



COMPARISON OF LEARNING MANAGEMENT SYSTEMS BASED ON CRITICAL FEATURES

**A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF APPLIED
SCIENCES OF
NEAR EAST UNIVERSITY**

By

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**In Partial Fulfillment of the Requirement for
the Degree of Master of Science
in
Computer Information Systems**

NICOSIA 2013



**Zaid Dawad Al-Rustom: COMPARISON OF LEARNING MANAGEMENT
SYSTEMS BASED ON CRITICAL FEATURES**

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23/7/2013

ACKNOWLEDGEMENTS

My deepest gratitude goes first and foremost to Assoc. Prof. Dr. Nadire Çavuş, my supervisor, for her constant encouragement and guidance. She has walked me through all the stages of the writing of my thesis. Without her consistent and illuminating instruction, this thesis could not have reached its present form.

Finally, my unlimited thanks and heartfelt love would be dedicated to my dearest family for their loyalty and their great confidence in me. I am greatly indebted to my dad who is indeed my inspiration and the man who led me to the treasures of knowledge. To my mum who gave me all her love and her continued faithful supplication.

COMPARISON OF LEARNING MANAGEMENT SYSTEMS BASED ON CRITICAL FEATURES

ABSTRACT

In these days, can seen the rapid changes and developments in technology. The important developments that have occurred in computer and communications technologies which culminated in the Intranet network and the Internet have transformed the world into a small village. Hence, throughout the previous two decades there has been a great interest in the use of computers in teaching and learning. Learning Management System (LMS) is software that enables the management and handing of the learning content and resources to students. Also, delivery of teaching material electronically depending on good standards and quality across the board without the limitation of a specific location. Researchers commonly focused on comparative study of their technical features but there are many software companies that have developed a lot of learning management systems. The huge amount of LMSs offered yearly over the web and because of this rapid development in learning technologies over the world, we are now in an insisting need to evaluate the quality, efficiency, and performance of this development. But there is no system that combines all the requirements for the various disciplines, because they have different structures and the biggest difference is in their features. For these reasons users find difficulties when choosing an appropriate system. The biggest problem facing the user of LMSs is how to choose a system that can meet the raised needs. The main aim of this thesis is to compare the Learning Management Systems using a logical, clear and simple way. By using the mathematical method which gives the comparison points for each LMS according to each tested feature. This research was used the comparison method to find the proper education and the required properties. The features are classified to seven main factors in the comparison operation and the comparison was done in several consecutive steps. According to the results, it has the characteristics of LMS is superior to the others. So that, quite difficult to be able to say specifically that is the best LMS. When the user choose a system that can meet his needs, he should not assume that which one is the best LMS; instead of this, he must taking into account his needs. This thesis presents the results to all learners, teachers, and educational institutions who are looking for LMS based on their needs using the detailed comparison method and illustrate simple and clear results. This research will provide service for universities, scientific institutions, professors, students, and each beneficiary of the LMS.

Keywords: Learning Management Systems(LMS); comparison of Learning Management Systems; comparison method; features of LMS; e-learning; best LMS

YÖNETİM ÖĞRETİM YÖNETİM SİSTEMLERİNİN KRİTİK ÖZELLİKLERİNE GÖRE KARŞILAŞTIRILMASI

ÖZET

Günümüzde, teknolojiye hızlı değişim ve gelişmeler görülmektedir. Bilgisayar ve iletişim teknolojilerinde meydana gelen önemli gelişmeler sayesinde, Intranet ağı ve İnternet teknolojileri dünyanın küçük bir köy haline gelmesine neden olmuştur. Bunun sonucu olarak son yıllarda eğitim ve öğretimde bilgisayar kullanımına büyük ilgi olmuştur. Özellikle akademik ortamlarda, yüksek teknoloji sektöründeki gelişmeler E-öğrenmeyi önemli ve en hızlı büyüyen alanlarından biri haline getirdi. Öğretim Yönetim Sistemi (ÖYS) ders içeriğinin ve materyallerinin yönetimini ve öğrencilere iletilmesini sağlayan yazılımdır. Ayrıca, bu yazılımlar öğretim materyalinin elektronik olarak iyi standart ve kalitede, belirli bir konuma sınırlı olmadan öğrenene teslim edilmesine olanak sağlar. Araştırmacılar genellikle ÖYS'lerinin teknik özelliklerini karşılaştırmaya dayalı çalışmalar yapmaya odaklanmışlardır. Ama, dünya genelinde birçok yazılım firmasının olması, pek çok öğretim yönetim sisteminin geliştirilmesine neden olmuştur. Bunun sonucu olarak, ÖYS'lerinin yıllık olarak çok sayıda web ortamında sunulmasına, bu da sistemlerin kalite, verimlilik ve performans değerlendirmelerinin yapılmasını zorunluluk haline getirmiştir. Ama, farklı disiplinler için tüm gereksinimleri birleştiren hiçbir sistem yoktur. Çünkü, her ÖYS farklı yapıya ve özelliklere sahiptir. Bu nedenle kullanıcılar kendilerine en uygun ÖYS'ni seçerken zorluklarla karşılaşmaktadırlar. ÖYS kullanıcısının karşılaştığı en büyük sorun, hergeçen gün artan kişisel ihtiyaçlarını karşılayabilecek en uygun sistemi seçmektir. Bu tezin temel amacı, Öğretim Yönetim Sistemlerini mantıklı, açık ve basit bir yolla karşılaştırmaktır. Kullanıcıya uygun eğitim ve gerekli özellikleri bulmak için karşılaştırma yöntemi kullanılmıştır. Araştırmada, değerlendirmeye alınan her ÖYS'nin test edilen her özelliği için karşılaştırma puanı veren matematiksel yöntemden faydalanılmıştır. ÖYS'lerinin özellikleri yedi ana faktöre ayrılarak karşılaştırma işlemi birçok birbirini takip eden aşamada yapılmıştır. Elde edilen sonuçlara göre her ÖYS'nin diğerlerine göre üstün olduğu özellikleri vardır. Yani spesifik olarak şu ÖYS en iyidir diyebilmenin oldukça zor olduğu ortaya çıkmıştır. Kullanıcının en iyi LMS hangisidirden çok kendi ihtiyaçlarını gözönünde tutarak hangi sistemin kendisine en uygun olduğunu düşünerek ÖYS seçimi yapması gerekmektedir. Çalışma sonunda, ihtiyaçlarına göre LMS arayan tüm kullanıcılara (öğrenciler, öğretmenler ve eğitim kurumları) ayrıntılı bir karşılaştırma yöntemi kullanılarak elde edilen sonuçlar basit ve açık bir şekilde gösterilmektedir. Araştırmadan elde edilen sonuçların üniversitelere, bilimsel kuruluşlara, profesörlere, öğrencilere ve ÖYS'nden yararlanmak isteyen herkese yararlı olacağı düşünülmektedir.

Anahtar Kelimeler: Öğretim Yönetim Sistemi (ÖYS); ÖYS'lerinin karşılaştırılması; karşılaştırma yöntemi, ÖYS özellikleri, e-öğrenme, en iyi ÖYS

To my parents.....

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LIST OF ABBREVIATIONS

ACLT:	Advanced Collaborative Learning Tool
CIS:	Computer Information Systems
CMS:	Course Management System
EduTools:	Education Tools
E-Learning:	Electronic Learning
HTML:	Hypertext Markup Language
IEEE:	Institute of Electrical and Electronics Engineers
LCMS:	Learning Content Management System
LMS:	Learning Management System
MySQL:	My Structured Query Language
NEU:	Near East University
OS:	Operating System
OSS:	Open Source Software
PHP:	Hypertext Preprocessor
SCLT:	Standard Collaborative Learning Tool
SCORM:	Shareable Content Object Reference Model
SDLC:	System Development Life Cycle
SQL:	Structured Query Language
VLE:	Virtual Learning Environment
XML:	Extensible Markup Language

CHAPTER 1

INTRODUCTION

1.1 Overview

In these days, we can clearly see the rapid changes and developments in technology, the important developments that have occurred in computer and communications technologies which culminated in the Intranet network and the Internet have transformed the world into a small village. Throughout the previous two decades there has been a great interest in the use of computers in teaching and learning. The disease takes many forms: It is computer-assisted learning, e-learning, distance learning, online learning, and learning using virtual reality (Walker et al., 2010).

One of the most confusing aspects of e-learning is that nobody knows what it is. Most of us know the “E” stands for “Electronic”. But the “E” in E-Learning would be better referred to as Extended or Evolving or Everywhere Enhanced (Heller et al., 2012). In general, there is no universally accepted definition of e-learning but the following is used by the Chartered Institute of Personnel and Development (CIPD): Learning that is delivered, enabled, or mediated using electronic technology for the clear purpose of training in organizations (Jeong & Hong, 2012).

The researchers are going to name this generation as the speed generation or the electronic world. E-Learning becomes one of the important fields and one of the fastest growing areas of the high technology sector development especially in the academic environments. It is the newest way for the individuals and organizations to get knowledge and meet their requirements. These requirements are met by electronic learning (e-learning) (Heller et al., 2012).

The ability to keep pace with the rapid developments in modern technology mainly depends on the awareness of the size of the challenges and difficulties that are faced in all areas. The rapid developments in the field of computer and communication technologies have become need perseverance and sustained effort to ensure following-up and interacting with them and using them to serve the community these have been reflected in the e-learning programs. And here comes the constant review need for its educational institutions, which provide this type of education. For the introduction it is important to make the programs keep pace with the rapid

changes in successive technology and the need for the learner and the environment in which they live (Cavus, 2007). The enormous developments in information and communication technology as it facilitates the learner to obtain the required information have increased at the same time it renews the learner's skills and develops it (Cavus, 2009). The need for the learner to a broad base of information that contributes to the promotion of specialization has become automated in the present time through e-learning. In addition to requiring this type of education the learner's communication skills are developed because it became a key note that contributes to raising the skills of the learner and increases his ability to acquire information as well as after receiving a certificate through continuing education programs via the Internet. The experiments will be considered the world leader in the field of education-mail access to the best ways to get better performance and faster results if we apply the scientific material especially in the field of computer science (Jason, 2007).

E-learning is the delivery of teaching material electronically depending on good standards and quality across the board without the limitation of a specific location. It involves the use of multimedia interaction. This multimedia includes more than one form of media such as text graphics, animation, audio, video and video conferencing (Momani, 2008).

Throughout history technological advances in communication had a lot of developments such as the printing press, telephone, radio, film, television and more recently the Internet. In education these advances have facilitated the progression from one-to-one tutoring to mass education.

Learning Management Systems have become the default; the starting point for technology enabled learning in an environment largely overlooked by the educational institution and the learner (Cavus, 2011). Learning Management System (LMS) is software that enables the management and handing of the learning content and resources to students (Santos et al., 2007). Educational centers broadly adopt learning at all stages, specifically in higher education organizations trying to back up the life-long learning (LLL) paradigm. It gets rid of space and time barriers (Santos et al., 2007). Various articles and sites provide LMS reviews, commonly focused on comparative study of their technical features (Walker et al., 2010), but there are many and many software companies that have created a lot of learning management systems and then they were used to know what are the problems to be solved.

4. Forms,
5. Help and Documentation,
6. Common Student-facing Modules/Tools,
7. Authoring Tools and Content Creation.

The main objective of this thesis is to compare the Learning Management using a logical, clear and simple way. By using the mathematical method which gives the comparison points for each LMS according to each tested feature. The graphs are used to illustrate the results of the comparison between the LMSs used in this research.

This research was used the comparison method to find the proper education and the required properties. The comparison was used in several steps from selecting the LMS, determining the general characteristics of the LMS and identifies the systems that possess these characteristics. The next step will be to put the largest number of characteristics needed by the student and the recipient of the LMS and determine the relationship of the LMSs with detailed characteristics. Then the results are displayed in a grade manner while giving a percentage of each characteristic belonging to the LMS to be able to work on the graph clearly and easy enough to see results and develop a set of explanations for each comparison table and each graph.

1.4 The Goal of this Thesis

The main aim of the thesis is to compare the Learning Management Systems and present the results to all users (learners, teachers, and educational institutions) who are looking for LMS based on their needs using the detailed comparison method and illustrate simple and clear results. This research will provide service for universities, scientific institutions, professors, students, and each beneficiary of the LMS. It is an easy and understandable way to choose the best system and the required features and detect errors in comparison systems, provide useful techniques in systems and at the end everything that helps to development and progress in the e-learning.

1.5 Limitation of this Thesis

This thesis and the comparison of the LMSs have the following limitations:

- 1- This study is limited by the date that starts from March, 2013 until July, 2013 depending on the systems version are mentioned in this study.

- 2- This study discusses and compares the features that mentioned in the result chapter.
- 3- For the comparison of the LMSs, the total number of systems presented through this study is four (Blackboard Release 9.1, Desire2Learn Learning Suite 10, Moodle 2.5, Sakai 3.0).

1.6 Research Question

After completing this thesis, one can easily answer the question that aim to make the study understandable and more effective. The question is:

Which LMS has the best features activity with the following categories?

- a) Login, Configuration, and Compatibility Testing
- b) Personalization and Customization
- c) Navigation
- d) Forms
- e) Help and Documentation
- f) Common Student-facing Modules/Tools
- g) Authoring Tools and Content Creation

1.7 Definition of Terms

E-learning: E-learning can be defined as the use of digital technologies and media to deliver support and enhance teaching, learning, assessment and evaluation (Armitage & O'leary, 2003).

Web-Based Learning Environment: The educational environment where students can learn at any geographical place, any time of the day, at their own learning pace, whenever they feel ready, and where they can establish a two-way communication and exchange ideas with their instructor (Cavus, 2007).

Learning Management System (LMS): A learning management system is a software application or a Web-based technology used to plan, implement, and assess a specific learning process. Typically, a learning management system provides an instructor with a way to create

and deliver content, monitor student participation, and to assess student performance. An LMS may also provide students with the ability to use interactive features such as threaded discussions, video conferencing, and discussion forums. The Advanced Distance Learning (ADL) group, sponsored by the United States Department of Defense had created a set of specifications called Shareable Content Object Reference Model (SCORM) to encourage the standardization of LMSs (Cavus, 2009).

Open Source Software (OSS): Open Source software offers the source code along with the software at no charge. This enables users to change the instructions of the software, change its behavior, and add functionality and so on. It gives anyone the opportunity to participate in the development of the software project (Cavus, 2007).

1.8 Overview of this Thesis

The following chapters are more specific and will go in depth to understand more about what is going to be developed in this thesis. These chapters will contain a full analysis of the Learning Management System's features, full description of the algorithm. A set of methods have been developed which will put the systems under comparison. In what follows, an overview of the thesis's chapters:

Chapter one offers dissertation topics in general and the problems faced and the solutions proposed to solve them, it also displays the goals and objectives contained in the research.

Chapter two gives some background information about the LMSs and some literature review comes out from the research operation about the LMSs. At the end of this chapter, there is a summary of what was got out of this research operation.

Chapter three contains most of the information of the systems that have been in the process of comparison and a set of properties that was compared and extended information about each system type and its importance and how to start dealing with it and also through the footage desktop which contains a collection of fees on the properties, at the end of the chapter the importance of education systems are explained.

Chapter four analyzes the criteria of the study and its methodology; the logical and mathematical views of the work are explained.

Chapter five documents the comparison process results and everything that explains these results starting with the general features and how to get the features in details and gives the grades to each system along with the explanation of how to get these grades. In the end of this chapter there is a summary about the comparison processes.

Chapter six includes conclusions and recommendations related with the study. It denotes the most important findings and results that came out of this study and the recommendations that might be advised for such kind of studies in the future.

1.9 Summary

The biggest problem facing the user of LMSs is how to choose a system that can meet the raised needs. The main motive that led to this research is how to choose the appropriate system in the abundance of these problems and simplify the method of choice for users, universities, colleges and educational institutions. The main objective of this thesis is to compare the Learning Management Systems using a logical, clear and simple way. By using the mathematical method which gives the comparison points for each LMS according to each tested feature. The graphs are used to illustrate the results of the comparison between the LMSs used in this research.

CHAPTER 2

RELATED RESEARCH

2.1 Introduction

The Open University in the United Kingdom (WEB-1) has been providing distance education programs using the TV for several decades. It has been successfully delivering many courses including engineering courses by using the TV remote, lecture notes, and the major experiment groups. The Open University started distance education programs in 1970 and by 1980 the number of students increased to 70,000 with 6,000 students graduating each year (Isman, Barkan & Demiray, 2005). Today, more than 180,000 students use the Internet access from the Open University, before the advancement of technology computers, videos, CDs, TV, and the Internet were used as the main means of distance education. China's educational program has been established at the national level via satellite in 1986 (International Encyclopedia of Education, 1993). Satellite Education Network has more than 400 relay stations, and 30,000 receiving stations (Cavus, 2007).

2.2 Related Research

The researches and studies mentioned below are arranged by date from the oldest to the newest:

(Truong, Bancroft & Roe, 2003): They described The Environment for Learning to Program (ELP), an online, active, collaborative and constructive Environment for Learning to Program, which was currently being developed at Queensland University of Technology to help students how to program successfully at an early stage in their learning. ELP allowed students to undertake programming exercises by "filling in the blanks" of a partial program. The basic requirements of the system were an internet connection and a web browser which supported the Java Runtime Environment. Research concerning extending the environment to support collaboration between students learning to program is ongoing.

(Batpurev & Ulaanbaatar, 2005): The aim of this paper was to use recognized standards, evaluate existing OS software for evaluation in the areas of performance, customization cost and various features as required by the users in the region, using recognized standards, evaluate

existing commercial software for evaluation. In terms of performance, customization cost, various features and other associated costs, performance needs analysis of learning management systems for Pan Asia Networking, Distance and Open Resource Access (PAN-dora) network member countries. It was expected that a dozen of the most highly reviewed learning management system (LMS) products would be compared, determination requires modules, specific features and performance for the customization of the OSS, identify the DE OSS that was capable of accommodating the needs, customize the selected DE OSS for the needs, prepare comprehensive manual for the end users and developers for the customized OSS, localize into languages of PAN DLT member countries, Disseminate the DE OSS under GNU/GPL license.

As the project team consisted of four smaller teams from Indonesia, Mongolia, Sri-Lanka and Vietnam, the project teams from participating countries were collaborating with the help of mailing list, a portal site www.pandora-asia.org and other means of ICT. Three project team meetings were scheduled for the joint discussions during the implementation of the project.

Evaluation results of existing OS and commercial software available for DE in performance, compatibility, security, scalability, adoptability and cost, and other standard measures. Results of the analysis of the needs of the participating member institutions, the comparative analysis of the performance of the software with respect to these needs and identification of relative advantages and disadvantages of OS software in meeting the needs of Asian DE institutions. Recommendation on OS software that was suited to meet most needs of the DE institutions in the region Technical and user manuals in English for future customization of the recommended OSS (Batpurev & Ulaanbaatar, 2005).

(Liu, 2005): This study was endeavored to explore the present state of how instructors utilize technology in online courses. Main results showed that asynchronous discussion was understood as being necessary or essential to be used in online courses; whereas video/audio and real time chat seemed to be not that necessary or less important. In this study how the instructor used these technologies in their courses was reported in detail. Positive correspondences were found between the instructors' perceived necessity and importance of the technology and how they used it. The results of the study contributed to the relevant research, and were assessed to assist online administrators, technical and instructional support staff, and instructional designers,

offering appropriate workshops, developing superior tools by tool developers and giving consistent support.

(Van den Berg, 2005): This thesis investigated the unique characteristics of open source software for building a model to evaluate open-source software systems. The researcher found a number of unique characteristics with respect to open source software, among them the way projects are driven by the community and the openness of information which allows for a more comprehensive assessment of this type of program. These had been identified properties in the standards model to assess the open-source software.

(Susan & Cochran, 2006): This study combined the principles of usability testing designed for Industry with the principles of the Educational Testing to develop usability testing methodology that will work in a specific educational content area. The goal is to make the course more "Usable" for students while developing a methodology for usability testing that other coaches can use it to evaluate their own courses. The study was searching for patterns in the data and determines students faced problems within each task, and the problems that spanned several tasks, and similarities in students' responses and actions. The analysis is organized in accordance with the study found patterns in the data, and they will address each and every one of the questions that previously described in their discussion of these patterns.

(Özçınar, Özdamlı & Uzunboylu, 2006): This research aims to evaluate some opened sources LMSs in the market. They said that there were seventy two (72) systems available on the web, and the researchers selected eight of them to be included in their evaluation. They were: ATutor, Bazaar, Bodington, Claroline, Coursemanager, ILIAS, Moodle and Sakai. All these software were evaluated by comparing each one with the other depending on their features. The researchers used the edutools.org features' classification which includes: (1) communication tools, (2) productivity tools, and (3) student involvement tools. They found out that the best file sharing is Bazaar. Some LMSs do not support e-mail service yet users should have an e-mail from other hosts. All software supports the bookmarks except Claroline and Bazaar. ATutor supports the helpdesk and online courses about the using of software. Other software include online manual for help. All systems support the portfolio system.

been used together with the *Groupware Research in Education and the Workforce Project* (GREWP) Tool for the teaching programming languages. It appears that in common with other LMS systems, although Moodle on its own is sufficient and successful to deliver the lecture notes, it lacks the instructor-student and student-student interaction which exists in a “real” classroom environment.

(Arh & Blažič, 2007): This study described the findings of a survey-style evaluation of open source LMSs. The aim of this study is to recommend an LMS which can be implemented by Commonwealth of Learning (COL). This study identifies the criteria which will be useful in evaluating open source LMS's and then it assesses the candidate LMS by using the criteria. Finally, it recommends a LMS for installation and gets used by COL. The researchers were using the following methodology for evaluating the LMSs: (1) Develop evaluation criteria, (2) Identify open source candidate, (3) Filter candidates to produce a short-list, (4) Systematic evaluation of features, (5) Systematic evaluation of general criteria, and (6) Recommendation.

(Machado & Tao, 2007): The purpose of this study was understood the e-learning system and its development. They compared the benefit of the blackboard system and the Moodle system. The managers can also have an overview about those systems in order to decide the most appropriate e-Learning system for their organization. This study shows some Advantages of Blackboard and Moodle in the table:

Table 2.2: Advantages of Blackboard and Moodle (Machado & Tao, 2007)

Blackboard advantages over Moodle	Moodle advantages over Blackboard
- Moodle's fixed block at the top wastes screen "real estate" - Blackboard's features seem more intuitive for beginners - Already available Built-in survey tool "Resources" area Readily available for external web sites to be grouped	- Free and open source software (fewer "clicks"!) Easier maneuvering - Less area taken over for navigation - Easier multimedia Elements incorporation

Blackboard advantages over Moodle	Moodle advantages over Blackboard
• More polished appearance • Better grade book • Threaded discussions easily differentiate between read and unread posts • Announcements are more prominently displayed upon entering the course	• More available tools (journal, Lesson, poll, glossary) • Student activity Tracking to see the preferred parts of the course • Quiz tool scores correctly and offers student's use details • Can be modified to add desired

This study was given enough information about the two systems and clarifies the importance of the systems. The study discussed the structure, functions and usage issue, and at the end of the research it was shown that Moodle has functions and features more than Blackboard.

(Rusch et al., 2008): The aim of this study was develop a model to evaluate educational software in children schools with non-professional evaluators. It emphasized the importance of the role of a peer review in the selection of educational software. The author defined the usability and the human-computer interaction as: "The effectiveness, efficiency, and satisfaction with which specified users achieve specified goals in particular environment". He classified the usability to some functions: Easy to learn, easy to use, easy to remember, few errors, and subjectivity pleasing. This study offered a usability evaluation method depending on four main features: (1) usability testing, (2) usability inspection, (3) usability inquiry, and (4) modeling and simulation. It also introduced the most important usability methods. In general, children reported that this page was fun. There were no negative comments on the colors. Both children and the parents really liked the song. Children, especially the younger ones liked the objects that moved around and made noises (i.e., the sign that went "boing!" the boy dribbling the ball, and the hat that flew off of the man's head in the far back of the page).

(Momani, 2008): This Master thesis offered a web-based application to create an evaluation process to LMSs. The goal here was develop an intelligent decision making algorithm that will evaluate some LMSs over the web in order to provide a web-based DSS which helps the users to choose the convenient system depending on their needs and their usage using some artificial

intelligent concepts with fuzzy logic values. This project considered to be useful to do any evaluation process to any set of Learning Management Systems based on some of the features needed. It was also possible to make a lot of comparisons between the Learning Management Systems based on the descriptions of their properties and give an opinion or point of view on any LMS or even discuss any advantage of any LMS offered in the system, regardless of the user's experience level: Expert, administrator, and end-user. Thus, performing any evaluation operation to any group of LMSs based on some features you need became easier and understandable. It is also possible to make a lot of comparison operations among the LMSs depending on their features' descriptions, giving the opinion or the viewpoint about any LMS or even discussing any feature of any LMS offered in the system, regardless of the level of your experience: expert, administrator, end-user or anyone else. This system was designed and programmed by using the MS-Visual Studio .NET and its database was designed by using MS-SQL Server .NET

(Martin et al., 2008): This paper was presented to evaluate the usability of three of the most well-known open Learning Management Systems: Moodle, Sakai and dotLRN. Five usability experts have participated in this study based approach to tasks. After the completion of the tasks, every resident filled out a paper record data. This table was based on 10 Nielsen data Heuristics, which are detailed in more than 300 usability checkpoints. This analysis was an initial attempt to compare the three platforms from the experience of the user's point of view, unlike the traditional analysis which focuses on technical issues and job performance. With regard to methodology, notes have been taken that possible improvements could be made in a future study and improving one is to add more difficult tasks to test platforms promote and facilitate the filling checkpoints, such as registering with the same username (to force an error), and heavy load a file (to check from time to wait and wait message), or delete the downloaded file (to check the reflection of the work). The last improvement is a refinement over the checklist by removing checkpoints, which have been notified as have nothing to do all 3 platforms. The results showed that the dotLRN has got the highest grades in this evaluation, while Sakai got the second place, very close to the degree dotLRN. Yet, Moodle took the last place.

(Velasco et al, 2013): Authors, at the time one of the senior managers of the previous IPOL, was commissioned by Pro Vice-Chancellor of learning and the quality of the investigation and write a case study With regard to the implementation of Moodle in the university more than

2009-10. As is the case Constructed study of views and perspectives from different staff College students, the review was conducted using qualitative methodology and included interviews and analysis of primary and secondary sources Eight. The interviews were identified using the technique of "snowball" And involved seven university staff and two students, who are studying in higher one Education and one at TAFE. The umbrella body included two officers and LMS Director LEWS Department who were responsible for the implementation of the Project through the university. The remaining four participants on Flexible Learning Technology officer in the field of technical education, and three supplementary Moodle users are responsible for teaching: Two TAFE teachers in higher education and one academic. There have been many surprises in this case study: the laissez-faire approach to what seems To manage the project worked, that the presence of high-caliber staff LMS was on an equal footing, at least The importance of the details of the emerging technology, and the change seems Have a place in the LMS applications. For this writer, who believes that the traditional Management of the project in line with the complexities of regulatory and non-life Silent on the level of competent staff bring to their work experience, the success of any emerging approach to change management uplifting.

(Cavus, 2011): The aim of this study was to identify the benefits of using LMS-EW for choosing the best LMS in terms of educational needs and the type of teacher to use. Furthermore, it has been an investigation to find out the views of trained persons on the feasibility of the developed system. The evaluation system was developed according to the standard user interface which is based on a specific standard and this proved to be an obstacle to the system. The use of English as the language of interaction in all steps of the system. It contained some links to associate the coach with the main parts of the system. For example, the LMS evaluation and comparison part products, and of Information products segment.

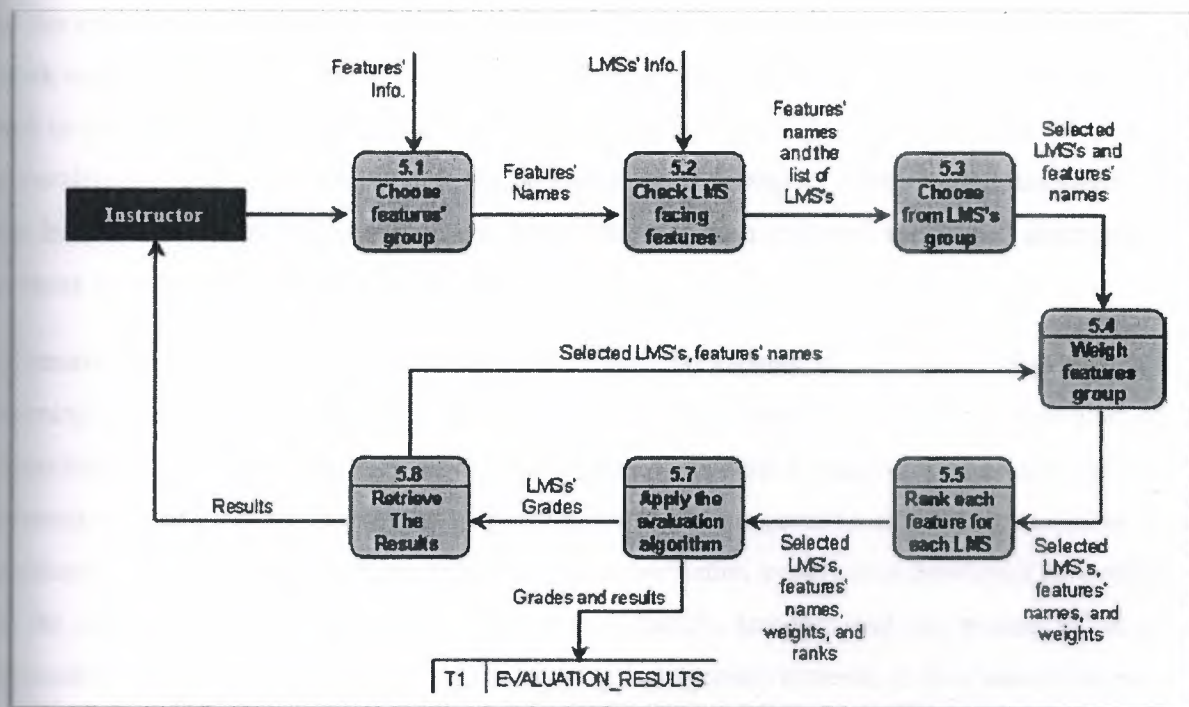


Figure 2.1: Data flow diagram of the evaluation process (Cavus, 2011)

(Krishnamurthy & O'Connor, 2013): The objective of this research was to develop the process that generalized OSSD will enable OS community to work together and develop more efficient E-learning systems OS. The fundamental issue that determined the development of the OSSD new process, "What approach should be adopted In order to design the generalized OSSD process?" The answer to this broad Question is to be divided into four basic researches but important Questions. And revisit this in order to ensure that the answer to this research issues were considered perfectly with the development of new OSSD Process.

To start off, samples from various e-learning systems OS were taken and three has been chosen as commonly used e-learning systems OS basis. These Include, Moodle, ILIAS and the Dokeos. At a later time and development practices were analyzed for each of the three e-learning systems OS which led to a deeper understanding of their current practices.

It can also be written as this question because "How the proposed OSSD of the process should be evaluated? ". Although the process has been designed OSSD proposed basis for the development

of the operating system Community, in this case, it has been developed as a research master's work conducted in an academic environment. Thus, due to the time and resources restrictions, and to validate the proposed OSSD using "expert review" method. Accordingly, the proposed generalized OSSD was presented to three external experts as well as a detailed questionnaire on the Internet. Based on their observations, the results were then analyzed and OSSD amendment process was proposed and used whenever necessary.

(Kumar, 2013): The purpose of this paper is to help participants in the process of selecting a learning management system (LMS) to make an informed decision. This paper provides a set of considerations for the selection of the system; it does not contain a comprehensive survey of the systems available in the market, as they do not contain comparative rating or evaluation of products, and should not be construed as such. The evaluation system was developed according to the standard user interface which is based on a specific standard and this proved to be an obstacle to the system. Turned many of the learning management systems, in their search for new horizons of jobs in addition to their system to add value for customers, to authoring and knowledge management additions. Authoring is a natural addition to the many learning management systems, because it moves in LMS closer to being LCMS, which derive many advantages that allow for LCMS (excluding content repository) without losing the basic components for LMS.

(Mahar et al, 2013): The study compared log files of four distinct weeks of the summer semester 2012 which we estimated as characteristic weeks in the WU semester plan. In total, we processed 264,837 log file entries. The first week comprised the Easter holiday, a period with usually modest traffic on Learn@WU (named 'holiday'). The second week comprised the week before the mid-term exam period (named 'pre-exam'). Students usually learn intensely for their exams in this week. The third week comprised the mentioned mid-term exam week (named 'exam'). At the WU, there are 6 exam weeks distributed among the academic year, and we estimated that the students' learning activities on Learn@WU before and during the exam weeks might differ from other periods. Finally, the fourth week comprised the week after the mid-term exam week, and thus a week with potentially somewhat usual student activities on Learn@WU (named 'post-exam'). In this paper we have proposed an educational data mining approach to identify and compare seasonal effects on the basis of patterns of learning activities of users

within an LMS platform. By comparing the data-set of several weeks, our case study showed that different seasons can be characterized e.g. through basic statistics on the data-set, rank/frequency plots of sequential activity patterns or types of learning sessions identified via PCA. Consequently, we showed that the intensity of platform usage as well as certain learning activities are highly dependent on the season within an academic year. Although our analysis is limited to four weeks of one semester only, we believe that our approach to detect seasonal effects can be used to improve the platform and for possible personalization and context adaptation features.

2.3 Summary

As a result of reading these eighteen research and academic papers for the purpose of knowing what is new in the field of decision-making that were applied to evaluate and compared learning management systems, the following results are collected:

- The most evaluations conducted by increasing but not enough. Scientific research is needed.
- Each evaluation process gives us an independent rating of Learning Management Systems' features which are focus on educational, administrative and technical features.
- It is possible to run two or more of the Learning Management Systems in parallel within one educational institution in order to assess which one works better than others depending on the views of students and teachers.
- The most evaluations conducted on open source systems such as Moodle, on assistance, and Elias.
- In Learning Management Systems most open source operating platform requires Linux, Apache, MySQL, and PHP; referred this group of applications, such as a lamp.

CHAPTER 3

CONCEPTUAL FRAMEWORK

3.1 Overview

This chapter contains most of the information of the systems that have been in the process of comparison and a set of properties that was compared and extended information about each system type and its importance and how to start dealing with it and also through the footage desktop which contains a collection of fees on the properties, at the end of the chapter the importance of education systems are explained.

3.2 E-Learning and It's Features

E-learning can be followed anytime anywhere, classroom learning has a limitation of time and space, E-learning can include audio, animation, video, simulations, and online resources, e-learning lends itself to the user to develop their own learning pace (Wu et al., 2010). When organizations consider e-learning, in the first place, it is important that the quality of the e-learning system at point state (Salas & Bowers, 2001). A well designed e-learning tool is an important factor that influences learning effects and satisfaction with e-learning (Piccoli et al., 2001). The quality of an e-learning system is based on the model (Medina & Chaparro, 2007) which is divided into three components, namely the quality of the obtained information, the quality of services, and the quality of the e-learning system itself. The quality of the information provided refers to the quality of the output, such as the scope, relevance, and accuracy. The accuracy of the information is generated by the information system (Seddon, 1997). The second component, the quality of the services, which can be defined as the actual physical aspect of the system, namely the reliability, responsibility, and empathy, as well as the confidence of the e-learner in the online support (Ho et al., 2010). Finally, the quality of the e-learning system includes the reliability of the system itself, the interface consistency, the quality of the documentation, the ease of use, and the quality and sustainability of the program code found a significant positive relation between the three components and the development of competencies of e-learners. Different researchers (Allen et al., 2004) found positively that each of the above components is related to the satisfaction of e-learners, in the second place, it is not only the quality that is important but also the content.

It is worth mentioning that e-learning can be effectively taken into account for the one course content but ineffective for another, which makes e-learning usable but not for all purposes. For example, e-learning according to (Allen et al., 2004) offers advantages in learning of foreign languages. The underlying idea is that easier access is made to interact with people whose foreign language is their mother tongue. However, more research in order to decide what the best course topics fit learning through e-learning and which course topics are best learned via traditional methods.

So on, one can also take into account the manner in which the information is transmitted in a training context. The nature of the communication channel is after all extremely important to distinguish the difference between e-learning and traditional learning or between different forms of e-learning. In the meta-study by Allen et al. (2004), there were three different channels: video audio and written text. The researchers found that, in an e-learning tool when transferring the instructions by a video channel and a written channel instead of a traditional design, a slightly higher level of performance occurred. The use of an audio channel showed a slight negative effect over the use of a traditional design.

Fourthly, also gives control to the trainee about what he / she will learn this is an important characteristic of the e-learning tool. Giving control to the trainee is usually seen as a tool for the motivation of the trainee. However, not always associated with better training outcomes, also Brown (2001) showed that trainees often make poor choices as they take control of their own learning. He noted that sometimes the trainee's early termination of the course causes them to skip important learning opportunities. Instead of giving the trainees the full control it would be better to ensure custom accompaniment. Custom accompaniment can be defined as a training strategy where trainees receive information that will help them to more effectively take courses. Learning decisions found that custom accompaniment improves basic and strategic knowledge and performance (Bell & Kozlowski, 2002).

3.3 Previous Studies and Experiences in E-Learning

E-learning techniques evolved considerably and widely prevalent in previous years in most countries of the world and have become effective tools in the transport and delivery of scientific information to the faculty and students in different countries. Where are these techniques are the

most important developments in the field of communications and thus led to the development of teaching methods courses, according to these new developments, where it developed the world in front of a new revolution in the field of education and opened a Hobo vast new types of education and training in all educational institutions especially in higher education.

3.3.1 American Experience

In the U.S., most universities offer some sort of e-learning and virtual-based computer and communications technology. it operates these universities in addition to research centers and companies specializing on the employment of all that is new in the world of computer, communications, consumer electronics for the development of educational materials, electronics and facilitates access to it as well as providing effective means for the interaction of the learner with educational material online (Schwartz, 2012).

3.3.2 British Experience

The United Kingdom (UK) is one of the leading countries in devising ways and new methods in education, particularly with regard to the modalities of open learning and distance education to suit the needs of the learner and the global labor market.

The increased pressure exerted by the government to colleges and universities in the United Kingdom to increase the number of students enrolled within 18-30 years old was up to 50% in 2010, for the educational institutions in the UK their major challenges was to accommodate the growing number of students on one hand and develop their skills on the other hand. Hence the need to increase the learning resources through the adoption of new technologies will form the main part of the teaching and learning strategies with educational institutions (Jan, 2012).

3.4 History of Learning Management Systems

Walker (1991) knew there had to be some kind of tool that would enable people to communicate with each other without being in the same place at the same time. Learning management systems (LMSs) also sometimes known as course management systems (CMS) have come a long way since those early days (Heller et al., 2012).

3.5 Definitions of Learning Management Systems

When there are multiple definitions about what is an LMS both in the field of academic and practical, there are some similar views on the meaning of LMS. Basic description is a software application that automates the management, tracking, and reporting of training events (Dung & Florea, 2012). They underlined that it's not simple and any LMS should be able to do the following:

- Centralized management and automation,
- The use of self-service and self-directed services,
- Assemble and deliver learning content quickly,
- Promote training initiatives on a scalable platform on the web,
- Portability and standards support,
- Customize the content and enable the re-use of knowledge.

LMSs range from systems for managing training and educational records to software for distributing online or blended/hybrid college courses over the Internet with features for online collaboration. Colleges and universities use LMSs to deliver online courses and augment on-campus courses. Corporate training departments use LMSs to deliver online training, as well as automate record-keeping and employee registration (Askew, 2012). Learning Management System is a widespread term given to a wide range of systems that organize and provide access to online educational services for students, teachers and administrators. LMS is a software designed to simplify the administration of various types of learning and/or training programs within organizations (Paulsen, 2002). Also an LMS is a system designed to create and manage teaching materials for blended learning (distance or classroom-based). It is first and foremost a space used to centralize learning content, rendering it easy to search, identify and reuse at any time, whatever the training needs; the LMS provides tools for creating training content that is then manipulated by the teaching design teams, not by the learners (Jeong & Hong, 2012).

3.6 Importance of Learning Management Systems

Many universities and learning centers are using e-learning since it is very effective at a lower cost. Developing these systems is quite cheap in comparison to arranging classroom materials and even training the trainers, particularly if using multimedia or highly interactive methods. Yet, delivery costs for e-learning along with the costs of the web servers and internet techniques are much lower than those for classroom materials, instructor time, participants travel and the time lost just to attend the classroom sessions.

As for the term online machine learning, all forms of electronically supported teaching and learning are included in e-learning, in addition to educational technology. The communication systems and information, serve as a specific media to implement the learning process regardless of being networked learning communication systems or not. This most of the times involves both in-classroom and out-of-classroom educational proficiencies via technology, although progresses carry on in regard to curriculum and devices. Abbreviations like Web-Based Training (WBT), Internet-Based Training (IBT) or Computer-Based Training (CBT) have been used as substitutes of e-learning. E-learning is the computer and network-enabled transferring of knowledge and skills. E-learning processes and applications include computer-based learning, Web-based learning, digital collaboration and virtual education opportunities. Content is provided through the intranet/extranet, Internet, video or audio tape, CD-ROM and satellite TV. It can be instructor-led or self-paced and contains media in the form of image, text, animation, streaming audio and video. It is usually thought that a big difference in education can be made by new technologies. In particular, children under their parents' monitoring can interact with new media and develop their knowledge skills and perception of the world. Many e-learning proponents believe that everybody must be prepared with the basic knowledge of technology and be able to use it as a tool to reach a certain goal.

The LMSs that are used in the research are explained in detail as following:

3.7 Blackboard Release 9.1

Blackboard Learning System (<http://www.blackboard.com>) is a virtual learning environment. Blackboard course management system is developed by the company which is the server software on the Internet, which is characterized by management course, an open architecture,

customizable, and scalable design that allows integration with the student information systems and authentication protocols. It can be installed on local servers or hosted by Blackboard ASP solutions. The main purpose is to add elements of online courses traditionally delivered face to face and the development of fully online courses with little or no meetings face-to-face.

The Blackboard Learning System is an industry-leading software application used to power virtual learning environments, supplement classroom education and as a platform for distance learning programs. Featuring a robust core set of capabilities that enable instructors to efficiently manage courses, author content, create assignments, and foster collaboration. Among other key functions, the Blackboard Learning System helps institutions to accomplish mission-critical objectives related to instruction, communication and assessment (Thacker, 2012).

3.7.1 History

In 1997, two education consultants – Matthew Pittinsky and Michael Chasen – formed Blackboard LLCC (Lincoln Land Community College) and were contracted to help leading the formation of the Educause IMS standards group for online education technology. At the same time, a Course Info LLC at Cornell University was developing a software product that would power online education and be scalable for wider institutional application. Recognize the high request for developed and easy-to-use and affordable online education software platform. The two groups merged to form Blackboard Inc., which then developed the Blackboard Learning System (Bradford et al., 2007).

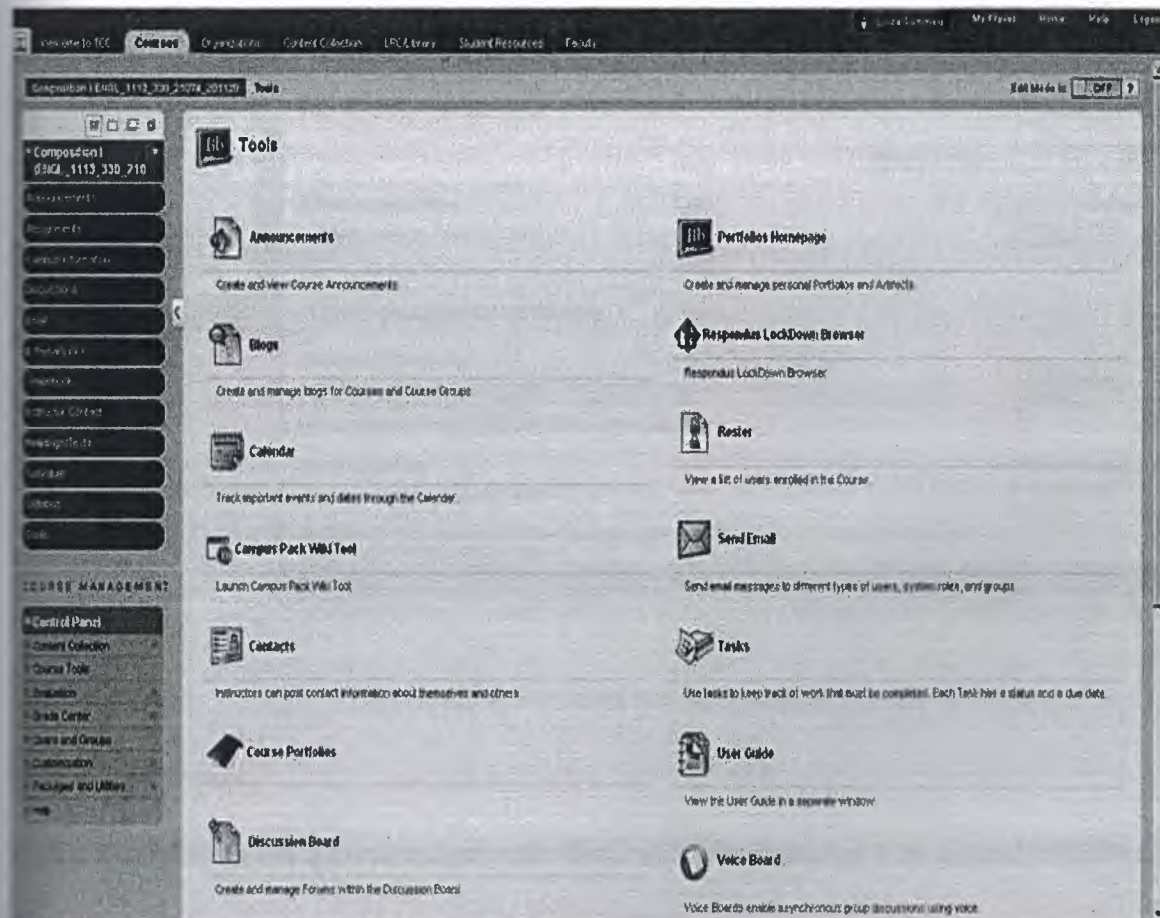


Figure 3.1: Blackboard features snapshot

3.7.2 Some Features

As we will see in the Figure 3.1, the features list in blackboard that will explain some of it in this chapter.

3.7.2.1 Announcements

The teacher use announcements for immediate dissemination of information in a timely manner to his/her students. If the teacher uses the default settings of his/her students, they will see the first area Announcements when they log on to the class.

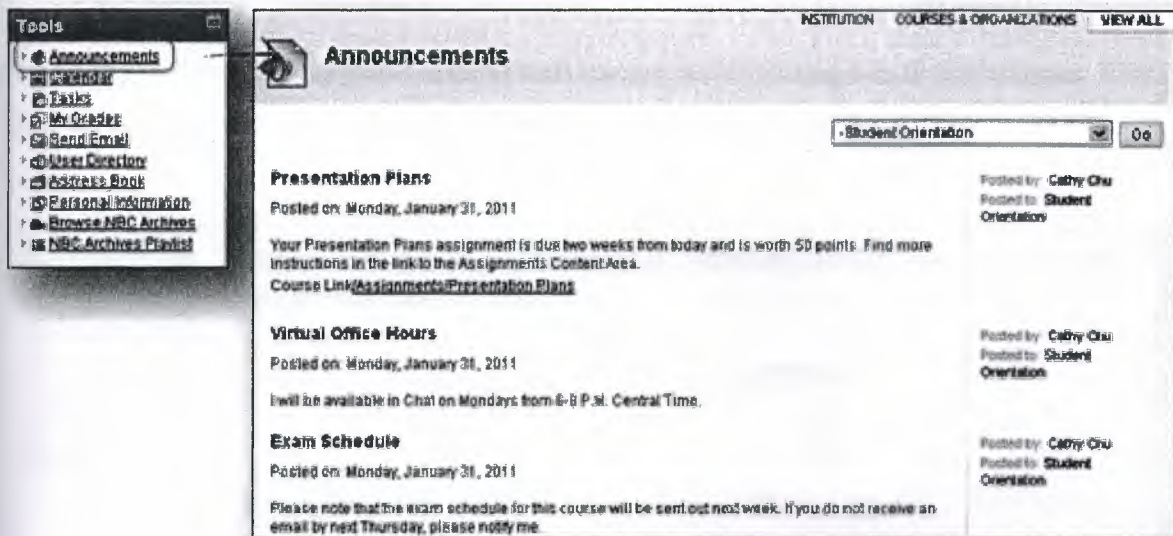


Figure 3.2: Blackboard announcements

3.7.2.2 Assessments

The student takes online quizzes and provides them with instant feedback. A total of 18 different types of multiple choice, fill in the blank, matching, true / false, ordering, essay / short-answer questions are available.



Figure 3.3: Blackboard assessments

3.7.2.3 Digital Drop Box

It allows the students to send their duties to their teacher without using e-mail attachments. This will result in a greater communication between the students and the teacher.

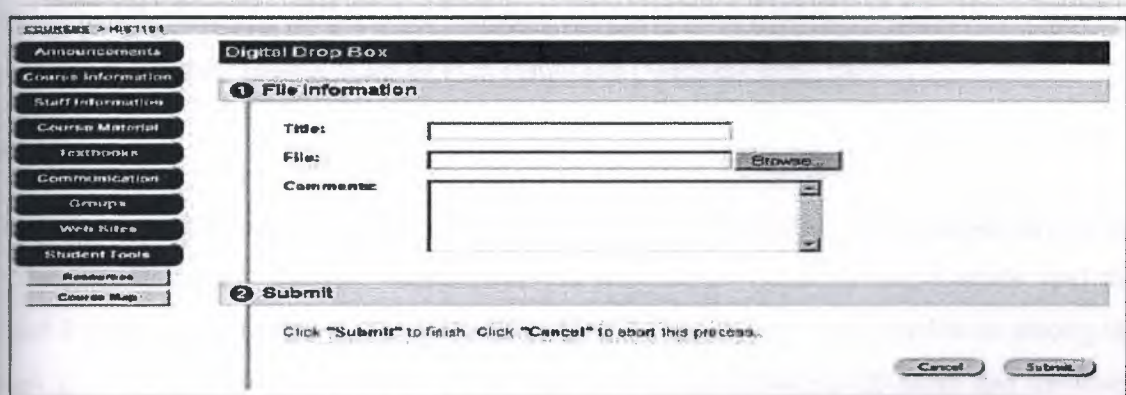
The screenshot shows the Blackboard Digital Drop Box interface. On the left is a vertical navigation menu with buttons for 'Announcements', 'Course Information', 'Staff Information', 'Course Material', 'Textbooks', 'Communication', 'Groups', 'Web Sites', 'Student Tools', 'Resources', and 'Course Map'. The main content area is titled 'Digital Drop Box' and is divided into two sections. The first section, '1 File Information', contains three input fields: 'Title:', 'File:', and 'Comment:'. The 'File:' field has a 'Browse...' button next to it. The second section, '2 Submit', contains a line of text: 'Click "Submit" to finish. Click "Cancel" to abort this process.' At the bottom right of the main area are two buttons: 'Cancel' and 'Submit'.

Figure 3.4: Blackboard digital dropbox

3.7.2.4 Personnel Information

The teacher uses this to provide their contact information, hours of work, and a personal website if they have not written this information in their curriculum.

3.7.3 Worldwide

- North America: Canada, Greenland, Mexico, United States.
- Asia pacific: approximately all the countries.
- Latin American and Caribbean: Antigua & Barbuda, Argentina, the Bahamas, Barbados, Belize, Bolivia, Brazil, and also many countries.
- Europe, Middle East and Africa: Aland Islands, Albania, Algeria, Andorra, Angola, Austria, Bahrain, and also many countries in this side of the worldwide. (<http://www.blackboard.com/international/overview.aspx>).

3.8 Desire2Learn Learning Suite 10

Desire2Learn Incorporated (also known as Desire2Learn or abbreviated as D2L) is a provider of enterprise eLearning solutions and develops online Learning Management Systems (LMS) used at more than 650 institutions in 20 different countries around the world. Cloud-hosted or on-premise, and the learning environment include a comprehensive offering of online tools that can be tailored to meet the unique needs of each institution (Manning et al., 2012).

3.8.1 History

The company was founded in 1999 by President and CEO John Baker. The headquarters of the company in Kitchener, Ontario, Canada, and his staff in the United States, Canada, and the United Kingdom, and Australia. The technology back in the 50's was considered to be among the fastest growing technology companies in Canada and is one of the top 50 small and medium-sized employers for two consecutive years 2011 and 2012. Desire2Learn was named in 2012 for the business year in Kitchener and Waterloo room - Grand Awards of Excellence for the business sector (Chawdhry et al., 2011). As we will see in the next figure 4 the features list in D2L10.

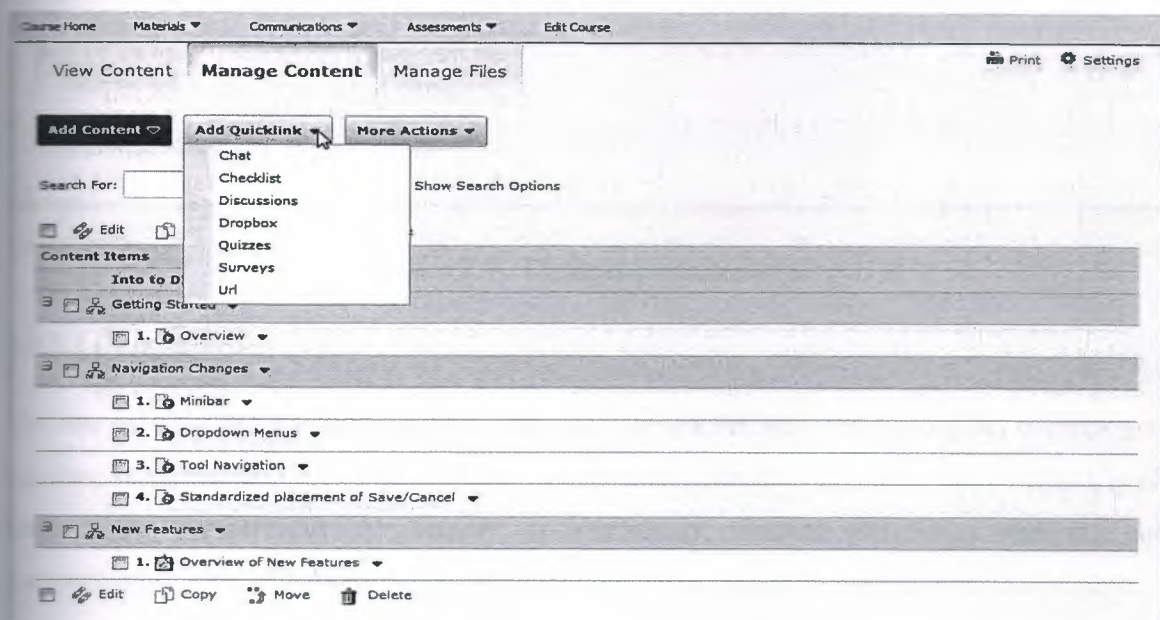


Figure 3.5: Desire2learn features

3.8.2 Tools

3.8.2.1 Checklist

A checklist is a way to highlight important or required duties, readings, or other items to complete. A checklist may list all the items the teacher needs to complete at one time, or the teacher may receive some items as students complete the other items. Each list contains one or more of the categories, which are organized in terms of reference. For example, the teacher may have "appointments" with reference categories for written tasks and competitions, both of which can have multiple items that need to be completed.

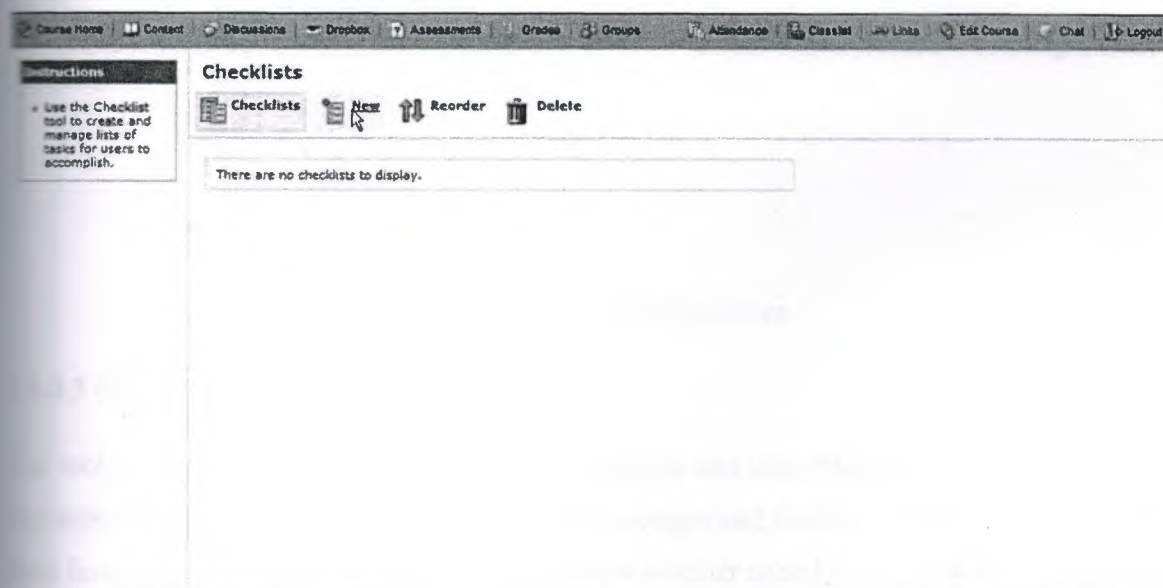


Figure 3.6: Desire2Learn checklist

3.8.2.2 Quizzes

The use of tests tool for managing the tests that the teacher has created, copied, or imported; opinion; management questions using the library issue; preview, organize, and students grade tests; Show competitions by category or availability; Current and future and the past competitions course and statistics Competition; and create categories and put the tests in them.

Quiz List

Without Category

Week 1 Quiz ▼

Jan 4, 2013 10:10 AM - Jan 5, 2013 10:10 AM

Unit 2 Quiz ▼

Jan 28, 2013

Submissions
Reports

M

Figure 3.7: Desire2learn quizzes

3.8.2.3 Grade Book

The tool is used to check their grades signs in the tasks and tests. Students can see their grades and individual comments, as well as the category averages and feedback. Students can also view their final grade and mark the formula used to assess whether issued by your grades.

Coaches can set up the Grade book to reflect the approach of the evaluation. They are trained to control the grading formula used to calculate the grades; classified what are the projects, assignments, tests, etc., and how they relate to the degree of material with other tools, and when the scores are released to users and what information is to be seen.

Integrity Statement - Grade



Users Attempts Questions

Display Options

Update Export to Grades Export to CSV file

View By: User Apply

Search For: Search Hide Search Options

Search In: ☒ First Name ☒ Last Name ☒ User ID

Restrict to: Users who have completed an attempt

100 per page

First Name ▲, Last Name	Completed	Score	%	G
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Figure 3.8: Grade book

3.9 Moodle 2.5

3.9.1 Overview

Moodle (**M**odular **O**bject-**O**riented **D**ynamic **L**earning **E**nvironment) is a course management system (CMS) - a free, open-source software package designed using sound educational principles to help educators create effective learning communities online. It has a free course management system used by thousands of educational institutions all over the world. Moodle provides an interface for the organization e-learning or online learning. It allows teachers to build online courses, which students can access in a virtual classroom.

Moodle Statistics

Registered sites	83,040
Countries	236
Courses	7,517,416
Users	70,590,132
Teachers	1,294,569
Enrolments	66,211,848
Forum posts	125,956,811
Resources	67,456,928
Quiz questions	182,209,813

Figure 3.9: Moodle statistics (Kats, 2013)

Moodle is a learning management system developed by teachers for academic uses and offers a multitude of channels for different learning activities. Faculty can download documents, assignment instructions and links to sites on the internet and the media. In this, a password-protected environment safe, learning can be extended beyond the boundaries of the traditional classroom setting through chat sessions, discussions, areas of cooperation, contests, surveys and more (Kats, 2013).

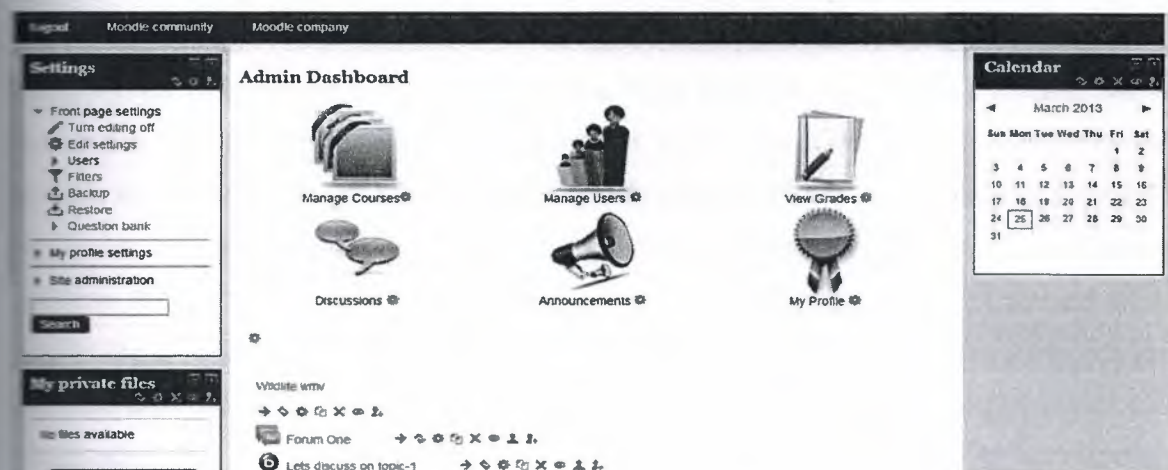


Figure 3.10: Snapshot of the main page of Moodle

3.9.2 The Most Powerful Characteristics of Moodle

- Moodle is software that enables you to create courses, activities and communities online.
- It is open source software which means that it is free to download and free to use - there are no license costs. You are also free to modify or extend Moodle to suit the needs of your organization.
- Moodle is installed on a server and is accessed by end users using their web browser - Internet Explorer, Firefox, Safari etc.
- It is flexible and fully featured - you choose how to use it in your organization and how much of Moodle you want to use e.g. for making content available, for assessment, communication, collaboration.
- It also allows you to monitor learner activity.
- There are over 50,000 registered Moodle sites worldwide.
- You can download Moodle for free here <http://download.moodle.org/>
-

3.9.3 Software Architecture

Moodle was made by means of free of charge web technologies. The exemplary diagram of the system application is presented in Figure 3.10 the web server was programmed using PHP technologies. The database used can be: MySQL or PostgreSQL.

It is implemented by PHP technology and allows choosing one of many web servers whose task is to make teaching contents accessible. In this case, Futa's (2005) study showed the structure of Moodle LMS by taking it as a suitable example helps to show the software structure. So, he chose open source technologies - Apache program. From a technical point of view, it is also possible to take advantage of other commercial web servers. This is significantly important for companies and institutions that aim for the security policies when choosing open source software. An important feature of Moodle is the possibility of separating the mechanisms which permits the users to carry out multiple tasks by the platform. Futa's (2005) system provided more than one database. This can be of great importance in the field of software implementation in organizations that have a large number of potential users, such as a university. An administrator can change its learning platform base. This role is generally performed by the servers

communicate via protocols: Directory Application Protocol (LDAP), Internet Access Protocol (IMAP), and Post Office Protocol (POP) (Futa, 2005). The Figure 3.10 related to Futa's (2005) research.

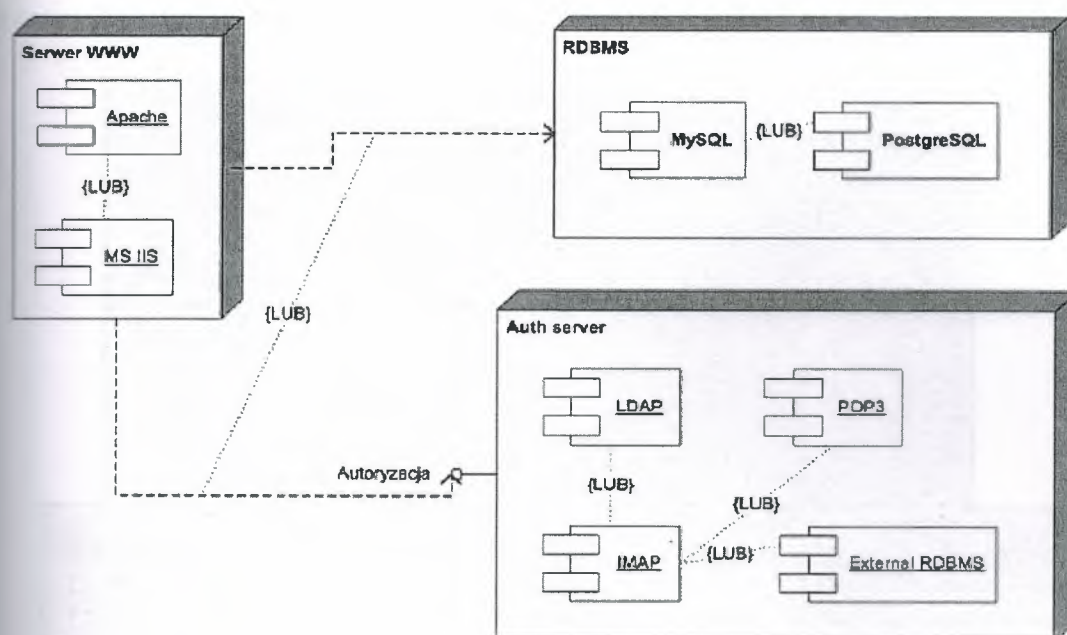


Figure 3.11: Software architecture (Futa, 2005)

3.9.4 Features

3.9.4.1 User Interface

The initial interface can be customized differently in each system but the above is the standard type of layout. In Moodle, the instructor interface in Moodle is much more intuitive and easy to use than the instructor interface in Blackboard. Moodle interface shows the instructor what the student sees with the addition of a common set of editing tools to the right of each course activity. Moodle is unable to edit posts while Blackboard system can easily allow post authors to modify their own posts by selecting the appropriate setting when a forum is created (Beatty & Ulasewicz, 2006).

3.9.4.2 Administration

The Administration control panel puts all important learner management functions a single click away. Teachers and students can be manually enrolled or removed from a course. Configuration of course Backup and Restoration is achieved on a single screen.

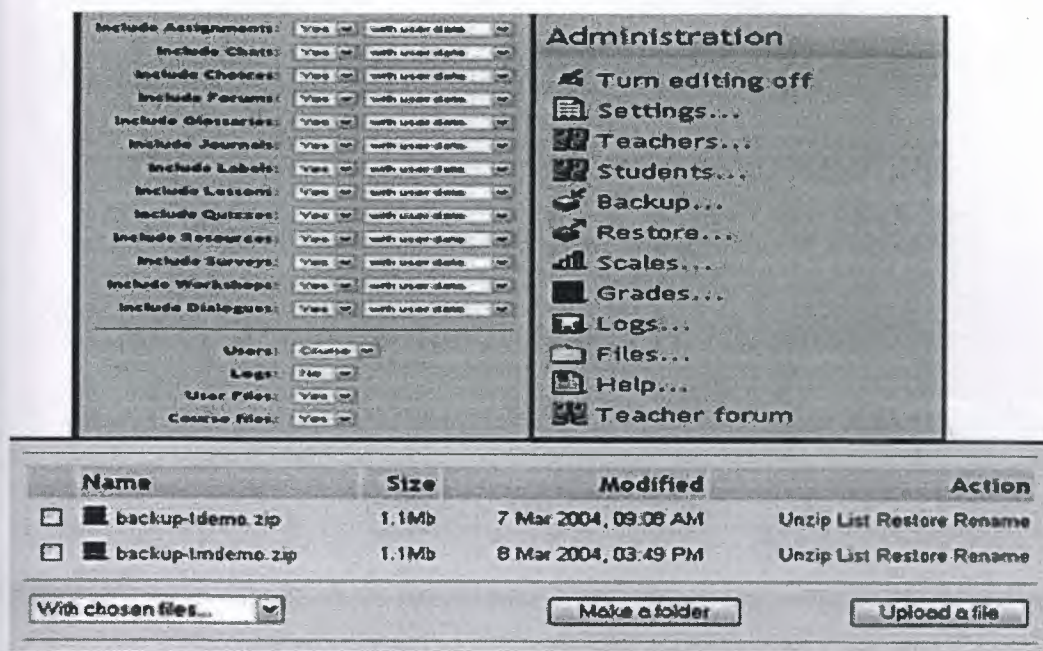


Figure 3.12: Moodle administration

3.9.4.3 Login

Learners find it easy to navigate a Moodle course homepage in their browser; intuitive “breadcrumb” links are always present. Login occurs on a familiar screen. Initial account set up may be handled by the learner or the administrator.

Returning to this web site?	Is this your first time here?
Login here using your username and password: (Cookies must be enabled in your browser) ⓘ Username: hipindritter Login Password: •••••••• Some courses may allow guest access: Login as a guest Forgotten your username or password? Send my details via email	Hi! For full access to courses you'll need to take a minute to create a new account for yourself on this web site. Each of the individual courses may also have a one-time "enrollment key", which you won't need until later. Here are the steps: 1. Fill out the New Account form with your details. 2. An email will be immediately sent to your email address. 3. Read your email, and click on the web link it contains. 4. Your account will be confirmed and you will be logged in. 5. Now, select the course you want to participate in. 6. If you are prompted for a "enrollment key" - use the one that your teacher has given you. This will "enroll" you in the course. 7. You can now access the full course. From now on you will only need to enter your personal username and password (in the form on this page) to log in and access any course you have enrolled in. Start now by creating a new account!

Figure 3.13: Moodle login page

3.10 Sakai 3.0

Sakai (<http://www.sakaiproject.org/>) is a community of academic institutions, commercial organizations and individuals who are working together to develop joint cooperation and learning environment (CLE). The Sakai CLE is a free, community and educational platform source software distributed under license educational community (which is a type of open source license). The Sakai CLE is used for teaching, research and cooperation. It is also known as systems such as course management systems (CMS), Learning Management Systems (LMS), or Virtual Learning Environments (VLE). Sakai project software is Java-based, service-oriented group of applications that have been designed to be scalable, reliable, interoperable and extensible. Version 1.0 was released in March 2005; a global, diverse group of individuals and organizations interested in and motivated to support Sakai the software and each other (VandenDriessche et al., 2012).



Figure 3.14: Sakai statistics (VandenDriessche et al., 2012)

Sakai 3.0 release involves major re-design of Kernel software (<http://www.sakaiproject.org/>) as well as significant changes in the user's interface and navigation. Sakai 3 seeks to dissolve the border of the site and allow the creation of interactive learning spaces that can be linked separately with groups; create a simple page, Interactive widgets and interface transfer molding away from the current over-reliance of it on Workflow tool focused on building customizable, and flexible content creation and the ability to sequence activities and content by integrating this directly on the page. The content is no longer being connected to the site but it can be associated with any individual or group; individuals or groups can be joined together in an academic network and finally the new system seeks to provide dashboard extended user / content management portal users and academic or personal Telecom as well as their entry into the session and project spaces (Khoo et al., 2011).

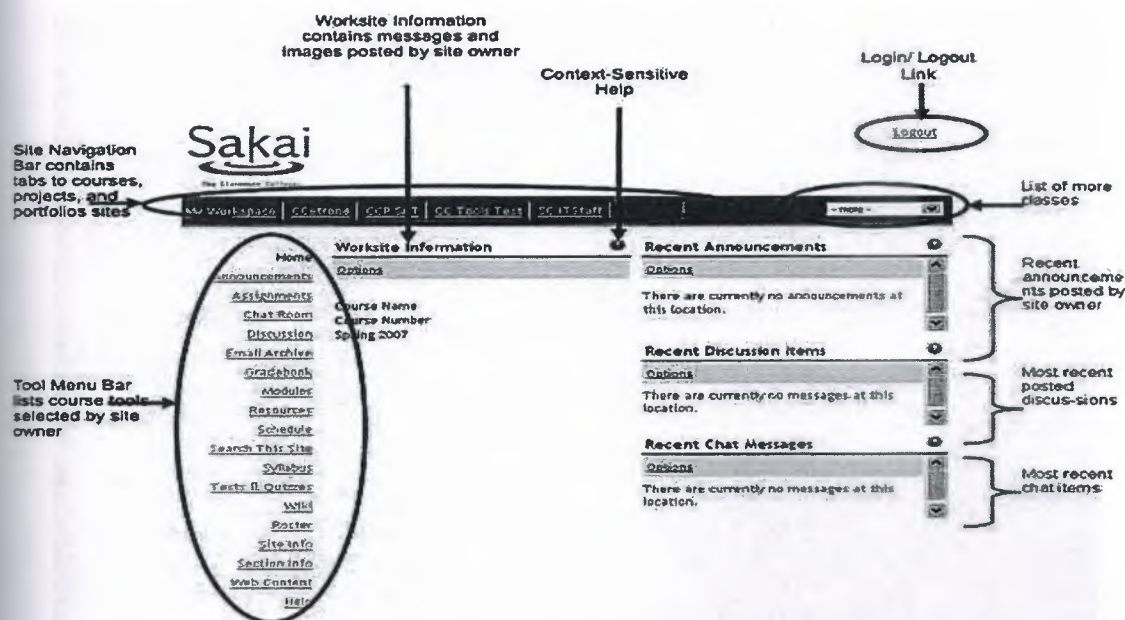


Figure 3.15: Sakai features page (Khoo et al., 2011)

3.10.1 Sakai Enterprise Technologies

Sakai is aimed at Enterprise Deployments. Sakai supports organizations with > 100,000 users in a single installation, Sakai consists of technologies chosen to be common in Java Enterprise Environments, and Sakai is a standard application-level N-production enterprise. UM devices (UM Wireless Network uses web-based authentication to allow access to the network) comfortably supports 5,000 users at one time (500 + per application server). Application servers can be dynamically added or dropped from the cluster (cluster is self-regulation). In this UM works in the field of production just like PeopleSoft or any other products with 24x7 application support rolls controlled production, etc. (i.e., developers do not have access to all the devices to production) (Khoo et al., 2011).

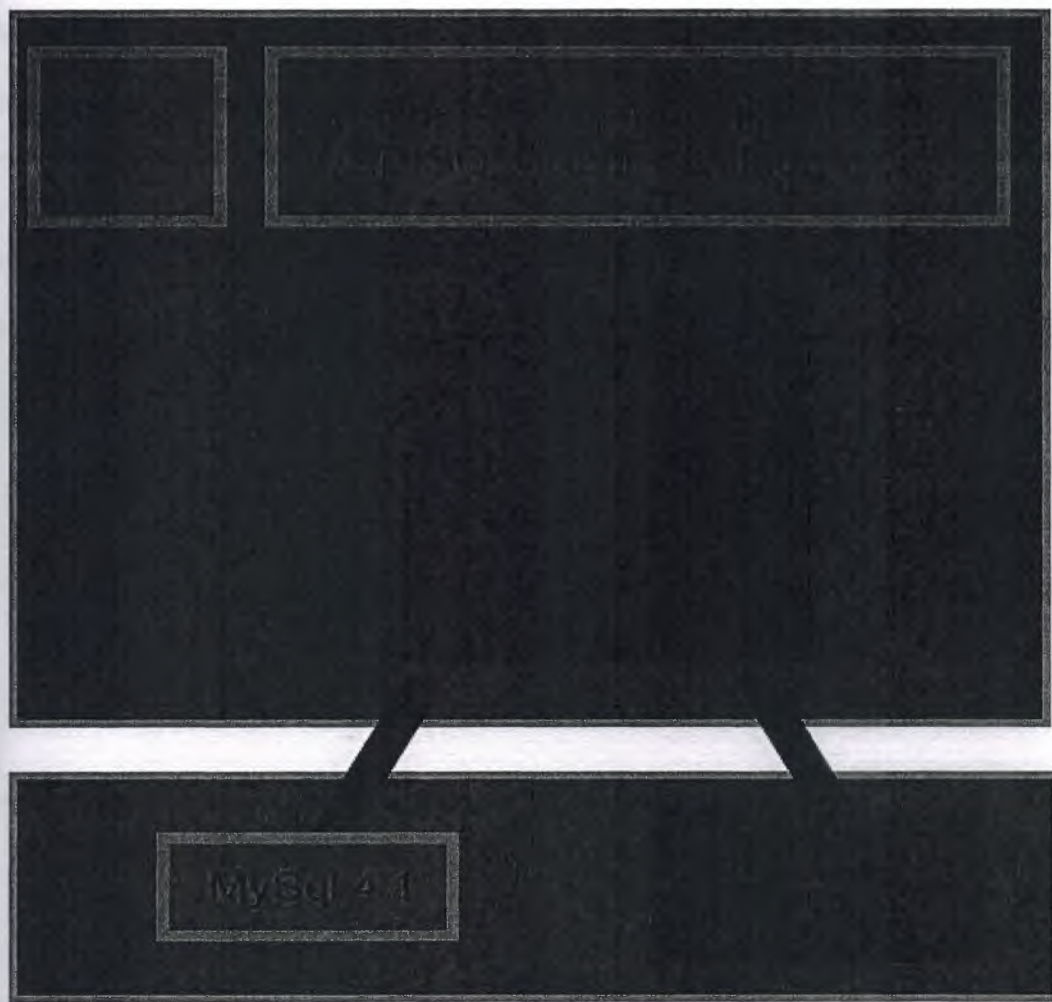


Figure 3.16: Sakai enterprise technologies (Khoo et al., 2011)

3.10.2 Sakai's Properties

3.10.2.1 Scalability

The exhibition has been designed as a widget Web browser that stores all its data in memory, so it can handle only a small number of units (about 500 to 1,000 depending on the Complexity of the items). Since many users shows have larger groups, so much that they want to put in a display, it will be necessary to re-design a tool to support both Small and large groups (Chakraborty & Sakai, 2005).

3.10.2.2 Extensibility

Exhibit (i.e. new views / facets / widgets) was designed to be a data navigation and visualization framework into which new views of data (e.g. plot, graph, map, timeline, or a particular facet) could be added. This process is working but with extreme difficulty, partly because it's not well explained how to do it and partly because the code to support this is complex (Glenn, 2005)

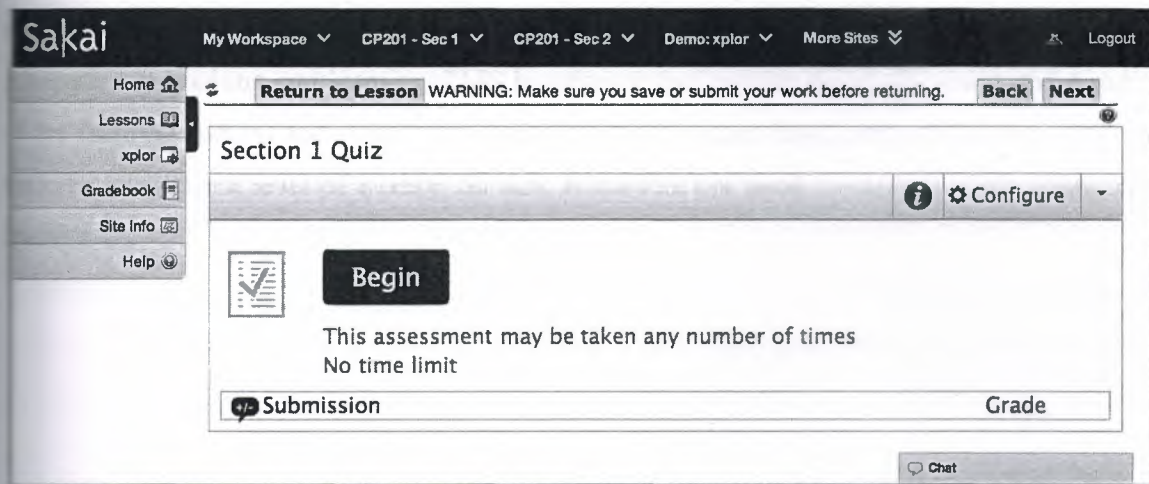


Figure 3.17: Sakai quizzes

3.10.2.3 Persistence

It is a part of the Web browser gallery which allows users to work with data in memory and change the local state. For example, identify aspects to reduce the range of records they display or choose a particular point of view of data. Users want to be able to point to the final product - the supply situation, which reached across a range of operations on Data (Aaron, 2008).

3.11 Summary

Many universities and learning centers are using e-learning since it is very effective at a lower cost. Developing these systems is quite cheap in comparison to arranging classroom materials and even training the trainers, particularly if using multimedia or highly interactive methods. E-learning can be followed anytime anywhere, classroom learning has a limitation of time and space. E-learning can include audio, animation, video, simulations, and online resources E-learning lends itself to the user to develop their own learning pace. For that, e-learning

techniques evolved considerably and widely prevalent in previous years in most countries of the world and have become effective tools in the transport and delivery of scientific information to the faculty and students in different countries. The LMS is learning environment which is use in e-learning. In these days, we can see the rapid changes and developments in technology. The important developments that have occurred in computer and communications technologies which culminated in the Intranet network and the Internet have transformed the world into a small village. Throughout the previous two decades there has been a great interest in the use of computers in teaching and learning. LMS is software that enables the management and handing of the learning content and resources to students. On the other hand, each of them has different features in different level of quality. So that, researches are need to compare them using their features

CHAPTER 4

METHODOLOGY

4.1 Introduction

The main objective of this thesis is to compare the Learning Management Systems using a logical, clear and simple way. By using the mathematical method which gives the comparison points for each LMS according to each tested feature. The graphs are used to illustrate the results of the comparison between the LMSs used in this research.

4.2 Research Model

Comparison method model was used in the study. A deep literature review has been done in order to collect information related with LMSs and to create background of this study. The study investigated which LMSs are the most widely used ones in among educational institutes what are the criterions that direct educational institutes to use those LMSs, do educational institutes use any LMS which are selected for comparison, which LMS gives the best quality, and which LMS has the highest score.

4.3 Comparisons Elements

Here is the comparison elements listed into two groups, choosing features that related with computer science that will be used in the comparison chapter, the first group, the general characteristics has helped to collect the features in details to be ready and clear for the comparison process and the second group is the testing and comparison categories that will be explained in detail in the next chapter.

4.3.1 General Characteristics

The following characteristics were used in the study to compare chosen LMSs:

1-Fee type

2-Source code availability

3-Licensing models

- 4-Installation type
- 5-Business orientation
- 6-E-Learning standards compliance
- 7-Content creation possibilities
- 8-Programming Language
- 9-Platform
- 10-Integration possibilities

4.3.2 Testing and Comparison Categories

Testing and Comparison Categories were used in the research:

- h) Login, Configuration and Compatibility Testing
- i) Personalization and Customization
- j) Navigation
- k) Forms
- l) Help and Documentation
- m) Common Student-facing Modules/Tools.
- n) Authoring Tools and Content Creation

4.4 Application

Conducted study for the research described in two main categories as follows:

4.4.1 Logical View

This section presents the logical understanding of the comparison operation step by step according to the work sequence from the beginning to the results.

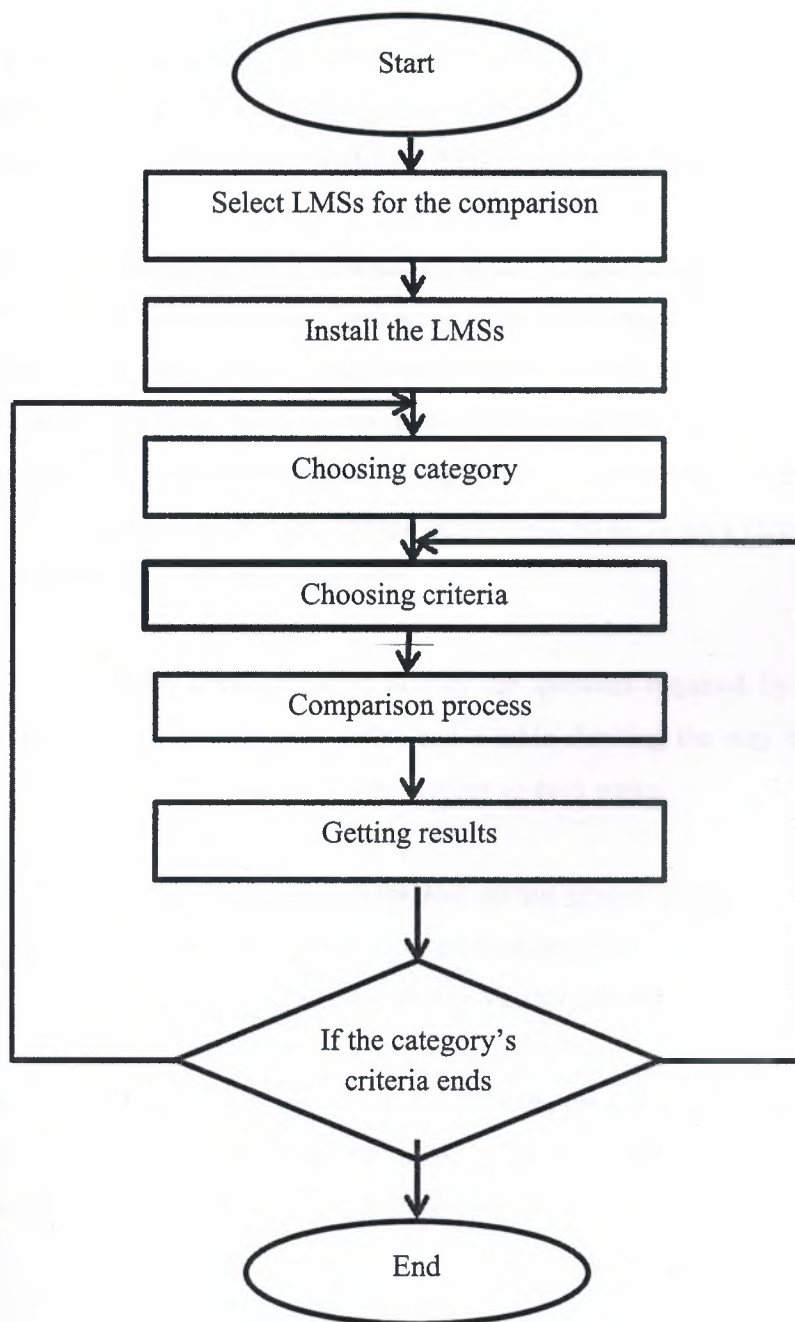


Figure 4.1: Comparison flow-chart

Work Mechanism:

Step (1): Initially, this work is to compare the learning management systems and it clarifies the comparison and compares the properties and characteristics and presentation of results are real, all this starts with the LMSs choosing process.

Step (2): After choosing the LMSs according to the scale of the top 20 systems in 2013 for (*TeachThought, LLC is a fluid platform dedicated to supporting educators in evolving learning for a 21st century audience*) and installing them and implementing them, most of the famous qualities and accepted properties were included in the tables and arranged according to the general characteristics, the general characteristics were first placed in the table to form a preliminary study of the regulations, so as to get a rating suitable for the systems according to the basic qualities.

Step (3): After that detailed tables display the qualities required by the user and the LMSs are arranged in the same tables and a table showing the way to give grades for each LMS and how to get the grades according to each status.

Step (4): After examining each status and giving grades to the learning management systems the rate and degree, max and the percentage of each case were found. The graph shows the difference in a simplified and easy way for the reader.

Step (5): After making this work clear to the user, the reader or the beneficiary, he can see the comparison method and the clear results to choose the right system for any purpose and search for the required system with ease.

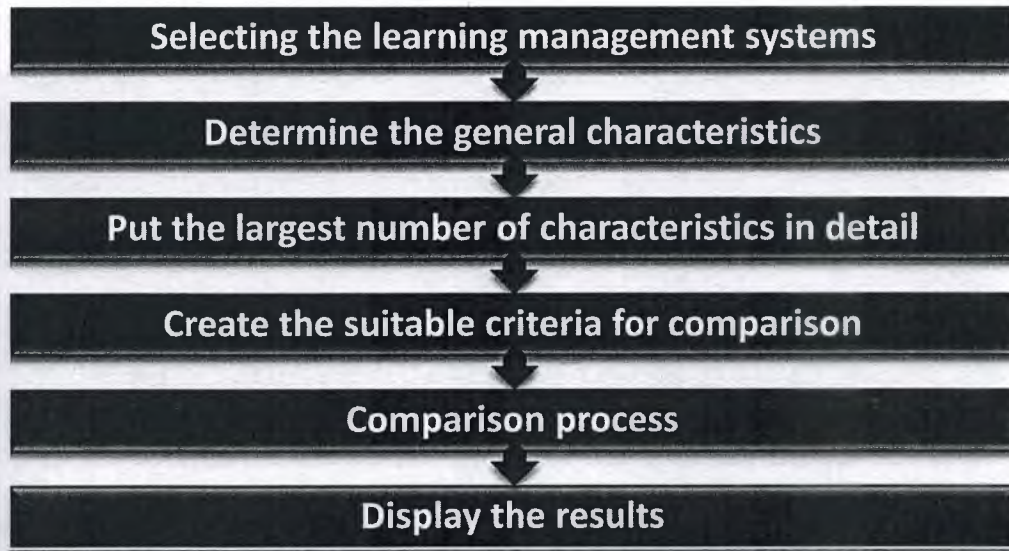


Figure 4.2: The comparison process of the study-flow graph

4.4.2 Mathematical View

This section presents the mechanism of the grading of the features and the mathematical operation related with the results, numbers, and percentage, all calculations are made by using Microsoft Excel.

Comparative Data Table:

- 1- Shows points received for each criterion.
- 2- Shows average score for each criterion.
- 3- Shows how each LMS is doing in each category.
- 4- Each LMS also has its own specific results page.
- 5- Data are linked to corresponding comments in specific LMS results page.

Table 4.1: Comparative Data Table Schema

POINTS	NAME	DESCRIPTION	EXAMPLE
		Very Important: Enhance the page with a useful widget	Form control labels
4	Very Important	Needed in order to interact successfully with the page	Form control labels
	Important	Needed in order to interact reliably and comfortably with the page	Link text indicates target
2	Very Helpful	Eases user's interaction with the page	Breadcrumbs
1	Helpful	Improves the user's experience and productivity	Aria landmarks
Not tested	Not tested	Not tested	Not tested

Explain The Work of Tables:

Work to find the best way compared understood easily by everyone, as it is commonly known in the simple life when dealing with numbers and comparison of the easiest ways to present the results are presented in percentage and simplified representation of the graph to facilitate comparison clearly so it would work as follows:

1 - Give grades for each system according to what is shown in the table previously Table 4.2.

2 - Find the subtotal and average and max and the total category for each of the systems so as to indicate the importance of the status in which each system examined using the following equation:

(1)

$$TS = \sum Xi$$

Where:

(TS): is summation all the score for the systems grade in the row.

(Xi): is the system score appending to its arrangement in the row.

(2)

$$AVS = \frac{TS}{4}$$

Where:

(AVS): is the average of the total score, the result is summation of all system score divided by 4.

(TS): is summation all the score for the systems grade in the row.

(3)

$$TAV = \frac{AVS}{MD}$$

Where:

(TAV): is the Total averages that mean the average of total score divided by the max degree from all systems degrees, the result directly been in percentage.

(AVS): is the average of the total score, the result is summation of all system score divided by 4.

(MD): is the max degree from all systems degrees. (Max column in the comparison table)

(4)

$$SUBT = \frac{\sum Xc}{\sum Mc} * 100$$

Where:

(Xc): is summation of the score belongs to the same system in that column.

(Mc): is summation of the max degree in that column.

(SUBT): is subtotal summation of the (Xc), divided by the summation of (Mc), all those multiplied by 100, all of this just related to one subtotal.

(5)

$$TC = \frac{Xtc}{Mtc} * 100$$

Where:

(Xtc): is summation of all system score in the same column for the whole table. The subtotal no count.

(Mtc): is summation of the max degree in the same column for the whole table. The subtotal not count.

(TC): is total category the result of summation (Xtc) divided by the summation of (Mtc) all those multiplied by 100.

3 - Take advantage of these results in a comparative graph to clarify the importance of capacity in each system and clarify the comparative ease.

4.5 Duration and Resources

The study started in June 2012 and was completed in July 2013. The work was carried out during this period and weekly duration is given in Table 4.2. First 3 month of thesis is appointed only for literature research and during later processes, literature search is done continuously. Books, internet, and academic journals are main information resources of this thesis.

Table 4.2: Time Schedule

WORK DONE	DURATION
• Literature Search	10 weeks
• Preparation of the Research Proposal	4 Weeks
• Selection of LMSs	4 Weeks
• Installation of the selected LMSs	4weeks
• Selection Comparison Categories	5weeks
• Compare each criteria of each LMSs	5 Weeks
• Writing the Thesis	14 Weeks
• Reading, discussion, and correction of the thesis based on the feedback by the thesis supervisor	2 Weeks

4.6 Summary

This chapter discussed the logical way to classify the steps of the comparison processes of the systems in detail, in addition to the calculation method for the classification of the results and how to distribute the degrees of comparison for each learning management system and how to calculate the final results for each comparison group.

CHAPTER 5

RESULTS

5.1 Introduction

The comparison processes start with the general characteristics to be able to move to the next step. When all the features and the questions are complete and ready to apply it in the tables, the process is divided into sections involving groups' properties that will be on the basis of comparison. Each section contains a comparison table and questions which are according to all properties belonging to the same group. And then the distribution of scores on the LMSs by the contents of the properties known in advance of the installation of the system then, look at the effectiveness of characteristics provided and work for the user. After each table is to explain and system-specific explanation is to clarify how the property in order to find the details of each LMS including distinguishes by from the other system.

5.2 General Characteristics

The following paragraphs describe the general characteristics of the each chosen LMS which were used to compare systems, were explained the groups of features were prepared to help comparison process by the author.

1-Fee Type

- **Free:** The distribution and deployment of the system is free of charge with the possibility of the existence of a free open source, and this can be useful for companies, educational institutions and technical institutions. Some of the system's features are free and others are not, however they usually provide free support with an open code which provides the opportunity of properties development.
- **Commercial:** Prepayment neither is to get the system nor distributed free of charge and these prices are placed according to which contains a system of techniques to facilitate the implementation of the user who is not a specialist or non-technical and always does not contain an open code but provides some extra services.

2-Source Code Availability

- **Open source:** In open source software all the files which make up the system are free for modifying, which allows customizing the system in the necessary way. Moreover, the usage of the LMS (number of users, courses, usage period etc.) is not limited.
- **Proprietary software:** For proprietary software vendors do not provide the source code. Along with commercial purposes, encrypting the source code serves as a security guarantee, as it prevents using the software for malicious code distribution (viruses, trojans etc.). Some vendors offer customization services, and can provide compatibility with future releases on request.

3-Licensing Models

- Per number of registered/enrolled users.
- Limitation by the general number of users who use the LMS (the license can limit either students or staff or both).
- Per number of concurrently connected users limitation by the number of users who are simultaneously connected to the LMS.
- Per license validity period Time limitation of LMS license validity. As a rule, license subscriptions are annual or monthly.
- Per number of courses
- Limitation by the number of courses the user can create in him/her LMS.

4-Installation Type

- **Hosted (Software as a Service):** Hosted solution means that the LMS is hosted on the vendor's servers and installed on the vendor's site. Customers can purchase access to separate LMS parts, manage their own content and students. It's a good quick solution if you don't have a website, or wish to avoid spending time and resources on administering the system.
- **Own:** Own installation means you get the LMS application which you can install on your site or local network. It allows having a completely individual solution tuned to meet

your specific needs. Plus it provides you with full control over your LMS and all the related processes.

5-Business Orientation

- **E-commerce:** LMSs designed for commercial use include an option allowing users to sell different kinds of subscriptions (student/teacher access to courses/LMS etc.), i.e. to provide eLearning on the paid basis.
- **Educational institutions:** Some LMSs don't allow selling LMS subscriptions as they focus on educational features. These LMSs are designed for educational purposes only.
- **Corporate training:** Corporate LMSs are focused on (evaluating) employee skills and competencies as well as providing tools for competency training.
- **Government structures:** This orientation includes possibilities of educational and corporate LMSs, with a greater focus on security and some other features depending on the certain government structure.

6-E-Learning Standards Compliance

- **International standard (SCORM, AICC, IMS etc.) compliant:** If the LMS is SCORM/AICC/IMS or other standards compliant, you can use the standard packages (SCORM/AICC/other) inside the LMS instead of (or together with) creating native LMS course content. It can be very useful if you don't want to tie yourself to using one particular LMS. Additionally, authoring software enables users to create customized look and feel for course content. Besides, courseware vendors often provide their course content in some of the widely used standards, so you can purchase ready-made courses instead of creating your own.
- **Local standards compliant:** Some LMS comply with local standards of a specific region (e.g. NCVER – Australian standard for training statistics) or specific field of learning.
- **No standards compliance:** Some LMSs are not compliant with any content standards, and native content created in such LMSs is not reusable for other LMSs. This feature can be useful if the unique nature of your course content is important in your business.

7-Content Creation Possibilities

- **Integrated tools for native courses creation:** Some LMSs provide special internal tools for creating native course content based on your learning materials.
- **Separate tools for native courses creation:** Some LMSs don't have integrated tools for course content creation, but vendors provide such tools as separate products compliant with their LMS.
- **Possibility to use reusable content only:** Some LMSs do not provide possibilities for creating native course content; you can only use standard packages (SCORM/AICC/IMS/other) in such LMSs.

8-Programming Language

Though not evident, programming language the LMS is written in is one of the important criteria which you should pay your attention to when selecting the suitable LMS, you will probably need a specific language depending on many factors, e.g. what language your server can handle, what language your team is most proficient in, or (if you outsource technical work) what language is more popular and what language programming costs less.

9-Platform

- **Stand-alone solution:** This solution allows installing the LMS as a stand-alone application. You can integrate it with your business platform as a custom project.
- **Integrated solution:** Some LMSs require certain platforms to be installed on. This LMS-platform integration gives you a possibility to use your platform capabilities together with the LMS functionality to enhance your eLearning process.

10-Integration Possibilities

- **Open source:** Applications with open source code provide the widest range of integration possibilities, as you can edit any part of the LMS to integrate smoothly with any other application.
- **Documented API (SDK):** Application programming interface (API) provides a possibility to use functions of one application by another application. API allows

integrating applications with encrypted source code and facilitates integration process for open source applications.

- **Integration via bridges:** Bridges are special plugins which allow integrating applications of different types. Bridges are especially useful if you want to integrate applications with encrypted source code or applications with no API.

5.3 Testing and Comparison Categories

The following paragraphs describe the testing and comparison categories of the each chosen LMS which were used to compare systems, were explained the groups of features were prepared to help comparison process by the author.

5.3.1 Login, Configuration, and Compatibility Testing

a) Criteria

Login and error recovery:

- Can users interact with the login page and submit necessary credentials with certainty?
- Can users detect error messages and recover from errors with certainty?

System Compatibility Testing:

- Can users perform the necessary tests to ensure compatibility with their computer?
- Does the system have features to alert users about required tools like Java and enabling JavaScript?

b) Patterns

Pro: a good job to provide accessible entry and compatibility testing. Entry fields and forms easy to move to the most LMS provides a clear way to test the system configuration for compatibility with Java, cookies, etc. not Moodle or SAKAI offer built-in test for JavaScript, cookies, etc..

Con: error recovery can be improved login and messages.

Table 5.1: Login, configuration, and compatibility testing

	Criteria	BB	D2L	Moodle	SAKAI	Max%	Avg.%
Login and Error Recovery	Can users interact with the login page and submit necessary credentials with certainty?	5	5	4	5	5	95.00%
	Can users detect error messages and recover from errors with certainty?	2	5	3	2	5	60.00%
	Subtotal %	70.00%	100.00%	70.00%	70.00%	100.00%	77.50%
System Compatibility Testing	Can users perform the necessary tests to ensure compatibility with their computer?	4	4	2	3	4	81.25%
	Does the system have features to alert users about required tools like Java and enabling JavaScript?	4	4	0	0	4	50.00%
	Subtotal %	100.00%	100.00%	25.00%	37.50%	100.00%	65.63%
Total Category %		83.33%	100.00%	50.00%	55.56%	100%	72.22%

The total category refers to that the highest percentage goes to D2L (100.00%) and the second one is the BB (83.33%), the third percentage is for Sakai (55.56%) and the lowest percentage for Moodle (50.00%) , the explanation below clarifies how each LMS got this percentage :

BB: Blackboard is doing a good job in this category they offer an easily accessible environment to enter and compatibility testing, but the error recovery needs to be improved. A unit tests that tests browser JavaScript, cookies, and Java Runtime Environment (JRE).

D2L: D2L done well in this area and it has in previous versions. Out of the box login page has a simple design and easy to navigate and is used to access dialogues alert JavaScript to indicate the

presence of errors. System detects the capabilities of the browser and will report if it is not enabled basic functions, such as JavaScript.

Moodle: Good job overall in the provision of access and access compatibility testing. Error recovery log on business needs, and is not valid logon still returns to focus the user to the top of the page, and users must screen reader to hear from the top of the page down until you discover the error message deeper into the tab order click the user name and password field.

Sakai: Sakai not a decent job in this category they offer an easily accessible environment, but the error recovery needs improvements. The error should be logged more obvious to users. Sakai does not provide any compatibility tests in this release.

5.3.2 Personalization and Customization

a) Criteria

Layout customization:

- Is the default layout the most accessible?
- Can the user configure and select desired layout independently and save the setting globally?

Styling:

- Can the user set globally the desired contrast, bg/fg colors, font-size, and font-type?

Session time out:

- Can the user set globally the session timeout to the desired length?
- Is the user alerted before the session expires and can it be extended if desired?

Saving current state:

- Can the user save/bookmark the current state and return to it on request? (side menu collapsed, hide unwanted menus, bookmark the state of a module e.g. page 6 of lesson 5)

Default page:

- Can the user set the default page globally?

Selecting Editor:

- Can the user set a desired editor globally?
- Can the editor be changed on-the-fly?

Alert Type:

- Is the default alert type accessible?
- Can the user select desired alert type

5) Patterns

Pros: All allows the user to adjust globally editor. Moodle has made great strides in transforming a number of personalization and customization options of the official course for the user.

Cons: More customization for bookmarking and would be very useful to see accessible alerts session timeout implemented in the BB and Moodle.

Table 5.2: Personalization and customization

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Personalization	Is the default layout the most accessible?	4	4	4	4	4	100.00%
	Can the user configure and select desired layout independently and save the setting globally?	3	0	3	1	3	58.33%
	Subtotal %	100.00%	57.14%	100.00%	71.43%	100.00%	82.14%
Appearance	Can the user set globally the desired contrast, bg/fg colors, font-size, and font-type?	3	4	3	0	5	50.00%
	Subtotal %	60.00%	80.00%	60.00%	0.00%	100.00%	50.00%
Time	Can the user set globally the session timeout to the desired length?	0	0	0	0	1	0.00%
	Is the user alerted before the session expires and can it be extended if desired?	0	5	0	2	5	35.00%
	Subtotal %	0.00%	83.33%	0.00%	33.33%	100.00%	29.17%
State	Can the user save/bookmark the	1	2	1	1	2	62.50%

	current state and return to it on request?						
	Subtotal %	50.00%	100.00%	50.00%	50.00%	100.00%	62.50%
Alt Page	Can the user set the default page globally?	0	0	0	2	2	25.00%
	Subtotal %	0.00%	0.00%	0.00%	100.00%	100.00%	25.00%
Editing	Can the user set a desired editor globally?	2	2	3	0	3	58.33%
	Can the editor be changed on-the-fly?	2	1	1	0	2	100.00%
	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
	Subtotal %	80.00%	60.00%	80.00%	0.00%	100.00%	55.00%
Type	Is the default alert type accessible?	3	4	5	2	5	70.00%
	Can the user select desired alert type?	0	2	0	0	2	25.00%
	Subtotal %	42.86%	85.71%	71.43%	28.57%	100.00%	57.14%
Category %		52.94%	70.59%	58.82%	35.29%	100.00%	54.41%

The total category refers to that the highest percentage goes to D2L (70.59%) and the second one is the Moodle (58.82%), the third percentage is for BB (52.94%) and the lowest percentage for Sakai (35.29%) , the explanation below clarifies how each LMS got this percentage :

BB: Blackboard does not allow the user to set the global session timeout as they do not provide an alert before the expiration of the term of the session. Blackboard uses two types alert one that works best with the Java Access Bridge and alerts, but the embedded page does not work consistently. Bookmarking can be improved by allowing users to bookmark areas in the case, but instead it is done through the collection of content, which complicates the user experience just because the coach can set the default login page playground. The user can set global editor on the fly, but it can also be set in the page of personal information that is difficult to go to.

D2L: D2L allows users a great deal of customization. Especially welcome is being warned about the time of the session (through access enabled Alert) and allow for the extension of the session.

Although the default page cannot be set, and the state of the page (sections that are displayed or extended range or folded) remembered between sessions. Editor's Choice is configured (WYSIWYG or raw text) and the font size and family at the global level, as is the type of alarm (unconditional or is likely to be more intuitive pop-up window).

Moodle: Moodle made great strides in transforming a number of customization options and user customization that was previously controlled by the administrator, of course, and the roles of the teacher. Cluster configuration at the site, of course, is now user configurable and saved the world and users can dock or crumble Block content to simplify keyboard navigation and navigation in general.

Sakai: Sakai provides only a small number of global and specific customizations tool, more personalization and customization options can be useful. However, the time of the session and other alerts can be accessed, but has never been easier to discover.

5.3.3 Navigation

a) Criteria

Page title:

- Does the page title convey current information about where the user is?

Breadcrumbs:

- Does the page provide meaningful breadcrumbs?
- Can breadcrumbs be easily located/navigated to?
- Can breadcrumbs be used for navigation (are they clickable)?

Navigation bars and menus:

- Are the navigation bars and menus accessible?
- Are they used consistently across the application?

Navigation technique:

- Does the page provide full ARIA landmarks?
- Are proper landmark types used for major components of the page?
- Does the page provide a logical heading structure for major components of the page?

- Is the main content area labeled with heading 1?
- Are there shortcut keys to move between major sections of the page?
- Is there a skip to main content or equivalent available to keyboard users?

Linearization and tabbing order:

- Does the page linearize logically without breaking the sequential flow of the reading order?
- Is the tabbing order logical?

Link type and Link text:

- Is the link focusable, and can it be activated with the enter key?
- Is link text understandable out of context?
- Are repetitive links given unique link text?
- If using image icon only as a link, does the image have unique alt text?
- If using image icon in the same anchor with link, is the image alt text empty (alt="")?
- Are the JavaScript-enabled links accessible?

Visible indication of cursor focus:

- Can the element with the focus be easily identified visually?

Tooltips technique:

- Is the tooltip accessible to keyboard users?
- Is the tooltip accessible to screen reader users?

b) Patterns

Pros: All hierarchies are used item to celebrate the effective structure, Effective use of breadcrumbs for navigation, Keyboard navigation and scheduling system and generally clear and logical. Some LMS began to take advantage of ARIA landmarks and roles for easier navigation D2L, Moodle, Sakai.

Cons: It can improve visual indication of the focus indicator. Dealing with the constant tooltips for keyboard users with contextual information is necessary, for example, and symbols in the editor and what they are doing.

Table 5.3: Navigation

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Title	Does the page title convey current information about where the user is?	0	4	4	2	4	62.50%
	Subtotal %	0.00%	100.00%	100.00%	50.00%	100.00%	62.50%
Breadcrumbs	Does the page provide meaningful breadcrumbs?	1	2	2	1	2	75.00%
	Can breadcrumbs be easily located/navigated to?	2	2	2	2	2	100.00%
	Can breadcrumbs be used for navigation (are they clickable)?	2	2	2	2	2	100.00%
	Subtotal %	83.33%	100.00%	100.00%	83.33%	100.00%	91.67%
Navigation and menus	Are the navigation bars and menus accessible?	5	4	5	5	5	95.00%
	Are they used consistently across the application?	3	2	3	2	3	83.33%
	Subtotal %	100.00%	75.00%	100.00%	87.50%	100.00%	90.63%
Accessibility	Does the page provide full ARIA landmarks?	0	1	0	0	1	25.00%
	Are proper landmark types used for major components of	0	1	0	0	1	25.00%

	the page?						
	Does the page provide a logical heading structure for major components of the page?	3	4	4	3	4	87.50%
	Is the main content area labeled with heading 1?	4	4	2	4	4	87.50%
	Are there shortcut keys to move between major sections of the page?	0	0	0	1	1	25.00%
	Is there a skip to main content or equivalent available to keyboard users?	0	1	1	0	1	50.00%
	Subtotal %	58.33%	91.67%	58.33%	66.67%	100.00%	68.75%
Linearization Tabbing	Does the page linearize logically without breaking the sequential flow of the reading order?	3	5	3	5	5	80.00%
	Is the tabbing order logical?	5	5	5	5	5	100.00%
	Subtotal %	80.00%	100.00%	80.00%	100.00%	100.00%	90.00%
Type Link	Is the link focusable, and can it be activated with the enter key?	5	5	5	3	5	90.00%
	Is link text understandable out of context?	2	3	5	2	3	100.00%
	Are repetitive links given unique link text?	3	3	0	1	3	58.33%
	If using image	1	3	3	3	3	83.33%

	icon only as a link does the image have unique alt text?						
	If using image icon in the same anchor with link, is the image alt text empty (alt='')?	3	3	0	2	3	66.67%
	Are the JavaScript-enabled links accessible?	0	5	5	5	5	75.00%
	Subtotal %	63.64%	100.00%	81.82%	72.73%	100.00%	79.55%
able ication of or Focus	Can the element with the focus be easily identified visually?	2	4	4	3	5	65.00%
	Subtotal %	40.00%	80.00%	80.00%	60.00%	100.00%	65.00%
tips nique	Where contextual information is essential is the tooltip accessible to keyboard users?	0	0	0	0	2	0.00%
	Are ARIA tooltips used for essential contextual information?	0	0	0	0	1	0.00%
	Subtotal %	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%
Category		62.86%	90.00%	78.57%	72.86%	100.00%	76.07%

The total category refers to that the highest percentage goes to D2L (90.00%) and the second one is the Moodle (78.57%), the third percentage is for Sakai (72.86%) and the lowest percentage for BB (62.86%), the explanation below clarifies how each LMS got this percentage :

BB: Blackboard does a good job in providing a single address for a large section of each page. Blackboard provides flexibility for the coach to design the Course Menu and content design.

Navigation can be improved by providing page addresses unique. Implementation of the Comprehensive detailed is well done but not quite consistent.

D2L: Breadcrumb navigation has been added to some of the interfaces and strengthen others in the latest version (10) and it is easily navigable. D2L 10 makes good use of the areas attractions song screen navigation gross reader and hierarchies her address and very well thought through. Keyboard navigation is easy to follow visually. D2L 10 feet new navigation drop-down menus. Implementation of these lists vary among the highest level of navigation and page / main content areas. The keyboard and screen reader performance is different, as well, and maybe take orientation training to use accurately and effectively.

Moodle: Browse generally good with titles that have been clearly identified, and consistent use of bread crumbs easily fall into the scheduling system, and navigation was characterized by mass consistent level 2 title identifiers. A clear indication of the focus indicator can be more pronounced, and can be applied in a manner more consistent links addresses and hints, and especially in the case of user-created content of the page.

Sakai: Browse generally good with unique titles and the main navigation consistently preceded H1, and excellent visual indication of focus. And improvements to access the keyboard of hints and sporadic cases of non-unique link text or descriptive promote ease of movement.

5.3.4 Forms

a) Criteria

Labeling form controls:

- Across the application, are form controls labeled correctly?
- Across the application, are form fields labeled correctly?
- Across the application, has the on change event handler been avoided?

Form submission:

- Across the application, are the submit/cancel buttons accessible?
- Across the application, are the submit/cancel functions used in a consistent manner?

Notification/verification:

- Across the application, does it provide an accessible verification message on successful submission?
- Across the application, is the error notification accessible?

b) Patterns

Pros: For the most part, the controls are a form explicitly described uniquely. However, there is still room for improvement. Cross-platform, there must be a more consistent use of verification and provide messages and focus, both visible and invisible, should be placed on these messages when they appear.

Cons: areas still vary from one to the other LMS in a fixed labeling of the required fields, and error notification submission. Confirmation can be extended to submit the model to include the coach facing areas involving the assignment of creating activity, for example. Error notifications make and model is not always clear, and may need screen reader users to rescan the page to locate the notification even though the user focus and put in the first field is invalid.

Table 5.4: Forms

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Control Labels	Across the application, are the form controls labeled correctly?	3	5	5	3	5	80.00%
	Across the application, are the required fields labeled correctly?	4	5	5	4	5	90.00%
	Across the application, has on Change Event handler been avoided?	5	5	5	3	5	90.00%
	Subtotal %	80.00%	100.00%	100.00%	66.67%	100.00%	86.67%
Submission	Across the application, are the submit/cancel buttons accessible?	5	5	5	5	5	100.00%
	Across the application, are the	3	3	3	3	3	100.00%

	submit/cancel functions used in a consistent manner?						
	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Verification/Notification	Across the application, does it provide an accessible verification message on successful submission?	4	5	5	3	5	85.00%
	Across the application, is the error notification accessible?	3	4	4	3	5	70.00%
	Subtotal %	70.00%	90.00%	90.00%	60.00%	100.00%	77.50%
Category %		81.82%	96.97%	96.97%	72.73%	100.00%	87.12%

The total category refers to that the highest percentage are sharable goes to D2L and Moodle (96.97%) and the second one is the BB (81.82%), the lowest percentage for Sakai (72.73%), the explanation below clarifies how each LMS got this percentage :

BB: provide / Cancel buttons can be accessed and implemented consistently across the application. The required fields, and error notification, and confirm the offer is not always labeled, announced, or concentrated to a screen reader. Most controls have enough labels, but there are pages where more detail will improve the user experience.

D2L: D2L consistent in the use of the labels associated with properly with all the form fields in version 10 - tones needed for the required fields. Submissions are advertised via screen reader alert messages accessible tone. The focus error notification area, and have hyperlinks to the fields of errored, but when focused only obvious errors, not that they are connected to the problem of fields with labels (the song or otherwise).

Moodle: generally described, and controls the form and fields correctly, although confirmation of the success of the make and model and error notification can be improved in several areas. Confirmation can be extended to submit the model to include the coach facing areas involving

the assignment of creating activity, for example. Error notifications make and model is not always clear, and may need screen reader users to rescan the page to locate the notification even though the user focus and put in the first field is invalid.

Sakai: For the most part, the controls are a form explicitly described uniquely. However, there is still room for improvement. Cross-platform, there must be a more consistent use of verification and provide messages and focus, both visible and invisible, should be placed on these messages when they appear.

5.3.5 Help and Documentation

a) Criteria

Inline Help

- Is inline help provided across the application including for the editor?
- Are help tip links/buttons focusable and contextual?

Tutorials and Guides

- Is the tutorial accessible?
- Is the tutorial available from within the application?
- Is the tutorial available from outside the application?
- Is the tutorial available publicly?

b) Patterns:

Pros: Providing help in context

Providing help in video and text support

Providing text externally, outside the LMS without authentication

Cons: Stress the need for accessible media player controls and captioning.

Table 5.5: Help and documentation

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Help	Is inline help provided across the application including for the editor?	3	3	3	3	3	100.00%
	Are help tip links/buttons focusable and contextual?	3	3	3	3	3	100.00%
	Subtotal %	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Tutorials	Is the tutorial accessible?	2	3	3	3	3	91.67%
	Is the tutorial available from within the application?	2	0	2	2	2	75.00%
	Is the tutorial available from outside the application?	2	2	2	2	2	100.00%
	Is the tutorial available publicly?	1	1	1	1	1	100.00%
	Subtotal %	87.50%	75.00%	100.00%	100.00%	100.00%	90.63%
Total Category %		92.86%	85.71%	100.00%	100.00%	100.00%	94.64%

The total category refers to that the highest percentage are sharable goes to Sakai and Moodle (100.00%) and the second one is the BB (92.86%), the lowest percentage for Sakai (85.71%), the explanation below clarifies how each LMS got this percentage :

BB: Blackboard well in providing assistance within the application and in the context. Providing translations of video lessons and made available to the public with controls that are usable with the keyboard. Help text-based and are also well provided for teachers and students within the application and can also be accessed without logging on to the application.

D2L: D2L has had well written and accessible built-in instructions for the last few versions. Changes to assist in the WYSIWYG editor are welcome and editor announces shortcut keys are

available (check reader users, and it is not clear how other users discover this, though). Instructional manuals can be accessed and downloaded from the web site of the main companies in the D2L. All links to help / information is unique, especially in the Help topic.

Moodle: Moodle continue to do a good job to some extent provide contextual included assistance through the links graphical instructions. Moodle has also made good progress since 1.9 Add contextual links at the bottom of every page on Moodle.org documents relevant outside the LMS to a specific page content ranging from the home page, of course, the book units to the Forum, assignment, and activity units.

Sakai: Sakai provides a very good documentation contextual instruction in all parts of the platform. All information assistance available both within the application, and through a Web site available to the public. Many involved the Sakai actively working groups in an attempt to constantly update and improve the documentation of assistance, including information specific utility for users with disabilities.

5.3.6 Common Student Facing Modules/Tools: Announcements

a) Criteria

- Can the user easily and reliably identify this tool/module and navigate to it?
- Does the announcements tool indicate how many new announcements have been posted?

Operation Features

- Can user interact easily and reliably with applicable operations in this tool/module?

Table 5.6: Announcements

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Navigation Features	Can the user easily and reliably identify this tool/module and navigate to it?	5	5	5	5	5	100.00%
	Does the announcements tool indicate how many new announcements have been posted?	1	2	2	0	3	41.67%
	Subtotal %	75.00%	87.50%	87.50%	62.50%	100.00%	78.13%
Operation Features	Can user interact easily and reliably with applicable operations in this tool/module?	4	4	4	4	4	100.00%
	Subtotal %	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Total Category % (Tools: Announcements)		83.33%	91.67%	91.67%	75.00%	100.00%	85.42%

The total category refers to that the highest percentage are sharable goes to D2L and Moodle (96.97%) and the second one is the BB (83.33%), the lowest percentage for Sakai (75.00%), the explanation below clarifies how each LMS got this percentage :

BB: Not able to do keyboard testing with a Mac they indicate in the tool the new announcement, but there is nothing in the announcement module, from the student side, there is no way to filter or sort announcements.

D2L: News on the course home page each item begins with a heading. There is no indication of how many are new. However, the student has the option of "dismissing" (marking read or no longer relevant) each item or list all news and searching those items. In the "Updates" tool/region we see an indication of how many new/non-acted upon updates there are, Well organized with

accessible search (search region in an ARIA landmark), there are advanced search and filtering options, and the number of items returned from a search is displayed (though perhaps not in the most easily discoverable location, for screen reader users).

Moodle: Announcements are managed in 2 ways: 1) using the Announcements Forum, a special forum that allows the instructor to post one-way announcements to the course, and which is set to email the announcement automatically to all students in the course; 2) a combination of the Announcements Forum and the "Latest News" block in which the Latest News block provides quick access to the most recent Announcement Forum posts. The Latest News block does not indicate how many new announcements have been posted unless the User Profile setting for Forum Tracking has been set to "yes: highlight new posts for me.", Students can read announcements; instructors can read and delete. No sort/filter. Announcements Forum is set up as a table with proper use of table headings and scope to facilitate navigation (although table lacks summary).

Sakai: There are lists of the most recent announcements on the course home page. Students cannot remove announcements, but instructors can make them expire. On change events may negatively affect accessibility.

5.3.7 Common Student Facing Modules/Tools: Discussion

a) Criteria

Navigation Features:

- Can the user easily and reliably identify this tool/module and navigate to it?
- Can user easily and reliably navigate to different items in this tool/module?

Reading Messages

- Can the user easily distinguish new threads?
- Can the user easily distinguish sub threads?
- Can the user easily distinguish replies?
- Can the user easily distinguish the parent message for a given reply or sequence of replies?
- Are the filter options accessible?
- Are the sort options accessible?

Replying to Messages

- Can user reply directly via external e-mail systems?

Message Discovery

- Can users be notified about new posted messages?
- Does it support RSS?
- Is the feature to subscribe/unsubscribe accessible?

b) Patterns

Pros:

In learning management systems do not provide a lot of ways to view: grid view or list view. There is an attempt to regulate content.

The content of the discussion board and this is technically available, the user has the means of information and restructuring, but because of the complexity, the number of responses.

Challenges in all areas, this makes it difficult for the user to keyboard may not understand the context.

Cons:

There are functional issues, we would like to see increase mobility, and detect and identify unread message.

Table 5.7: Discussion

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Navigation features	Can the user easily and reliably identify this tool/module and navigate to it?	5	5	5	5	5	100.00%
	Can user easily and reliably navigate to different items in this tool/module?	1	4	2	5	5	60.00%
	Subtotal %	60.00%	90.00%	70.00%	100.00%	100.00%	80.00%
Reading messages	Can the user easily distinguish new threads?	0	4	5	4	5	65.00%
	Can the user easily distinguish sub threads?	2	5	3	5	5	75.00%
	Can the user easily distinguish replies?	2	3	3	5	5	65.00%
	Can the user easily distinguish the parent message for a given reply or sequence of replies?	0	2	3	5	5	50.00%
	Are the filter options accessible?	3	4	0	4	4	68.75%
	Are the sort options accessible?	4	4	4	4	4	100.00%
	Subtotal %	39.29%	78.57%	64.29%	96.43%	100.00%	69.64%
Replying messages	Can user reply directly via external e-mail systems?	0	0	2	0	2	25.00%
	Subtotal %	0.00%	0.00%	100.00%	0.00%	100.00%	25.00%
Message recovery	Can users be notified about new posted messages?	2	2	2	2	2	100.00%
	Does it support RSS?	0	0	2	0	2	25.00%
	Is the feature to subscribe/unsubscribe accessible?	0	5	5	5	5	75.00%
	Subtotal %	22.22%	77.78%	100.00%	77.78%	100.00%	69.44%
All Category % (Total: Discussion)		38.78%	77.55%	73.47%	89.80%	100.00%	69.90%

The total category refers to that the highest percentage goes to Sakai (89.80%) and the second one is the D2L (77.55%), the third percentage is for Moodle (73.47%) and the lowest percentage for BB (38.78%) , the explanation below clarifies how each LMS got this percentage :

BB: It can be integrated this unit in the course depending on how the coach set it up: It can be a menu item that connects all the discussion forums at once, or it can be found in the area of content as a link to the forum individual or all of the forums. While the filtering and sorting options offered by the blackboard can be accessed, and they can be enhanced by improving the structure of the head to simplify navigation, Can further strengthen this unity through increased functionality for users with screen reader in discovering new topics, subtopics, and Responses.

D2L: There are multiple ways you can view the discussions, configurable by the user. Some may be best for users with learning difficulties. Planning the most accessible to screen reader users to view messages without thread and because of "reading." The menu tree has been added forums and threads to assist in navigation between the index and sub-themes. He had access to decent, but could be improved by being a tree song list. Threads will have a message hierarchy item shallow (all messages and replies are headlines H2) which may make responses distinctive challenge to screen reader users.

Moodle: Content Forum primary is organized clearly in tabular form (subject headings, by, responses, columns last post), but more work needs to be done to improve the organization and navigation on the topic, as there is still no easy mechanism to navigate one job to another, or in the case of screen reader users, self-placement context in a particular topic of discussion. Advanced search functions Moodle is very powerful, allowing fine-grained control over a wide range of useful search options.

Sakai: It is organized content of initial Forum in the planning a nested table of that is easy to for the user to understanding of the-oriented visits all times are and one, but there are is a need to and existence of scheme navigation of improved and easier in all throughout the a tool for users with special of disability. New messages can be very distinguishable. There is also a need for improvements and additions to the United Lamm / options that are supported under (RSS, and respond Foreign Affairs, and options to subscribe).

5.3.8 Common Student Facing Modules/Tools: E-mail

a) Criteria

Navigation Features

- Can the user easily and reliably identify this tool/module and navigate to it?
- Can user easily and reliably navigate to different items in this tool/module?

Composing

- Can user easily and reliably identify and interact with the applicable fields such as To, CC, Attachment, and Message body?
- Can user easily and reliably include recipients from the list of available users/groups?
- Can user easily and reliably style and format a message?
- Is the Add Attachment feature accessible?
- Is the Spell-check feature accessible?
- Is user notified upon successful message delivery in an accessible way?
- Is user notified about errors/warnings in an accessible way?

Table 5.8: E-mail

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg%
Navigation Features	Can the user easily and reliably identify this tool/module and navigate to it?	5	5	5	5	5	100.00%
	Can user easily and reliably navigate to different items in this tool/module?	5	5	5	5	5	100.00%
	Subtotal %	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
	Can user easily and reliably include recipients from the list of available users/groups?	5	4	5	5	5	95.00%
	Can user easily and reliably style and format a message?	0	4	0	4	5	40.00%
	Is the Add Attachment feature accessible?	3	5	0	4	5	60.00%
	Is the Spell-check feature accessible?	0	4	0	3	5	35.00%
	Is user notified upon successful message delivery in an accessible way?	2	5	2	0	5	45.00%
	Is user notified about errors/warnings in an accessible way?	5	5	2	3	5	75.00%
	Subtotal %	54.29%	91.43%	40.00%	68.57%	100.00%	63.57%
Total Category % Tools: E-mail)		64.44%	93.33%	53.33%	75.56%	100.00%	71.67%

The total category refers to that the highest percentage goes to D2L (93.33%) and the second one is the Sakai (75.56%), the third percentage is for BB (64.44%) and the lowest percentage for Moodle (53.33%) , the explanation below clarifies how each LMS got this percentage :

BB: The recipient name selection is not intuitive. It's a two-step process, select name and then add it, there is only a plain text editor, Browse button is not consistently functioning for a screen reader, the button is there but the function is not available, it returns an error, Visually notifies user, but the screen reader focus is not moved.

D2L: All fields are accessibly labeled. The rich text editor can be a bit fussy with certain screen reader or keyboard-only users as it requires special, edit-specific shortcut keys to jump out of the editor and into the toolbar. Much easier would be the option to shift-tab out of the top of the editor window. The contacts dialog and controls are fully accessible and the search can streamline the process, though the interface is a bit cumbersome to use. The editor takes practice to use, but it does announce markup as the user moves through the editor window, Uses the operating system default browse window/finder, It is buried as the last option in the "Advanced panel of the editor, but it is accessibly implemented, Notification of success or errors is given when the compose window refreshed after the message has been sent. Success and errors are clearly explained.

Moodle: Moodle does not include an email tool in its base installation package. Some email capability for short messages is built into the base installation's messaging system. Various email packages from the community, like Quick mail, are available as add ons, Accessed from the Messages block on the home page. Main content area is organized as a series of links containing online contacts and new incoming contacts. Messages are plain text messages that do not permit any styling. Users cannot send attachments with the messaging system in Moodle. There is no spell check feature. The sent message is displayed as inline text on the message page after sending. Page is refreshed upon submit, but screen reader users must re-scan the page to confirm the message has been sent. Error message is displayed as inline text at the top of the page after sending. Page is refreshed upon submit, but screen readers must re-scan the page to read the message.

Sakai: Users must choose from an address book, Editor is usable, but needs improvements to make things easier, multiple non-unique button form controls could cause confusion. Only one file at a time if it is not uploaded with resources tool, There are shortcut keys, but problems exist for both keyboard and screen reading users, No focus on error message.

5.3.9 Common Student Facing Modules/Tools: Chat

Navigation Features

- Can the user easily and reliably identify this tool/module and navigate to it?
- Can user easily and reliably navigate to different sections in this tool/module?

Text-to-Speech (TTS)

- Does the chat tool have a built-in text-to-speech or use OS TTS with ARIA live-regions or other effective technique to enable chat messages to be live updated?

Chat Log

- Can user configure how to display the chat thread?
- Can user suppress time-stamps?
- Can user select and copy the content of chat log with keyboard alone?
- Are clickable items such as hyperlinks or send mail clickable?
- Can user be notified audibly on new incoming posts?
- Is a private message labeled as private?
- Can user change the chat font size and style?

Chat Room Participation

- Can user discover who is in the chat room?
- Can user easily and reliably locate the desired participant and perform applicable function such as sending a private message?

Posting a Chat Message

- Are the basic editing features (word-by-word, home, end navigation, delete forward/backward, etc.) supported?
- Can a message be submitted upon pressing enter?

Table 5.9: Chat

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Navigation Features	Can the user easily and reliably identify this tool/module and navigate to it?	5	5	5	5	5	100.00%
	Can user easily and reliably	5	5	5	5	5	100.00%

	navigate to different sections in this tool/module?						
	Subtotal %	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
	Does the chat tool have a built-in text-to-speech or use OS TTS with ARIA live-regions or other effective technique to enable chat messages to be live updated?	0	0	0	0	4	0.00%
	Subtotal %	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%
Log	Can user configure how to display the chat thread?	0	4	2	0	4	37.50%
	Can user suppress time-stamps?	0	0	0	3	3	25.00%
	Can user select and copy the content of chat log with keyboard alone?	1	0	0	4	4	31.25%
	Are clickable items such as hyperlinks or send mail clickable?	0	0	0	0	3	0.00%
	Can user be notified audibly on new incoming posts?	0	4	0	0	4	25.00%
	Is a private message labeled as private?	5	0	0	0	5	25.00%
	Can user change the chat font size and style?	0	0	0	0	4	0.00%
	Subtotal %	22.22%	29.63%	7.41%	25.93%	100.00%	21.30%
	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
	Can user easily and reliably locate	0	0	1	0	5	5.00%

	the desired participant and perform applicable function such as sending a private message?						
	Subtotal %	10.00%	0.00%	60.00%	50.00%	100.00%	30.00%
Sending a message	Are the basic editing features (word-by-word, home, end navigation, delete forward/backward, etc.) supported?	5	5	5	5	5	100.00%
	Can a message be submitted upon pressing enter?	3	3	3	3	3	100.00%
	Subtotal	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Category % (Tools: Chat)		42.37%	52.54%	44.07%	50.85%	100.00%	47.46%

The total category refers to that the highest percentage goes to D2L (52.54%) and the second one is the Sakai (50.85%), the third percentage is for Moodle (44.07%) and the lowest percentage for BB (42.37%) , the explanation below clarifies how each LMS got this percentage :

BB: Chat module cannot be started in Firefox or IE without installing Java Access Bridge version 1.0.3, an outdated version. Current 2.0 versions is not compatible with chat module. It installs the plugins under IE but not under Firefox and now chat is compatible with Java Access Bridge 2.0.2, Time stamps are not available to screen reader user for non-private messages. The function is there, but visually a keyboard user cannot see the curser in the chat log. With a screen reader it didn't have consistent behavior, could not copy the last line in the chat log. You can use mouse but keyboard user cannot focus on chat log or click on hyperlink, yes, also includes time stamp Nothing in the menu, CTRL +/- has no effect, Cumbersome, traps curser and can't get out of participant easily, Trapping effect in participant list prevents keyboard user from sending a private message, can't get to the private message button that is outside of the table of participants.

D2L: Available in the settings for chat, a tone can be set for this and for participant leaving and entering, Implemented as an unordered list and introduced by a heading Is a simple text area.

Moodle: When joining a chat session, user may choose the "more accessible interface" chat option that consists of headings, lists, and properly labeled forms for input, Chat messages are not live updated, but can be updated by the user by clicking the refresh button next to the send button. User may choose to show only new messages. There is no private message feature, Participants list is preceded by a heading 2, User may locate a desired participant, and view their profile from chat, but there is no private message feature from within chat, When joining a chat session, user may choose the "more accessible interface" chat option that consists of headings, lists, and properly labeled forms for input.

Sakai: There are other customization options but not sort order, Use Firefox and press F7 to enable caret browsing mode. In other browsers, tab to frame and use shift+arrow keys to select content. Or use screen-reader tools to select content from the screen, however instructor delete links are clickable, private messages not supported, No customization options.

5.3.10 Common Student Facing Modules/Tools: Assignments, Activities, Course Content

a) Criteria

Navigation Features

- Can the user easily and reliably identify this tool/module and navigate to it?
- Can user easily and reliably navigate to different sections in this tool/module?
- Can user easily and reliably discover new assignments/activities and navigate to them?
- Is there a single place to view the outline of assignments/full syllabus of the course?
- Is it possible to determine what sort of content is linked to in outline/syllabus (links to PDF, PowerPoint, HTML content, etc.)?
- Is there a way for the user to bookmark a location in content?
- Is there a simple way to return to the last viewed content?

Uploads/Downloads:

- Can the user easily and reliably operate the download feature?
- Can the user easily and reliably operate the upload and attachment features?

b) Patterns

Pros: providing Learning Management Systems is generally a good platform for the course content. Through Learning Management Systems courses tend to be easy to navigate. Blackboard provides a flexible way to develop content, for example to build rolls out on track and put the content into folders.

Cons: blackboard approach provides a tool, but it's used globally.

Table 5.10: Assignments, activities, course content

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
ation es	Can the user easily and reliably identify this tool/module and navigate to it?	5	5	5	5	5	100.00%
	Can user easily and reliably navigate to different sections in this tool/module?	0	5	5	5	5	75.00%
	Can user easily and reliably discover new assignments/activities and navigate to them?	0	5	5	4	5	70.00%
	Is there a single place to view the outline of assignments/full syllabus of a course?	0	3	5	1	3	75.00%
	Is it possible to determine what sort of content is linked to in outline/syllabus (links to PDF, PowerPoint, HTML content, etc.)?	0	4	2	4	4	62.50%
	Is there a way for the user to bookmark a location in content?	0	2	2	1	2	62.50%
	Is there a simple way to return to the last viewed content?	0	0	0	0	2	0.00%
	Subtotal %	19.23%	92.31%	92.31%	76.92%	100.00%	70.19%

Uploads/Download	Can the user easily and reliably operate download feature?	3	5	5	5	5	90.00%
	Can the user easily and reliably operate the upload and attachment feature?	2	5	0	4	5	55.00%
Subtotal %		50.00%	100.00%	50.00%	90.00%	100.00%	72.50%
Category %							
Assignments,	Activities, Course	27.78%	94.44%	80.56%	80.56%	100.00%	70.83%

The total category refers to that the highest percentage goes to D2L (94.44%) and the second one are sharable goes to Moodle and Sakai (80.56%), the lowest percentage for BB (27.78%), the explanation below clarifies how each LMS got this percentage :

BB: A tool provided curriculum, but most coaches use the process more convenient to add an attachment to an item in the content area, and there is no standardized method for the student to view their curriculum through courses. Unit assignment on the blackboard provide students with the Content Editor to enter their work, but depending on how instructed the student to provide their user may encounter difficulty in linking a document.

D2L: As in previous versions, the course content is very well organized, Navigation, and can be accessed. Types of session content easy to discover their prayers, bookmarks can be set and the content has already been visited is shown in the table of contents for the session.

Moodle: total content, of course, can be reached easily by 3 column table format on the home page, of course, and blocks marked down by subject Level 3 IDs. Upload and download content through a new tool Picker file raises some important concerns for people with disabilities, which stems largely from the fact that it is a widget with an unconditional dialogue that is dealing with the content of the page instead of a separate window. There is no way for a screen reader user to say that the piece Picker file is a separate window (not part of the content of the page itself).

Sakai: general content cycle is easy to navigate and understand. Improvements can be made on the consistency and discovery of file types, content previously viewed and new assignments. There are also restrictions on the single file upload and download without external tools.

5.3.11 Common Student Facing Modules/Tools: Grade Book

a) Criteria

Navigation Features

- Can the user easily and reliably identify this tool and navigate to it?
- Can user easily and reliably navigate to different sections in this tool/module to view grades for various assignments?
- Can user easily and reliably access individual scores and any related instructor feedback for specific assignments that have been graded?
- Can user easily and reliably locate the current cumulative grade for completed work in the course?
- If grade tool offers statistics for student score relative to the class average, is this information accessible?

b) Patterns

Cons: Across the board to deal with the giant table.

Pros: The provision of a folding table. Moodle provides methods of regulation by the grading categories.

Table 5.11: Grade Book

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Navigation Features	Can the user easily and reliably identify this tool and navigate to it?	5	5	5	5	5	100.00%
	Can the user easily and reliably navigate to different sections in this	5	5	5	5	5	100.00%

	tool/module to view grades for various assignments?						
	Can user easily and reliably access individual scores and any related instructor feedback for specific assignments that have been graded?	5	4	5	5	5	95.00%
	Can the user easily and reliably locate the current cumulative grade for completed work in the course?	5	5	3	5	5	90.00%
	If grade tool offers statistics for student score relative to the class average, is this information accessible?	Need to test again	4	4	4	4	100.00%
	Subtotal %	83.33%	95.83%	91.67%	100.00%	100.00%	92.71%
Total Category % (Tools: Grade Book)		83.33%	95.83%	91.67%	100.00%	100.00%	92.71%

The total category refers to that the highest percentage goes to Sakai (100.00%) and the second one is the D2L (95.83%), the third percentage is for Moodle (91.67%) and the lowest percentage for BB (83.33%) , the explanation below clarifies how each LMS got this percentage :

BB: blackboard table layout provides accessible to students to view their grades and reading instructor feedback and comments.

D2L: grade book is easy to navigate by keyboard and a screen reader. D2L has done considerable work to ensure that the comments and grades, and statistics screen reader category are fully accessible. As noted in the detailed analysis we have, there is a slight problem with the navigation screen reader from the list of competitions (column alignment from grade items nested in the table overview degrees may cause some confusion), but overall this area of D2L is very accessible.

Moodle: Book continues to be a row of keyboard navigation table that makes effective use of the table headings and scope to make the grade book content accessible to screen reader users.

Sakai: Sakai Grade book tool is very accessible. The tool consists of only one page, most of the information is contained in a single table. There are a few drawbacks that are not issues for people with disabilities. First, you must access the coach feedback in the tool where the item was created grades. Second, only the statistics are created that can be accessed by users student after the final course grade is calculated.

5.3.12 Common Student Facing Modules/Tools: Quizzing/Testing Components

a) Criteria

Navigation Features

- Can the user easily and reliably identify this tool/module and navigate to it?
- Can user easily and reliably navigate to different sections in this tool/module?
- Can user easily and reliably navigate between questions?
- Can user easily identify unanswered questions?
- Can user easily identify point value for each question?
- Can user easily identify required or optional questions?

- Can user easily obtain information about elapsed/remaining time?
- Question Types (only minimum/common types listed)
- Can the user easily and reliably interact with the multiple choice question type?
- Can the user easily and reliably interact with the true/false question type?
- Can the user easily and reliably interact with the short answer question types?
- Can the user easily and reliably interact with the blank question type?
- Can the user easily and reliably interact with the numerical/arithmetic question type?
- Can the user easily and reliably interact with the matching question type?

Saving Quiz Progress/Draft:

- Can quiz results be easily saved without redrawing the page?
- Notification and verification:
- Does the quiz tool provide an accessible verification message on successful submission?
- Can the user easily and reliably detect and address error notifications?

b) Patterns

Pros: Submissions confirm and verification than answers. If you have questions unanswered and Learning Management Systems and tell you.

Cons: contrary to labeling of question types. Can improve provide confirmation and verification users at the level of individual questions.

Table 5.12: Quizzing/testing components

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg.%
Navigation Features	Can the user easily and reliably identify this tool/module and navigate to it?	5	5	5	5	5	100.00%
	Can user easily and reliably navigate to different sections in this tool/module?	5	5	5	5	5	100.00%
	Can user easily and reliably navigate between questions?	5	2	5	5	5	85.00%
	Can user easily identify unanswered questions?	5	3	5	4	5	85.00%
	Can user easily identify point value for each question?	5	5	5	5	5	100.00%
	Can user easily identify required or optional questions?	5	4	0	1	5	50.00%
	Can user easily obtain information about elapsed/remaining time?	3	4	5	5	5	85.00%
	Subtotal %	94.29%	80.00%	85.71%	85.71%	100.00%	86.43%
Question Types (most common/commo- des listed)	Can the user easily and reliably interact with the multiple choice question type?	3	5	5	0	5	65.00%
	Can the user easily and reliably interact with the true/false question type?	3	5	5	0	5	65.00%
	Can the user easily and reliably interact with the short answer question type?	0	1	5	4	5	50.00%

	Can the user easily and reliably interact with the long answer/essay question type?	0	3	5	4	5	60.00%
	Can the user easily and reliably interact with the fill in the blank question type?	0	5	5	2	5	60.00%
	Can the user easily and reliably interact with the numerical/arithmetic question type?	0	not tested	5	2	5	46.67%
	Can the user easily and reliably interact with the matching question type?	0	not tested	5	2	5	46.67%
	Subtotal %	17.14%	54.29%	100.00%	40.00%	100.00%	52.86%
Quiz Press/Draft	Can quiz results be easily saved without redrawing the page?	5	2	0	0	5	35.00%
	Subtotal %	100.00%	40.00%	0.00%	0.00%	100.00%	35.00%
Question and Notification	Does the quiz tool provide an accessible verification message on successful submission?	5	4	5	5	5	95.00%
	Can the user easily and reliably detect and address error notifications?	5	4	5	4	5	90.00%
	Subtotal %	100.00%	80.00%	100.00%	90.00%	100.00%	92.50%
Category % (Quizzing/Testing Components)		63.53%	67.06%	88.24%	62.35%	100.00%	70.29%

The total category refers to that the highest percentage goes to Moodle (88.24%) and the second one is the D2L (67.06%), the third percentage is for BB (63.53%) and the lowest percentage for Sakai (62.35%) , the explanation below clarifies how each LMS got this percentage :

BB: The transition to online tests is clear and explicit, but can flexibility provided by the teacher to publish online tests in different areas to create navigation is consistent across different courses. Users can easily determine the point totals, questions and question marks. Labeling on the type of question needs to be improved because the screen reader user has no way of fixing it. Labeling of the stadium answer or input is also a problem because the screen reader user cannot tell if the answer to the right question.

D2L: Some of the question types have issues for the disabled, but most of them can be accessed in general. The option to have one question for each "page" of this competition (configurable by the coach) can represent difficulties for users of screen reader, in particular, because there is no announcement on the response of competition has been saved successfully, or that the next question was loaded (all operations vital, and revives the same pages of content).

Moodle: Although the test results cannot be saved without redrawing the page, Moodle generally does a good job of providing a tool accessible contest and question types. Notification and verification are also effective in providing a list of any answer to the questions without answer before the user is presented with the option to "provide all finished," and then confirm the request, prior to the submission.

Sakai: Sakai needs significant improvements to the test and component tests. Many question types have the form of controls inconsistent or non-named and questions is not required is difficult to detect. However, the notification and verification excellent and users can easily find a question unanswered (if your boss allows this feature). May be patched many of these issues in newer versions of Sakai, which is in the process of being ported back to older versions.

5.3.13 Authoring Tools and Content Creation

a) Criteria

File uploading:

- Does the tool perform an automated accessibility evaluation of the content or provide a wizard that directs the user toward accessible content?
- Does it allow multi-file selection and upload?
- Does the tool offer helper features, such as graphics upload and alt tag wizard, that help make content more accessible and educate users about the accessibility of the content they create?

Authoring tool:

- Is the primary editor accessible?
- Does the editor support HTML format?
- Is the editor capable of stripping out all non-HTML markups (bad code)?
- Does the editor support wiki-style markup format?
- Does the editor support plain text format?

Grade Book (instructor-level):

- Can the user easily and reliably navigate to different sections in this tool to manually enter grades for various assignments?
- Can the user easily and reliably navigate to different sections in this tool to enter comments and feedback on individual assignments?
- For group assignments, can the user easily and reliably isolate specific assigned groups for the purpose of assigning grades and providing feedback?
- Can the user easily and reliably change the weighting on specific assignments and assignment categories?
- Can the user easily and reliably create and deploy basic calculation formulae/grading schemes (e.g., for averaging grades, assigning extra credit, etc.)?
- Are other LMS-specific features, such as Release Conditions or Grade Visibility settings, able to be easily and reliably used?

Multimedia Content Handling

- Can user easily and reliably use the LMS-provided multimedia player?
- Does the provided video player support captions?
- Does the provided video player support audio description?
- Can user play audio/video content with desired client-based multimedia player?

b) Patterns

Pros: General improvements in the default content editors, including access options and prompts users (with alternative text insertion Photo).

Cons: But this trend can be extended to make it easier to author content access, for example, helping users make the proper agenda item tags with scope and a summary table; media help users distinguish from decorative images. If the provision of the media, it should invoke the default media player for the user.

Table 5.13: Authoring tools and content creation

	Criteria	BB	D2L	Moodle	SAKAI	Max	Avg%
Loading	Does the tool alert the user about accessibility issues with the file to be uploaded?	0	0	1	0	2	12.50%
	Does the tool allow multi-file selection and upload?	2	2	0	1	2	62.50%
	Does the tool offer helper features, such as a graphics upload and alt tag wizard, that help make content more accessible and educate users about the accessibility of the content they create?	Partial (test again)	3	2	0	3	55.56%

	Subtotal %	28.57%	71.43%	42.86%	14.29%	100.00%	39.29%
Learning 1	Is the primary editor accessible?	3	4	5	3	5	75.00%
	Does the editor support HTML format?	5	5	5	5	5	100.00%
	Is the editor capable of stripping out all non-HTML markup (bad code)?	0	5	2	2	5	45.00%
	Does the editor support wiki-style markup format?	0	0	3	0	3	25.00%
	Does the editor support plain text format?	5	5	5	2	5	85.00%
	Subtotal %	56.52%	82.61%	86.96%	52.17%	100.00%	69.57%
Side k structor el)	Can the user easily and reliably navigate to different sections in this tool to manually enter grades for various assignments?	2	5	5	3	5	75.00%
	Can the user easily and reliably navigate to different sections in this tool to enter comments and feedback on individual assignments?	0	5	5	3	5	65.00%
	For group assignments, can the user easily and reliably isolate specific assigned groups for the purpose of assigning grades and providing feedback to specific assigned groups?	2	3	2	3	5	50.00%
	Can the user easily and reliably change the weighting on specific assignments	0	5	5	2	5	60.00%

	and assignment categories?						
	Can the user easily and reliably create and deploy basic calculation formulae/grading schemes (e.g., for averaging grades, assigning extra credit, etc.)?	0	5	5	5	5	75.00%
	Are other, LMS-specific features, such as Release Conditions or Grade Visibility settings, able to be easily and reliably used?	5	5	5	3	5	90.00%
	Subtotal %	30.00%	93.33%	90.00%	63.33%	100.00%	69.17%
Multimedia Content Handling	Can the user easily and reliably use LMS provided multimedia player?	0	0	2	0	5	10.00%
	Does the video player support captions?	0	0	0	0	5	0.00%
	Does it support audio description?	0	0	0	0	3	0.00%
	Can user play an audio/video content with desired client-based multimedia player?	4	4	4	4	4	100.00%
	Subtotal %	23.53%	23.53%	35.29%	23.53%	100.00%	26.47%
Total Category %		36.36%	72.73%	72.73%	46.75%	100.00%	57.14%

The total category refers to that the highest percentage are sharable goes to D2L and Moodle (72.73%) and the second one is Sakai (46.75%), the lowest percentage for BB (36.36%), the explanation below clarifies how each LMS got this percentage :

BB: Editor default content cannot be accessed, but the user can change the text editor or HTML-based. Blackboard does not provide space for ALT text input when the image is loaded. For multimedia playback blackboard does not provide a media player, blackboard know new content

editor provides for easy integration of media embedded from external sources (Flickr, YouTube), so it is the responsibility of the coach to include the players arrive. If the host media files in the system LMS player will launch the user's default.

D2L: Generally, tools for content creation and grades can be accessed in D2L. There are some issues with the WYSIWYG editor, previously noted, her relationship in ways that are not clear to leave the editor, which may affect the screen reader and keyboard only users. There is no accessible media player default - even though the content of the pages of D2L will accept custom players with some small business by system administrators or content creators. And D2L added support for global MathJax in D2L 10. This provides a straight-forward way to create mathematics can be accessed (via MathML) inside the LMS.

Moodle: Input file Picker tool in Moodle 2 brings with it some important issues navigation, as is the piece that, when it started, is dealing with the content of the page instead of a separate window. There is no way for a screen reader user to say that the piece Picker file is a separate window (not part of the content of the page itself). Other authoring tools, such as the default TinyMCE editor, is currently offering some playback options and prompts such as prompt text alternative that also warns users that have not submitted an alternative text of the image, for example. Editor can provide a wider choice for people with WYSIWIG and demanding (claims to determine the table headings, scope, and abstracts, for example; or to pay for users to distinguish decorative media images when you add pictures).

Sakai: Sakai does not offer any features to help improve the content creators or verify access to the content they download. Editor also has a main feature is very limited compared with other WYSIWYG editors set available including signs and wiki support HTML. The new editor will be used in future a version of Sakai which are more fully accessible and offers more features. Grade book is a tool has a very limited feature set and more of an overview of the tool. All grades must be changed and options in the tool and home and not in the grade book tool. Sakai offers no support multimedia origin. You must be an integral part of these files using external players or downloaded for viewing.

5.4 Summary

Comparison process was explained and it was most mentioned which is the choice of the most important properties to be affected by a significant impact on the system. And its effectiveness and its importance to the user, has been mentioned and ask all the important questions to clarify the comparison and answer them in a way tables and give grades. In addition to giving advice and explanations were mentioned some of the benefits and disadvantages logical to define the importance of characteristics.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

After completing of the comparison process and getting the results, they have been summarized in this section using graphs to illustrate the results of each that system underwent a comparison of its properties, the systems were divided into groups according to their relations to one another, in addition to a summary of how the systems got these grades in general to enable the reader to see all the systems at once. However the method will be introduced in the first chart and then a simple illustration of how the systems got these results, but in general all the systems include these categories described below:

1. Login, Configuration, and Compatibility Testing

Here are the main logical reasons that each system got its total grades:

- First point of contact / interaction with the LMS.
- LMS relies on external programs / plug-ins, browser settings, etc.
- Users must be informed about the required / optional software and optimal configuration before attempting to enter.
- Users must be able to download / install the required / optional software and change the necessary settings independently.

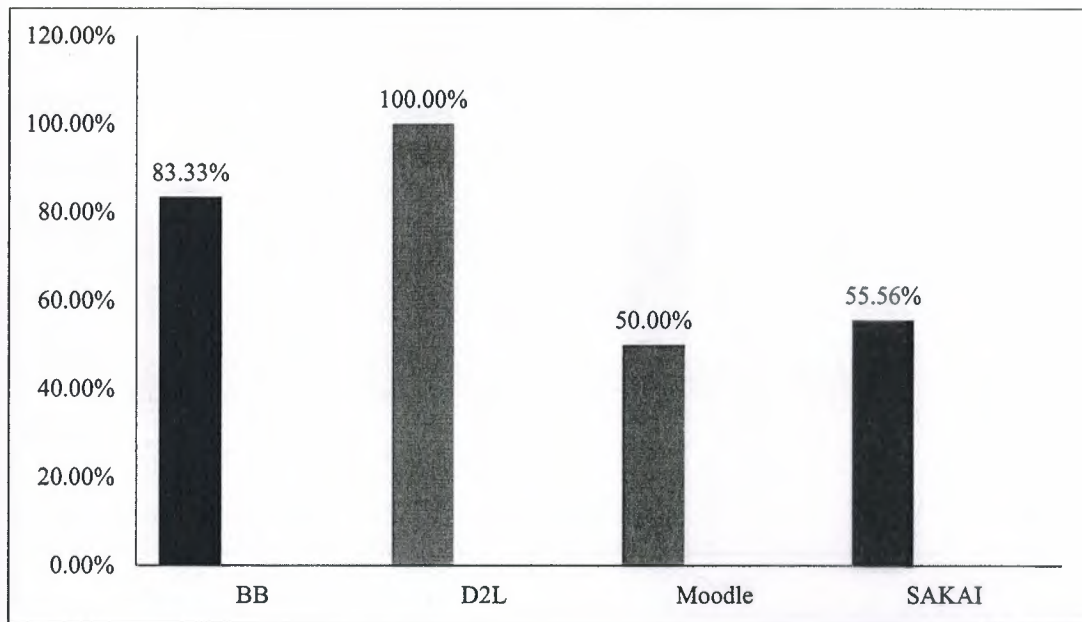


Figure 6.1: Login, configuration, and compatibility testing

The highest percentage is (100%) for D2L which has done well in this area as well as in its previous versions. the login page has a simple design and is easy to navigate through and is used to access dialogues alert JavaScript to indicate the presence of errors. The system detects the capabilities of the browser and will report if the basic functions are not enabled such as JavaScript. And Blackboard (83.33%) is the second highest percentage which is doing a good job in this category it offers an easy accessible environment to enter along with a compatibility testing. The third Sakai (55.56%) not that good in this category it offers an easy accessible environment. the last one is Moodle (50.00%) not that good as well in the overall provision of access and access compatibility testing.

2. Personalization and Customization

Here are the main logical reasons that each system got its total grades:

- Users have different needs and ways to view and interact with applications.
- Users can adapt the system to their needs, rather than adapt to the application.
- Personalization to improve the user experience.

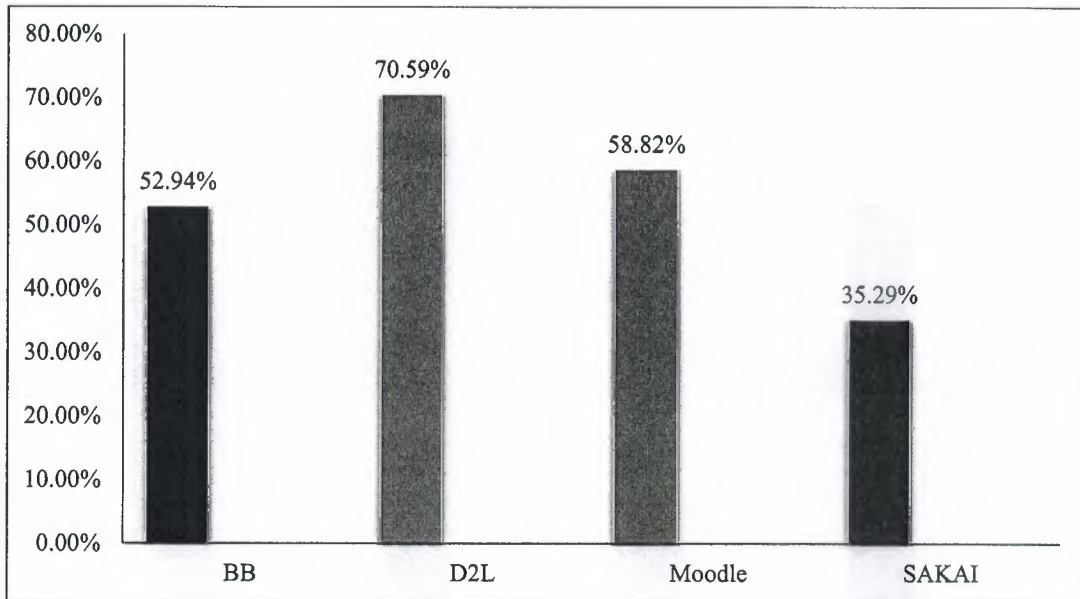


Figure 6.2: Personalization and customization

The highest percentage goes to D2L (70.59%) which allows users to a great deal of customization. The user is being warned about the time of the session (through access enabled alert) and he is allowed to extend the session. And the second one is Moodle (58.82%) which had made great strides in transforming a number of customization options and user customization that was previously controlled by the administrator. Blackboard is the third one (52.94%) which does not allow the user to set the global session timeout as well as they do not provide an alert before the expiration of the term of the session. The lowest percentage goes for Sakai (35.29%) which provides a small number of global and specific customization tools, however most of the personalization and customization options are not provided.

3. Navigation

Here are the main logical reasons that each system got its total grades:

- Navigation is the most important element for accessibility.
- Often there is no visual clue or description of the layout.
- Users need to obtain necessary information to make navigation decisions.
- Users must be able to navigate effectively and with certainty.

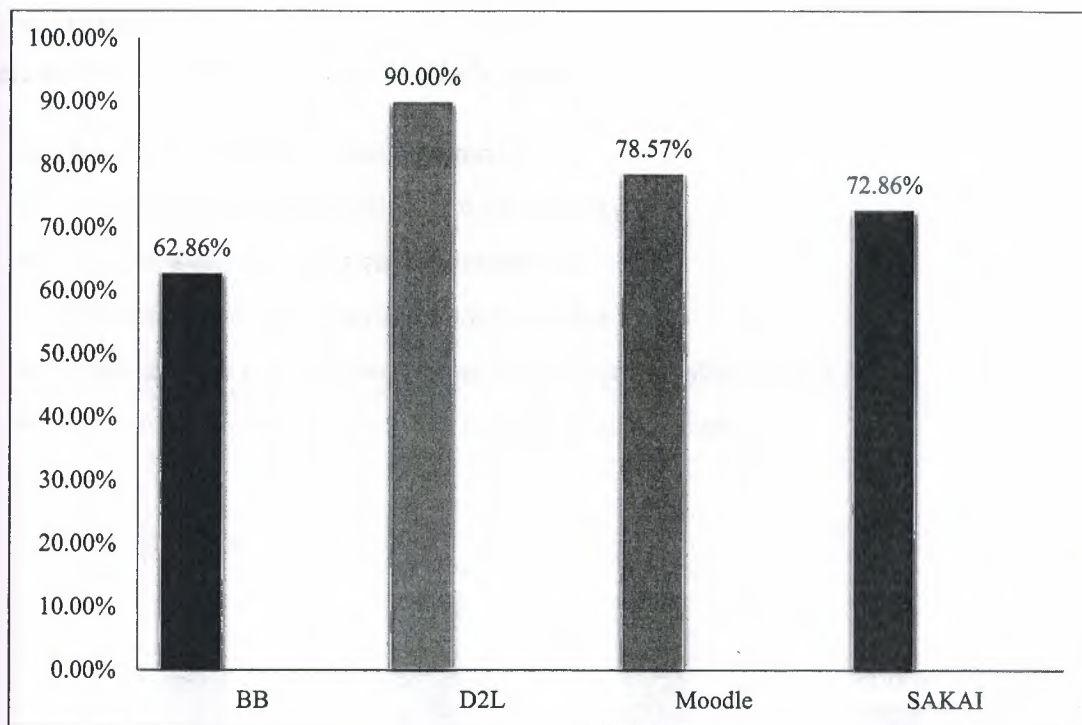


Figure 6.3: Navigation

The highest percentage goes to D2L (90.00%) which makes good use of the areas of the attraction tones and the navigation screen is clear and easy to the user and it's addressed in a hierarchical manner. The second one is Moodle (78.57%) has a clear and focused indication and can be applied in a manner of more consistent links, addresses and hints especially in the case of user-created content of the page. The third one is Sakai (72.86%) which has good browsing in general with unique titles and the main navigation consistently precedes H1 with an excellent focused visual indication. improvements to access the keyboard of hints and irregular cases of non-unique link text or descriptive promotes ease of movement. The lowest percentage goes to the Blackboard (62.86%) which does a good job in providing a single address for a large section of each page; Blackboard provides flexibility for the coach to design the course menu and content design.

4. Forms

Here are the main logical reasons that each system got its total grades:

- Real interaction begins with the models.
- Users must enter data easily and with certainty.
- Must be a data format is easy to understand.
- Instructions must be clear and understandable.
- Users must be notified about possible errors and be able to fix it.
- Users must be notified about the successful submissions.

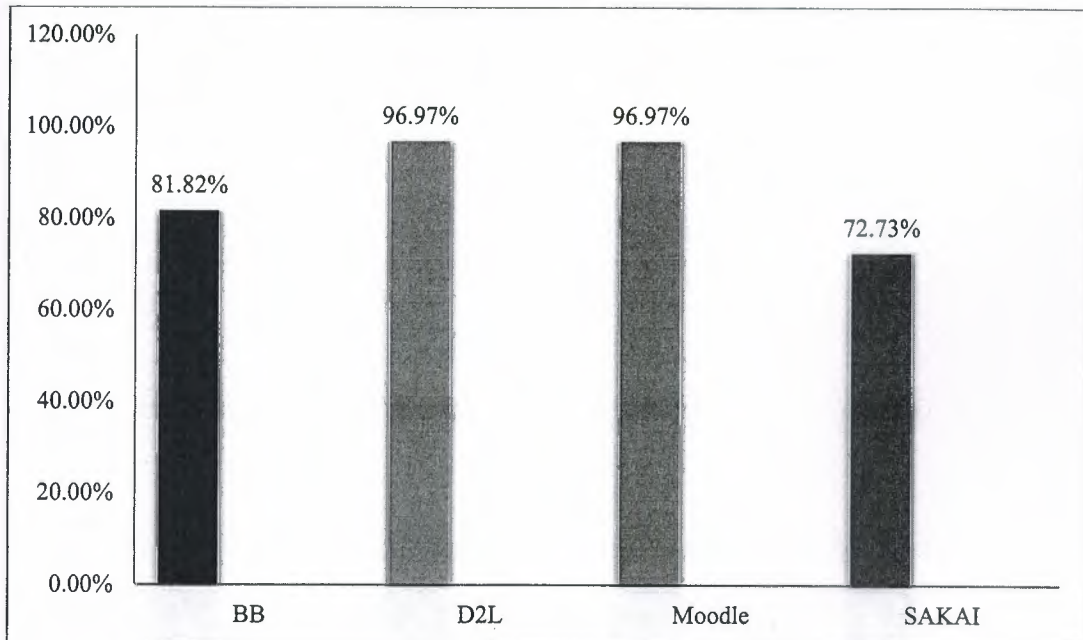


Figure 6.4: Forms

The highest percentage is (96.97%) which is shared by D2L and Moodle, D2L is consistent in the use of the labels properly associated with all the form fields in version 10 adds tones needed for the required fields. Moodle generally describes and controls the forms and fields correctly although the confirmation of the success of making and modeling and error notification can be improved in several areas, the second one is Blackboard (81.82%) which provides the cancel buttons which can be accessed and implemented consistently across the application. The required fields, error notifications and confirming the offer are not always labeled, announced or pointed in the user's screen. Sakai the last one (72.73%), some of the form's controls are clear and

unique. However, there is still room for improvement, cross-platform there must be a consistent use of verification and providing messages and focusing for both the visible and invisible they should be placed on these messages when they appear.

5. Help and Documentation

Here are the main logical reasons that each system got its total grades:

- LMS applications are complex and require a learning curve.
- The main functions of the tools must be clear and easily visible.
- You must provide a step-by-step instructions prior to or during the process of assistance.
- Must be documented accessibility features and support available within the LMS, as well as outside the LMS.

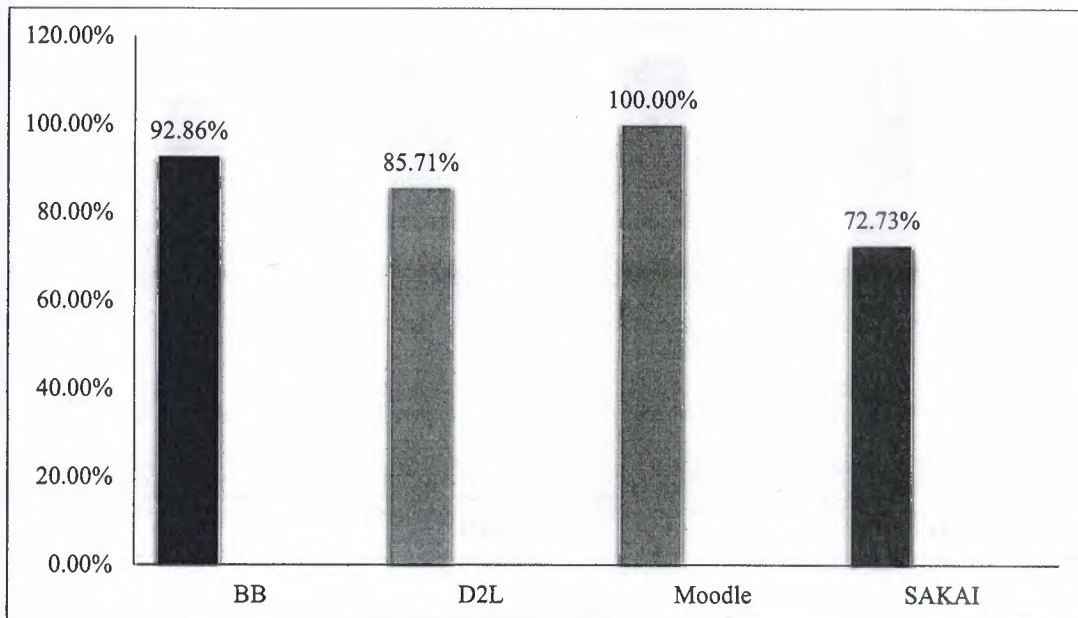


Figure 6.5: Help and documentation

The highest percentage is (100.00%) which goes for Moodle, it continues to do a good job to some extent and it provides contextual included assistance through the link's graphical instructions. The second one is Blackboard (92.86%) it is good in providing assistance within the application and in the context, providing translations of video lessons and makes it available to the public with the controls that are usable with the keyboard, the third percentage goes for D2L (85.71%) which has well written and accessible built-in instructions for the last few versions.

Changes to assist in the WYSIWYG editor are welcomed and the editor’s announcement shortcut keys are available. The lowest for Sakai (72.73%) it provides a good documentation of contextual instruction in all parts of the platform.

6. Tools

Here are the main logical reasons that each system got its total grades:

- The user needs to interact with different tools in the LMS.
- Have been selected the most important units / common tools for evaluation.
- Standards based on the functionality of the tools.

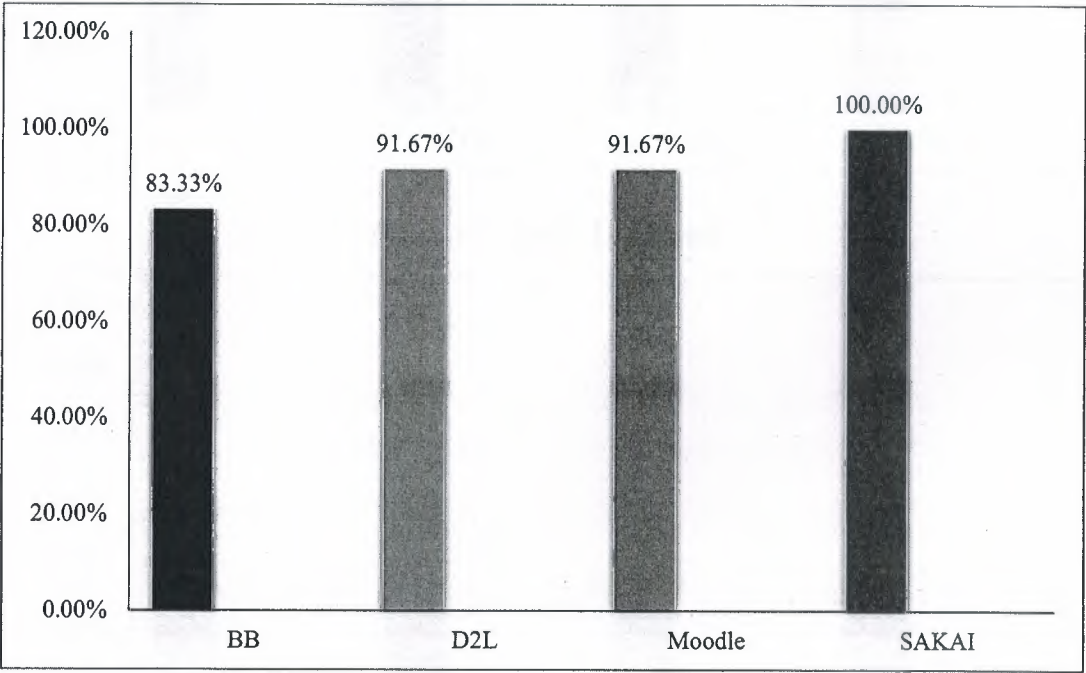


Figure 6.6: Tools: Announcements

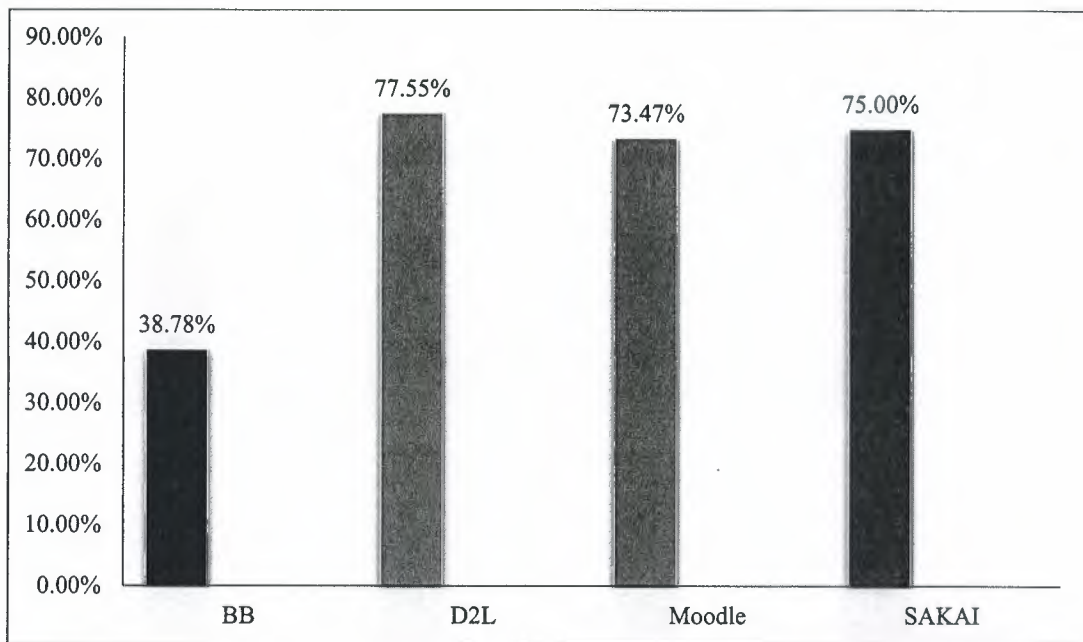


Figure 6.7: Tools: Discussion

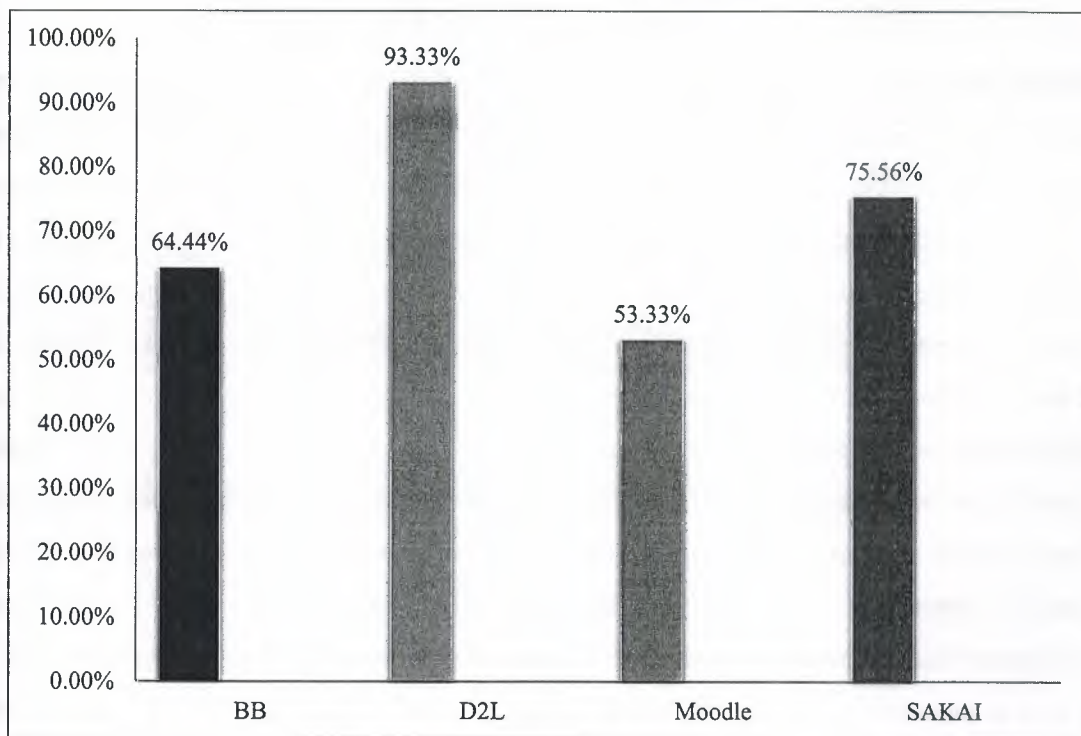


Figure 6.8: Tools: E-mail

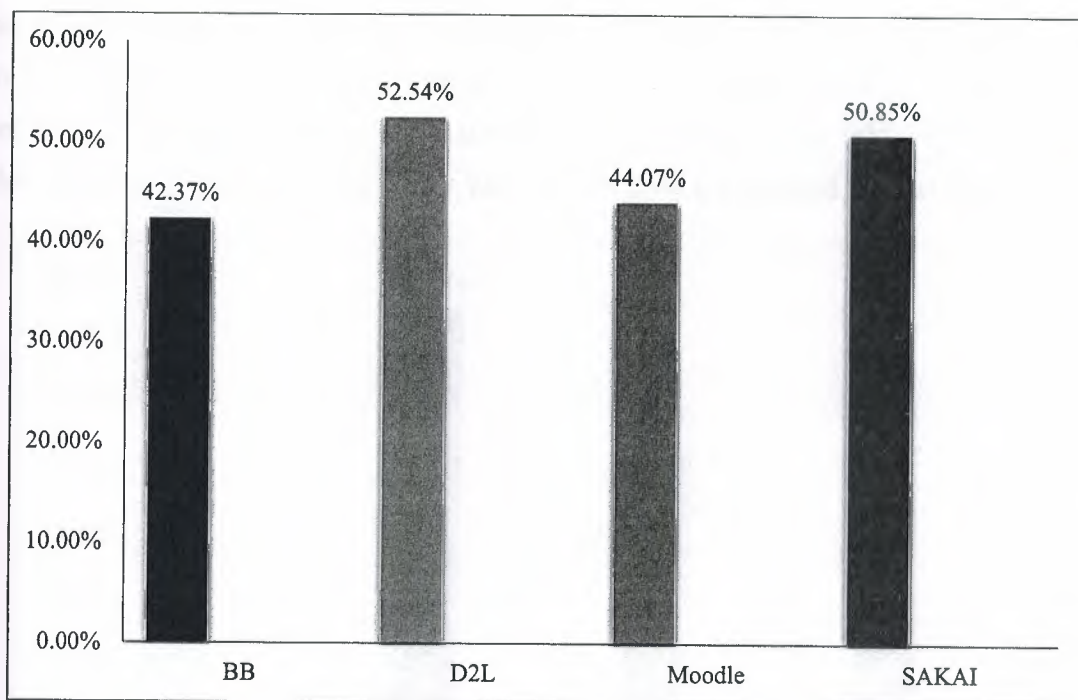


Figure 6.9: Tools: Chat

This is a summary explanation about the tools categories (announcement, discussion, email and chat) which are shown in the above figures. So, Blackboard can integrate with the course unit depending on how the coach set it up, Blackboard is unable to do keyboard testing with an OS, However they put the new announcements in the tools but there is nothing in the announcement module from the student's side, there is no way to filter or sort the announcements. In D2L there are multiple ways you can view the discussions, they are configurable by the user. Some may be the best for the users with learning difficulties; each new item begins with a heading on the D2L course's home page. There is no indication of how many are new. However, the student has the option of "dismissing" (marking read or no longer relevant) each item or list all new items and searching them. Moodle's content forum is primarily clearly organized in a tabular form but more work needs to be done to improve the organization and navigation of the topic, still there is no easy mechanism to navigate one job to another, Moodle announcements are managed in 2 ways: 1) using the announcements forum, a special forum that allows the instructor to post one-way announcements of the course which is set to email the announcement automatically to all students in the course; 2) a combination of the announcements forum and the "Latest News" block in which the latest news block provides quick access to the most recent announcement

forum posts. There are lists of the most recent announcements on the course's home page. Students cannot remove announcements but instructors can make them expire. On change events may negatively affect accessibility. Sakai organizes the contents of the initial forum by a nested table planning; this makes it easy for the user to understand the-oriented visits at any times.

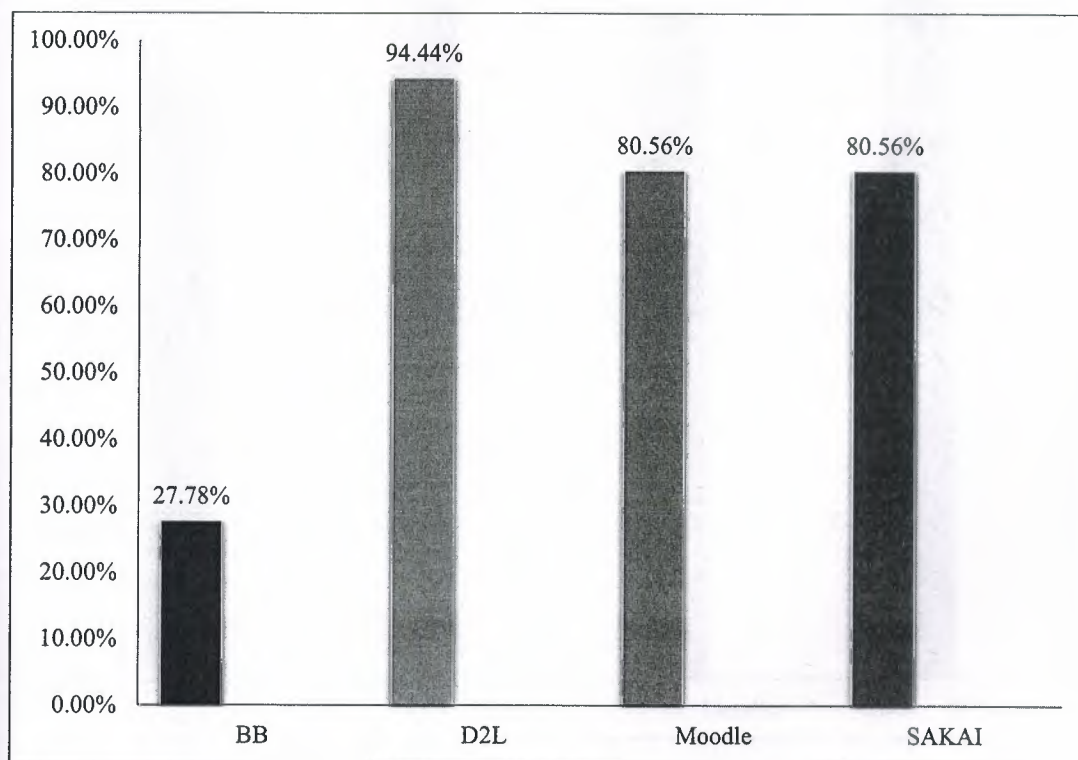


Figure 6.10: Tools: Assignments, activities, course content

The highest percentage is for D2L (94.44%) it's session's content types are easy to discover by the users, bookmarks can be set and the content that has already been visited is shown in the table of contents for the session. The second highest percentage (80.56%) is shared by Moodle and Sakai, Moodle's total content of the course can be reached easily by a 3 column table format on the home page. Sakai's general content cycle is easy to navigate through and understand. Improvements can be made on the consistency and discovery of file types. The lowest percentage (27.78%) goes for Blackboard tool provided curriculum but most of the coaches use the process more conveniently to add an attachment to an item in the content area and there is no standardized method for the student to view their curriculum through courses.

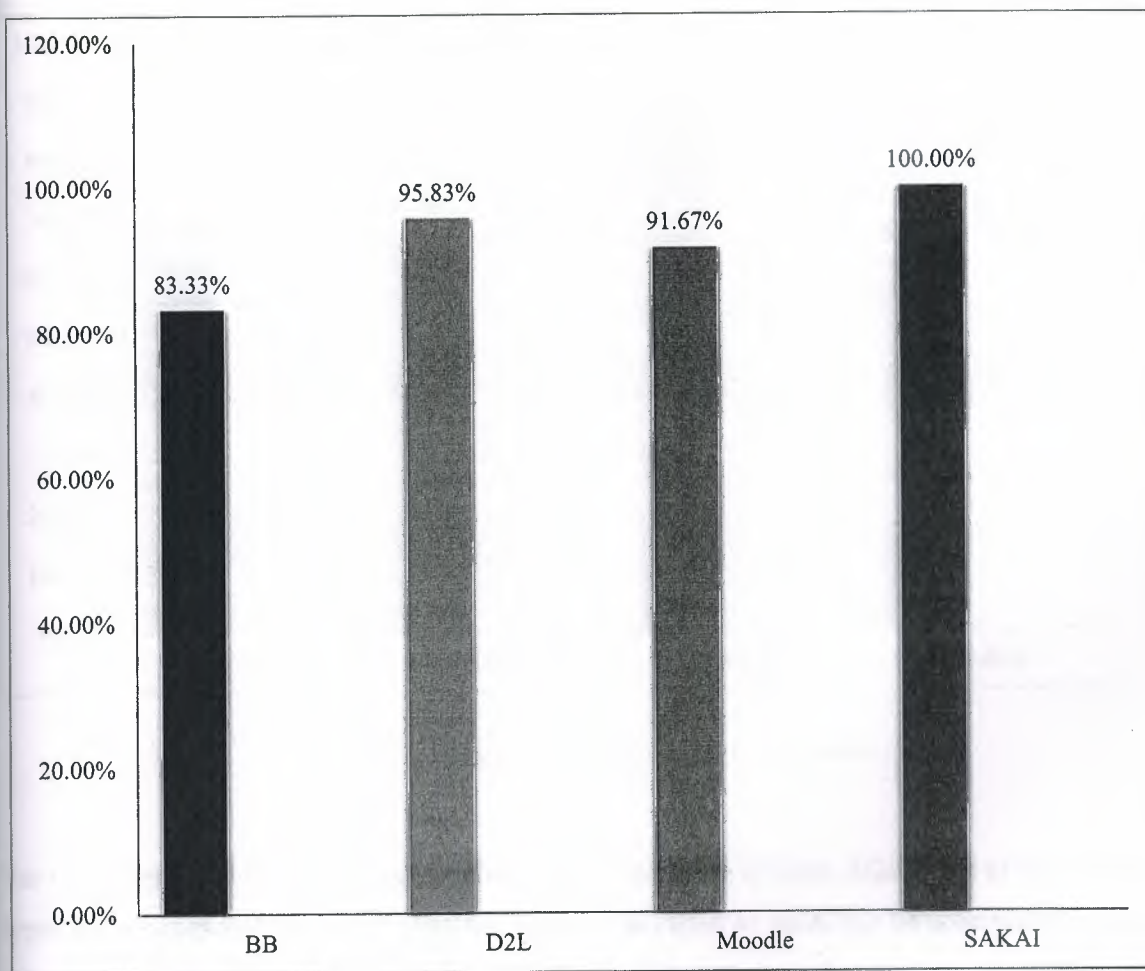


Figure 6.11: Tools: Gradebook

The highest percentage (100.00%) for Sakai the Grade book tool is accessible. The second one is D2L (95.83%) the grade book is easy to navigate through by a keyboard and a screen reader. The third percentage (91.67%) is for Moodle, Moodle book continues to be a row of keyboard navigation table that makes an effective use of the table's headings and scopes to make the grade book content accessible for the users screen, the lowest percentage is (83.33%) for Blackboard, it's chalkboard table layout provides accessibility for the students to view their grades and read the instructor's feedback and comments.

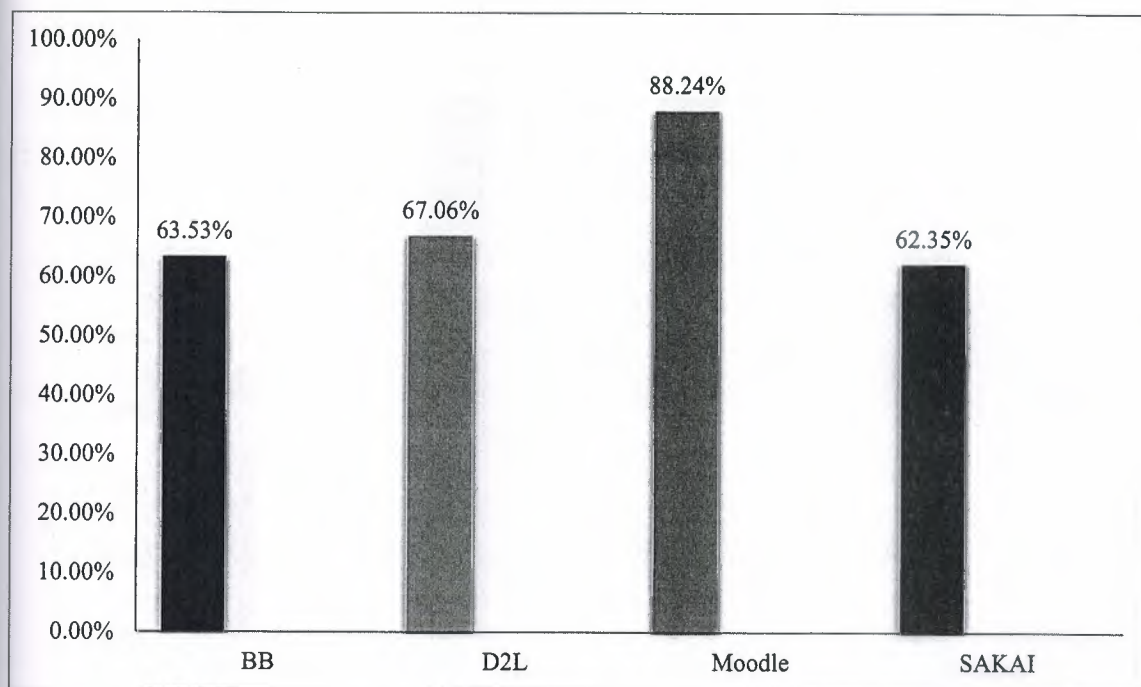


Figure 6.12: Tools: Quizzing/testing components

For the Blackboard the transition to online tests is clear and explicit, D2L some of the question types have issues for that reason they are disabled but most of them can be accessed in general, for Moodle although the test results cannot be saved without redrawing the page, generally Moodle does a good job of providing an accessible contest tool and a question types tool, Sakai needs significant improvements of the test and the component tests. The questions that are not required to answer are difficult to detect by the student.

7. Authoring Tools and Content Creation

Here are the main logical reasons that each system got its total grades:

- Content is the main ingredient in online learning.
- Authoring tools play a crucial role in creating content that can be accessed.
- And can guide / educate content creators to create content can be accessed.
- And be able to test for easy access before loading.

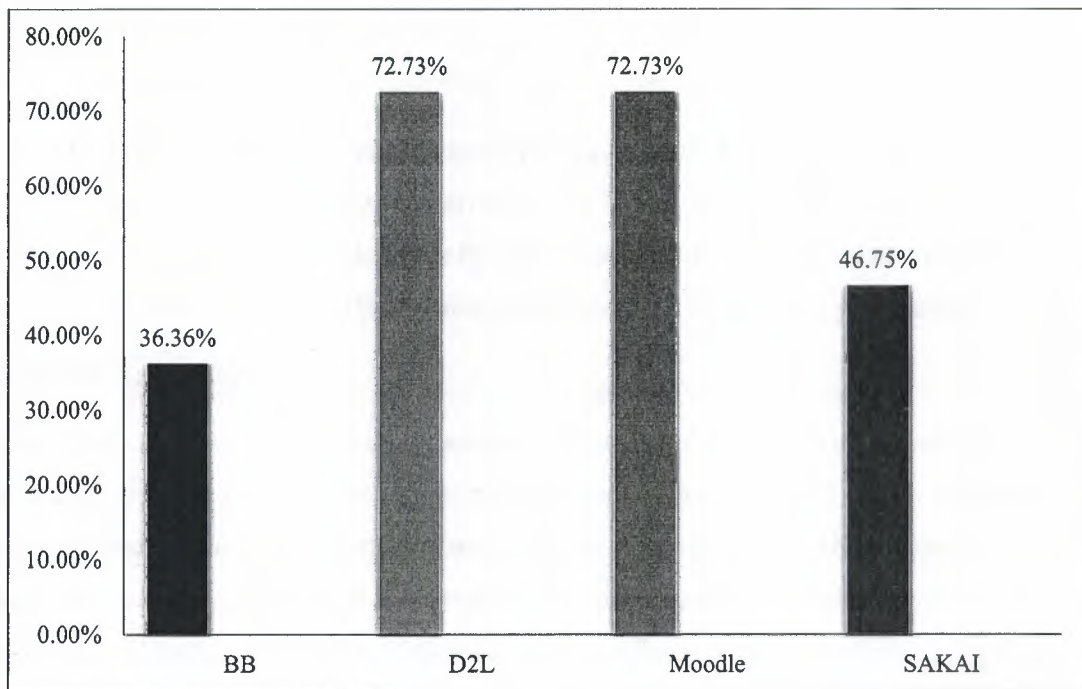


Figure 6.13: Authoring tools and content creation

The highest percentage (72.73%) is shared by D2L and Moodle, for the D2L Generally the tools for content creation and grades can be accessed, Moodle's input file picker tool in Moodle 2 brings with it some important navigation issues, however it deals with the page's content as a whole instead of dealing with it in separate windows. The second one is Sakai (46.75%) it does not offer any features to help improve the content's creation or verify access to the content they download. the lowest percentage (36.36%) for Blackboard, it founded a new content editor which provides easy integration of media embedded from external sources (Flickr, YouTube), so it is the coach's responsibility to include these players for the users or not.

6.2 Recommendations

For performing a good comparison with best results, one has to provide the system with what he/she exactly needs from this LMSs. Below; there are some of these demands:

1. Choosing the specific features group from the whole features list offered by the system depending on your urgent need to the system.

2. Weighing each feature chosen, showing how much this feature is important to be included in your LMS that you seek.
3. Proper ranking of each feature relating to each LMS through a careful reading of the descriptions given to you by the system. Such rank will be as an evaluation grade given by you to the LMS on a specific feature: how it works, how it is efficient and performing, and how it suits your needs.

6.3 Future Researches

A possibility to develop a research by adding a larger number of systems in addition to a larger amount of properties that include everything related to the system of public properties to the properties and detailed method of restructuring, the research can also be expanded by adding a chapter that explains how to get the systems from the sources and explains how to install them by using snapshots taken from the desktop or by recording an explanatory video clip. As well as another chapter to help beneficiaries at any stage for beginners or users or professionals, to make it a detailed learning course it must contain a huge amount of information to make it easier to deal with e-learning. As well as trying to cooperate with the manufacturers of these systems and to provide a background for mistakes and characteristics desired, corrected or developed to suit the user, all of this will be useful in the development of the field of e-learning and to facilitate science and learning at all levels and keep pace with the rapid developments in the world of electronic communication and communication through the Internet and make the systems communicate scientifically at an advanced stage.

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