REPUBLIC OF TURKEY
FIRAT UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCE

DEVELOPING ADDITIONAL FEATURES INTO ILIAS WEB-BASED LEARNING MANAGEMENT SYSTEM

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Master Thesis
Department: Software Engineering
Supervisor: Prof. Dr. Asaf VAROL

OCTOBER 2017

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MASTER THESIS

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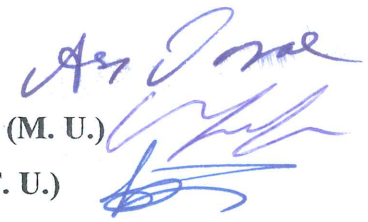

OCTOBER 2017

DECLARATION

I hereby declare that the thesis entitled “Developing Additional Features into ILIAS Web-Based Learning Management System” is my own research and has been prepared by myself, except for the passages and single words that are quoted. It is being submitted for a Master’s Degree in Software Engineering at Fırat University.

DEDICATION

First of all, I give thanks to God for giving me the ability to do the work. I would like to thank all those who have contributed in one way or another to the completion of this thesis. This thesis is dedicated to my husband, who encouraged me and supported me. It is also dedicated to my father, my mother and all my family members because of their understanding, moral support, encouragement, prayers, patience and support in every way.

ACKNOWLEDGEMENTS

I want to begin by expressing my sincere gratitude and respect to my supervisor, Prof. Dr. Asaf VAROL. He has been a great support and maintained utmost confidence in me, and was always there to help and guide me whenever I needed. I am thankful for his kindness, patience and understanding. I want to express my gratitude to all individuals who have participated in this study in one way or another, and to the Turkish people in Elazig for their support and hospitality.

Payman Hasan

Elazığ 2017

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ABSTRACT

Developing Additional Features into ILIAS Web-Based Learning Management System

Electronic learning or e-learning has changed the design of teaching. Institutions of higher education are reviewing their organization to become familiar with e-learning to help achieve their goals in the educational sector. E-learning creates a new practice of education for students; what was not possible in a conventional classroom environment has now become a notable process.

E-learning platforms have been adopted by pedagogical institutes, involving many attempts and the expenditure of large amounts of money. With these efforts, new technologies like knowledge detection frameworks, e-cooperation kits and project learning gates have been invented to support knowledge participation. One of the significant web-based inventions for distance learning platforms is Learning Management Systems (LMSs), which combine education in class and online learning during the learning process. There are many learning management systems; one of them is ILIAS, which is a web-based LMS developed by utilizing open source technologies such as PHP, MySQL and Apache as web server. ILIAS is most sophisticated in the German language, but also includes various languages like English. The ILIAS LMS platform is a medium that serves as the classroom repository for reading materials and related course work such as course syllabus and associated course content.

The aim of the research is to search the literature to get more information about LMSs and to understand the concept, to learn more about ILIAS, to examine ILIAS to better understand its features and to search for features missing from ILIAS. Thus, the goals of the study will be writing codes to add three missing features to ILIAS. New features such as date filter for e-mails, move e-mails to folders by drag and drop and text formatting editor for message content have been added into ILIAS.

Keywords: Electronic learning, Distance Education, Learning Management System (LMS), Open Source Systems, Course Management System.

ÖZET

ILIAS WEB Tabanlı Öğrenme Yönetim Sisteminde Ek Özellikler Geliştirme

Elektronik öğrenme ya da e-öğrenme dünyadaki öğretim tasarım sürecini değiştirmiştir. Yükseköğretim kurumları, eğitim hedeflerine ulaşmada yardımcı olan e-öğrenme teknolojilerini tanımak için kurumlarını yeniden gözden geçirmektedir. Geleneksel sınıf ortamında mümkün görülmeyen yeni eğitim uygulamaları, öğrenciler için e-öğrenme dikkat çeken bir süreç haline gelmiştir.

E-öğrenme programları büyük çabalar ve bol parayla eğitim kurumları tarafından geliştirilmiştir. Bu çabaların yardımıyla, bilgi edinmeye destek olmak için algılama çerçevesini, e-işbirliği kitlerini, proje öğrenme kapısını bilme gibi yeni teknolojiler icat edilmiştir. Öğrenme Yönetim Sistemi (LMS), öğrenme işlemi sırasında sınıf içi eğitim ve çevrimiçi öğretimle harmanlanmış önemli web tabanlı bir e-öğrenme platformudur.

Birçok öğrenme yönetim sistemi vardır, bunlardan biri olan ILIAS, web tabanlı öğrenim yönetim sistemi, en iyi açık kaynak teknolojisini kullanarak geliştirilmiş PHP, MySQL ve Apache tabanlı bir platformdur. ILIAS Almanca olarak geliştirilmiştir, ancak aynı zamanda İngilizce de dâhil olmak üzere birden fazla dili destekleyebilmektedir. ILIAS LMS platformu; ders izlencesi, ders içeriği gibi okuma materyalleri ve ilgili ders işlemleri için sınıf görevi üstlenen bir ortamdır.

Bu tez çalışmasının amacı, LMS hakkında daha fazla bilgi edinmek, LMS kavramını anlamak, ILIAS hakkında daha fazla bilgi edinmek, ILIAS'ın özelliklerini daha iyi anlamak ve ILIAS'ta eksik özellikleri incelemek üzere literatür araştırması yapmaktır. Tez çalışmasının diğer bir amacı, ILIAS sisteminde eksikliği tespit edilen üç özelliğin kodunu oluşturmaktır. E-postalar için tarih filtresi, mesaj içeriği için sürükle ve bırak ve metin biçimlendirme editörü ile e-postaları klasörlere taşı özellikleri, bu tez çalışması sayesinde ILIAS'a ilave edilmiştir.

Anahtar Kelimeler: Elektronik Öğrenme, Uzaktan Eğitim, Öğrenme Yönetim Sistemi, Açık Kaynaklı Sistemler, Kurs Yönetim Sistemi.

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LIST OF SYMBOLS AND ABBREVIATIONS

CMS **:** Course Management System

ILIAS **:** Interdisciplinary Lab for Intelligent and Adaptive Systems

IM **:** Instant Messaging

LMS **:** Learning Management System

MOODLE **:** Modular Object-Oriented Dynamic Learning Environment

RSS **:** Rich Site Summary

SaaS **:** Software as a Service

TEI **:** Technical Educational Institutions

VLE **:** Virtual Learning Environments

1. INTRODUCTION

Distance education's history stretches around two centuries and this duration demonstrates big modifications in ways of communicating learning. Starting from basic correspondence courses using postal services to a large set of tools obtainable from the internet, society has adopted new forms of communication through the years. One of them, online learning, became accessible in the 1980s. Different sorts of learning environment designs can depend on the learning goal, physical or virtual access, target audience and content type. One should know how the learning environment is used, and the impact of the techniques and tools that recognize technological improvements in learning outcomes. The learning medium can be recognized as a Learning Management System [1].

The field of e-learning systems has generated a great interest in studies during recent years. Considerable web-based learning platforms have been advanced, to be made obtainable for saving time by simplifying the user's learning. With regard to such learning systems, research has suggested several architecture methods and used notable components to contribute to a system's personalization and to make up the architecture of the system [2].

Educational institutes have developed e-learning programs by spending vast sums of money and exerting considerable efforts, as [3] defines. Many institutions are interested in distance learning platforms which have a significant function in the efficiency of knowledge arrangement [4].

E-learning is described generally as the intended usage of electronic devices like television, computers and delivery of content by video or audio tape, internet or intranet for the learning process. Web-based technologies among the e-learning environments present various interacting applications such as virtual society training, 3D virtual world, forums or wikis [5].

The research's aim is to search the literature to get more information about LMSs and to understand its concept, to learn more about ILIAS, to examine ILIAS to better understand its features and to search for missing feature in ILIAS.

Thus, the goals of the study will be writing codes to add three missing features into ILIAS. Those features are: date filter for e-mails, move e-mails to folders by drag and drop and text formatting editor for message content. To reach these goals, several steps have been

taken like installing ILIAS, reading ILIAS's codes, writing the codes for missing features, testing the added feature and checking for bugs.

This research consists of five sections, which are Introduction, Learning Management System, Methodology, Result Analysis and Conclusion.

2. LEARNING MANAGEMENT SYSTEM

A Learning Management System (LMS) is a software platform or technology system used for tracing, assessing and achieving a particular teaching operation [6].

Martin [7] defines LMS as a software medium that allows the transmission of learning content and resources to students.

Lately, LMS has become an active area among researchers investigating online learning. LMS is often respected as the starting point to develop an online course or program by researchers, because it supplies an instrument for administration, tracking and forwarding online teaching. An LMS system acts as a bridge between learners and teachers. LMS systems have been configured by instructors in loading the system with the course material and authorizing students to access them. Students can learn the course notes at their own place of study and benefit from LMS systems by meeting their classmates and advisers in virtual classrooms, solving self-examination quiz questions and preparing themselves for tests [8].

2.1. Features of Learning Management Systems

LMSs are becoming a complete part of small- and large-scale learning media and can supply a range of features and capabilities. LMS allows users to deliver and access training content, leveraging a set of training media throughout all departments for increasing an organization's knowledge level. LMS contains tools for tracking and reporting a user’s training achievement [9]. In the following section, LMS features are explained in detail.

2.1.1. Content Management

There is a requirement for teaching resource management because a great number of faculties repeat the same course from one semester to the next, as shown in Figure 2.1. So, LMS supplies an individual login ID for teachers to create, store and manage materials for future use. Course material such as soft copies of lecture notes may be contained as part of the suite and uploaded in parallel with classroom education, using the "private file" tool supplied in LMS to store all previous notes [10].

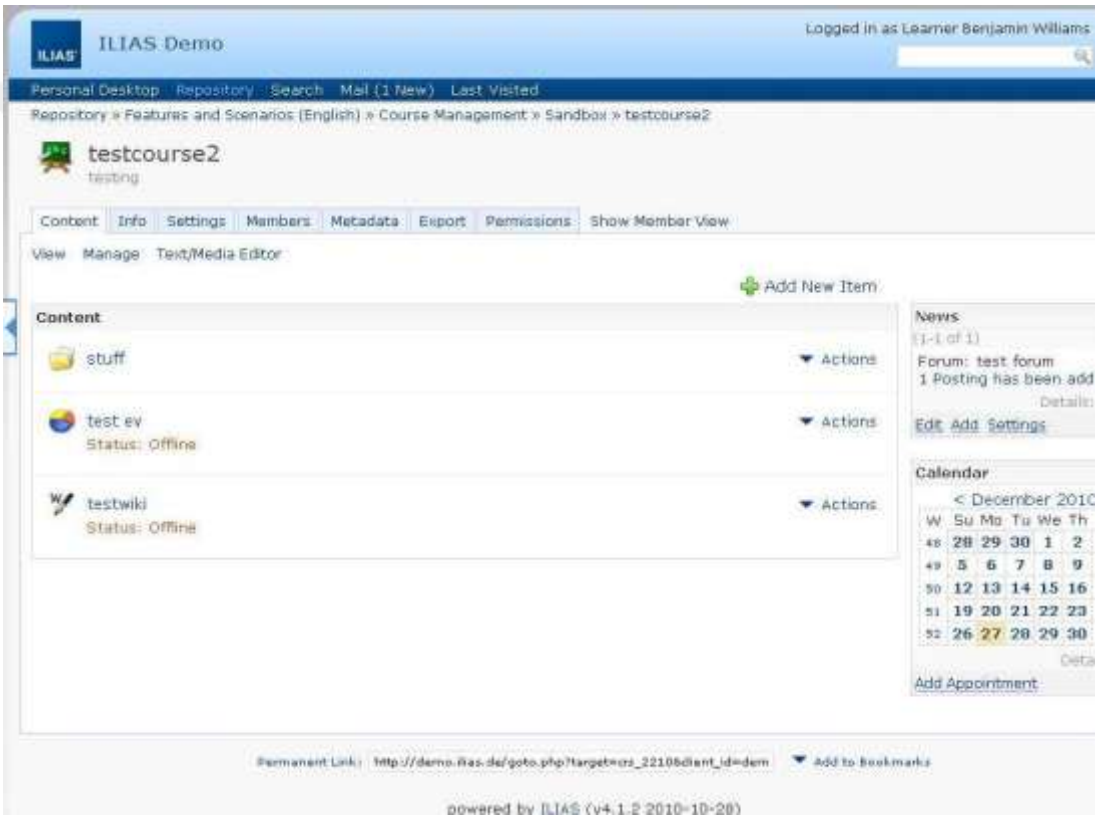


Figure 2.1. ILIAS course management page.

2.1.2. Communication and Collaboration

There are several researches on collaborative technologies. Using group work to learn collaboratively has many advantages. Through the computer all interaction between students is done, and logging it from the first use saves a whole record of this action. The additional usefulness of this process is that it allows an elaborated, readable instrument record for students' responses, simultaneously with the reference which they used [8].

According to Jones [11], collaborative learning is helpful for establishing a strong relationship between students such as knowing each other, building effective communication in strong teams, and so on. Several tools are provided by LMS for collaborative learning such as messages, wiki, chats, forum, etc. where students easily learn topics that they may find difficulty in learning during offline mode, as seen in Figures 2.2 and 2.3.

Finally, communication between students by using instant messaging (IM) has opened up the opportunity for all ages to develop peer learning group work methods, which may be well received by students of the current generation [8].

Figure 2.2. The collaboration system for SharePoint LMS in an external window.

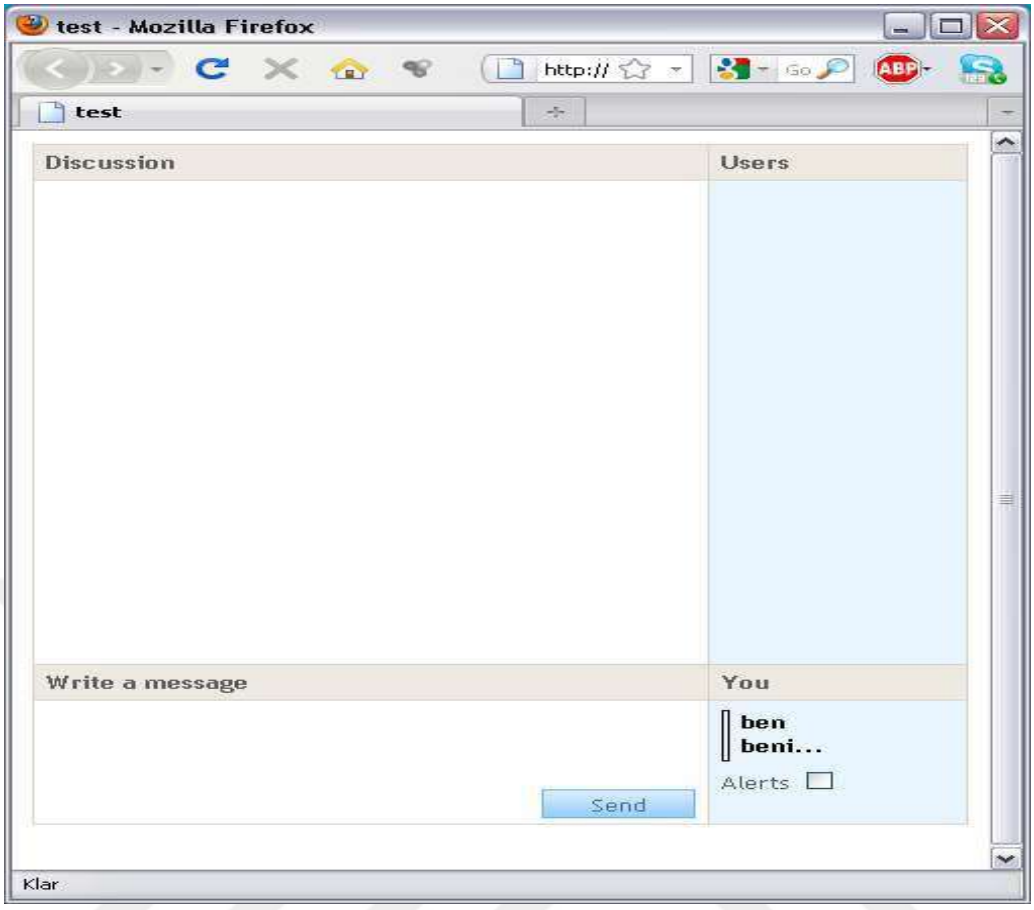


Figure 2.3. Edu2.0 chat in an external window.

2.1.3. Assessment and Testing

Immediate evaluation is supported by all LMSs for multiple choice questions asked during a test or exam. When a student clicks the submit button, the evaluating and grading of all the multiple choice questions are displayed together on screen. This tool is useful in removing students' worries about the result. The result is shown without any time delay, the student obtains more time for their improvement and using LMS is helpful for increasing the frequency of conducting exams or tests in a semester, as shown in Figures 2.4 and 2.5 [10].

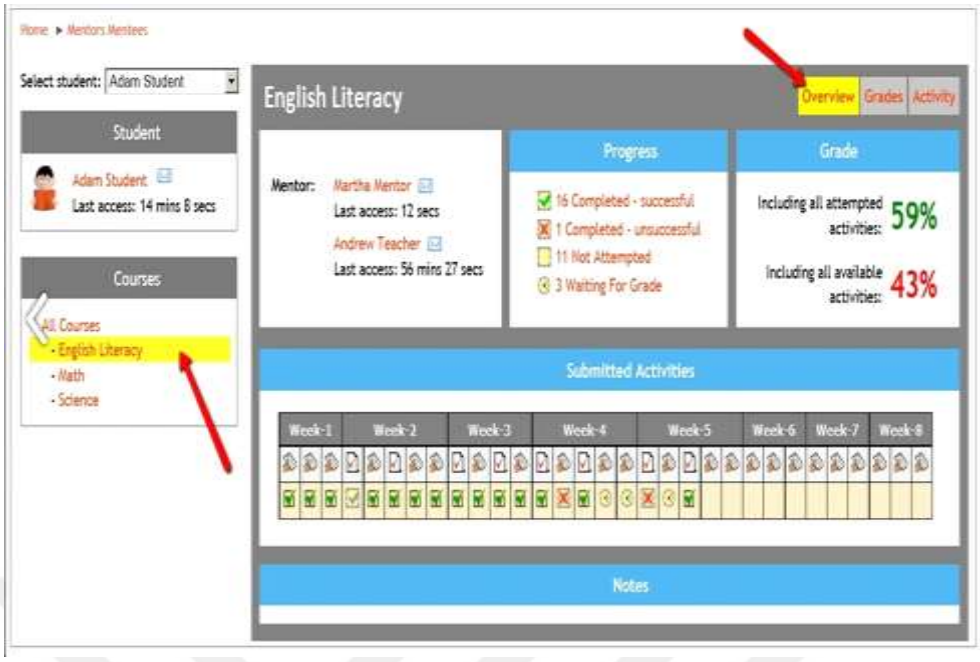


Figure 2.4. Student assessment process in Moodle.

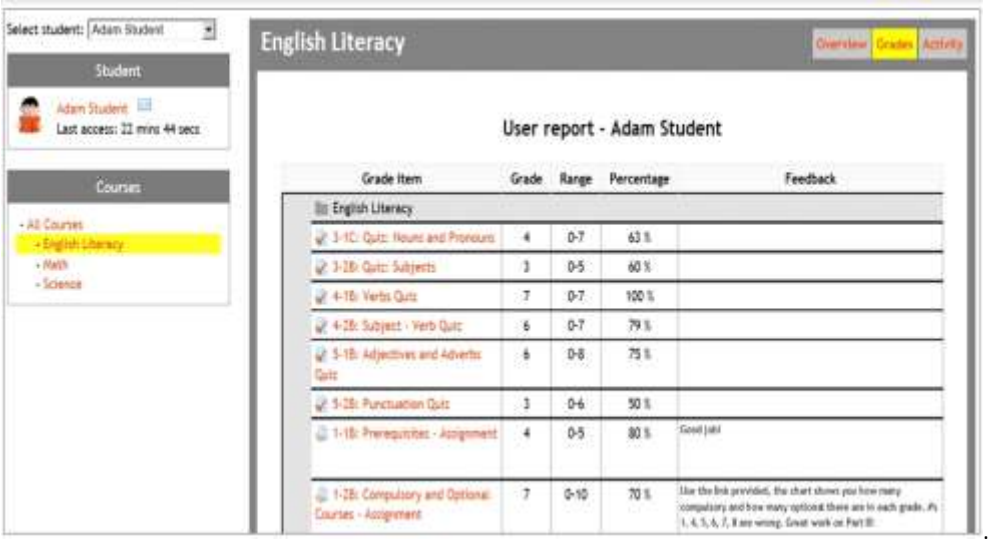


Figure 2.5. Illustration of students' grades.

2.1.4. Student Tracking

The aim of the tracking feature is to track the activities of the student and create reports for supporting decisions made by the educational institution or the teacher. Tracking records the evaluation of the education method by the instructor and is also linked to instructional design, aiming to constantly enhance the learning sphere. Testing how students utilize a

studying method and analyzing learners' performance can assist teachers to find a style for a decision-making plan in future learning activity [12].

An LMS tracks performance and progress, and also detects students who do not log into their online classroom or who log in without participating. The student tracking tool in the LMS supplies a quantitative view of student activity in the course, containing the numbers of original postings and replies, as shown in Figure 2.6 [13].

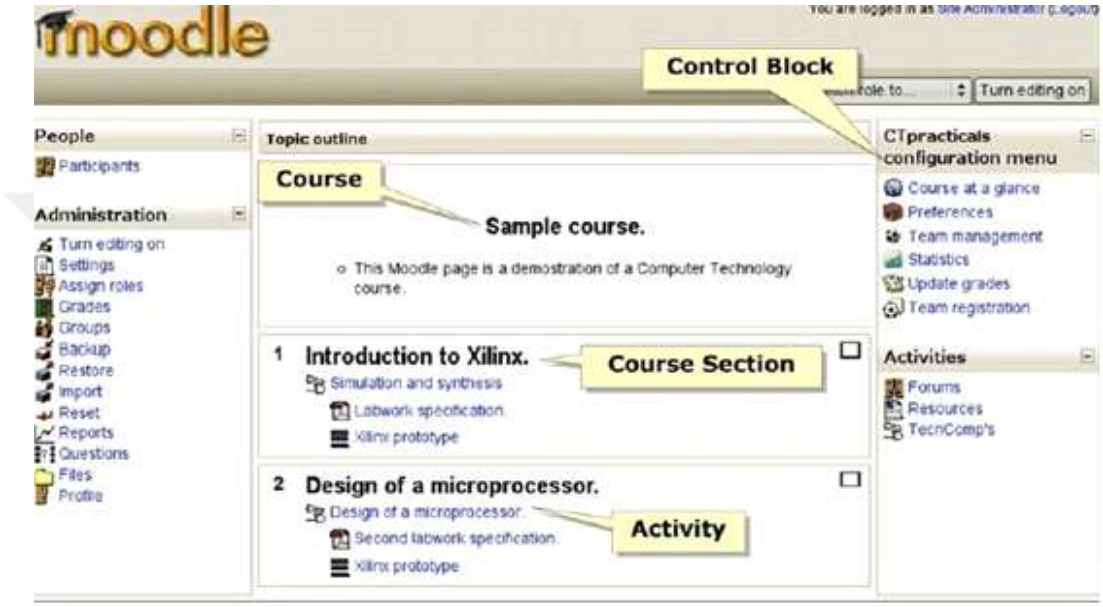


Figure 2.6. Control block and activities provided in Moodle.

2.1.5. Classroom and College Announcements

In a big LMS, all the users are participating in several courses and therefore it is important for them to receive course announcements regarding, for example, deadlines for project delivery and dates of online lectures and online tests, etc. This information must be visible in an area where the user is sure to see them when accessing the LMS, separately from the assignment that the student will carry out. For example, if there is an announcement on a mathematics course whereas the student accesses the LMS only to read their e-mail or access another course, they must also be able to note that announcement, as seen in Figure 2.7 [14].

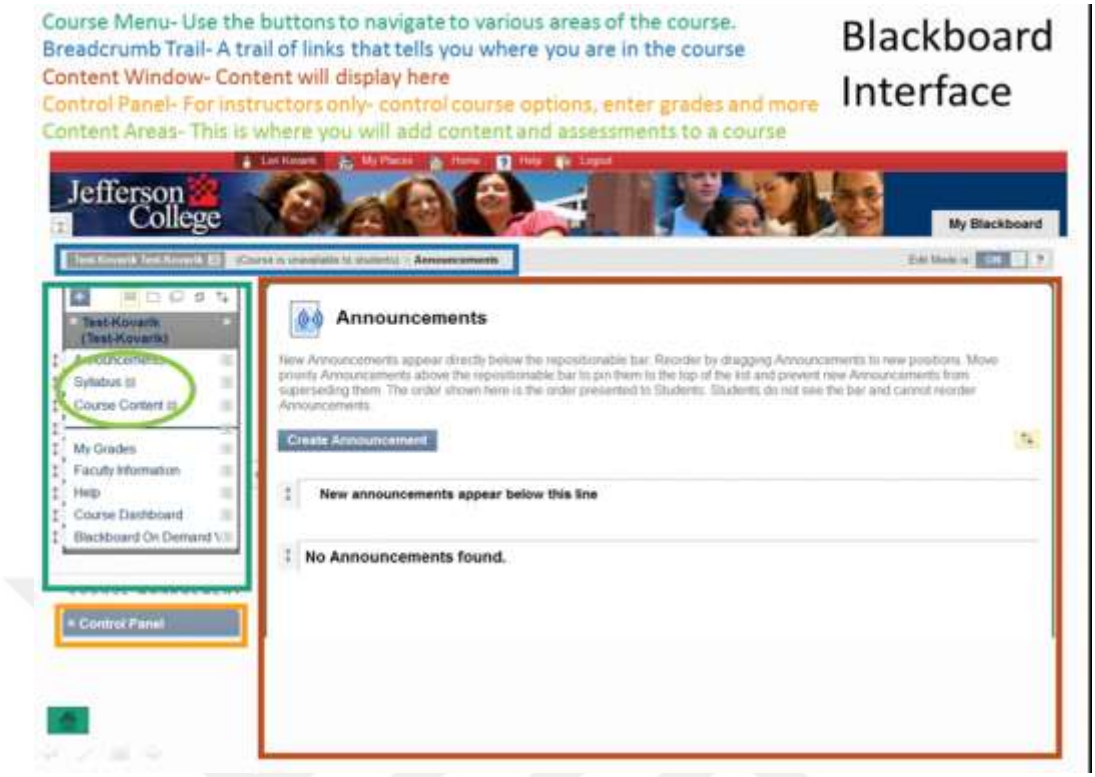


Figure 2.7. Illustration of announcement feature of an LMS.

2.1.6. Curriculum Planning

The meaning of the phrase ‘curriculum planning’ is what courses of study and topics to teach within a given course in an appointed semester or year in a college’s system. Technical institutions faculties take part in curriculum planning by creating a course program and lecture schedule before the course tasks start, as shown in Figures 2.8 and 2.9. The course’s detailed structure is called a course plan and clearly sets out all chapter descriptions and reading resources like websites, page numbers, handouts, etc. The lecture schedule states the total number of lecture hours needed for completing the course and the number of courses covered in a particular class [10].

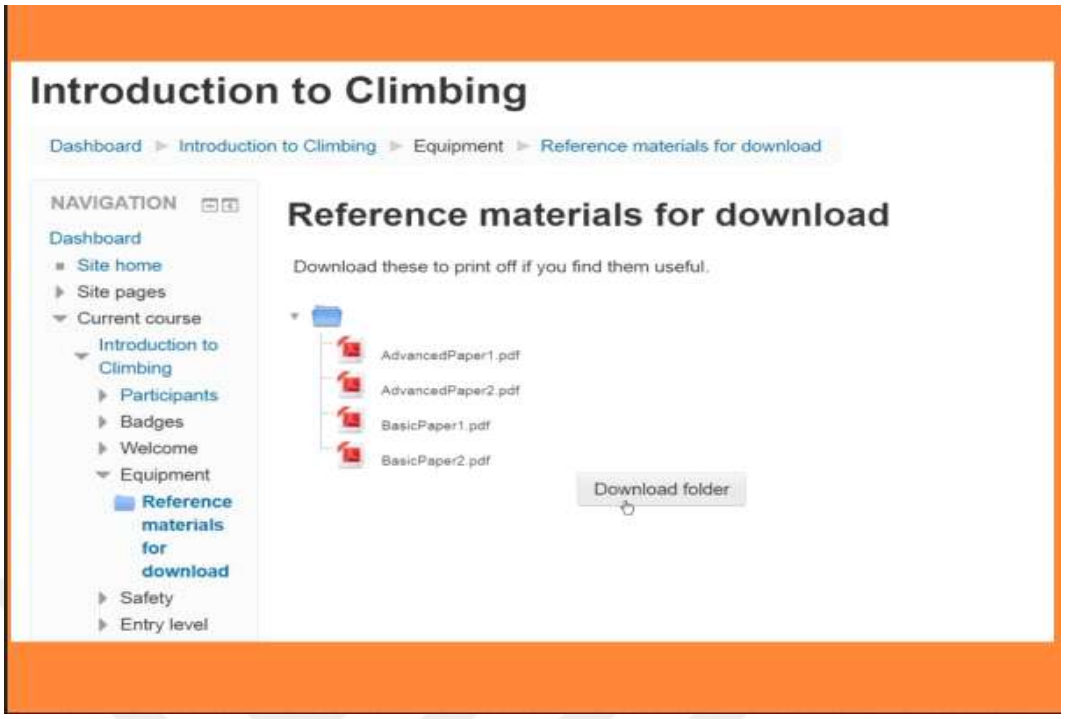


Figure 2.8. Shows materials to be downloaded.

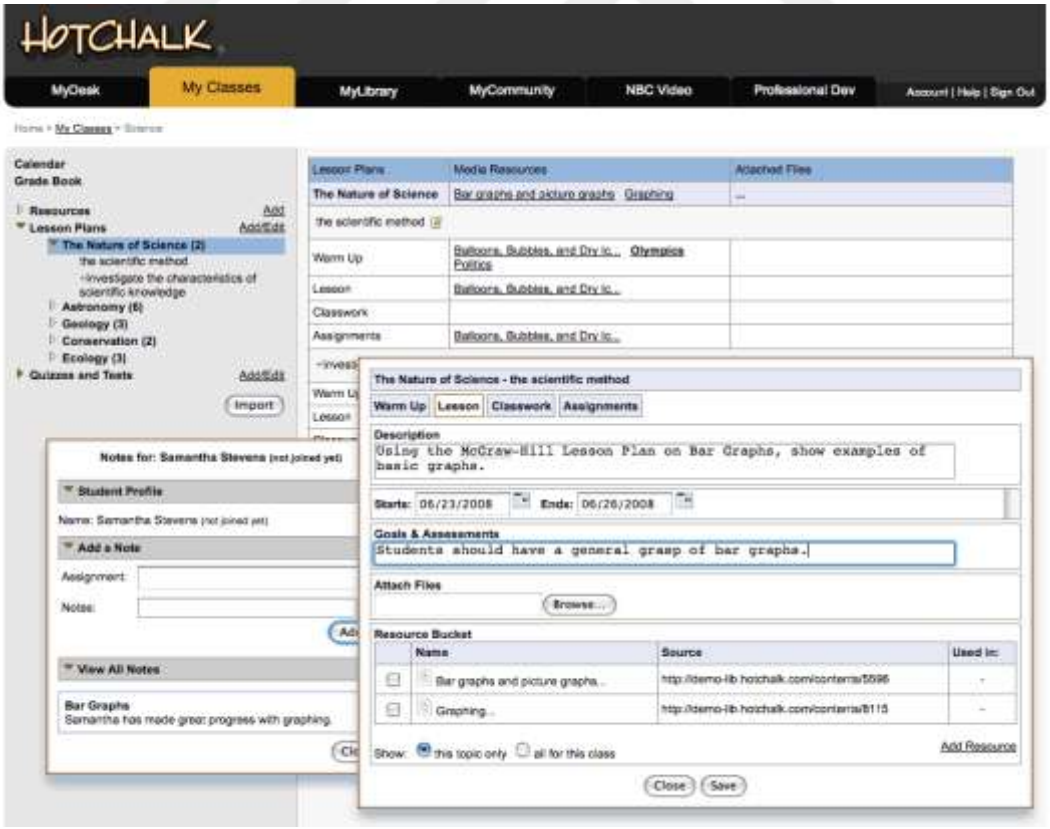


Figure 2.9. Hotchalks course management page.

2.2. Types of Learning Management Systems

Conventional LMSs provide a holistic medium for managing and delivering educational experiences. They offer suites of tools that provide online course maintenance [15].

Some LMSs are free open source software, while others are commercial LMSs. Universities are focusing attention on open source LMSs, which have become very involved in the e-learning landscape and also compete with other proprietary software [16].

2.2.1. Commercial Learning Management Systems

Software distributed under commercial license agreements is usually paid for. With a commercial software license, the recipient does not normally receive a right to modify, copy or redistribute the software without fees or royalty commitment; proprietary is a thing exclusively possessed by someone, often the concept is exclusive and cannot be utilized by other parties without negotiations. It may specifically denote that something is covered via one or more patents, as in commercial technology. Commercial software intends that some individual or company maintain the exclusive copyrights on a chunk of software, and prevent other people from accessing the software's source code, modifying or studying the software and having the right to copy it [17].

The best examples of commercial LMS are WebCT, e College and Blackboard. Numerous such systems are obtainable as commercial LMSs, selling the content of courses that plug in to their LMS interfaces. For instance, Blackboard currently offers 51 "cartridges" of content on psychology. These days commercial LMSs have become productive businesses. Many of these productive companies are engaged in acquisitions, contracts and merging with other LMSs, and also have profitable online subsidiaries of nonprofit corporate universities, joint ventures with educational institutions, fully-fledged corporate universities and virtual universities. Some higher education nonprofit institutions such as Columbia, Temple, UCLA and Cornell have already decided for subsidiaries' profit or linked with for-profit companies to offer online courses, degrees, programs and certificates [18].

In the following section, three commercial LMSs including WebCT, eCollege and Blackboard are described in detail.

2.2.1.1. WebCT

WebCT is an online course which has a portal for access. WebCT is a type of management system that manages learning and teaching, as shown in Figure 2.10. It is developed for assisting and consolidating the content creation organizational processes, retrieval, transfer application and delivery. WebCT's intention is to assisting teaching and learning operations, administration, decision making and analysis based on these works. WebCT is a reactive tool that instructors use for delivering online material and course information. Because WebCT is reliable, it is widely used for online classes to deliver course materials, communicate with students, administer examinations or hold group sessions online. It contains a wide range of materials which assist teachers and learners [19].

WebCT provides instructional tools such as references, glossary, quiz module and self-test to support course content. WebCT enable students, to input tasks and materials for courses for which they are registered. By using either Netscape or Internet Explorer web browsers, learners can access their course materials by utilizing a computer linked to the campus internet or intranet [20].

According to Lu et al. [21], a number of learning tools are provided by WebCT such as online discussion boards, calendar, content searches for courses, electronic mail, quizzes, tracking of students' progress, distribution and grade maintenance, access control, etc. This platform is the same as some other learning systems in organizing and integrating course materials and multimedia presentations in delivery of the course by providing a standard path. More importantly, it is prepared to assist knowledge building, collaborative processes of learning and multiple performance of knowledge structure. The evaluation of effectiveness and success by the WebCT system is a main challenge to educational sectors. The adoption and use of WebCT is utilized in higher education throughout the world [19].

The advantages of using WebCT include less administrative time, less grading time and more personal interaction with students using e-mail and the discussion forum. In general, the advantages appear to outweigh the disadvantages for both faculty and students. On the other hand, it has disadvantages as well. The use of WebCT in a large lecture class does not affect submission rates for assignments or grades for those assignments [22].

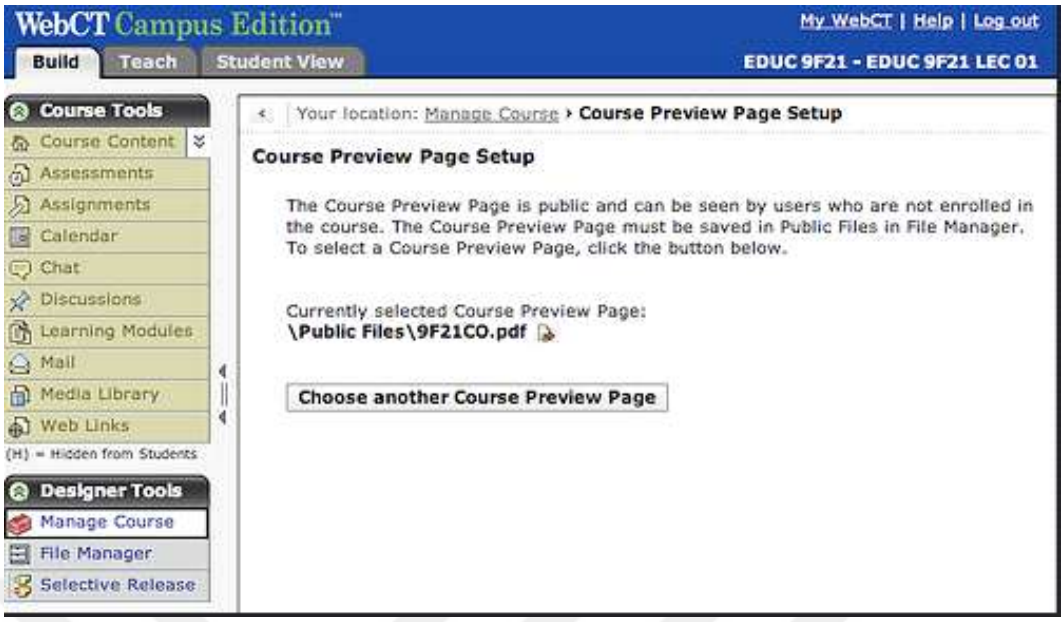


Figure 2.10. The main screen of WebCT.

2.2.1.2. Blackboard

According to Martin [7], Blackboard, which is used in Europe and North America, is treated as one of the main commercial products. The administration tools in Blackboard make online teaching and supplying a password-protected environment easier. Utilizing the Blackboard LMS in an online course is helpful for developing students' computing skills and also teaching courses. The use of a learning management system contributes to increasing computer and technology skills with the teaching of main computer usage in the face-to-face schoolroom environment. Blackboard supplies a large and easy to use system for learning instruction, assessment and communication. In the past three years, Blackboard has produced two great production lines, which are Blackboard Academic and Blackboard Commerce. The Blackboard learning system is the essence of the Academic suite, for online and classroom educational assistance. With 70% of universities and colleges in the US using Blackboard, the system has 12 million users in almost 60 countries. This product is available in 12 languages to more than 2,200 learning institutions [23].

As Martin [7] defines, Blackboard is an efficient LMS which has useful features such as assignments, grade books, course documents, communication, announcements, digital drop box, virtual classroom and group pages. It also has helpful areas such as online quizzes, immediate feedback, access to materials at any times, user-friendly technology, file

practicing, handling skills, downloading files, course goals achievement, collaborative work and communication with peers and instructor, as seen in Figures 2.11 and 2.12.

Among the advantages of Blackboard, according to Larsen et al. [24], are that it enhances teaching, eases communication, supports students with disabilities and allow students to progress at their own pace.

In addition to benefits, Blackboard has disadvantages as well. Specifically, Marc et al. [25] stated that there might be potential difficulty accessing the material, incompatibility with university administration systems, students may use Blackboard to access notes rather than attend lectures, and the time involved in teachers maintaining updated information.

Figure 2.11. Blackboard's main screen.

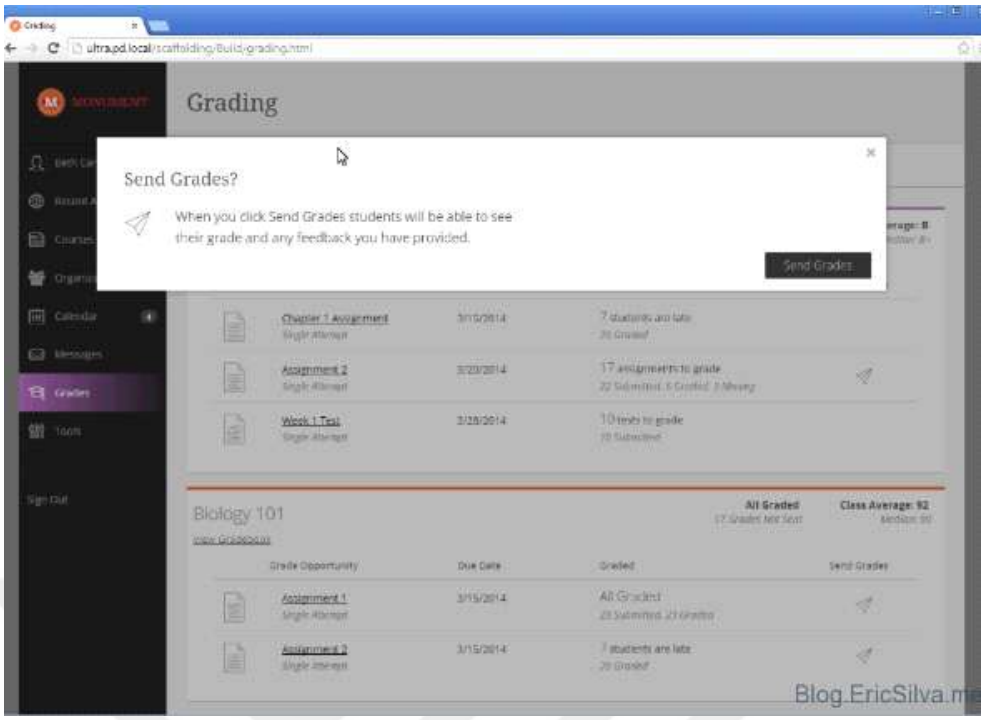


Figure 2.12. Shows how grades are sent to students by teacher in Blackboard.

2.2.1.3. eCollege

eCollege is defined as a "Software as a Service" (SaaS) LMS, also familiar as software on demand. It is marketed exclusively to the academic arena and developed in Java and JavaScript. It has several tools, as shown in Figures 2.13 and 2.14, like assign upload, with which students can upload assignments to course drop boxes; personal file storage allows users to upload their own material and share it with other users; course object reuse, used for sharing of content with other teachers; and digital library, that allows teachers and students to share content [26].

eCollege offers different services, including a learning management system, Pearson Learning studio and cloud computing for educators. It is primarily for higher education.

The advantages of eCollege are that students can interact through eCollege via discussion boards with others asynchronously, and access lesson topics and the concurrent weekly session's text-chat. The teacher acts as both lecturer and moderator and supplies a permanent virtual existence [28].

[26] explains some of the disadvantages of eCollege; for example, it has no results analysis feature, which is used to analyze results from course evaluations, and no wiki feature, that is used for adding wikis to course and group pages.

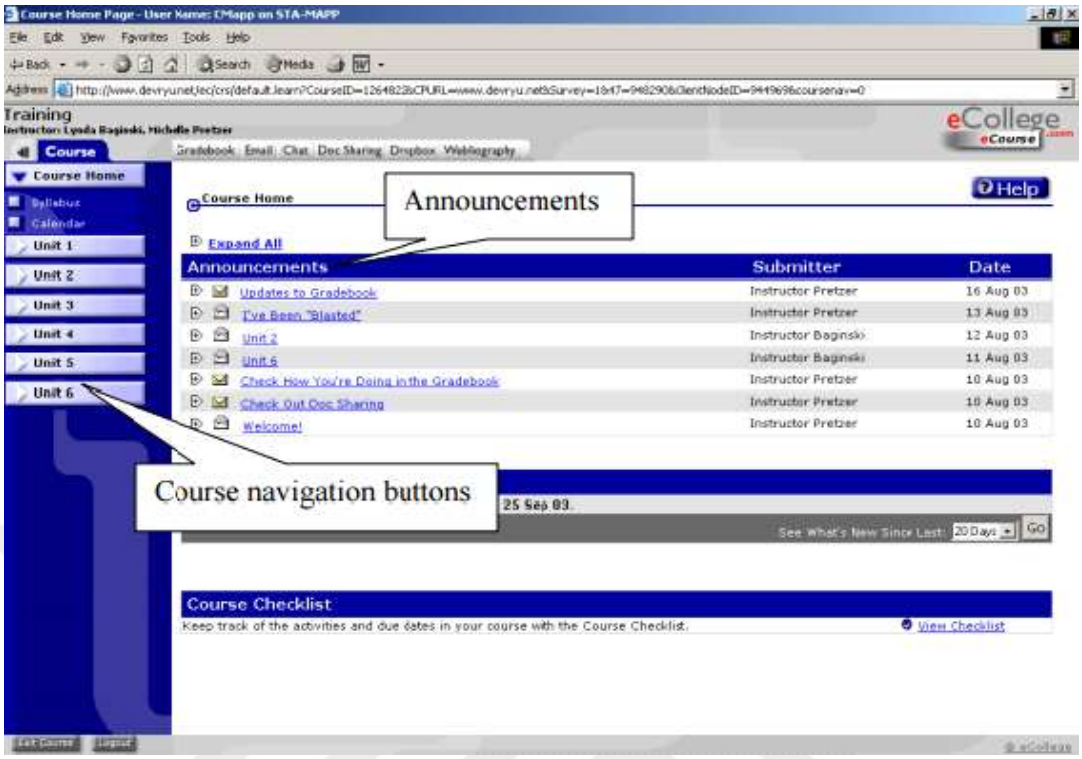


Figure 2.13. e College's main screen.

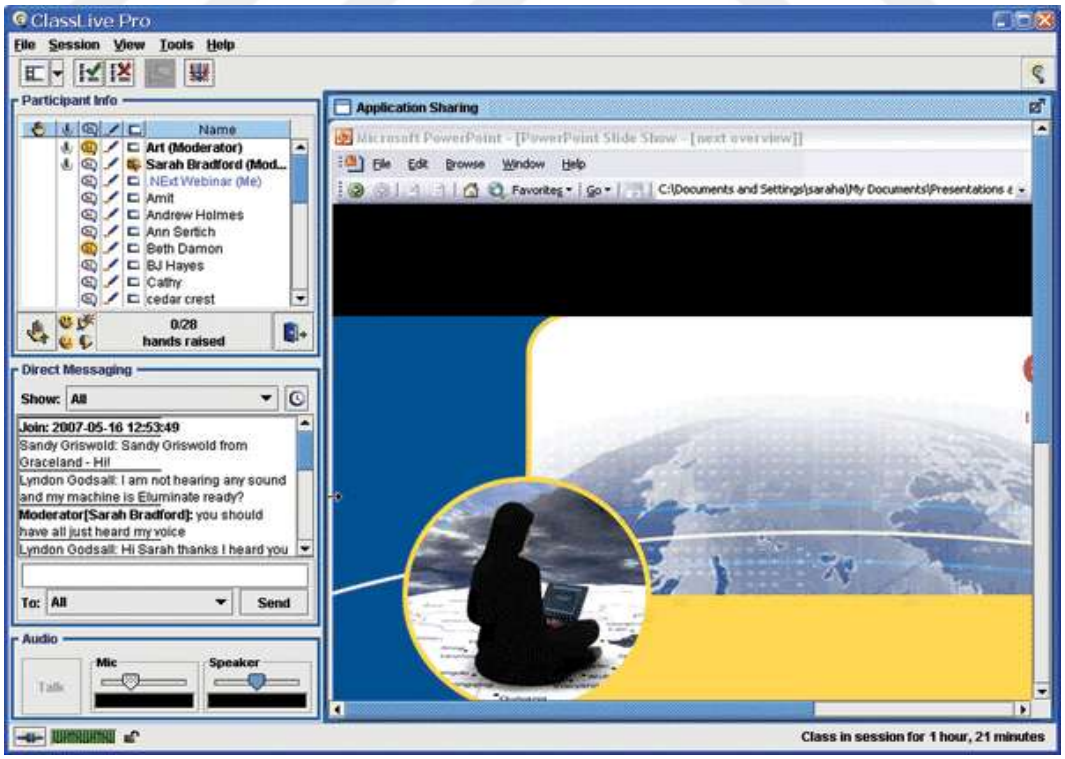


Figure 2.14. e College collaboration system in an external window.

2.2.2. Open-Source Learning Management Systems

This is an open source computer software platform; its source codes are available with an open-source license, in which the owner extends rights to anybody to study, distribute and revise the application for free and for any purpose. Open source platforms are very often developed in a cooperative public way, and often progress in a concurrent, generic manner. Open source platform is a notable instance of open source evolution and often compared with (legally known) open content movements or (technically known) user generated content. Open source code develops through community cooperation. These communities are composed of individual users and programmers as well as very large companies [17].

Some open source platform examples are ILIAS, Moodle, Claroline and ATutor. Those applications have mutual advantages, while at the same time some of them have greater flexibility than others in specific aspects, like chat management, role assignments, etc. [29].

Open source is very suitable for the university learning sector, because it is a good solution to control and format software based on their needs and the cost of using a license is almost nothing.

2.2.2.1 Sakai

Sakai learning and collaboration medium is one of the more expanded open source platforms utilized to assist learning and teaching operations. It was delivered as an open source system platform in late 2003 by a consortium consisting of the universities of Indiana. Sakai is a free system utilized for pedagogical purpose, expanded by the educational society license. Nowadays Sakai has to contend with other identical systems, such as Blackboard, Moodle and WebCT. There is a set of tools provided by Sakai to be used by all institutions to guarantee the generality functions frequently requested by students and teachers, these tools are communicative, collaborative, forum, evaluative, monitoring and content tools. In Sakai extra tools are available called contrib tools, which are developed by the society and used currently by institutions. All these tools are not developed for this platform by default. A particular subset of both sorts of tools, contrib and core, can be used by teachers to monitor, regulate and observe courses in Sakai. Teachers have to sort their courses and determine when and how the tools in the system should be used. These tools indicate to students how the missions should be carried out, what sort of content is obtainable for each

topic, or the closeness of deadlines for tasks and tests, among others, as shown in Figures 2.15 and 2.16 [30].

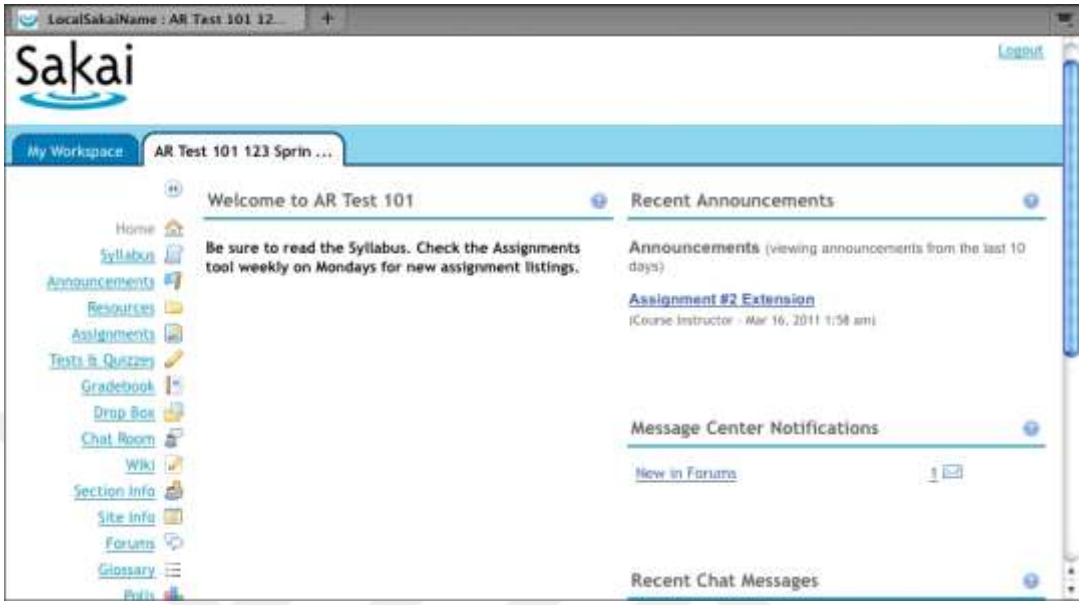


Figure 2.15. Example of Sakai course site's home screen.

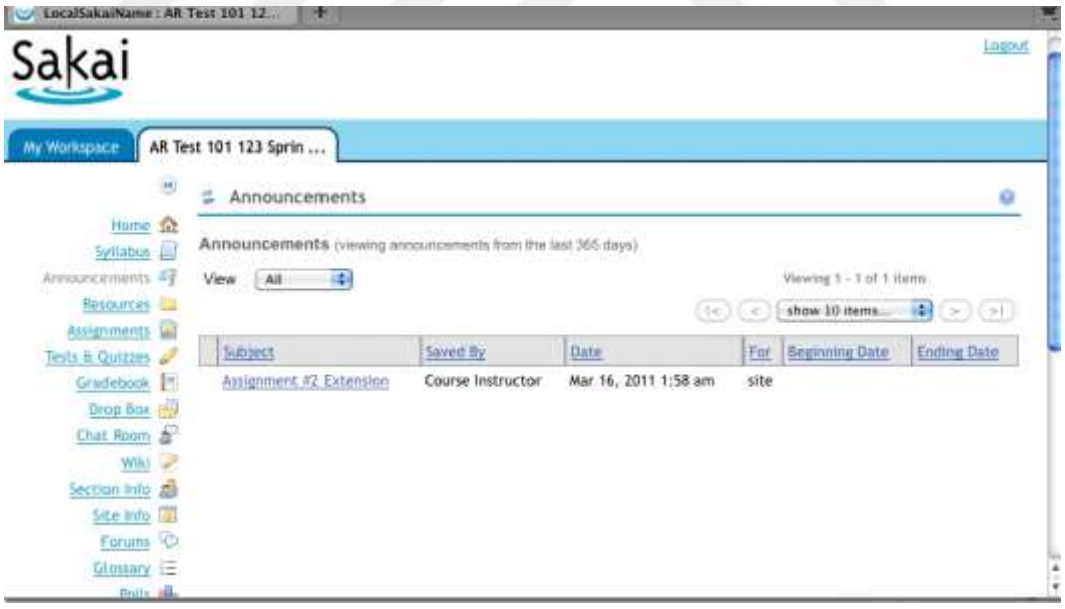


Figure 2.16. Providing a summary list of announcements by the announcement tool.

2.2.2.2. Moodle

Moodle is a software package programmed to help learners to easily generate their online courses. Moodle is an acronym for Modular Object-Oriented Dynamic Learning Environment. It is practical for an online course that has a large number of students all over the world. Moodle's efficiency includes forums, resources, quizzes and a division for showing missions. Moodle enables teachers to access students' logging and tracking, tasks are date-stamped; Moodle allows teachers to include their feedback to the assignment pages and viewed nested discussions. On the right side of the messages Moodle displays a photo of the person writing the message; the user's photo must be uploaded during the set-up. There are 6,429 sites registered as using Moodle from 137 countries. Moodle supports over 60 languages [31].

Moodle is known as an active and evolving product. It has so many features, is used for 100% online classes and face-to-face teaching, simple to use, functional, appropriate, installation is easy on any platform supporting PHP, courses listing shows descriptions on the server for every course, courses can be sorted and searched, confirmation on strong security, forms are examined, information validated, cookies encrypted [32].

The quiz module has a huge number of selections and tools to manage examinations efficiently. To offer random questions from a collection of questions, Bank is one of the best features in Moodle. Quizzes with various sorts of question can be randomly generated from several categories of questions. There is a lot of flexibility in creating online tests in Moodle. The test filters can allowed repeated attempts at a question or can also allow retaking a quiz multiple times. Various presentation methods produce the same quiz shows differently each time. This can be performed by customizing the printed format due to the page breaks setting or the number of questions setting per page and the questions can be shuffled as regards presentation order. Moodle has a number of formats in which questions can be imported into question bank categories. These formats contain some proprietary quiz software formats, as well as text files and the formats available in Moodle [33].

The major advantages of Moodle as Liu et al. [34] defines them are: students' behavior tracking is very sensible and ideal, teachers' ability for adjusting is timely, the chat function is perfect, users can exchange information through it easily, the RSS tool is good, it is easy to subscribe to resources outside the platform, it supports many languages and is used by the

educational sector in many countries as shown in Figures 2.17 and 2.18.

Beside its advantages, Moodle has many disadvantages; it needs several accounts for one person when accessing different courses, it is not user-friendly, poor in curriculum resources, the link's filename must be in English - causing obstacles for other language users and teachers' assignment are not shown well [35].

Figure 2.17. Moodle's main screen.

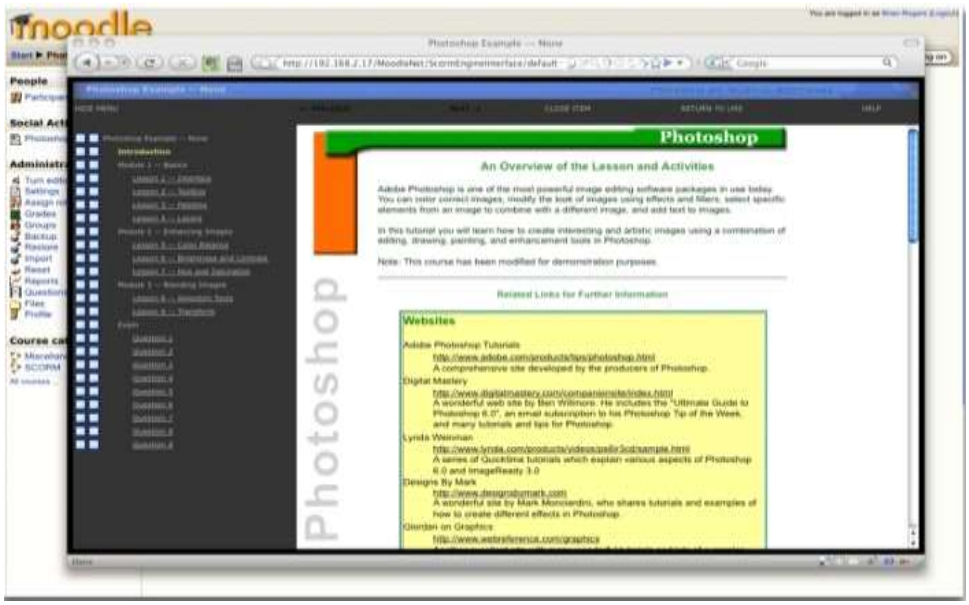


Figure 2.18. Photoshop course in Moodle.

2.2.2.3. Claroline

Claroline is another open source platform which is programmed using PHP language, permitting teachers to create efficacious online courses and to run collaborative and online learning activities. Every course area supplies a listing of tools allowing a teacher to publish records, run general and specific forums and publish announcements. Assignments can be set up to be sent in online, online exercises preparation, user statistics activity view, etc. as shown in Figures 2.19 [36].

Claroline has advantages, such as creating a teaching path is simple, and control's grade of the teaching operation is consolidated by instructors. Course creation models are good. It enables a user who has no experience to generate a course. The students' achievement managing is appropriate, advising students to learn, typical group tool is available. It is easy to scan for faults in the system, in case somebody inputs into the system incorrectly. It is appropriate for educational training; for example, several teacher training colleges use it [37].

The disadvantages of Claroline include: the chat action is simple, users are not interested of using it and there are few attachment tools for students [34].

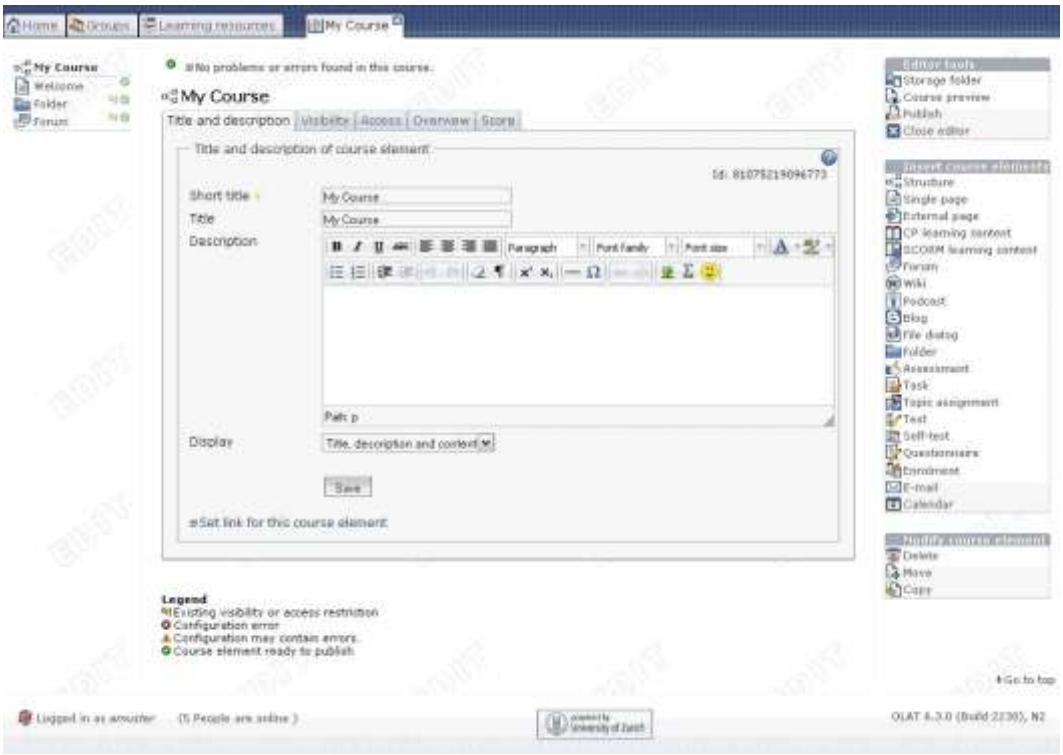


Figure 2.19. Displays a course page in Claroline as seen by the student.

2.2.2.4. ATutor

According to Alshomrani [38], ATutor is an open source platform, developed using PHP and MySQL programming languages. It has strong collaboration and built-in course assessment support. It supports several languages, and is flexible in use and access. ATutor stands out as a second LMS platform which is so convenient for mixed learning, cooperative learning and self-learning.

Liu et al. [34] listed the advantage of ATutor as: the user forms are of the right size, so using them to present data sources for learners is easy, resources searching is wonderful, a user can easily get the necessary resources, downloading resources in ZIP format, accessing resources is easy, whiteboard concordant accessibility, it is amended easily, audio and video supporting, student can test their tracking inputs in learning path, accessory to set self-learning as shown in Figures 2.20 and 2.21. ATutor is not able to support the teaching path in some languages, like Chinese, bad analyzing data tools, so students face difficulty for treating data messages, lack of helpful tools.

Figure 2.20. ATutor's main screen.

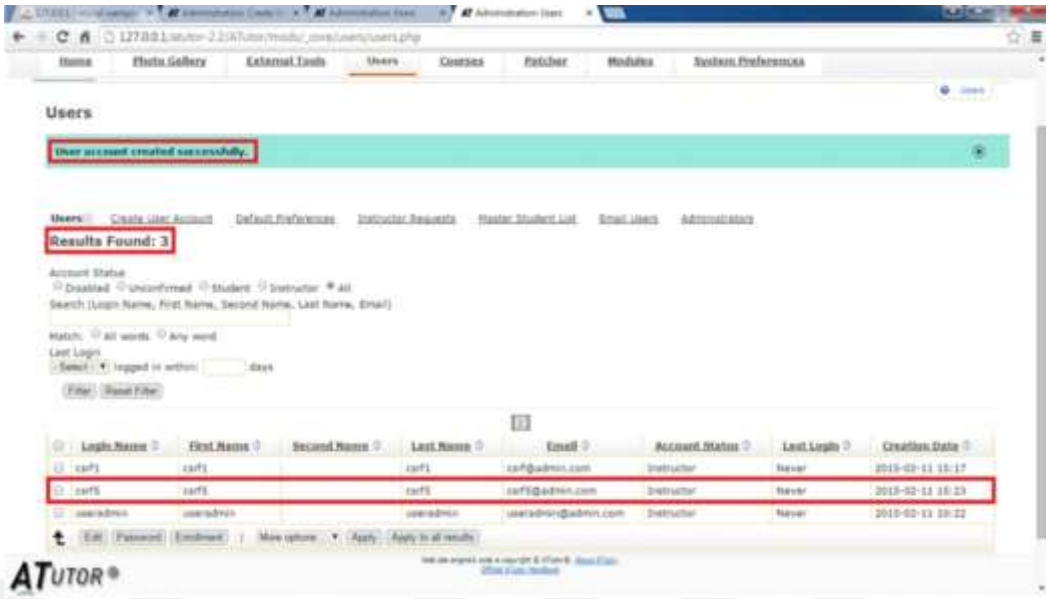


Figure 2.21. Showing that three users created their accounts in ATutor.

2.3. Learning Management System Requirements

An advanced e-learning system has to offer the following requirements:

2.3.1. Personalization

This requirement proposes that the learning process fails to take into account the user's priority and personal needs. This means either the user is in a situation to explicitly assign these preferences or the system has the capability to conclude them out of a monitoring process. The last is far more appropriate for the end-user and constitutes a highly desirable feature [2].

2.3.2. Adaptability

The user's priorities change over time and the system must be capable of tracking them and setting them properly. By 'properly' it is implied that the whole record of the user's learning behavior must be taken into account, and not merely the user's latest actions [39].

2.3.3. Extensibility

An e-learning system has to be extensible in providing learning material. The integration of resources and new courses must be simple to accomplish [40].

2.3.4. Interoperability

An e-learning system must be capable of both accessing content from and providing content to digital libraries and other e-learning systems. The provision of consolidated and updated content is practical. Concerning the client side, the interoperability requirement dictates that there should be no need for particular software for a user to access the e-learning platform. While the last two requirements can be accomplished by embracing open web-based interfaces and subordinating XML standards, the previous two call for the presence of a strong probabilistic scheme able to guess the user's preferences at any time, based on observed data and former experience [2].

2.4. Important Tools in Learning Management Systems

2.4.1. SCORM

SCORM is an acronym for Shareable Content Object Reference Model, which indicates how e-learning content should be preserved and how it should react with an LMS. SCORM was released in 2001 and was rapidly adopted by both government and industry. All educational resource and delivery systems created for the US Department of Defense are now required to conform to this standard. SCORM has been adopted by a range of industries in the United States and abroad. As defined previously, SCORM promotes collaborative learning among computing platforms and developers. SCORM does not deal with producing e-learning resources or how those resources are offered to the learner [26]

E-learning content has the possibility to justify its cost and to remain applicable as long as it is pertinent. Resources may be easily movable from one delivery place to another, without modification, as long as the delivery circumference includes a web browser.

SCORM lets developers construct learning content in small, reusable modules that might be recombined in various ways. SCORM explains the total structure of learning resources and the minimum conformance requirements for systems which might transfer learning content. Its content gathering model describes how learning content may be assembled for authorizing it to be reused and shared as shown in Figure 2.22. The Run-Time Environment (RTE) characterizes the launching of the educational sessions and how a learner's advances are marked and reported back to the educational system. The navigation and sequencing module characterizes how a content author may accelerate the learning experience. Conformance requirements characterize what is examined and how content is checked for conformity to SCORM standards. The content gathering model characterizes three different data structures that go into an individual learning topic [41].

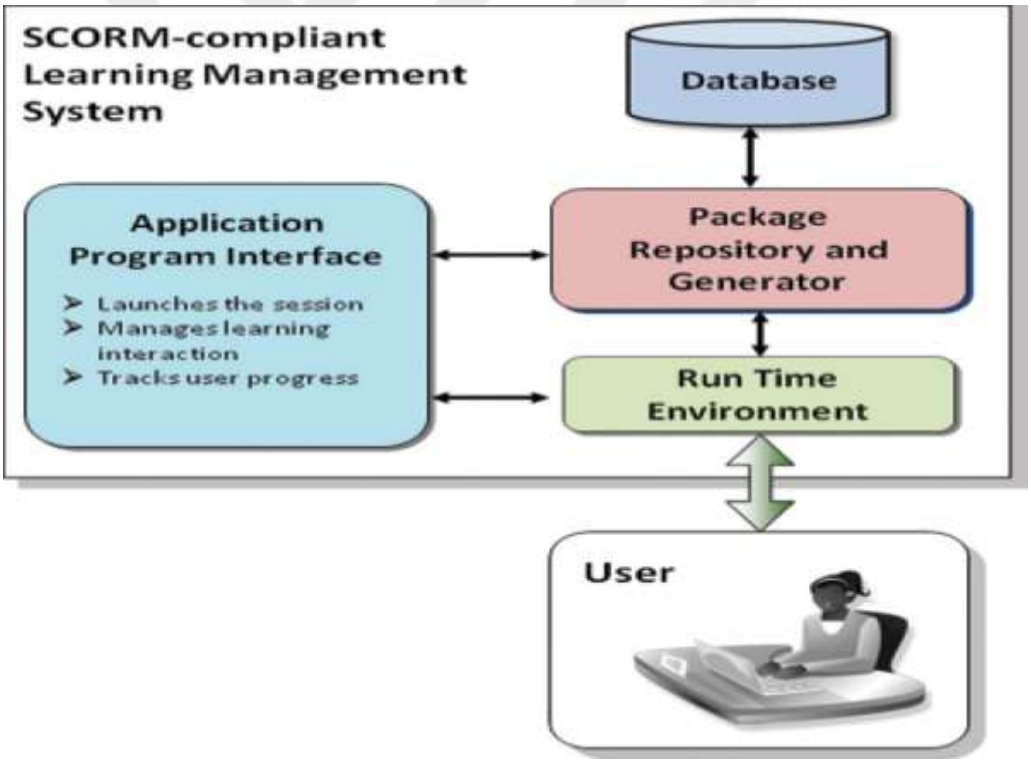


Figure 2.22. A summary of the learning interaction.

2.4.2. Calendar

Calendar is used to organize activities and events. Calendar has various types of proceedings which are connected with several entities such as site, user, course and groups. Actions like assignments, discussion and quizzes can be scheduled [42].

2.4.3. Forum

Forum is used for configuration and management of discussion subjects within a course. Entrants are able to post their opinions on topics and can send special messages to each other [26].

2.4.4. Group Management

Teachers can create and run groups and allocate learners to groups. Some collaborative projects, assignments, quizzes and case studies can be given to each group [43].

2.4.5. Resources

Resources are used to store, post and arrange course material. This may contain multimedia, website links or other supporting records during the teaching of the course [42].

2.4.6. Chatting

Via chatting, users can interchange real-time messages with group, site or course participants [44].

2.4.7. Glossary

Key idioms are defined through origination of course contents. In the glossary, an introduction or explanation for every key term is specified. Students are able to see the explanation of terms while searching in the course contents [43].

2.4.8. Wiki

A wiki is a teaching resource generally embedded in the course. A wiki is a hypertext framework for websites. Unlike HTML, a wiki can be modified by users. It can be utilized to document collaborative work. Wikis are a combination of web content authored in a cooperative way [45].

2.4.9. Blogs

Blogs are publicly accessible and act as personal journal including the writer's own practices, ideas and opinions. Blogs can be created for courses or groups. Teachers can share course texts, pictures or videos with students in a simple and quick way [42].

2.4.10. Online Discussions

Learners can take part in discussions via chat or forum discussion. Teachers may permit students to create discussion groups. Learners from several courses can react in universal chat or universal forum discussions. Instructors can check posts, lock forums for reading only, delete and edit posts [26].

2.4.11. Internal E-mail

Teachers can utilize the built-in e-mail operation to send messages to learners and groups. Students are also able to use e-mail to connect with one person or groups. An instructor can limit mailing to individuals, groups, alumni or all those registered. Sent and received messages archives can be released for back-up purposes [44].

2.4.12. File Storage

A storage area is assigned to users for saving data. Administrators can restrict the extent of storage space. Users can upload and save data in this space. Users can share contents of their special folders with other users [43].

2.4.13. Search

Students can choose course contents, all courses, debate threads, utilizers. Search results will be generated according to the expertise of users. Some LMSs also support web search [26].

2.4.14. Drop Box

Teachers make drop boxes for learners to present their assignments. After an assignment is completed, students upload their documents to the drop box [46].

2.4.15. Student Peer Review

Peer review assignments permit students to offer their work and revise other students' work. This is helpful to get extra feedback, participation of learners in assessment operations and development of an education community [42].

2.4.16. Grade Book

Teachers use the grade book to calculate, save and distribute grade inputs for students. Instructors enable define usage grading scale for every course that consists of letter grades, percent, pass or fail metrics. Grade book information can be exported for notification and analysis purposes [26].

2.4.17. Notes

This feature permits students to document their monitoring, notes and thoughts that might come up as they study their educational materials. It is particular and only accessible to the user. It assists learners to promote their study by writing learning practices [43].

2.4.18. Portfolios

With portfolios students can organize and reflect their learning progress. It enables them to selectively display their coursework. In Moodle, portfolios are used to export data from chat sessions, forums, assignment subordination and glossary logins to any suitable external system [47].

2.4.19. Community Networking

Users can react with each other through debate forums or universal chat rooms. Several LMSs also supply conferencing tools with text chat, video capabilities and audio [48].

2.4.20. RSS Feeds

RSS feeds are used to announce updated work. In some LMSs, a user can access RSS feeds from external websites, while some have internal RSS feeds attached with glossaries, forums and course announcements. A user can download the feeds using an RSS announcer [49].

2.4.21. Lesson

This feature permits students to identify self-direction lectures that are most appropriate for their needs. It is easy as regards customization of content submission and questions offered to each student. The learner can change between the lessons easily and rapidly [42].

2.4.22. Survey/Polls

Surveys or polls are done to get course members' opinions. The difference between polls and surveys is that a survey is graded but polls are not. Teachers can post survey or poll questions to collect data from learners which will help them find out about the students' views regarding courses, teaching methodology and study materials. By analyzing the survey/poll data, refinements can be made [48].

2.4.23. Whiteboard

Whiteboards allow users to cooperate in a real-time medium. Users can upload images, send immediate messages, implement group web browsing, do web conferencing or voice/video chat [44].

2.4.24. Reports

These reports include site reports, course reports, user reports, activity reports, participation reports, overview reports, logs and statistics [50].

2.4.25. Upload and Share Documents

Users have the facility to upload and share documents through the medium of file storage space. Users can save personal documents as well as take part with other users [48].

2.4.26. Community Support

Open source software societies are contributing in building and developing the respective LMSs. Moreover, community support is also obtainable for users in an assortment of ways such as e-mail lists, technical documentation, wikis, forums, etc. [15].

2.4.27. Customized Look and Feel

LMSs simplify the way for users to customize the consideration and sense of interface. Learners can make their own forms to customize the consideration and feel. Navigation controls can also be adjusted for convenience of use [48].

2.4.28. FAQ

FAQ is an acronym for Frequently Asked Questions. Teachers can compile a list of FAQs while creating course content. FAQs include the answers to the most-asked questions [48].

2.5. Comparison between Learning Management Systems

Comparison between the LMSs determines whether they support requirements as shown in Tables 2.1 and 2.2 like course content management features including: Assignment upload, uploads of course assignments for students; Personal file storage for the users; Course object reuse, allowing the teacher to create courses from existing course objects; Digital library - possible to share course objects and other content; evaluation features such as evaluation - possible for the student to evaluate the course, result page, results of the evaluation for the teacher; results analysis, tools to analyze the result; communication features including chat, forum, wiki, messages, collaboration system [26].

Table 2.1. Comparison between the commercial LMSs.

Commercial systems	Assignment upload	Personal file storage	Digital library	Course object reuse	Course evaluation capacity	Result page	Results analysis	Chat	Forum	Wiki	Messages	Collaboration system
WebCT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Blackboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
eCollege	✓	✓	✓	✓	✓	✓	_	✓	✓	_	✓	✓

Table 2.2. Comparison between the open sources LMSs.

Open source systems	Assignment upload	Personal file storage	Course object reuse	Digital library	Course evaluation capacity	Result page	Results analysis	Chat	Forum	Wiki	Messages	Collaboration system
Moodle	✓	✓	✓	_	✓	✓	✓	✓	✓	✓	✓	✓
Sakai	✓	✓	_	_	✓	✓	_	✓	✓	✓	_	_
Claroline	✓	_	_	_	✓	✓	_	✓	✓	✓	_	_
ATutor	✓	✓	✓	✓	✓	✓	✓	✓	✓	_	✓	✓
ILIAS	✓	_	✓	_	✓	✓	✓	✓	✓	✓	✓	_

2.6. ILIAS Learning Management System

ILIAS is an acronym for Interdisciplinary Lab for Intelligent and Adaptive Systems; it is a web-based LMS advanced by PHP, MySQL and using Apache as a web server. Although it is developed in the German language, it supports many languages including English [51].

ILIAS was developed at Cologne University by the VIRTUS study in 1997/1998. Its objective was improving conventional scenarios of learning using new information and intelligence technologies. ILIAS is increasingly employed in educational institutions, business foundation universities and managerial agencies like the office of German federal investment [52].

ILIAS is a huge open source LMS for realizing and developing web based e-learning. ILIAS offers many ways of delivering the content learning, and has been expanded with new functionalities to support several actors in the e-learning sphere [53]. This system expanded by providing a portal for accessing a course as well [54]. ILIAS's platform provides data regarding logging-in or logging-out times [55]. ILIAS is not specified for a particular

learning medium, it offers a repository of course content management as shown in Figure 2.23 [56]. In the process of creating learning materials, ILIAS offers the potential of reusing learning topics like media and glossary objects [57].

ILIAS has a desktop for learners, as seen in Figure 2.24. This personal space is used for organizing learning and working, communicating material and rich collaboration like unified content authoring, chat, group work system, and forums which all help ILIAS to become a better option for distance learning [38].

ILIAS stores, displays, manages and statistically evaluates test results as shown in Figure 2.25. Thereby, ILIAS supports all standard types of assessment and tests, like single and multiple response, fill-in-blank, ordering, matching and image maps which can be used in online examinations and online self-tests [58].

ILIAS surveys can be used to easily collect information from a great number of users, for instance, for evaluating courses or other events. Even for non-experienced users, the creation and administration of ILIAS surveys are easy [59].

There are 115 installations from 18 countries. It gains a perfect evaluation in some recent studies. It has sufficient credit. ILIAS also enjoys high popularity, because it has been translated into 16 languages. ILIAS is very interesting for programmers and developers, because it is open source, which means it is free to re-program, modify, etc. However, ILIAS is not easy to install, needs a lot of software, with the latest versions of that software, and requires a long procedure for installation. ILIAS is an open source system, which means an organization can customize it to their local needs and can evolve it when required without any licensing costs. More than 115 organizations are using it, developing it and sharing those developments. They can also ensure the security so they can review the source code [16].

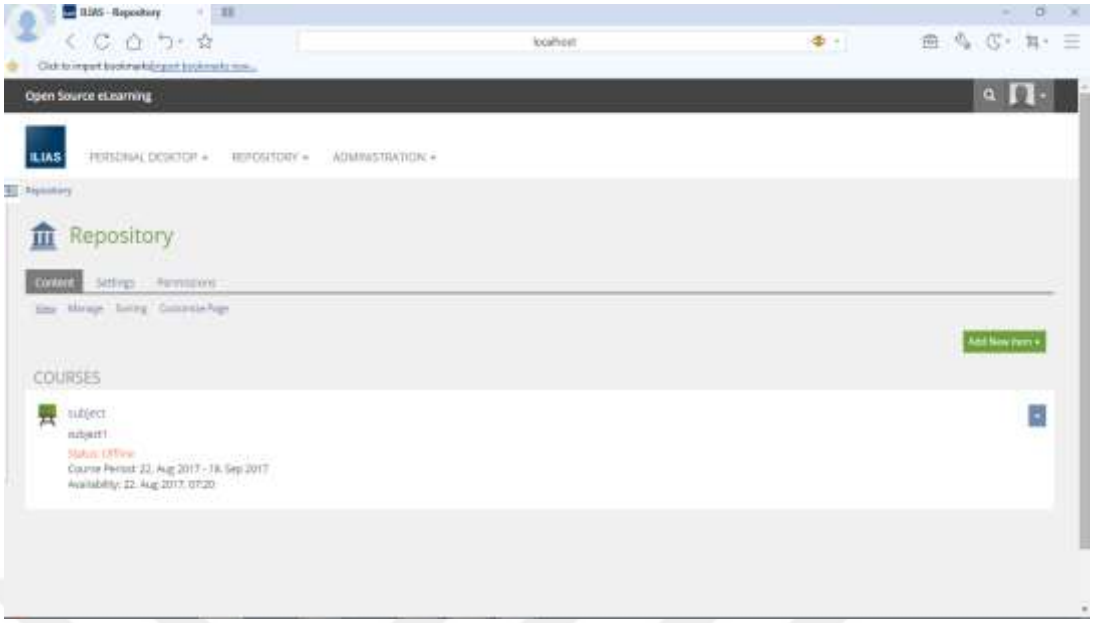


Figure 2.23. ILIAS's repository of course content managing.

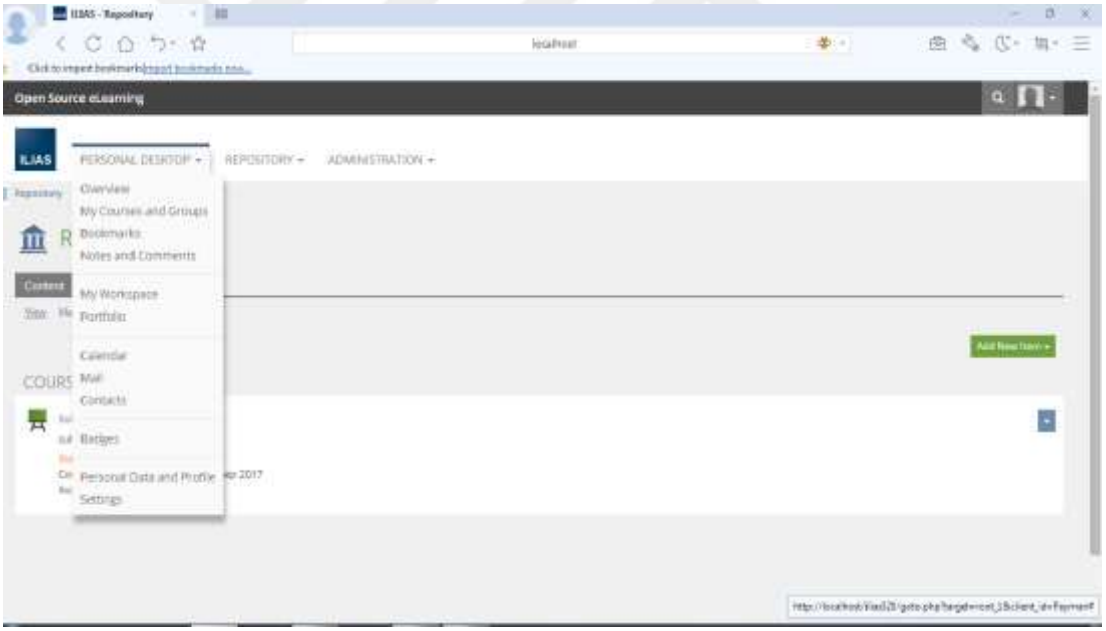


Figure 2.24. ILIAS's desktop for its learner.

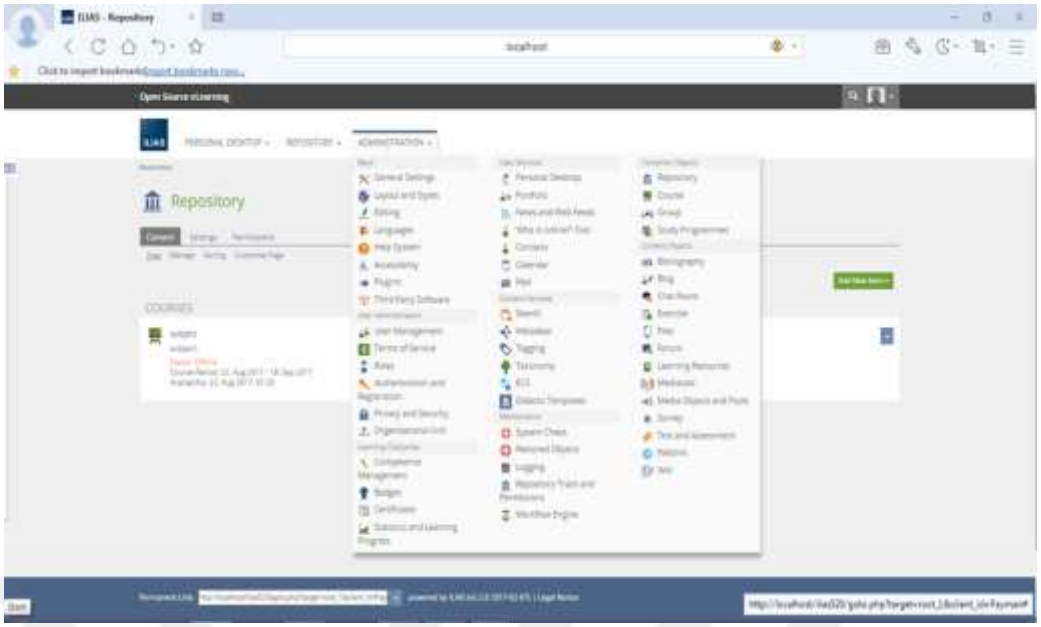


Figure 2.25. ILIAS's administration section which contains many useful tools.

3. METHODOLOGY

ILIAS LMS is a broad information platform that has many important features but one is not able to use more than one feature at the same time. As a result of a long search to find important missing features in ILIAS, finally found at ILIAS's home page as shown in Figure 3.1, which includes three main sections, these sections are:

- Using ILIAS
- Development
- Communities

Figure 3.1. Shows that ILIAS's home page includes three sections.

By clicking on the development drop-down menu a feature wiki selection can be seen, and later a wiki page will appear, which contains many important suggested features as shown in Figure 3.2.

Figure 3.2. Illustrates steps for selecting a feature wiki page in ILIAS**.**

From this page the three following suggested features were selected to be a main goal for this research as shown in Figures 3.3 and 3.4.

Figure 3.3. Shows the date filter for e-mails and move e-mail to folder by drag and drop.

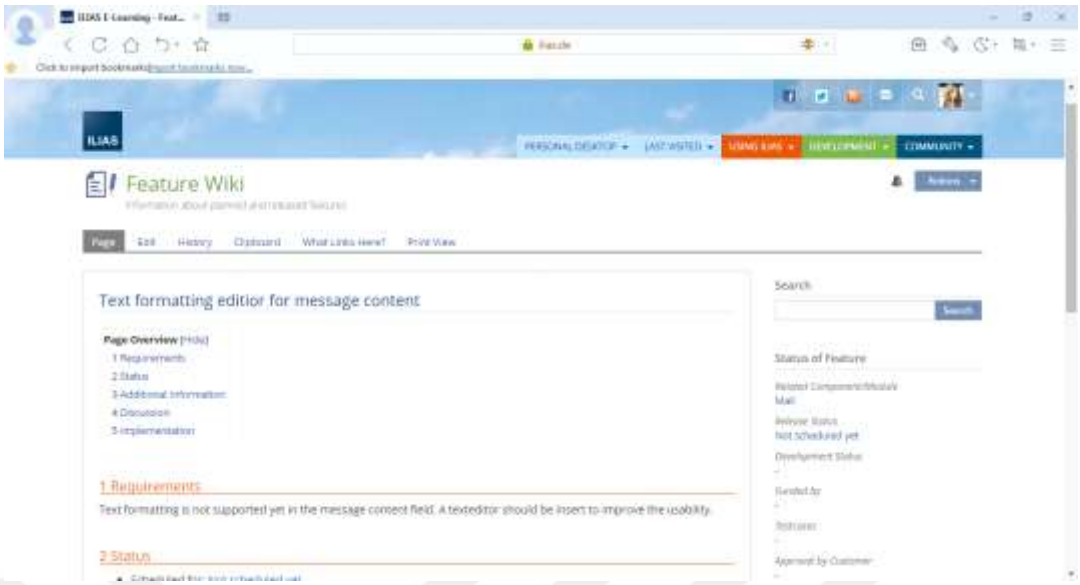


Figure 3.4. Displays text formatting editor for message content as missing feature in ILIAS.

To write the codes for those three features the following steps have been taken:

Step 1 - The Installation part:

To install ILIAS, software like XAMPP (PHP - MySQL- Apache) was needed to make the computer like a local host; this is due to ILIAS requirements in the installation and maintenance section in ILIAS's website, also installing extra tools like (zip, unzip, Image Magick Display, notepad++ for code editing).

Step 2 - Reading ILIAS's codes:

To read ILIAS's code first of all the software must be running, then one tries to find the codes of ILIAS that relate to the mail module, discover the database and tables related to mail (mail table in database) to add the codes of missing features in the right position.

Step 3 - Writing the codes for missing features:

As ILIAS is a web-based platform, the following programming languages were used for coding these features:

- HTML
- PHP

- MYSQL

Step 4 - Testing the added feature and checking for bugs:

Testing the developed copy of ILIAS with the new features manually by using the computer as a local host to allow users to access the software and use the developed features.

Because ILIAS is a platform used by students, after completing the programming side of the added features a survey was drawn up and answered by Fırat University students to determine the effectiveness and usefulness of the added features in saving time and improving usability.

The students answered the questionnaire in two ways, by filling out the question forms on Google Drive and also in hard copy.

4. RESULT ANALYSIS

To discover what effective results the added features of ILIAS LMS had, a questionnaire with many questions was prepared. Those questions were answered by 73 students from Fırat University Technical College/Software Engineering Department in Turkey after using ILIAS including the added features.

4.1. Result of the First Question

The first feature as shown in Figures 4.1, 4.2, 4.3 and 4.4, included adding a date filter to ILIAS's e-mail system.

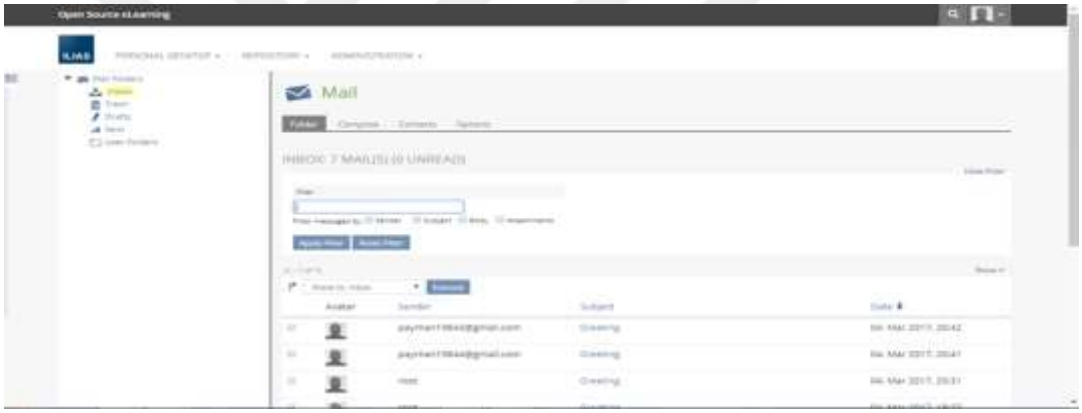


Figure 4.1. Shows ILIAS's mail system before adding date filter for e-mail.

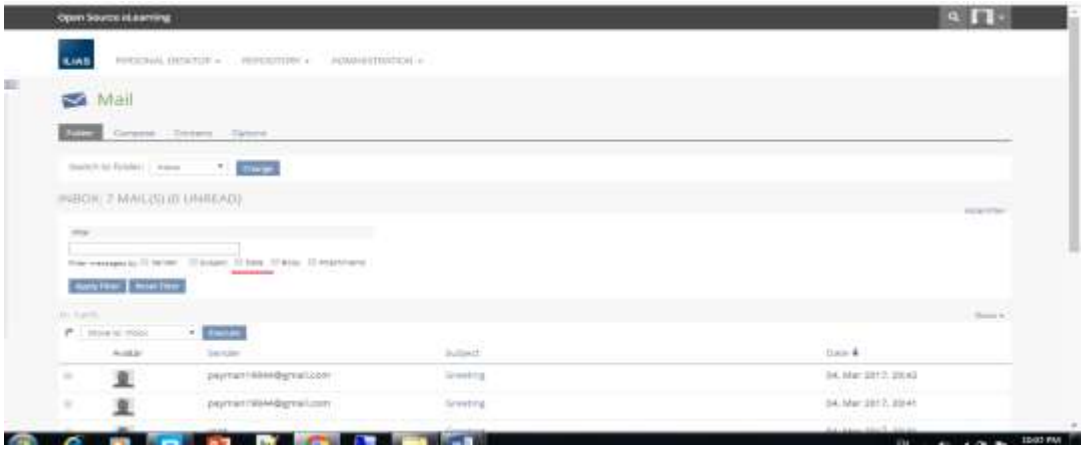


Figure 4.2. Shows ILIAS's mail system after adding date filter for e-mail.

Figure 4.3. Illustrates the GUI coding side for the date filter feature.

Figure 4.4. Adding array item to filter array for the date filter.

The first question of the survey and its result are illustrated as follows:

Question 1: Do you think using the date filter in searching for a specific e-mail will make your search easier and faster?

Table 4.1. The percentage of the students' answer about the 1st question.

Selections	Students' answer	Percent
No	3	4.1
Yes	70	95.9
Total	73	100.0

The above question was answered by 73 students. As shown in Table 4.1, 4.1% of the students answered No and 95.9% of them answered "Yes". This result shows that a large number of students thought that adding a date filter to ILIAS's e-mail system will increase and facilitate the usability of this platform.

4.2. Result of the Second Question

ILIAS enables its users to move e-mail to a folder in these steps (checking mail – opening menu – choosing folder – clicking Execute) as shown in Figure 4.5.

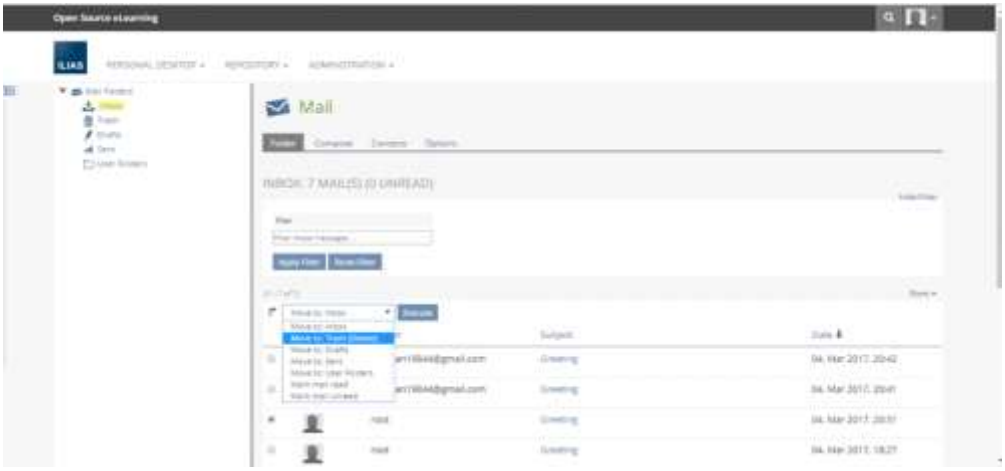


Figure 4.5. Moving e-mail to a folder in several steps.

To know the time which those steps take to move any e-mail, the following question was answered by 73 students.

Question 2: How much time do you need to move e-mails to a folder by these steps (checking mail – opening menu – choosing folder – clicking Execute)?

Table 4.2. The percentage of the students' answer about the 2nd question.

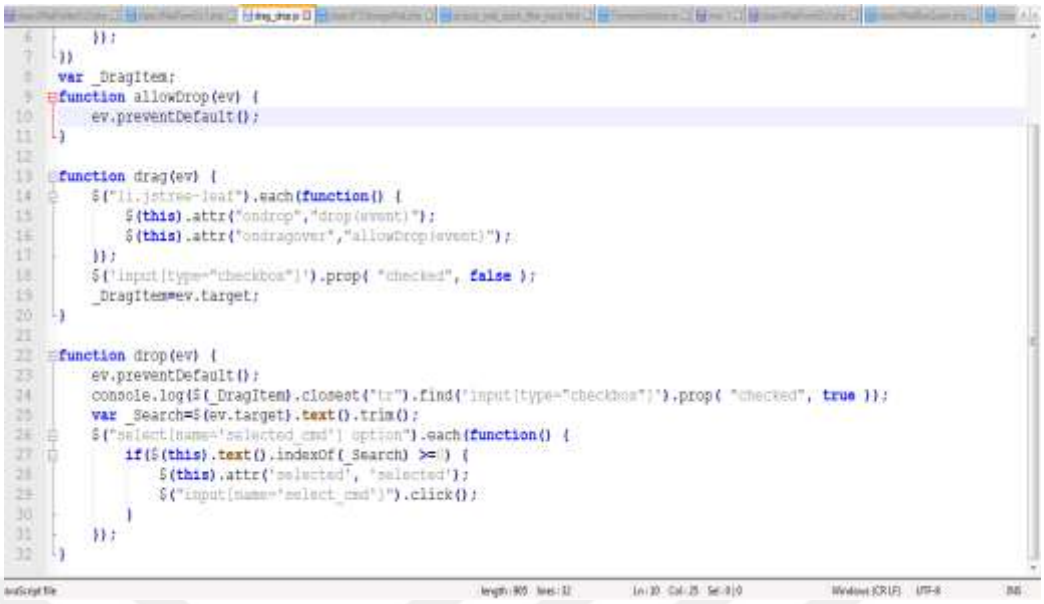
Selections	Students' answer	Percent
1 sec	1	1.4
2 sec	6	8.2
3 sec	15	20.5
4 sec	14	19.2
5 sec	37	50.7
Total	73	100.0

As a result, according to the answers of the students as seen in Table 4.2, 50.7% of the students thought these steps take about 5 seconds.

4.3. Result of the Third Question

The second added feature as shown in Figures 4.6, 4.7 and 4.8 is moving e-mail to a folder by drag and drop.

Figure 4.6. Moving e-mail to a folder by drag and drop.

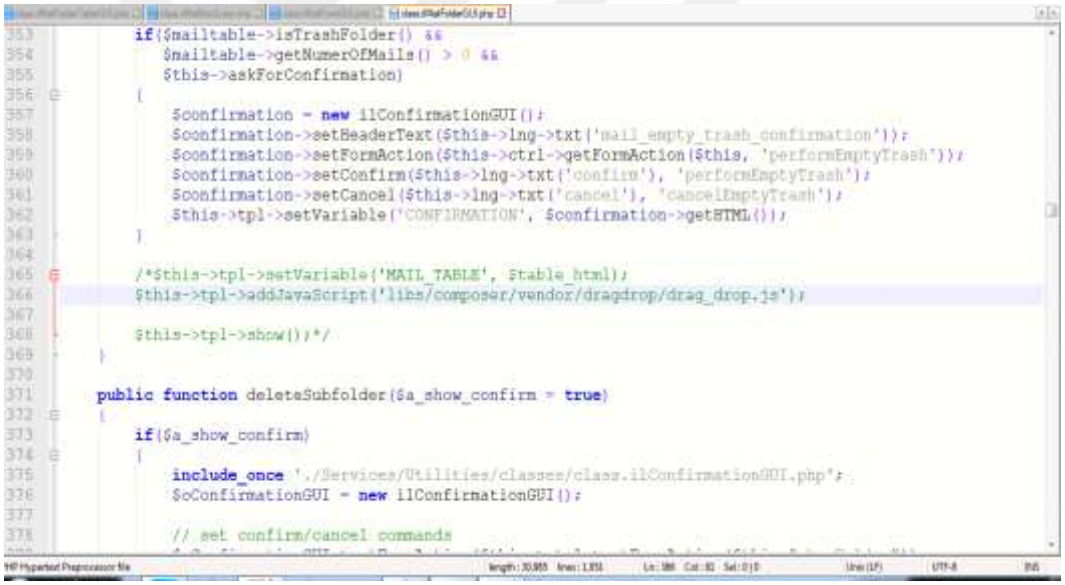


```
    });
})
var _DragItem;
function allowDrop(ev) {
    ev.preventDefault();
}

function drag(ev) {
    $("li.jstree-leaf").each(function() {
        $(this).attr("ondrop","drop(event)");
        $(this).attr("ondragover","allowDrop(event)");
    });
    $('input[type="checkbox"]').prop( "checked", false );
    _DragItem=ev.target;
}

function drop(ev) {
    ev.preventDefault();
    console.log($(_DragItem).closest("tr").find('input[type="checkbox"]').prop( "checked", true ));
    var _Search=$(ev.target).text().trim();
    $("select[name='selected_cmd'] option").each(function() {
        if($(this).text().indexOf(_Search) >= 0) {
            $(this).attr('selected', 'selected');
            $("input[name='select_cmd']").click();
        }
    });
}
```

Figure 4.7. The first part of the coding side of drag and drop feature.



```
        if($mailtable->isTrashFolder() &&
           $mailtable->getNumerOfMails() > 0 &&
           $this->askForConfirmation)
        {
            $confirmation = new ilConfirmationGUI();
            $confirmation->setHeaderText($this->lng->txt('mail_empty_trash_confirmation'));
            $confirmation->setFormAction($this->ctrl->getFormAction($this, 'performEmptyTrash'));
            $confirmation->setConfirm($this->lng->txt('confirm'), 'performEmptyTrash');
            $confirmation->setCancel($this->lng->txt('cancel'), 'cancelEmptyTrash');
            $this->tpl->setVariable('CONFIRMATION', $confirmation->getHTML());
        }

        /*$this->tpl->setVariable('MAIL_TABLE', $table_html);
        $this->tpl->addJavaScript('libs/composer/vendor/dragdrop/drag_drop.js');

        $this->tpl->show();*/
    }

    public function deleteSubfolder($a_show_confirm = true)
    {
        if($a_show_confirm)
        {
            include_once './Services/Utilities/classes/class.ilConfirmationGUI.php';
            $oConfirmationGUI = new ilConfirmationGUI();

            // set confirm/cancel commands
```

Figure 4.8. The second part of the coding side of drag and drop feature.

The students answered a question about the total time needed to move an e-mail to a folder using the drag and drop feature. The result is illustrated in the following table.

Question 3: How much time do you need to move e-mails to a folder by drag and drop?

Table 4.3. The percentage of the students' answer about the 3rd question.

Selections	Students' answer	Percent
1 sec	10	13.7
2 sec	40	54.8
3 sec	15	20.5
4 sec	5	6.8
5 sec	3	4.1
Total	73	100.0

40 students out of 73, which is equal to 54.8%, selected 2 seconds as a total time for moving an e-mail to a folder by drag and drop, as shown in Table 4.3. So this result shows that the drag and drop feature takes less time than the old way which took about 5 seconds to move an e-mail to a folder, and this is a good way for students to save time.

4.4. Result of the Fourth Question

The following answers from the students to a question about which method is a faster way to move e-mails proves that drag and drop is a faster way to move e-mail to a folder than the old way, which included many steps to move e-mails.

Question 4: Do you think moving e-mails to folders by drag and drop is faster than the old way which needed the following steps (checking mail – opening menu – choosing folder – clicking Execute)?

Table 4.4. The percentage of the students' answer about the 4th question.

Selections	Students' answer	Percent
No	4	5.5
Yes	69	94.5
Total	73	100.0

69 students out of 73, which equals 94.5%, thought drag and drop is a faster way to move e-mail to a folder than the old way of moving e-mails, as seen in Table 4.4.

4.5. Result of the Fifth Question

Formatting a text can draw the reader's attention to specific parts of the text, and also emphasize important information. There are several options for adjusting text, including font, size and color, as well as adjusting the alignment of the text to change how it is displayed on a message.

To compose a new e-mail by using ILIAS's mail system, you will not find the above attributes. Therefore a text formatting editor has been added as a third additional feature, as shown in Figures 4.9, 4.10, 4.11 and 4.12.

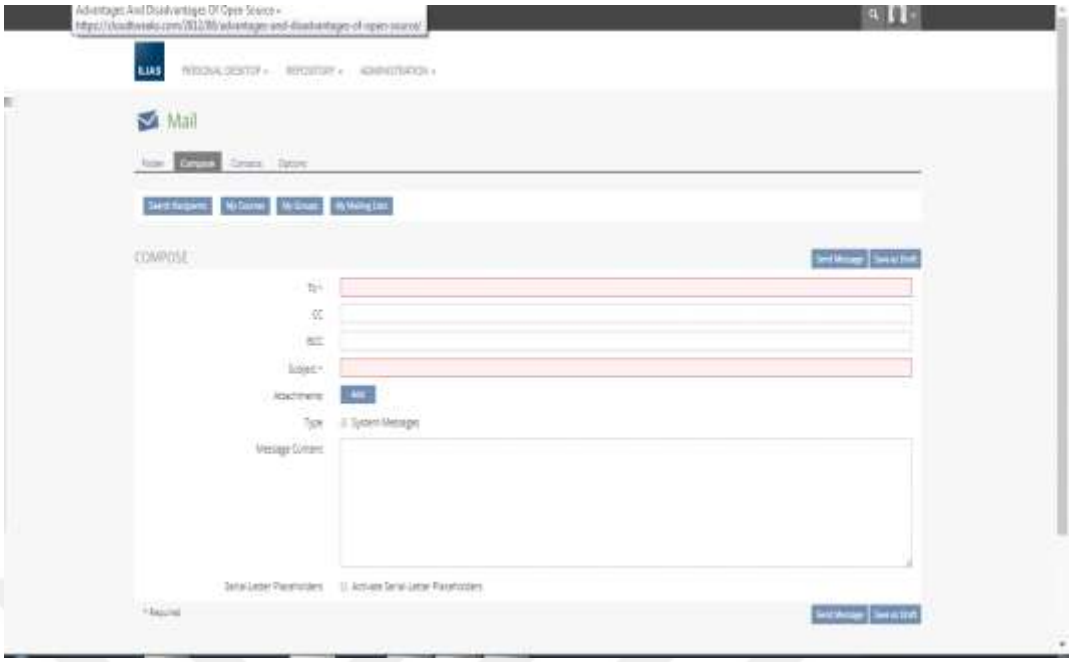


Figure 4.9. ILIAS's e-mail composing page before adding a text formatting editor.

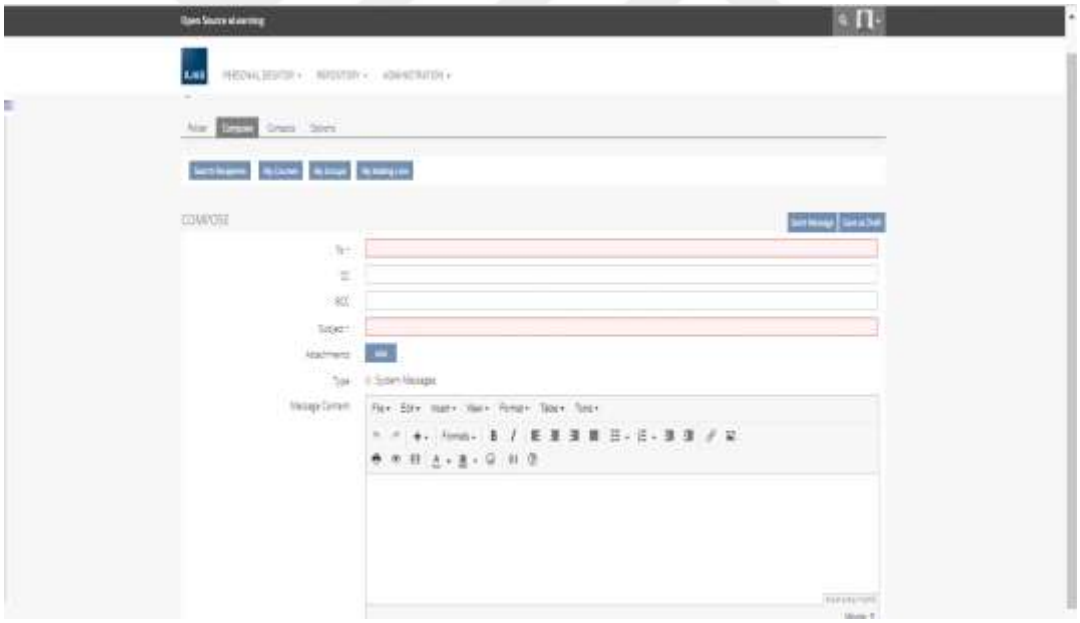


Figure 4.10. ILIAS's e-mail composing page after adding a text formatting editor.

Figure 4.11. The first part of the codes for adding the text formatting editor.

Figure 4.12. The second part of the codes for adding the text formatting editor.

To know whether adding this feature is effective or not, a question about this feature was answered by the students, and the result is displayed in the table below.

Question 5: Do you find adding a Text formatting editor for the message content useful?

Table 4.5. The percentage of the students' answer about the 5th question.

Selections	Students' answer	Percent
No	1	1.4
Yes	72	98.6
Total	73	100.0

The question was answered by 73 students, as seen in Table 4.5, and 72 of them, which equals 98.6%, thought that adding a text formatting editor feature was necessary to improve the usability for composing a message.

5. CONCLUSION

ILIAS is a huge open source LMS used to reduce the costs of using new media in education. This software was also developed for further training in the implementation of the software and to assure the maximum scale of customer action. ILIAS is issued by ILIAS open source distance learning under a universal public license and is free to use. Internal e-mail in ILIAS is used for communication with other users and to receive notifications from forums and courses. Learners can use internal e-mail to e-mail groups and individuals. There are already some filters available in the ILIAS mail system (Sender, Subject, Body, Attachments). However, with more and more e-mails being sent over the years, students might also need a date filter to find what they are looking for, so a date filter feature has been added. The addition of a date filter to ILIAS's e-mail system will increase and facilitate the usability of this platform.

Sorting e-mails in the ILIAS mail system is not very convenient, moving an e-mail to a folder requires four clicks (checking mail – opening menu – choosing folder – clicking Execute), which is quite a lot. In order to save time and to keep inboxes tidy, a drag and drop feature has been added as an alternative to the old way of moving e-mails.

To compose a new e-mail when using ILIAS's mail system, you are not able to add attributes to the text, and therefore a text formatting editor has been added as a third additional feature.

Future work in this area will include further work on sorting of mail according to courses and groups. Now users of ILIAS can sort their e-mails according to sender, subject and date. For people who are active in many different courses, it would be great to have a way to filter mail according to courses, so that only e-mails which refer to a certain course will appear.

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