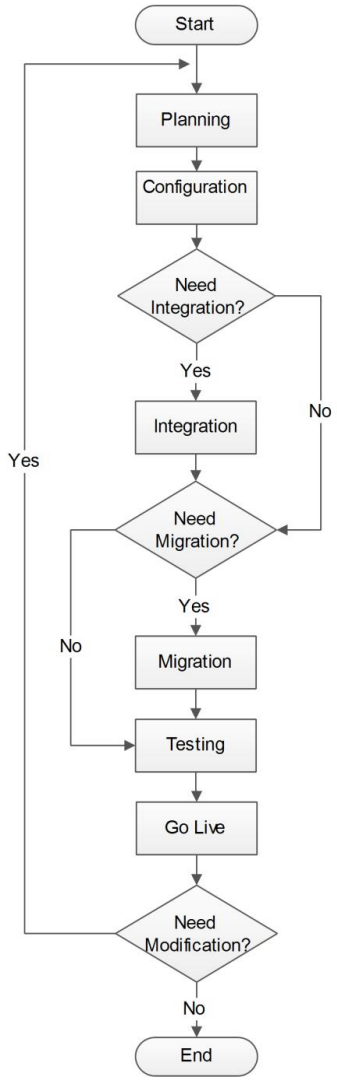


Fig. 1. Modified six steps to successful LMS implementation.

The LMS implementation process involves six major steps as shown in Fig. 1. Planning specifies the requirements organization. The plan should include all the tasks needed to implement the LMS from the vendor's point of view. Configuration includes understanding of data and operations and understanding of the system's data fields, functionality, and capabilities. While integration means that it may integrate with a

number of systems such as Systems containing user accounts and profiles. Course and data migration happens when changing from LMS software to another. It is needed to move the data and courses from your legacy system to the new LMS. It is a complex task that needs a specific sequence, and addressing to any incompatibilities between the way the data and courses were stored in the legacy system versus the new LMS.

The last major step before going live with LMS is to conduct user acceptance testing. Testing the LMS ensures a fully working system, configuration, courses, and data are available in the system as you expect them to be. Once all tests have been completed, end-to-end, and all bugs have been fixed, then go live with LMS [31].

The users of LMS are learners who use the system for the educational process, Instructors who use the LMS to supervise, assist and evaluate the learners and administrator who take the support of all the users to control the functioning of the system.

It is noticed that current LMSs are lacking in some functionalities such as receiving feedback from the users and processing accounting information. There could be more studies needed in different aspects like extra modules for indicating the best content of similar subjects, transmission any information from the participating universities, and checking the quality of the content. These can be taken as future work [1]. The next Figure presents a generic architecture of LMS that consists of four layers: presentation layer, service layer, application layer and database layer.

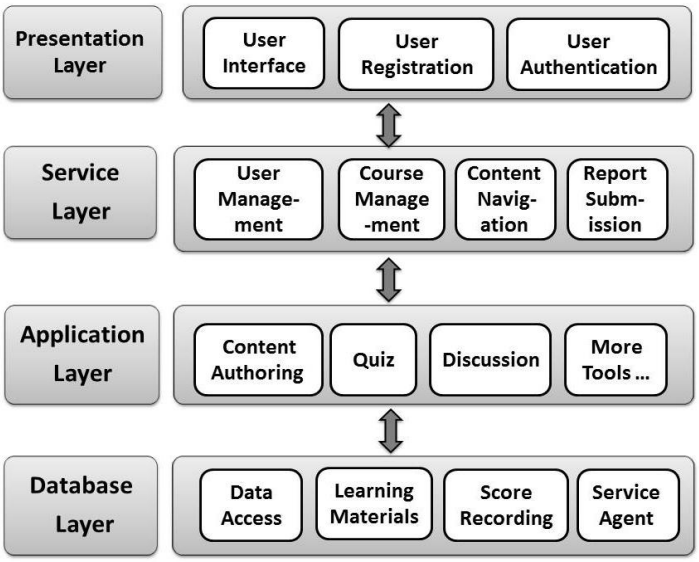


Fig. 2. A generic LMS logical architecture.

## 4. Evaluation of LMS

Evaluation of Software is a type of assessment that seeks to determine if software is the best suitable for the requirement includes functional requirements, non-functional requirements and user requirements of a given customer. Based on a prepared list of criteria along with some practical experimentation, it is possible to determine if the software would be helpful to the customer or not [32].

Evaluation is a decision making process that is needed to select the most suitable LMS option from a set of alternatives due to organization requirements. One of the approaches to decision making is multi-criteria decision making [33]. It solves problems and help in taking decisions involving multiple criteria. Taking a decision could correspond to choose the best alternative from a set of alternatives or to choose a small set

of good alternatives by analyzing the different criteria [34].

The evaluation process of LMSs is in general costly, time consuming, and needs an effort. A study was developed to present this evaluation process steps. Some of these steps are used to insert the entries needed into the algorithm to get a result that refers to the most suitable LMS satisfying the specified requirements [35]. Another study [33] used the Evaluation Cycle Management as an evaluation system which consists of two phases of evaluation methods: Criteria evaluation and Usability evaluation. In which, the results gained from the criteria evaluation model is being verified on user usability testing. In case user usability testing shows unacceptance, it returns to the criteria evaluation once again to edit the criteria value and get the needed results.

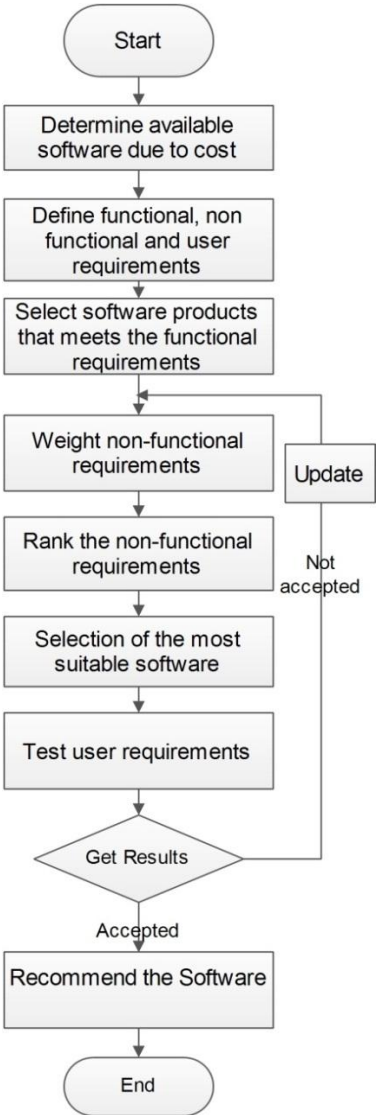


Fig. 3. Evaluation process [33], [35].

From these previous studies the altered evaluation process steps can be integrated and illustrated as follows in Fig. 3. Where first step is determining the cost of LMS needed to select the set of available software. Functional requirements are defined to select the most appropriate software set that meet these requirements. Nonfunctional requirements are determined and weighted by decision maker, an expert or group of experts according to the specified criteria. Ranking the nonfunctional requirements will help in the selection of most appropriate software. Then testing user requirements will be performed to take a decision and select the software or going back and weight again the nonfunctional requirements.

## 5. Challenges and Work Directions

Assessing the success of LMS and the quality of LMS systems is one of the most significant issues in e-elearning field. Several studies have conducted to assess the quality of LMS systems and evaluate LMS as it has become an important issue. Latest research showed that there is a need to measure the efficiency of LMS and to explore other factors for measuring the success of e-learning systems in general and LMS in particular. A framework that contains challenges and work directions of this area is proposed as shown in Fig. 4.

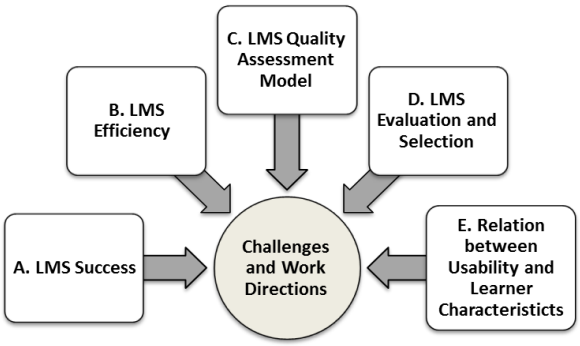


Fig. 4. Challenges and work directions of LMS.

### 5.1. LMS Success

A study was conducted to indicate the factors that influence the successes of e-learning systems. The study uses fuzzy TOPSIS technique as a new method to evaluate e-learning systems. The results show that system quality, information quality, service quality have the most positive impact on learners understanding of e-learning. Also the findings that the system quality is very important factor in relation to the service quality, information quality and learning community [20] *Future work may discuss other factors for measuring the* success *of LMS from different perspectives such as learner's, instructor's and organization. Further studies are needed to explore the critical factors affecting organizations' implementation and deployment of LMS especially in developing countries.*

### 5.2. LMS Efficiency

A research was performed to focus on the system quality concept and explores usability, accessibility, reliability, and stability dimensions to evaluate the effect of these dimensions on e-learning system efficiency. The results show that usability factor was found as important dimension that affects the system quality and also the system quality is the main factor that increase or decrease the efficiency of LMS. *The future studies deals with further evaluation to other system quality dimensions such as objectivity, completeness, and consistency, examine the relationship between system interface and information quality to achieve the LMS efficiency* [36].

### 5.3. LMS Quality Assessment Model

A work was carried to contribute on developing website quality assessment model for website's quality evaluation depending four quality parameters such as accuracy, feasibility, utility and propriety. The work analysed the system quality of an existing e-learning site and obtained the feedback of the users where the preliminary assessment phase and the criterion based analysis of each parameter is made. Then the evaluation process has been accomplished with two phases of evaluation: preliminary assessment phase and evaluation results analysis phase. With the suggestions obtained from the assessment process, a new improved e-learning environment is developed to satisfy the users with their best quality of content and design [37]. *Future exploration is still necessary that assess various e-learning platforms including LMS.*

*Designing a website quality assessment model including the quality parameters that affect the LMS to act as a tool for organizations to achieve a base standard of consistent quality that is essential for user satisfaction is a challenge.*

### 5.4. LMS Evaluation and Selection

With the ever-growing number of LMSs, the task of selecting the most suitable becomes even more important. Multi criteria decision making methods help in taking decisions involving multiple criteria. Taking a decision could correspond to choose the best alternative from a set of alternatives or to choose a small set of good alternatives by analyzing the different criteria [34]. *A future work is necessary to develop an evaluation model that considers quality standards from software engineering perspectives and takes into consideration the quality aspects of the e-learning system* [38]. *In future studies, decision making process of LMS evaluation can be supported by the fuzzy set theory* [39].

### 5.5. Relationships between Usability and Learner Characteristic's

A study was executed to investigate the validity and reliability of a Greek version of system usability scale was investigated in the context of LMSs perceived usability evaluation. The results indicate that the degree of contribution of various interaction characteristics to the system usability scale score requires further examination. Results from the study related to how learners achieve their goals, what criteria they use to evaluate information, how they adapt to any given learning environment, which navigation strategies they follow, and how different structuring of the learning material affects their learning effectiveness. *Future work deals with exploring the factors that influence the system usability of LMSs and developing educational usability evaluation practices. Further research also includes investigating relationships between usability and various learner characteristic's such as gender, age, ICT competence* [36], [40].

## 6. Current Trends of LMS

There are many Learning Management System trends and many others are still to come since eLearning technology is rapidly changing. Then a question is emerging which is how the LMS of the future will look like. The following part presents some key trends that may find an outstanding place in the progress of the LMS.

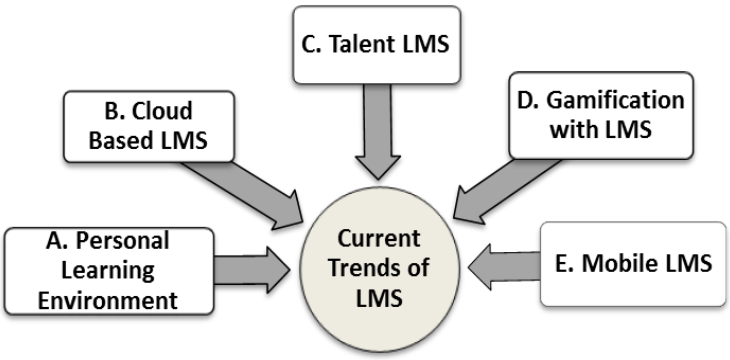


Fig. 5. Current trends of LMS.

### 6.1. Personal Learning Environment

A current trend of LMS is that Personal Learning Environment (PLE) features will become part of LMS. PLE refers to a set of tools, social software and systems that provide control to the students to direct their own learning and achieve educational goals. Learner under the PLE can create his profile, customizes LMS content, and participates with other learners. *Further research deals with the necessity to LMSs to*

*include constructivist instructional design methods and pedagogy, particularly emphasizing active and shared learning and personalized attention to all students* [41], [42].

### 6.2. Cloud Based LMS

Web-based services such as cloud computing, mobile internet, and modern format for distributing web content are some trends that may affect e-learning environment. Cloud based LMS is a trend where are testing out cloud based LMS to focus on education excluding most of barriers associated with cost and support. Cloud based training means the courses are available anytime and anywhere there is an Internet connection. The future LMS will increasingly be run on cloud for its agile, flexible and economic characteristics. Cloud-based LMS are able to take advantage of the convenience and flexible aspects of the technology. Learners can be better served by Cloud- based LMS that could contain social bookmarking tools, document sharing applications, social networking applications, timeline tools, and media options[41]-[43].

The organizations face a challenge in implementing Cloud-based LMS such as costs, a lack of resources, and resistance by users to the implementation of systems. However, Cloud-based LMS can reduce costs due to lower requirements of hardware and software, and less need for on-site maintenance*. The limitations of cloud-based LMS are high speed Internet connection is needed for the efficiency of the presented e-learning services, and issues surrounding the security of a cloud remain unclear. As the speed and stability of the Internet are continuing to improve, it seems likely that the popularity of cloud computing for e-learning will increase* [44].

### 6.3. Talent LMS

Talent management identifies the current skills of learners and the gaps in skills. A LMS is a tool to present courses. The talent management and LMS have traditionally worked independently of each other. The integration of talent management and LMS can fill the skill gaps of the learner and improve the learner's job-related skills. *Another new trend is the integration of talent management into the LMS where learning management systems can recommend new training courses due to learner's needs and skills* [45].

### 6.4. Gamification with LMS

The "Gamification" of courses is a movement that is gaining traction in educational research communities and universities. Games are designed for user learning, entertaining and satisfaction. Gamification with LMS to is needed to gain learners interest and may fulfill learning goal. An interesting way to enhance LMS is an attempt to engage and motivate learners with games. It is observed that the games have good acceptance among the learners. *Future work deals with quantifying the learning degree and the satisfaction degree of learner if they are using games in the learning process* [46], [47].

### 6.5. Mobile LMS

There is a trend to add mobile learning functionality to LMS. This allows learners to continue learning process by accessing their learning materials using mobile devices. Mobile devices in future need to support Mobile content and LMS access, personal notification systems and response systems. *For further research, there is a need for analyzing the usage of video lessons with the mobile devices to arrive out the results of learning effectiveness, performance and the system quality* [5], [48].

## 7. Conclusion

With the fundamental changes in e-learning technology, there is a need to take into considerations the current trends and challenges of developing and evaluating Learning Management Systems (LMS) to benefit learners and organizations. This paper presents the factors that have an impact on LMS success which are

personal factors, system factors, organizational factors and supportive factors. It shows the importance of these factors from previous studies. Then it presents the developing process of LMS, and current LMSs challenges in functionality. And with the ever-growing number of LMSs, the paper presents the evaluation process for evaluating and selecting the suitable LMS satisfying the organization requirements.

The next section is about the challenges and work directions that discuss the LMS success, LMS efficiency, LMS Quality Assessment Model, LMS evaluation and selection and LMS usability. LMS success is affected by LMS characteristics which are system quality, information quality, and service quality. While the system quality is the main dimension that increase or decrease the efficiency of LMS and the usability factor is a main factor that affects the system quality. Also there is a need to contribute in developing LMS quality assessment model including the quality to achieve a base standard of consistent quality essential for user satisfaction. LMS evaluation and selection is another challenge with the ever-growing number of LMSs. Therefore, an evaluation model for LMS selection is needed for decision making process that considers quality standards from software engineering perspectives and the quality aspects of the e-learning system where Multi criteria decision making methods can help. Last further examination is for studying the factors that influence the system usability of LMS.

The last section presents the current trends of LMS to answer question like how the LMS will look like in the future. Some key trends are shown which are Personal Learning Environment (PLE), Cloud based LMS, Talent LMS, Gamification with LMS, Mobile LMS. PLE of LMS allows learners with the ability to create his profile, customizes LMS content, and participates with other learners. Cloud-based LMS served learners better as it provide them with social bookmarking tools, document sharing applications, social networking applications, timeline tools, and media options. Cloud based LMS needs to be studied taking into considerations costs, lack of resources, and resistance by users. Another trend is Talent LMS that integrates the talent management and LMS that could recommend and present training courses to learners due to learner's needs and skills. The Gamification can enhance learning process as it could engage and motivate learners with games. The satisfaction degree of learner if they are using games is a future study. Adding mobile learning functionality to LMS is a trend while learners can access their learning materials using mobile devices.

This couldn't cover all the LMS issues. It has just shed light on some views and future work. Further studies are needed to deal with analysis of the presented challenges to overcome it and trends to know the return benefits.

## Appendix

The 99 LMS functionalities listed in alphabetical where MIS functionalities are checked [14].

| LMS Functionalities | MIS |
|---|---|
| 1. Administration | ✓ |
| 2. Administrative Reporting | ✓ |
| 3. Assessment Tools Built in | |
| 4. Authentication & Security | |
| 5. Authoring - 3D Simulation | |
| 6. Authoring - Courses | |
| 7. Authoring - Gamification | |
| 8. Authoring - mLearning | |
| 9. Authoring - PowerPoint Conversion | |
| 10. Authoring - Serious Game | |
| 11. Authoring - Storyboarding | |
| 12. Blended/Hybrid Learning | |

| | |
|---|---|
| 13. Career Tracking | |
| 14. Certification Management | |
| 15. Certification Tracking | |
| 16. Classroom Management | |
| 17. Collaboration Management | |
| 18. Competency Management | |
| 19. Compliance - AICC | |
| 20. Compliance - 3rd Party Authoring Tools | |
| 21. Compliance - 3rd Party Teleconferencing Tools | |
| 22. Compliance - SCORM | |
| 23. Compliance - Tin Can API | |
| 24. Compliance Management | |
| 25. Conferencing | |
| 26. Content Library | |
| 27. Content Management | |
| 28. Course Catalog | |
| 29. Course Interactivity | |
| 30. Coursework Grading | |
| 31. Custom Learning Vocabulary | |
| 32. Custom User Interface | |
| 33. Customizable Branding | |
| 34. Customizable Fields | |
| 35. Customizable Functionality | |
| 36. Customizable Reporting | |
| 37. Data Import/Export | ✓ |
| 38. Data Management | ✓ |
| 39. Development Tracking | |
| 40. Document Management | ✓ |
| 41. eCommerce | |
| 42. eLearning Management | |
| 43. Event Management | |
| 44. Exam Engine | |
| 45. Goal Setting / Tracking | |
| 46. Individual Development Plans | |
| 47. Installation (Hosted, Local, Saas, Cloud) | |
| 48. Instructor Led Classes | |
| 49. Instructor Scheduling | |
| 50. Job Hierarchies | |
| 51. LCMS | |
| 52. Legacy System Integration | |
| 53. Licensing (Free, Trial, Open Source, Paid) | |
| 54. Live Video Presentations | |
| 55. Locations Served | |
| 56. Maintance (Backups, etc) | |
| 57. Mobile Access | |
| 58. Multi-Currency | |
| 59. Multi-Language | |
| 60. Multi-Lingual Courseware | |
| 61. Multi-Lingual User Interface | |
| 62. Multimedia Environment | |

| | |
|---|---|
| 63. Multi-Organization Structures | |
| 64. Multiple Delivery Formats | |
| 65. Notifications - Email | |
| 66. Notifications - SMS | |
| 67. Offiline Learning | |
| 68. Online Learning | |
| 69. Performance Assessment | |
| 70. Perpetual Licence | |
| 71. Platform | |
| 72. Podcast Management | |
| 73. Registrar Enrollment | |
| 74. Registration Management | ✓ |
| 75. Reporting | ✓ |
| 76. Resource Management | |
| 77. Self-Enrollment | |
| 78. Self-Paced | |
| 79. Self-Registration | |
| 80. Single Sign On | |
| 81. Skills Assessment | |
| 82. Skills Tracking | |
| 83. Social Learning | |
| 84. Software Development Kit | |
| 85. Student Management | |
| 86. Student Portal | |
| 87. Student Self Service | |
| 88. Student Tracking | |
| 89. Survey Management | |
| 90. Term License | |
| 91. Test Building | |
| 92. Test Scoring | |
| 93. Testing | |
| 94. Training Metrics | |
| 95. Training Tracks | |
| 96. User Access Controls | |
| 97. Users Size Served | |
| 98. Virtual Classes | |
| 99. Waiting Listing | |

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