University of Applied Sciences Wildau

Business and Computer Science Faculty

Graduation Thesis

Implementation of a Learning Management System for a small American company

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Table of Contents

1. Introduction

1.1 Purpose of study

During the last ten years, the internet and the World-Wide-Web have fundamentally changed how the world works. Few decades ago, it took a mail *three* weeks for it to cross the Atlantic. Nowadays with the use of e-mail, the mail is there in a fraction of a second, traveling at the speed of light. Information exchange and communication is almost instant from all corners of the world, dramatically shrinking the boundaries and limitations of the past, to an extent that some have started to call the world a 'global village'. The internet is the main driver of globalization, the integration of economic, political, cultural, religious, and social systems reaching the across world. This movement will only gain more momentum as more use people reach the web, and generation internet users approach work, learning and play in new ways [1].

The internet has sweep across entire industries, and radically altered the way they do business. A good example is the book printing industry. In the past, printing a book was a risky proposition. Only a certain amount of books where printed. If they sold well, they quickly where out of stoke and if they didn't sell the publisher was stuck with many copies of the same book. Nowadays the books are printed on demand, only after a customer has ordered a book via online. This reduces the fixed production cost almost to zero. As a result, far more people are able to print and sell there books than ever before, and customers have a wider pallet of products. An other good example is the entertainment business. In the past, a large budget, studios, actors among others things where required to shoot a movie. Nowadays anyone with a camcorder can film something and post it online, reaching an audience far grater that was previously possible.

On the other hand, there are certain industries have not been changed dramatically by the internet revolution. One of these industries is education. "In many ways education has lagged behind some of these trends and is just beginning to feel their wake." [2] Terms as 'e-learning' and 'computer based training' have been around for some time now, but where not able to find enough traction to have an impact on the landscape. But recently, the technology aspect as well as new pedagogic alternatives had caught up with e-learning that have the potential of revolutionizing not only learning via the internet but

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[1] Tapscott, D. Rise of the Net Generation
[2] Downs, S. E-learning 2.0

learning as a whole. Since this market is still in the early stages, it is basically untapped. Organizations that take advantage of this an invest in e-learning have the potential of being very successful.

What is e-learning? What benefits and disadvantages does it pose for the organization that wants start using this medium as a platform? What criteria is important when selecting the technology (LMS)? How should it be implemented? These questions are the backbone of this graduation thesis. They will be explained with a practical example, by implementing a LMS for a small American Company (E-Hazwoper University), from start to finish.

1.2 Structure of the document

This document is divided into two pats: theoretical and practical segments.

The theoretical segment starts with a general definition of what both *E-Learning* and *Learning Management System* mean. Followed by discussion of the a*dvantage, disadvantage and common misconceptions regarding e-learning*. Followed by a discussion talks about the 2.0 Generation, and how the landscape of the internet has been dramatically changing for the last few years. The last part of the theoretical segment provides a brief description of the *general pedagogic philosophies* that are relevant to the subject.

The practical segment first discusses the *Business Context*. Here a general information about the host company is provided, followed by the project proposal. Next is the *Design* chapter, where detailed information about both the functional and technical requirements are defined and the different software alternatives are discussed and reviewed in order determine what alternative is better suited to meet all the business needs. Now with an alternative chosen, the Development phase follows. All required installation and addition configuration in order to have a functional service are described here. The last chapter is the *Rollout*, where the application itself is properly configured, tested and accommodated to the business standards.

2. E-learning fundaments

2.1 E-learning and Learning Management System definition

Electronic learning or e-learning is a broad term used to describe computer-enhanced learning. A wide range of terminologies have been used for e-learning in the past, making it difficult specify a *general* definition. Commonly used terms include *e-learning*, *internet learning*, *distributed learning*, *networked learning*, *tele-learning*, *virtual learning*, *computer-assisted learning*, *Web-based learning*, and *distance learning*. All of these terms imply that the learner or trainee is at a physical distance from the tutor or instructor. The learner uses various types of technology (e.g. computer) to access the learning materials, using the system to interact with the tutor or instructor and other learners, and that some form of support is provided to learners.

There are many definitions of electronic learning in literature, the definitions that reflect different practices and technologies associated with it. Carliner defines electronic learning as "educational material that is presented on a computer"[3]. Khan has a more detailed definition, describes it as "an innovative approach for delivering instruction to a remote audience, using the Web as the medium" [4]. However, online learning involves more than just the presentation and delivery of the materials though the web: the learner and the learning process should be the focal point of e-learning. As a result, a suited definition of electronic-learning is 'the use of the internet to access learning materials. To interact with the content, instructor, and other learners and to obtain support during the learning process, in order to acquire knowledge, to construct personal meaning, and to grow from the learning experience.'

A *Learning Management System* or *LMS* is a term used to describe web-based technology, designed for plan, implement, and assess a specific learning process. LMS are also more commonly referred as e-learning platforms, used as a medium to put e-learning content to the web. Typically, a learning management system provides an instructor a method to create and deliver content, monitor student participation, and assess student performance. According to Brandon Hall, a *LMS* is "software that automates the administration of training events. All Learning Management Systems manage the log-in of registers users, manage course catalogs, record data from learners, and provide reports to management."[5]

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[3] Carliner, S. Overview of online learning.
[4] Khan, B. Web-based instruction
[5] Hall, B. Online Glossary

2.2 Advantages, disadvantages and misconceptions

One of the key advantages that e-learning provides to users is flexibility. They can access the course from virtually anywhere with internet access. Since the courses are asynchronous, each learner can adjust when and how long they want to participate, depending on their daily commitments. This allows learners to be enrolled in desired courses and still maintain their regular hours at work. Additionally, the learner would save time and transportation costs that occur when traveling to the campus. Learners can use the Internet to access up-to-date and relevant learning materials, and can communicate with experts in the field in which they are studying. Another key feature is the convenience that e-learning provides. The learner can repeat each lesson as many times as he or she wants. Videos and other media can be played as often as needed. Also by using resources as media, this provides greater variation in the learning experience and can supply greater adaptability to the learners needs. Learners can easily interact with each other, regardless of their physical location. For the instructor, tutoring can be done at anytime and from anywhere. Online materials can be updated, and learners are able to see the changes at once. There are also great benefits in the business: although implementation cost might be on the high side, training cost go dramatically lower as more users use the system. Courses can be taken multiple times, with no extra cost to the host company.

E-learning may also have drawbacks: The lack of face-to-face interaction, not only with the faculty members but also student-to-student interaction, leaves the learner with a sense of isolation. There are tools available to minimize this effect (such as chats and forums), the general sentiment remains constant. The trainee's motivation is also an issue. Since the learner is not bound by a fixed schedule like a real class would have. No progress is done if he/she is not well disciplined and motivated.

Marc Rosenberg[6] lists the common misconceptions and misbelieves that people haven when thinking about E-learning. In order to successfully implement an E-learning system these points need to be taken into consideration and then cleared out. The misconceptions are:

- Everyone Understands What E-learning Is

  This is simply not true. Without an agreed-upon definition and a common framework for thinking and talking about e-learning, confusion reigns

- E-Learning is Easy

  Building and deploying great e-learning that is both effective and efficient takes real effort,

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[6] Rosenberg, M. Beyond E-Learning

discipline, and experience in the fields such as design, information design, communications, psychology, project management, and psychometrics, not to mention a healthy consideration of needs assessment and evaluation.

- It's boring by nature

  Many only think of e-learning as a computer screen with a long text. There are many ways to make the courses engaging and interesting by using different resources such as media and interactive elements such as a group discussion.

- Success is getting E-Learning to work

  For too many, this means getting the technology to work. It is far more than that. Course flow and layout, generating focused and well explained media is among many other elements that are required for a successful system.

- Only certain content can be taught online

  This argument, often raised by sponsors as a reason not to support e-learning, is untrue. With the right instructional design approach, almost any type of knowledge or skill can be developed and delivered online.

- e-Learning's value proposition is based on lowering the cost of training delivered

  What should really be the focus is the substantial benefits e-learning can generate in worker productivity, speed of learning deployment, and shortened times to competence.

2.3 The 2.0 Generation

2.3.1 Web 2.0

Web 1.0 was the so called *'Dot Com Boom'* of the early and middle 90's and the eventual stoke crash at the end of the decade. Web 2.0 is the next iteration of web-based communication and services, revolving around the *'social network'*. This new movement has spawned a new wave of entrepreneur business such as YouTube, Digg, Skype among many others. Now the technology has matured, and investors have a better concept of what to expect from companies. This has created a stable environment for new companies to grow. The term was originally conceived by Tim O'Reilly who explains it as: "Web 2.0 is the business revolution in the computer industry caused by the move to the internet as platform, and an attempt to understand the rules for success on that new platform. Chief

among those rules is this: Build applications that harness network effects to get better the more people use them." [7]

On a more practical level, there are common design elements that are widely employed by this new 2.0 movement, although none of these are standards. "These new sites usually feature modern web technologies like *Ajax* and often have something to do with building online communities. But even more characteristic among these brands is their appearance. Web 2.0 sites nearly always feel open and friendly and often use small chunks of large type."[8] Colors also play a big role. They are usually bright and cheerful, typically using blue, orange and lime green. Company logos also follow this trend. They tend to be soft, rounded surfaces and *gradient overlay*, giving the company a kinder look, for what otherwise be a cold trademark logo. Figure 2.1 shows a typical 2.0 logo.

Figure 2.1: Logo of ShoutWire.com

O'Reilly also wrote an extensive article regarding this subject[9]. To pull the most relevant aspects for eLearning 2.0:

- Software Services

  This refers to software that runs on an external platform instead of a local drive. The use interacts with it using only a browser. The benefits of this are that there is no downloads, no installation and no configuration. The software is instantly available.

- Harnessing Collective Intelligence

  Companies such as Amazon and Google have been taking advantage of this approach for some time now. Amazon analyses customer pattern and generates dynamic lists for other users with similar interest to help the find what they need. Google ranks web pages partly on how many other pages like to a particular site. They are relying on the fact that the more other people have linked to something, the greater possibility that it has value.

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[7] O'reilly, T.; Web 2.0 Compact Definition: Trying Again
[8] The logos of Web 2.0
[9] O'reilly, T.; What Is Web 2.0? Design Patterns and Business Models for the Next Generation of Software

- Everyone as a Publisher

  The barrier to publish has been dramatically reduced. Now someone can write an article and publish it in a matter of seconds. There are no editors involved in this process and the costs are technically non existent. This is not only limited to the written medium: photos (Flickr), videos (YouTube), radio and talk shows (podcasts).

- Aggregation and tagging

  Now that everyone is a publisher, there is an information saturation. In order to cope with this, there are new ways to grab the information, like RSS feeds. Additionally, there are tools that help people distinguish between good sources and bad and help them organize them (tools like Digg.com and del.icio.us.)

- Lightweight programming and composition

  Software is now design and build differently than before. Instead of writing a large program, development has shifted toward small tools, that can be embedded into applications. The best example is how *Google Maps* allows users to insert maps into their websites.

2.3.2   E-learning 2.0

Stephen Downes in a article written for eLearing Magazine explains that "E-learning is evolving with the World Wide Web as a whole and it's changing to a degree significant enough to warrant a new name: E-learning 2.0."[10] As with Web 2.0, the E-learning 2.0 movement is the reinvention of the e-learning services, after the failures of the first wave at the start of the decade. This new iteration services, borrows from technology developed for the Web 2.0, such as wikis and blogs, and implements them to further enhance the e-learning experience. Downes describes in that same article, how he noticed the potential, when students where assigned to use an primitive version of a blogging tool, and people from all over the world started responding to those threads.

Groups and communities have slowing been forming throughout the web, where people create their own learning materials and share them with other people with their same interests. Learning becomes a social experience, a community characterized by "a shared domain of interest where members interact and learn together and develop a shared repertoire of resources."[11] This new way of learning puts the traditional model, where content is created by a centralized instance and the consumed by the students, on it's head. What was the role of the content creator of the past, has gradually changed to a 'facilitator'

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[10] Downs, S. E-learning 2.0
[11] Wenger, E.; Communities of practice a brief introduction

role. Where content created by the students is edited, formatted and integrated with the rest of the course, later making it available to all students.

2.4 General pedagogic philosophies

Besides the traditional 'instructional' pedagogic approach, where the trainee follows a fixed curriculum that is created by an educational group or a single teacher, there are other techniques that help the developer focus the experience to achieve effective learning from the learner's point of view. There are many schools of thought on learning, and no one school is used exclusively to design electronic learning materials. As there is no single learning theory to follow, a combination of theories to develop learning materials can be used. In addition, as research progresses, new theories are evolving that should also be taken into consideration. The online developer must know the different approaches to learning in order to select the most appropriate instructional strategies, depending on the content and type of training. Learning strategies should be selected to motivate learners, facilitate deep processing, , promote meaningful learning, encourage interaction, provide feedback, facilitate contextual learning, and provide support during the learning process.

2.4.1   Constructivism

Constructivism states that people actively construct knowledge as they interact with the environment around them. "Learners should be allowed to construct knowledge rather than being given knowledge through instruction."[12] This learning theory was fist conceived by the Swiss Jean Piaget in the mid 1950s. This is achieved through the process of *accommodation* and *assimilation.* Everything that an individual perceives is tested against prior knowledge and if it is viable within their internal representations of the world, then this is transformed into new knowledge, this is considered 'assimilation'. In contrast, when individuals' experiences contradict their internal representations, they may change their perceptions of the experiences to fit their internal representations. According to this theory, accommodation is the process of reshaping one's mental representation of the external world to fit new the experiences. Accommodation can be understood as the mechanism by which failure may lead to learning. When someone act on the expectation that the world operates in one way and it violates their expectations, they often fail, but by accommodating this new experience and reframing their model of the way the

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[12] Ackermann, E. Piaget's Constructivism, Papert's Constructionism: What's the difference?

world works, the individual learns from the experience of failure, either from his or her own failure or the failure of others.

"Conceptual changes in children, like theory changes in scientists, emerge as a result of people's action in-the-world, or experience, in conjunction with a host of 'hidden' processes at play to equilibrate, or viably compensate, for surface perturbations."

2.4.2   Constructionism

Constructionism asserts that that learning is particularly effective when an individual constructs something from what they have recently learned. These constructs can range from simple conversations, to more complex artifacts such as a software program or a painting. This theory was developed by the American Seymour Papert of MIT, basing it on Piaget's constructivism.

"Constructionism shares contructivism's view of learning as 'building knowledge structures' through progressive internalization of actions. It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe." [13]

For example, an individual is asked to read a text and by the next day he would probably have forgotten about it already. But if he where to try and tell someone what the text was about using his own words, there is a higher chance that the individual will withhold the information and have a better understanding that is more integrated into his own ideas. This also explains why some people take notes during classes, even if they are not going to read them again.

2.4.3   Social Constructivism

This theory extends from the above ideas and adds the social group to the context. The idea is that a group constructs things for one another, collaboratively creating a small environment or culture of shared artifacts with related meanings. When the individual is placed in an environment like this, he or she is constantly learning how to be part of the culture on may levels, mutually helping each other to learn. Peter Berger and Thomas Luckmann state, that all knowledge, including the most basic, taken-for-

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[13] Ackermann, E. Piaget's Constructivism, Papert's Constructionism: What's the difference?

granted common sense knowledge of everyday reality, is derived from and maintained by social interactions.[14]

A very simple example is an object like a cup. It can be used for many things, but its shape does suggest some 'knowledge' about carrying liquids. A more complex example is an online course. Not only do the 'shapes' of the software tools indicate certain things about the way online courses should work, but the activities and texts produced within the group as a whole will help shape how each person behaves within that group.

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[14] Berger, P. L. and T. *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*

3. Business Context

3.1 Background

E-HAZWOPER University or EHU is a newly formed small American business that provides on location training services.

Its staff of professionals has performed extensive *industrial hygiene* and *health* and *safety* training services for large and small clients, with a field experience ranges from tank removals at gasoline stations and military bases, major demolition projects at former oil refineries and fuel terminals, serving as Safety Inspectors representing major refineries, to residential mold inspections.

The staff of scientists and specialists is trained in *OSHA* safety regulations related to hazardous waste site work, indoor air quality investigations, personnel monitoring for toxic exposure, safety documentation, and health and safety training.

e-HAZWOPER University instructors have provided safety training to dozens of major clients, including engineering companies, major oil companies, construction companies, and government agencies. Training includes the OSHA required hazmat classes such as the 40-hour site worker training, lead awareness, hazard communication, respiratory protection, confined space entry, excavation and shoring, first aid and CPR.

The professional staff includes a Chemist/Certified Industrial Hygienist (CIH) and a Certified Environmental Trainer (CET), as well as other qualified support staff with a total of fifty years of combined experience in regulatory compliance, environmental/health and safety, hazardous waste operations and management, and training in numerous technical and specialty areas.

The Hazardous Waste Operations and Emergency Response Standard applies to five distinct groups of employers and their employees. This includes any employees who are exposed or potentially exposed to hazardous substances including hazardous waste and who are engaged in one of the following operations as specified by the Code of Federal Regulations, 29 CFR 1910.120 (a)(1)(i-v) and 29.CFR 1926.65 (a)(1)(i-v)[15] :

- Cleanup operations, required by a government body, whether federal state, local, or other involving hazardous substances, are conducted at uncontrolled hazardous waste sites.

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[15] U.S. Department of labor; Regulations (Standards - 29 CFR)

- Corrective actions involving clean-up operations at sites covered by the Resource Conservation and Recovery act of 1976 (RCRA) as amended (42 U.S.C. 6901 et seq/).
- Voluntary clean-up operations at sites recognized by federal, state, or other government body as uncontrolled wastes that are conducted at treatment, storage and disposal facilities regulated under Title 40 Code of Federal Regulations Parts 264 and 265 pursuant to RCRA, or by agencies under agreement with U.S. Environmental Protection Agency to implement RCRA regulations
- Emergency response operations for releases of, or substantial threats of release of hazardous substances regardless of the location of the hazard.

By having trained, qualified employees, the company can effectively generate more business and satisfy its client needs for quality and experienced personnel. Trained qualified employees are less likely to have an accident because they know the requirements, restrictions and critical nature of the work in this very specialized field. There are many job sites where workers may not set foot on the properly without 40-Hour Hazardous Waste Operations Training and/or a valid 8-Hour Refresher training certificate.

Managing hazardous waste at a facility can pose a significant liability if site workers are not familiar with the critical aspects properly handling and managing the materials and the consequences of it's mismanagement or negligence. Incidents at the work site can endanger not only the employee and co-workers but could have a significant impact on the public. The potential liability for a company with unqualified or untrained workers is enormous and can lead to significant criminal charges for managers and supervisors. Companies operating in this environment can avoid this potential by providing a reliable and quality training program to their employees.

The goal is to provide a quality training experience to the company's employees as the first step in developing their full potential as an effective Hazardous Waste and Emergency Response site worker or Emergency Response Technician. Upon successful completion of the course each learner will have proficiency assessment (in the form of a test) and the opportunity to rate the course quality and effectiveness, and to add their personal comments.

Due to the hazardous nature of Hazardous Waste Operations and Emergency Response activities, site workers and technicians may encounter numerous risks during the course of their activities. The course objectives include hazard identification, risk ranking and developing effective mitigation for these risks. By identifying and mitigating risk, workers will have a much more successful, productive and rewarding experience.

3.2 Proposal

The project proposal is to take the courses that are thought face to face, and move them to an online environment, using an Learning Management System. The online courses should achieving the same impact and quality as their face to face counterparts. The online platform will use various exercises and examples, sometimes even mimicking the instructor to simulate face to face or interactive classroom environment. Each learner will take a test (evaluation) to demonstrate proficiency with the course content and material. At the close of the course the learner may also be asked to rate the course content, materials and delivery methods, this will complete the validation method by allowing personal interaction to influence course material or platform improvements and validate the effectiveness of the course.

3.3 Driver

The main driver behind this project is the potential of increasing the EHU profit. Additionally, since there is no fiscal location restriction, the courses can be offer to a wider client base greater than was previously possible.

3.4 Benefits

Online courses, compared to the traditional alternatives, cost dramatically less to produce and distribute. As a result the online courses can be marketed at a lower cost. Once the service is in place and fully functioning, additional courses and training can easily be added covering different subjects. A broadening the market share and an income increase would be the result.

There is currently a market niche that is untapped. Many online courses currently available are geared to the industry professional (scientists, geologists, engineers,) there is a gap in available on line courses for the average site worker (laborers, construction, demolition, and craft workers). These learners have a lower reading level than the average professional, that will require more graphics and exercises that will engage their senses. Also there is a gap in the international community, many companies are now considered international firms, but most to the training for this field is geared for the United States market. International firms want there people to have a global standard to they can travel across boundaries and apply high quality standards throughout their sphere of influence without limiting them form country to country.

Since these certifications are required by the Federal Government, marketing the courses to the different companies should not be problematic. Additionally, the companies gain in prestige by having a

well trained workforce, capable of interacting with facility and emergency service personnel at various hazardous waste sites due to their level of training and proficiency in meeting established goals and objectives. Also there is safety and environmental performance can be improved, measured and tracked, thus demonstrating diligence and continuous improvement by the companies that use the web site. Employees that enroll in online courses are more efficient, since they can continue with there current tasks and take the online course parallel to that. Additionally, e-learning is more rentable for companies, since they can save the secondary costs(e.g. no charge for the training room, saved hotel, travel and parking fees).

3.5 Risk assessment

#	Description	Severity	Urgency	Mitigation Approach	Contingency plan
1	**Technical:** For technical reason the site is not working properly or not working at all	Low	Low	• Regular backups • Security checks • Regular software updates	• Alternative system in place • Face-to-face courses can supplied
2	**Financial:** The project is financially not successful	Medium	Low	• Site marketing via online and commercial partners	• Changing the business model
3	**Legal:** Legal action is taken against the company	Low	Low	• Courses are updated regularly, adjusting to new regulations	• Selecting a licensed lawyer as consultant
4	**Trainee acceptance:** Trainees are unable to use the software	Low	Low	• Regular reviews of course evaluation	• Changing software vendor

3.6 Critical success factors

For the project to be considered successful, a 50% return of investment should be met within the *fist year* of the service being offered to the public. A 100% reimbursement of the investment should be met after *two years* and profitability within *three years*.

After each learner completes a course, he/she would be asked to complete a course evaluation. This evaluation would cover all aspects of the online course, from content to support. In order for the project to be successful, a reasonable good response from the learner evaluation would be required.

The courses need to fully meet the recognized requirements, both the State and Federal regulations.

The level of quality needs to meet or exceeded expectations. The material developed for the site hast to follow the guidelines stated by the industry, and the end product should be recognizable by professionals (i.e. if goals and objectives are used to develop the material, professional trainers, managers, industry professionals will recognize the quality aspects of the product).

4. Design

4.1 Functional Requirements
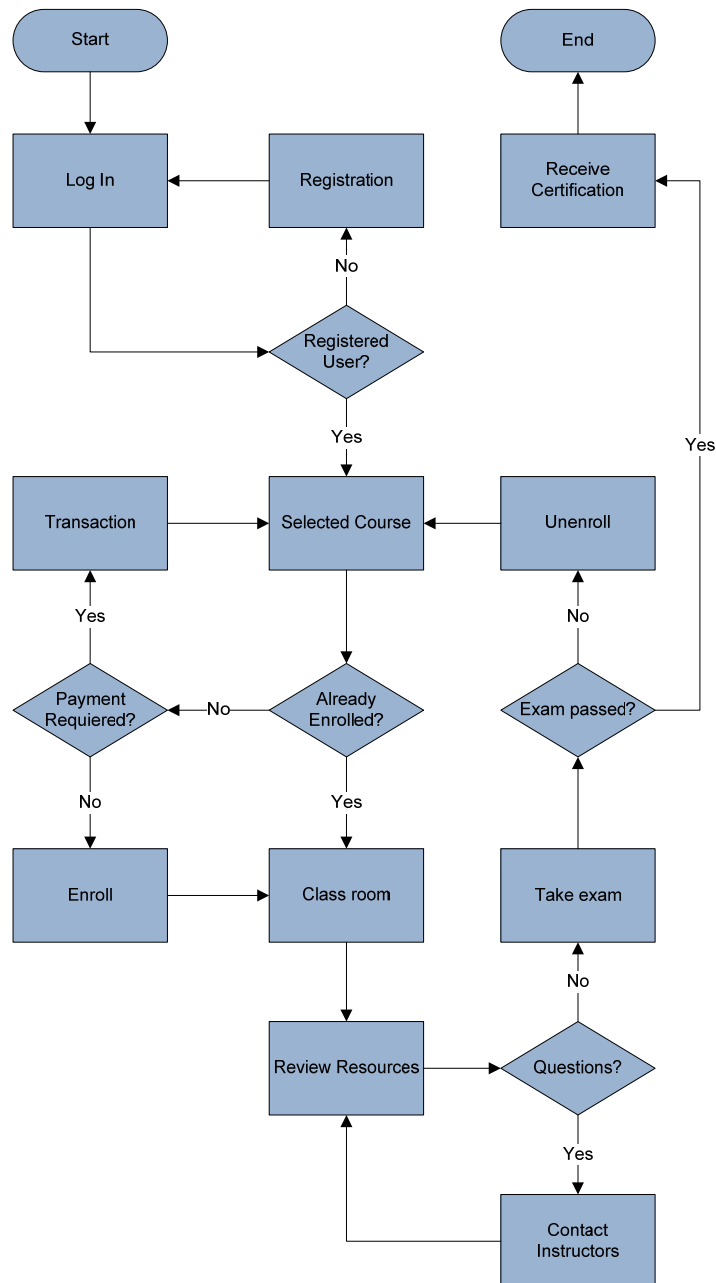
4.1.1 Trainee

Diagram 4.1: Trainee cycle flowchart

Figure 4.1 illustrates how a typical trainee cycle should proceed. It starts with the trainee accessing the front page. There he can login or create an account if he isn't registered yet. In the registration the trainee needs to complete a form with all his personal data.

Once logged in, the trainee can choose in what course he wants to participate in. If the student is already enrolled in that particular course he is then redirected to the classroom. To enroll, the system first checks the course configuration. If the course is free, the trainee is automatically redirected to the classroom, otherwise the he/she would be taken to the transaction module where he/she selects their preferred method of payment to register for the course. After a successful transaction he or she would also be redirected to the classroom.

In the classroom, the student can review all the resources available to him (e.g. text form, videos, wiki, short quizzes). If the student has at any point a question about the content he can contact an instructor. Once the student finished with the content and has no further questions, when can now take the final exam (or student evaluation).

If the student passes the exam, a certification is generated and sent to him or her via mail using the personal information that he or she provided when registering the system. If the trainee fails the exam, he is automatically un-enrolled. He has to then go through the enrollment process if he decides to take the course again.

At the end of the course of each course, the student is asked to a course evaluation. Here the student gives his/her input on different aspects of the course.

4.1.2   Instructor

The instructor basically has two responsibilities: create and update content and support the trainees trough out the learning experience.

In order to create content, the system needs to make available to the instructor powerful tools. These not only have to perform well, but also be intuitive and easy to use. A in An instructor should be able to create entire courses with ought resorting coding. For example if an instructor requires a diagram or video integrated with the course, he/she can link the resource and place it in the correct location in the course. Since the content and federal regulations are constantly evolving, there should be an easy way to edit content that is already available to the students. The information provided by the students via

the course evaluation should be reviewed on a regular basis, constancy improving the student experience.

The system needs to have different alternatives in place, so that a trainee can contact an instructor in case of an inquiry regarding a particular course. By providing different communication alternatives, this helps the trainee use tool that better fits his type of inquiry. These alternatives range from forum posting to an internal mailing system.

4.2 Technical Requirements

Security: Since the system will handle personal and confidential information, security is one of the most relevant aspects of the system. These range from encrypting the information set to the server via form to securing content from unauthorized usages.

Browser compatibility: The LMS needs to run stable and smoothly with al major browser, such as MS Internet Explorer, Mozilla Firefox and Opera.

Payment: Some source of payment module should be in place to process money transactions. It should connect to a popular vendor such as Paypal or CheckFree.

Language support: The system should have multi language support, in order to have a wider market availability.

Stability and expansion: The system should run with a verity of different operating systems and configurations.

5. Solution Alternatives

Now with the requirements clear, the process of selecting the systems and technologies can proceed. As with all software projects, the first question that needs to be answered is: *Developing a system vs. customize*, which one is better suited to cover requirements?

Developing a system from scratch can have substantial benefits. By doing so, the software will meet the business requirements exactly, since it's tailor made. The clear disadvantage is that it is very resource intensive and time consuming. There are a wide range of LMS alternatives in the market that can be customized to the level that is required by the customer. Taking into consideration the time constraint and resources available, the decision was quickly made to *customize an existing application* instead of developing a solution from scratch.

By analyzing the LMS market, a trend quickly became apparent. Two variations are available: there is the *Open Source* and *Proprietary Software*. This is the second question that needs to be cleared: *What is better, open source or proprietary software?*

Proprietary software involves the acquisition of a license to be able to use the software. It has the advantage that it all developed by one team, a "selected group of developers with a much more narrow range of expertise"[16] that all follow a predetermined goals. This impacts the software by being well implemented and all different modules are consistent and cohesive with each other. Support, hosting and other services are also made available by the company, making it work seamless with the software. The drawback of this alternative is the substantial cost of the license fee.

Open source software can be downloaded for no charge through the using GLP (General Public License). Since the code is made available to everyone, this kind of software encourages people to modify and redistribute it. The clear advantage is that there is no license fee. Additionally "open source software's transparency makes it more secure than proprietary software because so-called 'back doors' used by hackers can be exposed early and programmers can root out bugs from the code."[17] The disadvantages are that since it's developed by many people, it has the potential of not being structured and cohesive. Additionally, since there is no official product support, when a problem is encountered, the software user has to rely on the community for help. Since costs are an important factor to this project, the open source variation was selected. There are a wide range of open source LMS systems available. So the next

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[16] Barr, M.; Open source versus proprietary software: a discussion
[17] BT Group; Open source discussion

logical step was to narrow down the field. After extensive research, reviews and closely analysis of each of the product features, two contenders emerged: *Ilias* and *Moodle*.

CUE Corporate University did an independent assessment of the many different open source LMS systems for implementation on there own campus. Both Ilias and Moodle where present in there potential candidates . Their final recommendation was awarded to Moodle, closely followed by Ilias.[18]

 The Austrian learning portal BM:BWK was tasked by education ministry to perform a comprehensive review of Open Sours LMSs. Ilias was one of the two recommended systems.[19]

Catalyst IT Limited made an evaluation of LMS for New Zealand Open source virtual Learning Environment project, where both Ilias and Moodle where highly recommended.[20]

5.1 Moodle

Developer: Moodle Org (Australia)	URL: www.moodle.org
Version: 1.8.1	Release Date: 2007-06-11

5.1.2   General information

The Moodle project was created by Martin Dougaimas, a former WebCT administrator at Curtin University in Australia. Frustrated by all the restrictions that WebCT provided, he started to write his own LMS from the ground up. He also saw a need to create a easy to use platform, so that people who want to make better use of the internet but don't know where to start in, could come in and take advantage of the project. This is how the Moodle project was born. Moodle is actually an acronym. It stands for 'Modular Object-Oriented Dynamic Learning Environment "It's also a verb that describes the process of lazily meandering through something, doing things as it occurs to you to do them, an enjoyable tinkering that often leads to insight and creativity."[21] A number of early prototypes where produced but never tested in a real environment. On the August the 20th 2002, version 1.0 was made available to the world. This first version was design toward smaller, more intimate classes at a university level and it also was used to as a research base to closely analyze the nature of collaboration between students. Over time Moodle has grown in popularity, the platform has also continually evolved, widening it's original scope to fit different teaching situations. For example, Moodle is now used not

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[18] Learning Management Systems for the Rest of Us; CUE
[19] Evaluation von Learning Management System; BMBW
[20] Technical Evaluation of selected Learning Management Systems; CATALYST IT limited
[21] Moodle Group; Background

only in universities, but in high schools, primary schools, non-profit organizations, private companies, by independent teachers and even homeschooling parents. Moodle is now one of the most implemented LMS in the world. Having 30 000 registered sites, 12.4 million users and 1.6 million Teachers.[22]

Because of the large community that employs Moodle, there is a large pool of different third party plug-ins that are available on the official site. This makes LMS far more versatile and cover more different teaching scenarios than many other alternatives.

5.1.3 Key features

- *Learning-by-doing* is the key philosophy behind Moodle.
- Modules and plug-ins are the backbone.
- Promotes a social constructionist pedagogy (collaboration, activities, critical reflection, etc).
- Suitable for 100% online classes as well as supplementing face-to-face learning.
- Simple, lightweight, efficient, compatible, low-tech browser interface.
- Easy to install on almost any platform that supports PHP. Requires only one database (and can share it).
- Full database abstraction supports all major brands of database (except for initial table definition) .
- Course listing shows descriptions for every course on the server, including accessibility to guests.
- Courses can be categorized and searched - one Moodle site can support thousands of courses.
- Emphasis on strong security throughout. Forms are all checked, data validated, cookies encrypted etc.
- Most text entry areas (resources, forum postings etc) can be edited using an embedded WYSIWYG (*What you see is what you get*) HTML editor. [23]

5.1.4 Trainees' viewpoint

The Moodle GUI is based on blocks. These blocks are distributed on the left and right parts of the screen. They exist individually and can be expanded or closed independently by each user. They can held different kinds of information, for example: displaying who is currently online, site's navigation and calendar. In the center, and the largest part of the screen, is the actual content. On the homepage it lists

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[22] Moodle Group; Moodle Statistics
[23] Moodle Group; Moodle Features

the courses that are available to the student. Clicking on a course, displays a brief summery of what the course is about, and how is teaching it.

Figure 5.1: Moodle Demo course

Once in the course, the different recourses that the trainer has made available are placed inside blocks. This recourses can be for example: static objects (text, pictures, link to a website) or activities (wikis, forum, chat). Moodle also can be set be set to a weekly format . Each week, the new recourses are made available to the students in the order predetermined by the teacher.

Below the title of the company's name, a menu bar informs the student where he is currently located. This helps have the site a better overview.

What a student can see, while inside a course, is a simply-structured but very well designed, immediate understandable and efficient user interface. Usually the student would work through the agenda and use the resources and tools provided to him. Through some of the block the student can get reminders for dates, recent news, search trough the forums. Beside having course specific resources, there are resource such as the glossary that are available globally, thought the site. These objects appears always at the bottom of the site.

"Even though all these functions are rather complex: Moodle ensures clear structures. In contrary to other LMS Moodle shows it's mightiness little by little and guides the student through the various

screens and options. Even common internet tools like chats, forums or wikis, which are probably well known by most users, can be used at once and without any period of vocational adjustment."[24]

5.1.5   Instructor's viewpoint

On first impression, there is no large difference for a teacher compared to the student. On the left side of the screen there is an extra administrative box. Depending how the role set up, a teacher can simply administrate the grates or he can create and modify the content on the screen. On the top right side of the screen, there is an edit-mode button. Clicking on the button, additional icons appear on screen next to the resources. Using a combination of dropdown boxes (these are used to add new resources such as wikis, text documents and chats) and the icons (used to edit, past, delete, move a resource), a teacher can make a course look exactly how he/she wants it to look. For example by clicking on the right arrow next to a label, this item is tabulate to the right. There is a draw back: Each time something is changed, the entire screen is reloaded. It can also be somewhat irritating that each item has a long list of icons next to it. But in all, functions are easily understandable and easy to use, so a teacher doesn't have to read though a long set of instructions to understand how everything works. Every function has a help button in the form of a question mark. If a teacher is not sure how this particular function works, he can click on there and Moodle gives him/her a brief description. This is very useful and reinforces Moodle's philosophy of *learning-by-doing*.

Next to the already mentioned edit-mode function, Moodle offers many other options regarding course administration. It is possible to chose the name, course description, language, format (for example the weekly or theme-based format) or the assigned course-format. There is also possible to configure special cases: it is possible to offer paid classes using the pay-module, or students can enroll using a key previously provided to them by the teacher. The teacher can decide if he wants guest students allowed or if groups are mandatory. He can also set up how many messages he can receive. Moodle also provides help with the student administration. Next to the standard user list, is a list of achieved grades in the form of the grade module. The system is very versatile, for example the grades of the students can be exported to Excel spreadsheet. Moodle also offers an extensive report and evaluation possibilities for each course. Although everything is recorded, the amount of data can be staggering and the lack of structure can be overwhelming and not very useful as an end result.

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[24] LMS News; Moodle Review

Using the WYSIWYG HTML editor, the trainer can easily create a course that looks exactly how he wants. Options range from font, text color, size and alignment. Pictures and other recourses can be easily inserted within the text. The WYSIWYG editor resembles a simple word processor application, easy to understand and simple to use.

The system has two main alternatives so that the students can interact directly with the teacher. One option is the internal mailing system. A student can simply click on the portrait of a teacher and send them a short message. Next time the instructor logs in, the message is displayed on an extra window. If the instructor doesn't login within a few hours of the message being sent, Moodle automatically forwards the message via e-mail to the instructor's registered address.

With administration rights the design of Moodle can be customized extensively, using what Moodle refers as 'themes'. Changes can be done using a substantial number of forms. These range from setting of language (Moodle offers translations in 60 language till this day) to saving files in ZIP-format to indexing the courses in Google. The system also has a very in-depth backup system that lets the administrator save each course and download it to a local machine for safekeeping. Courses and also be restored on the fly.

5.1.6 Review

The system gives the didactic structure totally in the teacher's hand. Even though courses can be created fast , easily and intuitively in Moodle, the system still demands a didactic concept regarding structure, work-flow and administration from the tutor. Moodle does not specialize on 'the one' concept, a lot of graphics or a lot of collaborative learning – in these respect it does not even have an opinion.

Moodle can be seen a tool or online platform, to make content available online. This is perfectly suitable for teachers that already have a concept of what can be achieved trough e-learning, and are only looking for a stable and powerful system to solidify their ideas. This also makes Moodle very flexible in for what kind of learning environment it can be used, this is proven by sheer number of registered installations. The many options available ensures that the software limitations can't be reached easily, further expanded by sheer number of third party plug-ins also available.

The missing options for administration are Moodle's biggest handicap. The system can't cope with more complex types of courses, typical for universities for example. Where there are many different courses, with different rules and orders.

5.2 Ilias

Developer: University of Cologne (Germany)   **URL: www.ilias.de**

Version: 3.7.8   **Release Date: 2007-05-22**

5.2.1 General information:

ILIAS is a German acronym for Integrated Learning-, Information- and Cooperations-System. It is also the German translation of Homer's *Iliad*. It was started by the Cologne University as part of its VIRTUS project. This project was stared in 1997, spawning four years, its goal was the "*adaptation of new media on campus*"[25] Both economic and social faculties contributed to the project, witch became the fist and largest implementation of this kind of technology in Germany. Organizational and productions models where developed, that could be used on real environments that could facilitate the flow of information using the new information and communications.

What later would be known as Ilias was firstly used as a simple online learning platform to aid students with their classes. Seeing greater potential in the software, the technology faculty decided to fund the cooperation network *Ilias*, where many collages and universities would participate, and began the process of further developing a full version LMS. In 2002 the fist official version of the software was made available to the public for no charge by using the GPL license agreement. Since then, Ilias has gone through many iterations and has grown in polarity thought out Europe, with a widening cooperation network. It's now mostly use in the academic sector. "Besides the many universities where it is used already, ILIAS is used at the software-development company Novell, the training-portal of MarZ Consulting Inc., Saxony's TV-station for Economics or the Healthevidence corporation in Bern, to name only a few."[26] QUIALITUS corporation Ilias was specially founded to provides pay support ranging from setup to full implementation.

In 2006 as many as *1800* referenced installations where registered.

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[25] VIRTUS Projektziel
[26] LMS News; Ilias Review

5.2.2 Key Features

- ILIAS allows efficient creation of courses and course materials. It offers standardized tools and templates for the learning and working process including integrated navigation and administration.

- Every user in ILIAS has their own Personal Desktop. In ILIAS, the assignment of roles determines user access to different tools, features and materials.

- The integrated authoring environment allows easy content creation of learning and working materials.

- All kinds of formats, useable on the Internet, can be also adopted by ILIAS.

- A high-capacity test & assessment supports the monitoring of learning progress and offers the possibility for online-tests.

- Full SCROM support (Sharable Content Object Reference Model) [27]

5.2.3 Trainee's viewpoint

 After logging in, Ilias takes the student to his *personal desktop*. The *personal desktop* is the backbone of this system. Here hyperlinks with their corresponding icons are displayed to the all important function within the e-learning environment, for example current classes, favorites, help guides, notes and special modules. A calendar with important dates is also availed here. A good feature Ilias provides, let's the students *continue* with the course where they left off.

The first impression of the system, it is immediately apparent how slick the user interface is. From the color pallet, to the icons gives it a cohesive look, keeping up with the *Web 2.0* look and feel. Everything is arraigned in a logical order and immediately understandable.

Ilias can be navigated though a tab-system, always located at the top of the window. This method of navigation is kept consistent though out the system, which makes it very easy to use. On top of that there are always tree links that are always available: the personal desktop, mail (internal mail system) and repository. The last one is where all the different courses available are listed with their corresponding resources. Below the tab bar, there is an other menu bar that displays where the user currently is located, the same way as with Moodle. This feature is very useful to make the system easier to navigate.

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[27] Ilias LM; Features

The user interface in Ilias is very clean. The layout is intuitive and easy to understand. The student actually just has to navigate between his personal desktop and the repository.
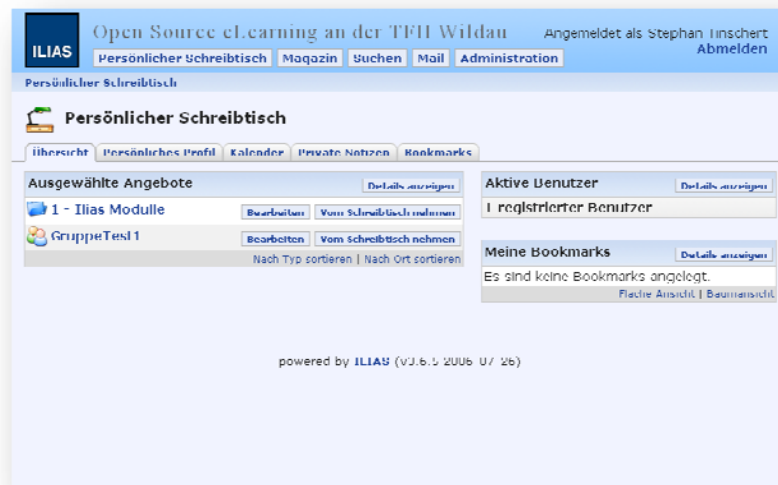
Figure 5.2: Ilias Personal Desktop

The courses are set like traditional books, in which the content (e.g. text, photos and videos) is displayed in pages. At the top and bottom of the page arrow are displayed that when clicked turns in to the next page, or goes back to the last page. Because the content is divided into chunks, this helps the student doesn't fell overwhelmed. With a mouse click the view can be changed from a flat point of view to a tree-structure. This is achieved through a frame that is displayed on the left of the screen (sometimes there are issues how the frame is generated). This is very useful especially for complex courses, where the path might take the students trough different levels.

The repositories as was previously explained is where the different courses are listed. Upon clicking on one such course a small description is given to student with general information. Then clicking on 'content' displays all the unlocked resources available specifically for that course are displayed. These can be for example learning materialing, tests, forums and groups. Next to all the recourse there are at least two buttons: an '*info*' button that gives general information about that particular resource and a '*add to desktop*' button that lets the student add the recourse to his personal desktop. "Regarding the

single modules like forums, chats or the glossary, ILIAS sticks to the basics and keeps it consistent and simple."[28] Making these resource not very powerful, but work as required.

Ilias testing module is very robust. The test can be implemented in many different ways. They can be set as small quizzes after each chapter to help the student see if he comprehended the material. They can go tough the quiz several times and see what mistakes they are doing. Test can also be set as examinations, where the student can only go though the test once and be accomplished in a fixed time frame. Usually the learner goes through a set of multiple-choice, gap-filling, matching-questions, 'set-in-the-correct-order' type questions, and so forth. At the end of the examination the student get's his grade generated automatically, if so configured by the administration.

One critic of Ilias is that there is no help documentation available for the student (only for teachers is available).

5.2.4 Instructor's viewpoint

As with the other Moodle, the teacher or instructor point of view is very similar to the student's. Menus and tabs remain the same, only additional functions that are available to teachers and administrators. For example in a course teacher get a drop-down-box in one corner of the screen, that allows them to inset new resources. Next to each resource there is an additional button labeled '*delete'*, that removes the selected resource. Most other functions are intuitive, and not require very much explanation. If the teacher has a question about a particular element, he can referred to the help documentation where he will find detail information about his inquiry (although the documentation is still being developed, and in some cases the teacher might encounter a 'under construction' page).

One big advantage of this system, is that it has full SCORM support. SCORM is "a collection of standards and specifications for web-based training."[29] This makes courses work more dynamically with animations and videos, but also take far longer to develop.

Apart from the common resources, such as forms and wikis (no chat support in this version, but in the newer versions this feature is already available) Ilias offers a special tool called Pools. Here videos and photos can be added and made available to all courses to use them. Even questioners can be added to. This is very helpful when having courses that utilizes the same materials. This saves the teachers time, and system memory.

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[28] LMS News; Ilias Review
[29] Dodds, F.; SCROM Primer

As mentioned before, the Ilias courses are set up like traditional books. To add and edit information, Ilias as well as Moodle use the same kind of WYSIWYG-HTML-editor. There are some limitations, but this tool helps the course creator/developer make the page look how he what's it to been seen.

Tests are very easy to create with this LMS. From a dropdown box the teacher can specify what kind of question he wants to create. The usual types of questions are available, such as multiple choice, fill-in-the-blanks, matching, set in the right order, and short text. Then he can assign a score to that particular question. The system provides in deep look on how the points are rewarded.

On the administrative side, Ilias also offers extensive options to customize the experience. The courses can be set up to be displayed in full screen or with the tree structure. Examples of other options would be: if unregistered user are able to view certain content. Certain courses can only be viewed if the student has previously passed the test. All this can be set in the administrative Tab, which is robust and easy to use.

5.2.5   Review

As with the other LMS reviewed, Ilias is but a tool or a platform where online courses can be distributed. How simple and straight forward it is to create a full course, and the many ways to customize the experience are proof of this.

The book structure is one of the strong advantages of Ilias. It divides the course in reasonable segments, allowing for a more focused and structural environment. This also helps the student not feel to overwhelmed by all the information. The testing module is very robust and easy to use. Additionally, the user interface is very stylish, easy and practical to use.

The biggest handicap this system has is the limited enrollment options. There is no e-mail authentication available or password recovery. This adds additional strain to the administrators, since a user that forgets his password now needs to directly contact the site's support. Additionally there is no payment support in the course enrollment module and limited documentation.

The online community is not as large as Moodle's . Support takes a hit because of this, since open source software relies on the community for help. Ilias is considered a closed package, no pool of third party plug-ins are available. This can also be seen as an advantage: since it's developed centrally, the design is kept consistent and coherent throughout the system. The setting options are numerous, sometimes a little too numerous.

5.3 Feature comparison

Taking into consideration the business background, the functional and technical requirements a *feature comparison* was developed to do a head to head comparison of both LMS contenders. Also taking into consideration the strengths and weaknesses of each system just previously discussed. The goal of this list is to *objectively* determine which LMS is better suited to cover the business needs.

The feature comparison is structured as follows:

All requirements were separated into *eight* different categories. Each categories is composed of more detailed subcategories . These where assigned a *total score* between 0 and 30 (zero being irrelevant for the project and thirty being very relevant). The score for each particular subcategories was determined by close collaboration with the EHU personnel. Once these values where in place, the LMS comparison proceeded. Both systems where reviewed on each of the specifications, awarding them full point if they fully met the specifications and zero point in not such feature wasn't present. At the end of the review, all points are then summed and the winner can be determined. Table 5.1 shows the summary of the feature comparison, showing only the main categories. For the complete please consult the appendix.

Category	Max Pts.	Moodle Pts.	Ilias Pts.
Company	70	70	48
Communication Tools	100	83	60
Productivity tools	65	38	44
Student involvement tool	30	21	30
Administration tools	95	95	72
Course delivery tools	140	125	125
Content delivery tool	150	132	140
Hardware / Software	50	50	45
Sum	**700**	**614**	**564**

Table 5.1: Summarized LMS feature comparison

As a result of the comparison, *Moodle* was chosen over Ilias as the LMS that is better suited to meet both functional and technical requirements for EHU.

6   Development

6.1   Server Setup

EHU acquired a sever especial for this project. The server needed to be properly set up before the Moodle server could be installed. After some research, Godaddy.com was chosen to host the service, because it met all the requirements and has a good track record. Godaddy.com provides a proprietary

Figure 6.1: Goddady's Simple Control Panel

tool called *Simple Control Panel* in order to interact with the server. This tool provides a graphical user interface where all basic functions that are required to run the server are available, as figure 6.1 shows.

After the server has been activated, the fist step in the configuration was to assign the server the domain name. "A domain name works a lot like an address forwarding service. All of your Web site content sits on a computer with a unique address, the IP address" [30]. This is done by adding the acquired

domain name in the System Configuration. By adding the domain name, the server automatically creates a new user on the server. With this user, an html-public folder is also created, where the all the websites can be placed and then viewed from the outside. Other components are also automatically created, such as a database system and PHP service. These are created for each user separately so that domain is fully independent of other domains that might be hosted on the same sever.

Once this step is done, the DNS for the domain needs to be set up. DNS stands for *Domain Name System*, this severs as the phone book of the internet. It links the human readable domain name (in this case *www.e-hazwoperuniversity.com*) to the IP address of the server. To do this, zone files need to be created on the server. A zone file is the file that maps the IP address to the domain name. This is created

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[30] Godaddy; Getting Started with Your Dedicated Server

automatically by the Simple Control Panel. To register a domain host, the server information (such as IP address and host name) need to be provided to the hosting company where the domain was acquired.

"After the DNS configuration, it can take up to 48 hours before your domain resolves to your IP address. This period is referred to as the 'propagation period'."[31]

Once the domain resolves, the sever is prepared for the application installation.

6.2   General Moodle installation

It is important to note that Moodle requires *Apache*, *PHP* and a database (MySQL or PostgreSQL) to run. This software was preinstalled and preconfigured on the dedicated server. A number of tests where run before the acquisition to test if all the components where compatible with the Moodle LMS.

The firs step in the installation is to download the latest stable version of the Moodle software in a packed file to a local computer. The packed file then needs to be uploaded to the dedicated server and placed in the '*public_html/*' of the user that was created in the setup. The packed file then needs to be unpacked. Now the Moodle can be accessed from the outside by going to the following address: 'http://e-hazwoperuniversity.com/moodle'.

Moodle structured with these key files:

config.php	contains basic settings.
install.php	the script you will run to create config.php
version.php	defines the current version of Moodle code
index.php	the front page of the site
admin/	code to administrate the entire server
auth/	plug-in modules to authenticate users
blocks/	plug-in modules for the little side blocks on many pages
calendar/	all the code for managing and displaying calendars
course/	code to display and manage courses
doc/	help documentation for Moodle
files/	code to display and manage uploaded files
lang/	texts in different languages, one directory per language

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[31] Godaddy; Getting Started with Your Dedicated Server

lib/	libraries of core Moodle code
login/	code to handle login and account creation
mod/	all the main Moodle course modules are in here
pix/	generic site graphics
theme/	theme packs/skins to change the look of the site.
user/	code to display and manage users

Table 6.1: Structure of the Moodle directory[32]

Now an empty database (e.g. moodle) needs to be created in the database system along with a special user that accesses (e.g. moodleuser) the database . It's important that only this specific user has access to this database, for security reasons. An other critical configuration is to set the character set to '*utf8*' so that Moodle can run properly.

An additional folder needs to be created on the server server's hard disk to store uploaded files, such as course documents and user pictures. This folder is not located in the '/public_html' subfolder to prevent direct access from the web. This folder is at the same level in the hierarchy as the 'public_html'. Permeations need to be added to this folder so that Moodle. 777 permission is required, which in Linux is associated with full access.

 Now it the installation script 'config.php' needs to be run. This is achieved by accessing '/moodle/config.php' URL. This process is completely automated. Moodle installs all required components and it also checks the existing software on the server to see if they are compatible. At the end of the installation a confirmation appears if all the components where correctly installed and configured.

To continue with the installation, the 'admin' site needs to be lunched. This is done by accessing the site's homepage. After reading and accepting GPL (General Public License), Moodle then will automatically start creating tables and populating them with data. A number of SQL statements followed by the status message are displayed. At the end of the process a short summery is shown. The next page is a form where you can define parameters for your Moodle site and the front page, such as the name, format, description and so on. The last step of the installation is creating the top-level administrator that will be used to further access on the site.

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[32] Moodle Installation, Moodle Group

After this step is done, the Moodle site is technically up and running. Some configurations need to be set, so that the service is running as it's required, and running safely.

6.3   Cron setup

In the Unix environment, a *'cron'* is time-based scheduling service for operations to be run on certain recurring intervals. Moodle uses the same concept in its system. Some of the modules require periodicl checks to perform certain operations. For example, Moodle needs to check the forums and mail out copies to people that have subscribed to them. There is a script located in the admin folder, named cron.php, that takes care of all these functions. However, it cannot run by its self.   A mechanism needs to be set in place that runs the script at regular intervals.

Figure 6.2: Cron Job page

"The cron.php script looks through all the module directories for function module-name_cron in lib.php files and runs them."[33] These files can contain a number of operations, such as: email functions, clean up functions or anything that needs to be done on a regular basis. As an other example of a sequence specified in the cron files, is the course back up. It is also important to know, that not all functions are triggered at the same time. Deleting old backups or un-enrolling students that haven't logged in a while, only occurs occasionally. The script isn't very processor intensive, so it is recommended that it runs on five minute intervals. If performance is an issue, the interval can be expanded. But this generates another set of problems. For example if the period is too long, as delaying mail-outs can slow down activity within the course. It is important to note that mail-outs also wait for the editing time to expire before being queued for sending.
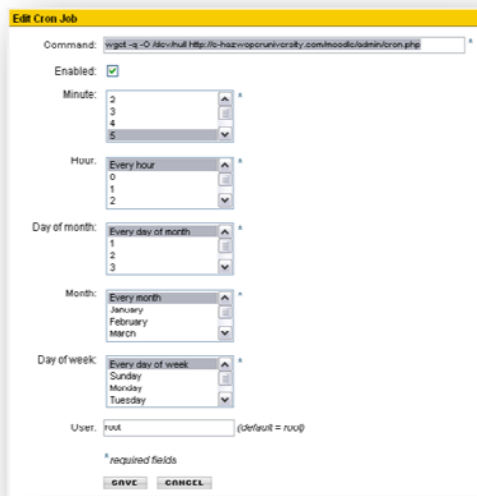
The CronTab- Manager is a tool is available on the *Simple Control Panel* and it used set up this mechanism. Here the command line can be written, and then specified how often it needs to be executed.   The   command   that   needs   to   be   run   is: *wget -q -O /dev/null http://e-hazwoperuniversity.com/moodle/admin/cron.php*

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[33] Moodle Group; CRON

6.4   Set up backups

There are two different methods to safely backup the data created by Moodle, there is one on server side and one using the backup feature in Moodle:

6.4.1   Server side

There is a Backup Manager included in the server control panel. Here it can be specified exactly what folders should be included in the compressed .tar.gz backup file and what folders can be excluded. Here, it can also be specified in the backups and should be triggered manually or on regular basis. The files can be stored in alternating locations, to better the chances of not loosing all data incase one of the backup disks fail. There is also feature to enable FTP service. This way the back up files can be accessed remotely and stored on a local hard drive for safe keeping.

There is a drawback from doing this kind of backups. The backups are more expensive, in terms of CPU usage. This means the site will be temporally unable. This is why it is recommended that this kind of backups are done only periodically and when user traffic is at a minimum.

6.4.2   Moodle's backup feature

The backup configuration page in Moodle, allows administrators to configure automated course backups and schedule them to be run on a regular basis. Here, it can be specified exactly what data should be backed into the compressed folder. For example the whole site can be backed up or just assignments, chat conversations, exercise and forums can be selected individually. After selecting what the data, the site will bring you to a synopsis of all the information that will be stored. The backup file is then generated, assigned a record file and stored at the previously specified location. This can be on an other server or locally.

This backup method is not as processor intensive as the server side backup. It is recommended that the backups be scheduled for maximum of once a week. It also should be run when not many users are accessing the site. The site doesn't go offline, but there is a decrease of performance while doing the backups are being generated. There is a drawback from using this alternative: not all data is backed up. Some user and site configuration, such as plug-ins and code modifications are not backed up, and might get lost if server is down.

6.5   Enrollment Setup

6.5.1   Paypal

Paypal is an e-commerce service that allows people and business to easily make payments and money transactions through the web. It serves as the electronic alternative to the more traditional paper methods such as money orders or checks. "PayPal's service builds on the existing financial infrastructure of bank accounts and credit cards and utilizes the world's most advanced proprietary fraud prevention systems to create a safe, global, real-time payment solution."[34] It's considered to be the world leader in online payment solutions with its 100 million accounts active accounts spreading trough 190 countries around the world. Paypal is an account-based system with two different types:

Personal accounts are intended for personal use only, possessing just core features. Personal accounts have a set number of transactions that can be made with a credit/debit card each year.

Premier or business accounts are charged a fee to receive payments. These accounts have no limit on the number of credit/debit card transactions that can be accepted.

Several different alternatives are provided so that websites can interact with the Paypal service. These alternatives range from a HTML form button that links direct to the Paypal website or a more complex fully integrating the payment process in the website.

6.5.2   Implementation

Since Moodle 1.4, an Paypal enrollment module has been integrated to the default system. A business account needs to be registered in order for the plug in to work. Paypal can be set as the default method of enrollment in the *Course Administration* page. Other data also needs to be provided so that the module is able to interact with the Paypal servers. Additionally, the e-mail of the Paypal business account and automatic mailing (for example the class instructor receives an e-mail when a student is enrolled) need to be set. The set the amount a course costs, there is a 'Cost' field in the 'Availability' segment when editing a course. If the 'Cost' is left emty or '0', this makes that particular course free of charge, and the students are automatically redirected to the classroom instead of going through the payment process. Here it can be set, how much the course will cost. If the entry field is left at zero, this means that there is no cost involved with this specific course.

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[34] PayPal Co. Inc; About PayPal,

The enrollment module utilizes the most simple way of interaction with the Paypal service. It uses the *Website Payment Standard* method that consists of a button using H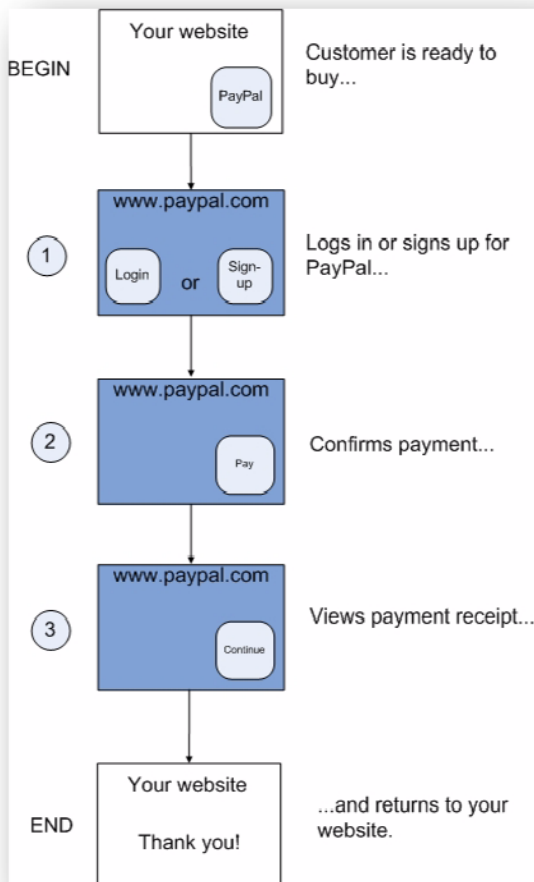TML forms for the transaction to take place. All needed information required for the transaction (e.g. business account, course charging amount) is sent to Paypal via the *hidden FORM* tags. This process is fully automatic, and does not require any interaction from the administration or instructors.

Figure 6.3[35] explains the process a trainee would be required to fulfill in order to successfully enroll in the desired course. After selecting the course, the trainee would be taken to the enroll screen, where a PayPal button appears (*BEGIN* in the diagram). By clicking on the button, he/she is taken directly to the PayPal (*step 1*). The e-hazwoperuniversity logo can be seen at top of the site. Here they have the option to login if they already have an account or sign up to create an account. Then a short description and amount of the course would appear (*step 2*). The trainee then has to

Figure 6.3: PayPal's payment process

click on the Pay button at the bottom of the page. Now they can select the method of payment. Many different alternatives can be selected, for example credit card or a bank transfer. Once selected they can review their payment (*step 3*). By clicking on 'continue' they accept the transaction. This takes them back to the e-hazwoperuniversity.com and a message is displayed that they successfully enrolled in the course and can now enter the course. Next time they log-in to the site, they are taken directly to the course.

The administrator can login to its Paypal business account and follow up on all transactions. He/she can anytime transfer the funds in his account to the company's bank account.

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[35] PayPal Co. Inc; Website Payment Standard Integration Guide

7 Rollout

7.1   Roles assignments

According to the Moodle documentation a Role is "an identifier of the user's status in some context, for example Teacher, Student and Forum moderator"[36] . Moodle now uses a set of roles throughout its system. Roles are mostly managed and maintained by the system administrator, but teachers have also the possibility to assign certain roles. A role is basically a collection of permissions defined for the entire site that can assign to specific users in specific contexts, but there are also global roles that are applied thought the site. For example, a user assigned the global role of Teacher will have this role in every course on the site.

For example, there is a Role called 'Teacher' that is set up to allow teachers to do certain things (and not others). Once this role exists, it can assign it to someone in a course to make them a 'Teacher' for that course. A role can be assign to a user in the course category to make them a 'Teacher' for all the courses under that category, or assign the role to a user just in a single forum, giving that user those capabilities just in that forum.

To better understand this aspect, '*contexts*' need to be clarified. Contexts are the 'areas' in Moodle where roles can be assigned to people. They are arranged in a hierarchical fashion, with permissions inherited from 'higher' to 'lower' contexts.

- Site (System)
- Course Categories
- Course Sub-categories
- Courses
- Blocks and Activities

If a user was defined as a 'Teacher' role for a Course Category, they would be a teacher in all of the course sub-categories, courses and blocks and activities that resided beneath that particular Course Category.

By default, when a course is created, the system administrator needs to assign someone as a teacher. They will then have all the options and capabilities that the role allows them to have. When students

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[36] Moodle Group; Roles FAQs

enroll in the course, they will have the role of 'student' assigned to them automatically. Other standard roles that exist include a 'non-editing teacher' and a 'guest'. The administrator can also create any additional non-conventional roles as necessary.
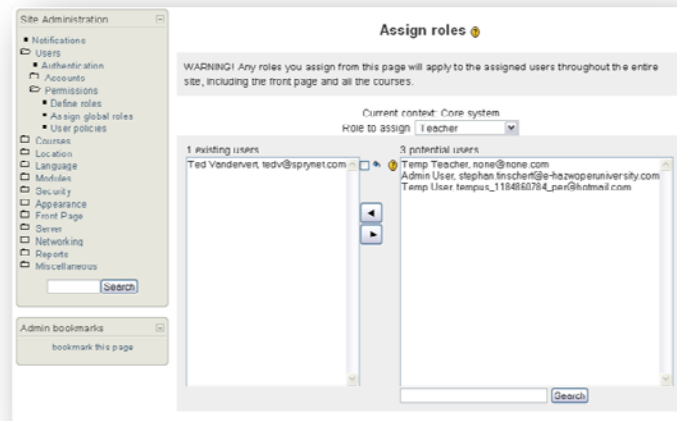
Figure 7.1: Role assignment page

Figure 7.1 shows how the role assignment is done within Moodle. At the top of the form there's a dropdown box where the users for a particular role can be displayed. Below that there are two lists are displayed with the potential users and the existing users. A user can be moved between lists simply by clicking on the arrows.

EHU uses the four standard roles that are automatically assigned as default by Moodle, yet the teacher or instructor role has been modified to have more permissions. These are:

- Admin – Used for all administrative purposes. Has all the rights and permissions.
- Instructor – This role is designed to be the course procreators and administrators. They have permission to modify the course content, add and delete resources and manage the forums.
- Student/Trainee – A registered user is upgraded to the student status only after successfully enrolled in a course. He/she has access to all the resources and content, can post in the forums and chat directly with the instructor.
- Un-enrolled students – They have limited access to the content, the paid courses are unavailable to them. They can access the demo course and see FAQs. They can only post in the general discussion area.

- Guest – Is designed to show potential customers how the site works. It has access to a demo course, FAQ same as the un-enrolled students, but they can't post on the forums or interact directly with the instructor.

7.2   Course creation

Entire courses can be created with a few mouse clicks using Moodle. A form with all the entry fields to create a course is located in the administration tab. The first required field is *Category*. This choice will affect where the course is displayed on the course listing and may make it easier for students to find this particular course. The second required field is *Course Full Name*, this is displayed at the top of the screen and in the course listings. Next is the Course Short Name, which is used in several places where the full name would be to long (for example in the navigation bar). Summary is the last required field, and here a short description of the course should be written. This will later be accessible to the students when selecting a course. Although this covers the minimal import required to create a course, there are extensive options to fully customize the experience. Among these there the most important are: Format (weekly, or topical); Enrollment plug-in (Paypal or internal enrollment); Enrollment duration (how long since enrollment can a learner access the content); Cost (how much the course enrollment cost);
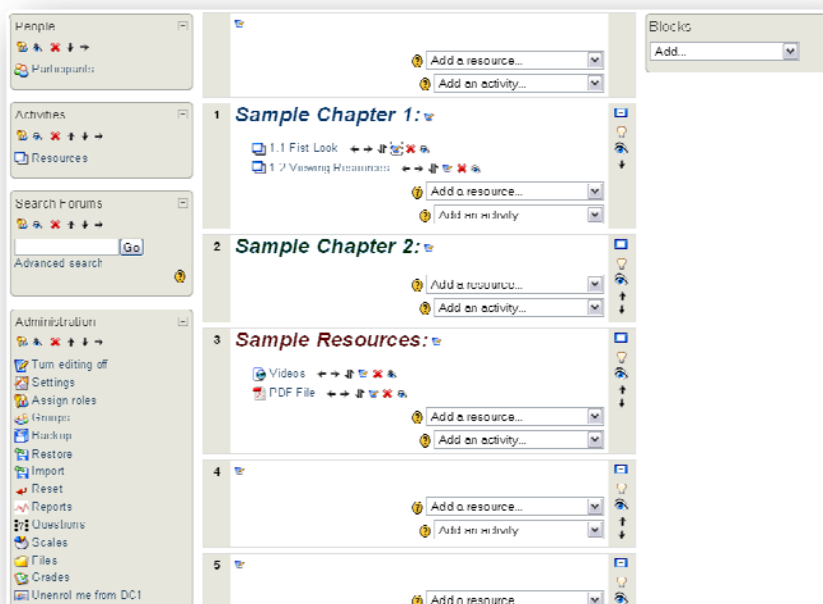

Figure 7.2 Course creation page

After saving the information, Moodle automatically displays the newly created course. This page is divided into 'topics', which are basically boxes where all the different resources and activities can be inserted and grouped. This is done by using the dropdown menus. Additionally there are several ways to format how this page is displayed, ranging from tabulation to font size and color (see figure X.X.) Using the Administrative block located at the left of the screen, there are further options that can be set specifically for a course. For example one of the students can be set as 'non-editing-teacher' just for this segment of the website. Additionally there are Reports, Back ups, Files among other things can also be access though here.

7.3   Text content and guides

A mayor part of the EHU course content is provided in written form. Moodle has two standardized resources for formatting and displaying text (there is an additional third party plug-in named 'Book' which will be covered later). The two alternatives are 'Text Page' and 'HTML Page'.

The input form, when creating a new resource, both look almost exactly the same. The only difference is how the body of the text can be formatted. Text Page is the easiest way to enter text, but it can't be formatted in any way. HTML Page by comparison has many ways to change the appearance of the page, insert pictures, change fonts among other things. As was stated earlier, it uses the WYSIWYG editor (*What you see is what you get*) that works like any standard word processor as figure X.X shows. A useful function is the 'Clean Word HTML' that is available in the editor, which tries to correctly format the text imported from MS Word (note that the content was originally written using this software).
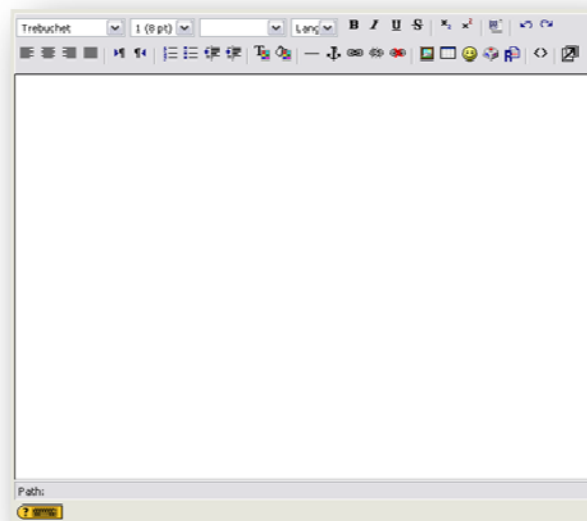
The following information needs to be provided in the input form in order to successfully create a text resource:

- **Name** - This is what the students will see in the classroom.

  Summary - is a brief summary of the main text. It is used to help students quickly determine if the resource is relevant to what they are looking for. The summary box supports formatting (bold, underline, etc.) that can be found on the tool bar.

- **Full text** - is where the main text is entered. This behavior can be changed in the "Formatting" pull-down menu under the full text box.

- **Formatting** - is a pull-down menu that defines how the text box is interpreted. You have the

  Figure 7.3: WYSIWYG text editor

  following options available:

  - Moodle auto-format. This is a good all-purpose setting that supports hyper linking and emoticons.

  - Plain-text – make the text to look just like it was typed (no emoticons or hyper-links).

  - Markdown format – Markdown format tries to make it easy as possible to type well-formatted XHTML pages using nothing but text written more or less like you would write an email. It's very good for writing clean text pages with some headings and some lists but without many links or images.

- **Window: Show (or Hide) settings** - lets you change how the resource is viewed. By default, the resource appears in the same browser window that the user started in. If you want it to open another browser window, click on "Show settings" and select "New window." You can then also define how big the new window will be, and other options.

The third party '*Book*' module, was created by Petr Škoda, it makes it easy to create multi-page resources with a book-like format (similar to the Ilias structure). This can be used to build complete book-like websites inside of your Moodle course. The book module allows the site to have main chapters and sub chapters, but it doesn't have deeper levels than that . In other words, sub chapters can't have their own sub chapters. This was an intentional decision by the creator of the book module. He intended this to be a simple resource for teachers and students.

Unfortunately there is no mechanism in place that stores a particular format thought the site. A workaround had to be in place, in order to keep the style and cohesiveness constant. A special page named 'Content Guide' was created that only instructors can access. Here every aspect of a course, ranging from title font and color to how big the pictures should be determined.

7.4   Additional Resources and activities

Moodle provides many different resources and activities to suit a wide rage of learning scenarios. The objects that will be discussed bellow represent the resources and activities that that are more relevant to the EHU project. (Note that the entry field information is partly taken from the Moodle help files, only available thought the LMS and cannot be linked)

7.4.1   Glossary

The Glossary option adds a flexible way to present definitions (among other things) that can be linked through your entire class site. For example, if the term 'toxicology' is defined and this word comes up in a forum discussion, the word will appear as a link that will take the user to the definition.

The input form has many options, but the most significant are:

- **Entries shown per page** - This is useful to help users with slow connections. If a limit to the entries is set to 10 or 15 per page, the load time is faster. By not specifying the number, the system will load every definition.

- **Glossary Type** - This can be either 'Secondary glossary' or 'Main glossary'. Only one Main Glossary can be used for an entire classroom. Many Secondary Glossaries can be set. Entries from Secondary Glossaries can be transferred to the Main Glossary. This allows the developer to build a Main Glossary with the definitions any definition in the Secondary Glossaries. Students cannot modify a Main Glossary.

- **Duplicated entries allowed** - This sets if students can define a term more than once (if two or more students can define 'toxicology' or the like).

- **Allow comments on entries** - This sets if others in the class can make comments on glossary entries or not.

- **Allow print view** - Students can be allowed to use the print view of the glossary. It can be choose whether this feature is enabled or disabled. Teachers always can use the print view.

- **Automatically link glossary entries** - If this option is set to 'Yes', then every time a term is used anywhere on the site, the term will link to the definition in the glossary. For example, if toxicology is defined, and someone uses the term in a forum discussion, the word sonnet will become a link to the definition.

- **Approved by default** - If this setting is set to "No," then all student entries must be approved by the teacher before they become available to everyone. If this is set to "Yes," then all entries are available to everyone.

- **Display format** - This sets how the glossary will appear to the students. There are several choices:

  - Simple, dictionary style – this presents the terms like a dictionary, in alphabetical order. Any attachments are shown as links.

  - Continuous without author – this presents the terms as one big page, and sorts the terms by date.

  - Encyclopedia – this presents the terms like an encyclopedia. All uploaded images are seen in the article, and the author is indicated.

  - Full with author – this is similar to the "Encyclopedia" setting, except attachments are seen as links instead of being in the definition. Author information is given.

  - Full without author – this is the same as "Full with author," except no author information is given. This looks very much like the "Simple, dictionary style" except time and date information is given.

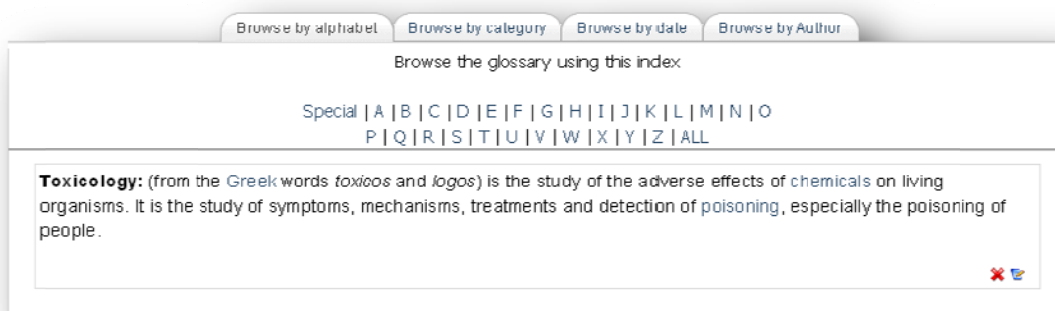Figure 7.4 shows the result, from the point of view of the trainee.

Figure 7.4: Glossary

7.4.2 Wiki

A Wiki is similar to a blog, except everyone can contribute, edit, comment it. A wiki starts with one front page. Each author can add other pages to the wiki by simply creating a link to a page that doesn't exist yet. In general, wiki posts are not approved by a central administrator, so the content can be built very quickly. This kind of resource can be very useful among other things, for tutorials and How-to-lists, since it can be easily be edited, and if one of the users encounters an error he can correct it. Ward Cunningham, developer of the fist wiki explained it as "the simplest online database that could possibly work"[37]. One of the most known wikis is Wikipedia.

In Moodle, wikis can be a powerful tool for collaborative work. The entire class can edit a document together, creating a class product, or each student can have their own wiki and work on it with you and their classmates.

To create a wiki, the course creator needs to add it from the resources/activities dropdown menus. This will take the creator to the input form. The most important fields there are:

- **Type** – This sets the type of wiki. There are three types, and each type sets access rules that also depend on whether or not classroom Groups are used or not. The following table explains the different wiki type:

	No Groups	Separate Groups	Visible Groups
Teacher	There is only one wiki which only the teacher can edit. Students can view the contents.	There is one wiki for every group which just the teacher can edit. Students can view the wiki of their group only.	There is one wiki for every group which just the teacher can edit. Students can view the wikis for all groups.
Groups	There is only one wiki. The teacher and all students can view and edit this wiki.	There is one wiki per group. Students can view and edit the wiki of their own group only.	There is one wiki per group. Students can change the wiki of their own group only. They can view the wikis for all groups.
Student	Every student has their own wiki which only they	Every student has their own wiki, which only they and their	Every student has their own wiki, which only they and their

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[37] Cunningham, W.; Welcome Visitors

	and their teacher can view and edit.	teacher can edit. Students can view the wikis of other students in their group.	teacher can edit. Students can view the wikis of all other students in the course.

Table 7.1: Different Wiki types[38]

- **Print wiki name on every page** – this sets if the name is displayed or not
- **HTML Mode** – this sets how the wiki is authored. It has three settings:
  - No HTML – this mode ignores all HTML commands and the authors cannot use the formatting bar (which is based on HTML). All formatting of the wiki is done using Wiki Words (a formatting style special to wikis).
  - Safe HTML – this mode allows the use of hand-coded HTML, but does not allow use of the formatting bar.
  - HTML only – this allows full use of standard HTML and the formatting bar, but Wiki Words are not used. If you and your students are new to Wikis, this is probably the mode you want to start with.
- **Allow binary files** – this sets if the wiki will allow binary attachments (like images, Zip files, etc.). Note that this only applies to attachments – even if this is set to 'no', students can still link to images if HTML is allowed.
- **Wiki auto-linking options** – By default, the wiki can auto-link certain words used in the wiki. It can turn the feature off by checking the 'Disable CamelCase linking' box. As an aside, CamelCase is any single word that has multiple capitals in it (like 'CamelCase' or like 'TesT').
- **Choose an Initial Page** – this allows the user upload a text file that will become the content of the first page of the wiki. If there are multiple text pages in a directory in the Files section of the classroom, all the text files will become content for the wiki, but the page specified here will be the first page.

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[38] http://docs.moodle.org/en/Wikis

7.4.3   Forums

A forum is an online billboard application for holding discussions and posting user generated content. "Forums can contribute significantly to successful communication and community building in an online environment."[39] In order to integrate a discussion forum as an online activity, it is important to note that some time has to be invested in order for it to be successful. To encourage interaction two things need to be noted: Know that the learner only will interact with some one else if he/she fells is learning from the experience and a sense of community can be fostered between participants.

There are many different ways EHU can integrate Forums to its classroom environments. For example a suggestion forum can be created in order to get input about the site, where something isn't working properly. Also Moodle supports 'news forums' to which a learner can subscribe and get actual information, for example: course announcements, lectures or seminars, changes to the exam dates, among other things.

The forum input form has these important fields:

- **Force everyone to subscribe** – If a person subscribes to a forum, he/she will automatically get updates via e-mail, when ever someone post on this particular forum. By forcing students to subscribe to the forum, this guarantees that everyone is up to speed on the discussion.

- **Read tracking for this forum** - If 'read tracking' for forums is enabled, users can track read and unread messages in forums and discussions. The instructor can choose to force a tracking type on a forum using this setting.

- **Maximum attachment size** – how big can the attachment followed by the post can be. This can be very useful so that people can better explain what they are discussing. They can embed a screen shot or a graph for example.

- **Time period for blocking** – Users will be blocked from posting after a given number of posts in a given period, and as they approach that number, they'll be warned that they are approaching the limit. This reduces spam and forces the poster to think more carefully before posting.

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[39] Moodle Forum module

7.4.4 Chat

"The Chat module allows participants to have a real-time synchronous discussion via the web".[40] The most important benefit of using the chat module, is the instant feedback and interaction both the trainee and the instructor have, simulating the face to face interaction that is not available in this environment. This is particularly well suited for small groups discussions, as with larger groups the discussion might turn out to be harder to follow. It is also important to note that the chat module will archive a session if two or more participants interact with each other. When entering the chat module, a new window is popped up and all the users that are currently in the chat are displayed on the right side of the window and the discussion is shown by the main panel, on the center of the screen. Chat can be set to archive, so that students and trainers can review the subjects discussed on a later date.

The chat input form has these important fields:

- **Next chat time** – This is to inform the students when to enter the chat room. Students may enter the chat room before the scheduled time, but this is useful to organize the start of a chat session.

- **Repeat sessions** – This works in conjunction with the next chat time, automatically changing the next chat time, depending on how it's configured. It can be chosen whether it is a one-time chat event, a daily event, or a weekly event.

- **Save past sessions** – Here it can be specified how long a chat room should be archived (from two days to never delete).

- **Everyone can view past sessions** – This sets if students can see past chat sessions (the teacher can always see past (archived) sessions regardless of this setting).

- **Group Mode** – This section can be used to assign how groups will operate with this activity.

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[40] http://docs.moodle.org/en/Chat
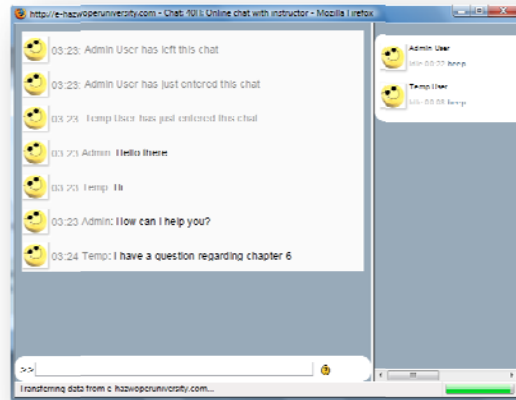
Figure 7.4 Moodle Chat pop-up window

7.4.5 Media

As stated in the requirements, another large portion of the content EHU uses to instruct the trainees is in the video form. Moodle has a file management system that can be used to upload files that are stored locally. The problem is that file manager has an upper limit of 2 MB per file. This is preconfigured by Moodle so that to keep the media files on a manageable size. A workaround was conceived to address this issue.
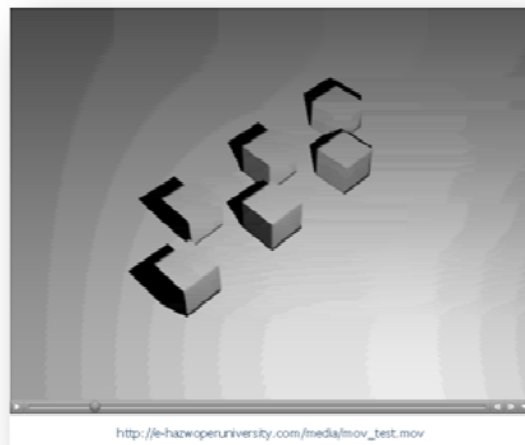
Figure 7.5 Media window using Apples' QuickTime

The video files are uploaded to the server using a FTP application. Once theses are in place, a 'link to file or website' resource is placed on the in the classroom that links to the video. The video can now be watched within the browser window, regardless of the file size.

It is important to note that there is an upper traffic limit, so a video format that can encode the video into a small size is highly recommended be used. Apples Inc. QuickTime (.mov) format can be a good alternative since the files are relative small, and it has the bonus feature that a position bar is automatically inserted at the bottom of the video.

7.4.6 Quizzes and final examination

Review quizzes, final examination and course evaluation all use the same 'Quiz' module within Moodle. Review quizzes should be made available after each chapter, to help the student better understand the content and was able to retain the information. The student should be able to repeat the quizzes as many times as he requires. The final examination on the other had, can only be done once. The final examination will test the proficiency that the learner acquired thought the course. If it meets the minimal requirements, the student will get the certification. At the end of the course, the student will be asked to rate the course they just completed. [More detailed information required?]

- **Open the quiz** – sets the opening date and time for the quiz. Students cannot take the quiz before this time.
- **Quiz Closes** - this sets the ending date and time of the quiz. Students cannot take the quiz after this time.
- **Time limit** – sets how long a student has to take the quiz (1-110 minutes). The default is '0', which means the student can take as much time as needed.
- **Time delay between first and Second attempts** - a time delay is set, then a student has to wait for that time before they can attempt a quiz after the first attempt.
- **Time delay between later attempts** – amount of time required to wait before they can attempt their third or later attempts.
- **Questions per page** - For longer quizzes it makes sense to stretch the quiz over several pages by limiting the number of questions per page. When adding questions to the quiz page breaks will automatically be inserted according to the setting chosen here. However it is also possible to move page breaks around by hand later on the editing page.
- **Shuffle Questions** – changes the order of the questions on the quiz every time the student takes it (or for every different student who takes the quiz). This helps to prevent students from copying each other.

- **Shuffle within questions** – very similar to the above point, except it changes the order of the answers given for multiple choice or matching questions.

- **Attempts allowed** – this sets the number of times a student may take a quiz. This can be very useful if the quiz is a review exercise, as the student can take it as many times as the teacher wants (and each grade does get reported to the teacher).

- **Each attempt builds on the last** – this sets whether or not the quiz builds on previous quizzes. If multiple attempts of a quiz are allowed, and this is set to 'yes', then the former quiz results will be included in this attempt (including feedback, if turned on). If this option is set to 'no', then the quiz will be a fresh (blank) quiz every time the student takes it.

- **Adaptive Mode** - If 'yes' is chosen for this option then the student will be allowed multiple responses to a question even within the same attempt at the quiz. For example, if the student's response is marked as incorrect the student will be allowed to try again immediately. A penalty will usually be subtracted from the students score for each wrong attempt (the amount is determined by the penalty factor).

- **Grading method** – this sets how quizzes are scored if the student can take the quiz multiple times. Choice ranges from keeping the highest grade, keeping the average of all the grades, keeping the first score, or keeping the latest score.

- **Apply Penalties** - If a quiz is run in adaptive mode then a student is allowed to try again after a wrong response. In this it would be recommended to impose a penalty for each wrong response to be subtracted from the final mark for the question. The amount of penalty is chosen individually for each question when setting up or editing the question. This setting has no effect unless the quiz is run in adaptive mode.

- **Decimal digits in grades** - By using this setting it can select the number of decimals to be shown in the grade of every attempt.

- **Students May Review** - This option controls whether and when students will be able to review their past attempts at this quiz.

- **Show quiz in a 'secure' window** - The 'secure' window tries to provide a little more security for quizzes (making copying and cheating more difficult) by restricting some of the things that students can do with their browsers. Note that this method is not failsafe. What happens is:
  - JavaScript is made a requirement.
  - The quiz appears in a new full screen window.
  - Some mouse actions on the text are prevented.

- o Some keyboard commands are prevented.
- **Require password** – An option field. A typed password. that students are required to type in before they can take the quiz.
- **Require network address** – An option field. An IP addresses can be given here, and only those addresses can take the quiz. The system can understand partial IP addresses, like 10.0. and can accept multiple addresses separated by commas (10.0.0.1, 10.0.0.2, etc.).
- **Overall feedback -** The overall feedback is some text that is shown to a student after they have completed an attempt at the quiz. The text that is shown can depend on the grade the student got.

After completing the form, one is automatically redirected to the 'Quiz Edit' form, shown in figure X.X. Here the questions and structure of the quiz can be determined. At the top of the screen there are four taps, that allow the quiz creator critical information about that particular quiz.
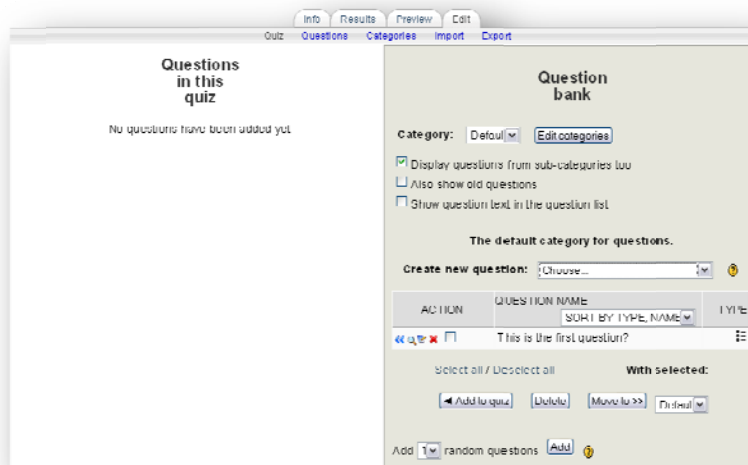
Figure 7.7: Quiz editing window

The 'Info' tab provides general information about the quiz (the information submitted in the input forms). 'Results' shows the quiz administrator general statistics about that course, such success percentage and grading. This information can be useful when reviewing a quiz. If most of the students are failing on a particular question, it might be the case the question formulation is the problem. The question can then be rewritten. The 'Preview' tab, allows the quiz creator a glimpse of quiz he/she is currently creating. The 'Edit' tab is where the questions are created and edited. To add a new questions to the quiz, a question pull hast to be created first. This is done by adding single questions using the

dropdown box to choose the question category. Moodle provides many different kinds of questions types, that cover most scenarios. Table 7.2 illustrates all the different categories:

Moodle's question categories	
Multiple Choice	The respondent chooses from multiple answers. There are two types of multiple choice questions - single answer and multiple answer.
Short Answer	The respondent types a word or phrase. There may several possible correct answers, with different grades. Answers may or may not be sensitive to case.
Numerical	From the student perspective, a numerical question looks just like a short-answer question. The difference is that numerical answers are allowed to have an accepted error. This allows a continuous range of answers to be set.
True/False	The respondent selects from two options: True or False.
Matching	A list of sub questions is provided, along with a list of answers. The respondent must 'match' the correct answers with each question.
Embedded Answers (Cloze)	These very flexible questions consist of a passage of text (in Moodle format) that has various answers embedded within it, including multiple choice, short answers and numerical answers.
Random Short-Answer Matching	From the student perspective, this looks just like a Matching question. The difference is that the sub questions are drawn randomly from Short Answer questions in the current category.
Random	A Random question in a quiz is replaced by a randomly-chosen question from the category that was set.
Description	This is not a real question. It simply prints some text (and possibly graphics) without requiring an answer. This can be used to provide some information to be used by a following group of questions, for example.
Calculated	Calculated questions offer a way to create individual numerical questions by the use of wildcards that are substituted with individual values when the quiz is taken.
Essay	In response to a question the respondent writes an answer in essay format.

Table 7.2: Quiz question categories available in Moodle (from the help files)

All question types require almost the same kind of input, once in the create/edit page. The 'Question name' field should be a descriptive and short name for the question. This name will appear in the Quiz

Edit page, but will not be visible to the student. After that comes the 'Question text' field, where the actual question intended for the student is posed. Then the maximum achievable points can be set from here (it can also be assigned later in the Quiz Edit page). The last segment of this page, is the student response. For example when creating a 'Multiple Choice' question, each choice has its own block, as figure 7.8 shows:
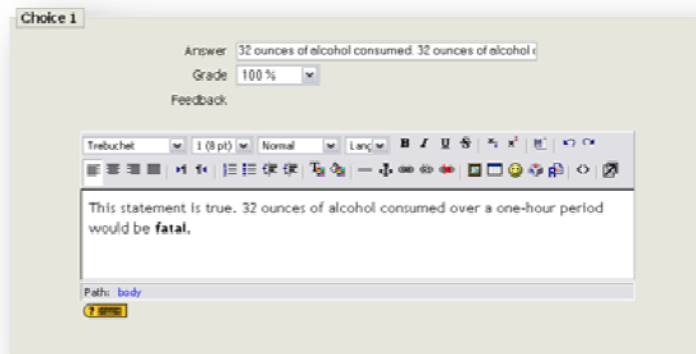
Figure 7.8: Choice 1 of a Multiple Choice question.

 In the block the one of the possible answers is assigned. Under that there is the 'Grade' field where the course creator can determine if that particular answer was correct false, by assigning a value. For example, if the question was true, the grade should be '*100%*', if not the grade can be set to '*none*' so the student doesn't get the points or it can even be set to '*-100%*' as a penalty. Moodle autonomously grades the question and awards a score depending on the configuration. Note that the 'Essay' question type requires for someone to grade it manually, since the answer is rated on content and Moodle has no way of assessing it.

Once the question is done, it will automatically appear in the question pool. The pool is accessible from any Quiz created thought the site. This is particularly useful, when the same question is used in different Quiz, saving time and effort (also, categories can be set up, to arrange the different questions more easily). To add a question to this particular question, a click to the arrows located in the 'Action' section, as it's illustrated by figure 7.9.
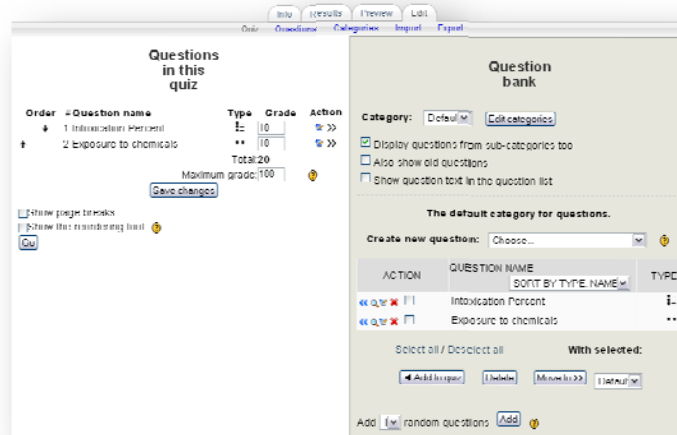
Figure 7.9: Quiz editing window with questions added to the quiz

Now the question is in the quiz. The order of the questions can be easily changed using the arrows located in each question. The grade can also be changed from this perspective. This is very helpful, since now there is an overview of the entire quiz, and the height of each question can be taken into perspective with the other questions. Once satisfied with the quiz layout and questions, the last step of the process is to save all changes.

7.5   PayPal's Sandbox

PayPal's Sandbox environment is a "self-contained environment within which developers can prototype and test the PayPal applications"[41]. Basically, the Sandbox is a testing environment that is a duplicate of the live PayPal site, except that no real money changes hands. The Sandbox allows the developer to test the entire integration before submitting transactions to the live PayPal environment.

The first step in order to set up the Sandbox environment, is to create an test account in the developer section of the PayPal site (https://developer.paypal.com). After providing all the required information, the service can now be accessed.

---

[41] Source: PP_Sandbox_UserGuide
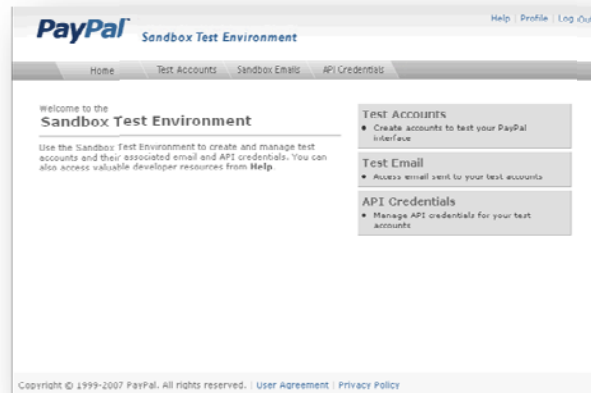
Figure 7.10: PayPal Sandbox Test Environment main window

Then the two different types of accounts need to be created: the business account(e.g. EHU) and the personal account (simulating a student's PayPal account).

Some changes need to be made in Moodle, in order to setup the test environment. First, in the course enrollment area, the PayPal configuration needs to be changed. The temporal e-mail address that was assigned when creating a business account needs to be entered in as the default address. Additionally, code in the 'ipn.php' file located in the 'enrol/paypal/' folder needs to be modified. The line *'$fp = fsockopen ('www.paypal.com', 80, $errno, $errstr, 30);'* needs to be replaced with *'$fp = fsockopen ('www.sandbox.paypal.com', 80, $errno, $errstr, 30);'*. Now Moodle will interact with the Sandbox service, and the payment process can be tested.

7.6   Future development

The following aspects, where not able to be included as part of the project. Part of them couldn't be achieved, because of the time constraint and limited workforce. Others can only be implemented after the course has gone live.

- Customize   UI
  Moodle has a powerful themes system that modify the user interface, that allows for a variety of effects through the use of XHTML and CSS. The Themes can easily be deployed for the entire side, using the Appearance module. The Moodle site also have extensive documentation so that developers can develop their own themes. By Customizing the UI, the look of the site can be

customize to exactly meet the business needs. The end result is a better integration between software and business.

- Streaming media

  This would make the courses dramatically more interactive and communication between instructor and trainee more efficient. There are many variable that need to be reviewed. For example encoding (Flash, MPEG-4, Quicktime, Windows Media Videos) as well as commercial and open source vendors.

- Optimize performance

  "Moodle can be made to perform very well, at small usage levels or scaling up to many thousands of users. The factors involved in performance are basically the same as for any PHP-based database-driven system." [42] In order to have a measurable performance increase, first a base line under real environment needs to be created. This can only be done, after the page has gone live, and actual users are interacting with the site.

- 3D animation

  By implementing costume 3D animation videos as part of the course resources, it can be used to convey information that would be problematic to do with simple text and graphics.

---

[42] Moodle Group; Performance

8 Conclusion

In order for a company to successfully made the transition from face-to-face training to an e-learning environment, the first step that needs to be achieved is defining e-learning . The term e-learning can lead to some confusion within organization, since it is a very broad term. With the definition, the general advantages, disadvantages, technologies available and common misconceptions also need to be clarified before the project can start.

Since e-learning is complete different medium, this makes the traditional pedagogic approach somewhat obsolete, alternative approaches have to be adopted. Although these new approaches have only been developed fairly recently, they have the potential of making the e-learning platform far more effective and engaging by using the new tools made available by next generation of internet technology.

By analyzing the business context of the project, a clear image of what is required should become apparent. The background provides information from where the company is coming, it will also help to project where it is going. The proposal should describes short and precise what the project's objective is, so that every person in the organization is understands what is expected. The drivers and benefits illustrate the motivation behind the project. The risk assessment quantifies the uncertainties involved with the implementation, as provide ways to mitigate the risk and fall back plans in the worst-case-scenarios. The critical success factors provides a baseline of the results that are required in order to for the project to be considered a success.

In the design phase, the information provided in business context needs to be distilled into the functional and technical requirements. This process is very important, since it will directly influence what Learning Management System is chosen. When comparing system, careful consideration should be done about the comparison and validation methods.

In the development phase, is where the software is installed on the server and the service becomes online. All the additional configuration that is required in order for the LMS to run safely and secured needs to be provided here.

The last aspect of the project is the Rollout. Here all the resources and activities that are required in order for the software to be 'production ready' needs to be set and configured within the LMS. Once all these phases are completed, the company can start using the LMS as a distribution platform.

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10 Appendix

10.1   Retention rates

PERCENT	SOURCES
10 %	Reading
20 %	Hearing
30 %	Seeing
50 %	Seeing and Hearing
70 %	Saying
90 %	Seeing and Doing

10.2   Outline of 40 hour course

Day One	
Introduction and Signup	½-Hour
Risk – Handout / Discussion	½-Hour
Toxicology	
-Dosage	2-Hours
-Toxic Effects	
-Measurement of Exposure	
Film – Trade Secrets	2-Hours
Types of Hazards	1-Hour
-Radiation	
-Chemical	
Hazard Communication	
-Physical	
Medical Surveillance	1-Hour
Sources of Information	1-Hour
Film -Work Clothes	1-Hour
Protective Clothing	1-Hour
-Types of Protection	

Day Two	
Film – Suicide Missions (HAZMAT)	1-Hour
1. Respiratory Protection (Part A) -SCBA -Fit Testing	1 ½-Hours
Film – SCBA / IDLH (North Respirator)	½-Hour

2. Levels of Protection
    a. Level A
    b. Level B
    c. Level C
    d. Level D
	2-Hours

3. Response Operations
    a. SPCC Plans
        i. Communication
    b. Spill Containment
        i. Reportable Quantities
    c. Fire Response
    d. Site Operations
        i. Control Zones
        ii. Security
        iii. Communications
        iv. Safe Work Practices
        v. Buddy System
	1 ½-Hours

4. Decontamination	1 ½-Hours

5. Material Identification
    a. Explosimeter
    b. Radiation
    c. Color metric Detector Tubes
    d. Hazard Categorization
	2-Hours

Day Three	

6. Regulations (RCRA, CERCLA, OSHA)
    a. RCRA
    b. CERCLA
    c. OSHA
	2.0-Hours

6B Respiratory Protection (Part B) Film – Air Purifying Respirators (APR)	1 ½-Hours

7. Instruments
    a. Photo ionization Detectors (PID)
    b. Flame Ionization Detectors (FID)
    c. Explosimeter
    d. Toxic Gas Detectors
	½ -Hour
	
	2-Hours

8. Hazardous Waste Management Practices	2-Hours

a. Facility Personnel
      b. Waste Storage
      c. Drum Management
      d. Labeling
9. Site Characterization
      a. Off-site Observations
      b. On-site Observations
      c. In-depth Sampling
	2-Hours

Day Four	
Review Previous Material	4-Hours

10. Exercise (Level C)
      a. Scenario
      b. Planning
      c. Staging
      d. Activity
      e. Debriefing (Questions and Answers)
  Student Evaluation (Exam)
 	
  Grading
 	
   -Review Missed Questions
 	
  Instructor Evaluation
	3-Hours
	
	2 –Hours
	
	1-Hour

10.3 40-Hour Training - Final Examination (partial)

1.   Toxicology and toxicity refer to the

    A.   Study of chemicals or agents which may interact with biological systems and their ability to cause injury.

    B.   Causes of cancer.

    C.   Hazardous waste and hazardous material.
    D.   All of the above.

2.   The concept of dose is defined as

    A.   Exposure to chemicals.

    B.   Response relationship with the number of individuals responding over a given exposure period.

     C.   How much you are tested for.

     D.   All of the above.

3.   Lethal Concentration Fifty (LC$_{50}$) is

    A.   Exposure to one or more of 50 chemicals.

    B.   Exposure to large doses of chemicals.

    C.   A calculated concentration of an airborne substance over a specified length of time which is expected to cause death to 50 percent of an animal population.

    D.   Exposure to a dose of chemicals exceeding 50 ppm.

4.   Identify the four ways chemical substances can enter your body.

    A.   Inhalation, contact, ingestion, injection.

    B.   Exposure, poisoning, drinking, breathing.

    C.   Eating, smoking, chewing gum, watching too much T.V..

    D.   None of the above.

5.   Identify the toxic effects which chemical materials have on the body.

    A.   Inflammation of membranes.

    B.   Deprive tissues of oxygen.

    C.   Destroy body tissues.

    D.   All of the above.

6.   Explain the corrosiveness of acids and bases and the pH scale.

    A.   pH is greatest at 7.0.

    B.   Acute vs. chronic.

C.   Acids and bases are damaging to body tissue due to corrosiveness which increases as you move either direction away from 7.0 on the 1-14 pH scale.

D.   All of the above.

7.   Who establishes Threshold Limit Values (TLV's)?

A.   OSHA establishes TLV's.

B.   CAL/OSHA establishes TLV's.

C.   The American Conference of Government Industrial Hygienists (ACGIH) establishes the TLV's.

D.   The Government establishes TLV's.

8.   Describe the use of IDLH concentrations at hazardous waste sites.

A.   IDLH environments are safe to breath.

B.   IDLH environments should never be entered.

C.   IDLH environments pose serious risk to employees if appropriate steps are not taken.

D.   IDLH's are never a factor at hazardous waste sites.

9.   Work place standards for exposures to chemical materials include.

A.   TWA's (Time Weighted Averages).

B.   PEL's (Permissible Exposure Limits) are enforceable standards set by OSHA, the PEL for a substance is the 8-hour TWA or concentration above which workers may be exposed.

C.   STEL's (for maximum exposure averages over 15 minutes).

D.   All of the above.

10.2   Full feature comparison

	Max. Score	Moodle 1.8.1	Score	Ilias 3.7.9	Score
LMS Comparison					
1. Company					
1.1 Website structure	10	The Moodle website is easy to use and navigate. And information can easily be found.	10	The Ilias website, is easy to use and navigate, although some of the features are sometimes hard to find.	8
1.2. Support / Forums	30	Moodle offers free support The forums have 10 000 active users.	30	No free support is available The forums have 1600 active uses.	20
1.3. Documentation	30	Extensive documentation material both online and with the use of context sensitive buttons located thought the site.	30	A good amount of documentation is available online, although information about some items is missing.	20
2. Communication Tools					
2.1. Discussion Forums	20	Students can enable or disable posts to be sent to their email. Students can receive posts by email as daily digests of subject lines or whole posts. Students can subscribe to forum RSS feeds. A spell-checker is available for student and instructor responses.	20	Students can receive posts by email as daily digests of subject lines or whole posts. Students can subscribe to forum RSS feeds.	15
2.2. Discussion Management	20	Posts may be peer reviewed by other students. Instructors can view statistical summaries of discussions displaying participation which can be used to generate grades.	18	Instructors can allow students to create discussion groups. Posts may be peer reviewed by other students. Instructors can view statistical summaries of discussions displaying participation which can be used to generate grades. Discussions can be shared any institutional unit.	20

2.3. File Exchange	Students can submit assignments using drop boxes. Students can share the contents of their personal folders with other students. Administrators can define disk space limitations for each user.		Students can submit assignments using drop boxes.	
		10		5
	10			
2.4. Internal mail	Students can use the built-in email functionality to email individuals or groups. Students can use a searchable address book. Instructors can email the entire class at once at a single address or alias. Students can elect to forward their mail to an external address.		Students can use the built-in email functionality to email individuals or groups. Students can use a searchable address book. Instructors can email the entire class at once at a single address or alias. Students can elect to forward their mail to an external address.	
		20		20
	20			
2.5. Online Chat	The chat tool supports unlimited simultaneous group discussions Instructors may moderate chats and suspend students from the chat rooms. The system creates archive logs for all chat rooms.		No chat function is available in the version tested. (Note that later versions do have this function)	
		15		0
	20			
3. Productivity tools				
3.1. Calendar / Progress Reviews	Instructors and students can post events in the online course calendar. Instructors can post announcements to a course announcement page. Students have a personal home page that lists all courses in which the student is enrolled, new email and all course and system-wide events from their personal calendar. Students can view their grades on completed assignments, total points possible, course grade, and compare their grades against the class performance. Students can subscribe to RSS feeds to be notified of		Instructors and students can post events in the online course calendar. Instructors can post announcements to a course announcement page. Students have a personal 'desktop' that lists all courses in which the student is enrolled, new email and all course and system-wide events from their personal calendar. Students can view their grades on completed assignments, total points possible, course grade, and compare their grades against the class performance. Students can subscribe to RSS feeds to be notified	
		20		20
	20			

		changes to materials.		of changes to materials.
3.2. Search within course				Students can search all course content.
	10	Students can search all discussion threads.	8	Students can search all discussion threads.	10
3.3. Work Offline		There is no function to download the courses to a local hard drive for alter review (Note that a third party plugging is available that allows this)	0	If the instructor enables this function, students can download the courses for later review when not online.	10
	10				
3.4. Oriented Help		Students can access context sensitive help for any tool.		Help files/links are only available to the course creators.	
	10	The system includes online tutorials for students that help students learn how to use the system.	10	No tutorials for students is available.	4
4. Student involvement tool					
4.1. Group work				Instructors can assign students to groups.	
				Students can self-select groups.	
				Each group can have its own discussion forum.	
		Instructors can assign students to groups.		Each group can have its own chat or whiteboard.	
		Each group can have its own discussion forum.		Each group can be given group-specific assignments or activities.	
		Each group can have its own chat or whiteboard.		Groups may be private or instructors can monitor groups.	
	10		5		10
4.2. Community Network		Students from different courses can interact in system-wide chat rooms or discussion forums.	10	Students from different courses can interact in system-wide chat rooms or discussion forums.	10
	10				
4.3. Student Portfolio		Students can create a personal home page in each course, but somewhat limited	6	Students automatically get a 'personal desktop' where they can save and display all resources available to him/her.	10
	10				
5. Administration tools					
5.1. Authentication		Administrators can allow guest access to all courses.		Administrators can allow guest access to all courses.	
		The system can authenticate against an external LDAP server.		The system supports Shibboleth.	
	20	The system can authenticate using the Kerberos	20	Administrators can set up fail-through	10

	protocol. The system supports Shibboleth. The system supports the Central Authentication Service (CAS). The system can authenticate against IMAP, POP3 or secure NNTP. The system can support multiple organizational units and virtual hosts within a server configuration. A PayPal plug-in is already implemented by default.		authentication against a secondary source (e.g. the system's own database) in the event that the primary source (e.g. LDAP server) fails. The system can support multiple organizational units and virtual hosts within a server configuration.
5.2. Course Authentication	The system supports restricting access based on roles and roles can also be customized by the service provider. Administrators can create an unlimited number of custom organizational units and roles with specific access privileges to course content and tools. Administrators can distribute the permissions and roles across multiple institutions or departments hosted in the server environment. Instructors or students may be assigned different roles in different courses.		The system supports restricting access based on roles and roles can also be customized by the service provider. Administrators can create an unlimited number of custom organizational units and roles with specific access privileges to course content and tools.
	10	10	5
5.3. Registration Integration	Instructors can add students to their courses manually or allow students to self-register. Administrators can batch add students to the system using a delimited text file. Administrators can transfer student information bidirectional between the system and an SIS using delimited text files. Administrators can transfer student information bidirectional between the system and an SIS using IMS Enterprise Specification v1.1 XML files via web services. The software supports data interchange with student information systems through an event-		Instructors can add students to their courses manually or allow students to self-register. Administrators can batch add students to the system using a delimited text file. Administrators can transfer student information bidirectional between the system and an SIS using delimited text files.
	20	20	15

driven API.

The software supports integration with SCT Banner, SCT Luminis, Datatel, PeopleSoft 8 or customized integration with other SIS or portal systems.

The software is compliant with the IMS Enterprise Specification for Student Data.

Feature		Description		Description	
5.4. Hosting Services	20	Hosting and support services from Commercial Affiliates.	20	Hosting and support services from Commercial Affiliates.	20
5.5. Role assignment	20	Roles can be customize extensively to fit all needs.	20	Roles can be customize extensively to fit all needs.	20
5.6. Language support	5	Language packages in 52 languages are available.	5	Language packages in 52 languages are available.	2
6. Course delivery tools					
6.1. Test Types	30	Multiple choice; Multiple answer; Matching; Fill-in the blank; Short answer; Essay; Questions can contain other media elements (images, videos, audio)	30	Multiple choice; Multiple answer; Matching; Fill-in the blank; Short answer; Essay; Questions can contain other media elements (images, videos, audio)	30
6.2. Automated Testing Management	30	The system can randomize the questions and answers. Instructors can create self-assessments. Instructors can set a time limit on a test. Instructors can permit multiple attempts. Instructors can specify whether correct results are shown as feedback	25	The system can randomize the questions and answers. Instructors can create self-assessments. Instructors can set a time limit on a test. Instructors can permit multiple attempts. The students are allowed to review past attempts of a quiz. The system supports a MathML editor for the inclusion of mathematical formulas in both questions and answers. Instructors can specify whether correct results are shown as feedback The system supports proctored tests.	30
6.3. Automated Testing Support	20	Instructors can create personal test banks.	15	Instructors can create personal test banks.	20

Feature	Score	Description	Score	Description	Score
		The system provides test analysis data.		Instructors can create system wide test banks. The system provides test analysis data.	
6.4. Online Grading	20	When an instructor adds an assignment to the course, the software automatically adds it to the grade book. Instructors can add grades for offline assignments. Instructors can export the scores in the grade book to an external spreadsheet. Instructors can create a course grading scale that can employ either percents, letter grades, or pass/fail metrics.	20	Instructors can export the scores in the grade book to an external spreadsheet.	10
6.5. Course Management	20	Instructors can selectively release assignments, assessments, and announcements based on specific start and stop dates. Instructors can personalize access to specific course materials based on group membership.	15	Instructors can selectively release assignments, assessments, and announcements based on specific start and stop dates. Instructors can release materials based on a single criteria (date, grade, etc.) or instructors can use Boolean expressions to identify multiple selective release criteria. Instructors can personalize access to specific course materials based on group membership.	20
6.6. Student Tracking	20	Instructors can track the frequency and duration of student access to individual course components. Instructors can get reports showing the time and date and frequency students as an aggregated group accessed course content. Instructors can get reports showing the number of times, time, date, frequency and IP address of each student who accessed course content, discussion forums, course assessments, and assignments.	20	Instructors can get reports showing the time and date and frequency students as an aggregated group accessed course content. Instructors can review the navigation record of each student.	15
7. Content delivery tool					
7.1. Ease of use	30		30		30
7.2. Accessibility Compliance	20	The product provider self-reports that the software	20	The product provider self-reports that the software	20

	complies with Section 508 of the US Rehabilitation Act. The product provider self-reports that the software complies with the WAI WCAG 1.0 Level A guidelines. The product provider self-reports that the software complies with the WAI WCAG 1.0 AA guidelines. The product provider self-reports that the software complies with the WAI WCAG 1.0 AAA guidelines.		complies with Section 508 of the US Rehabilitation Act. The product provider self-reports that the software complies with the WAI WCAG 1.0 Level A guidelines. The product provider self-reports that the software complies with the WAI WCAG 1.0 AA guidelines. The product provider self-reports that the software complies with the WAI WCAG 1.0 AAA guidelines.	
7.3. Content Sharing / Reuse	Instructors can make complete copies of entire courses and/or individual items in courses, and share them with other instructors or load them into one of the eCMS systems with a Moodle integration (Hive, Odalis, etc.) 20	10	Instructors can share content with other instructors and students through a central learning objects repository. The repository can be system-wide or for individual organizational units. The repository supports IEEE LOM and metadata application profiles such as, Dublin Core, Cancore, and custom profiles.	20
7.4. Course Templates	The software provides support for template-based course creation. Course content may be uploaded through WebDAV. The system allows administrators to use an existing course or a pre-defined template as a basis for a new course. 20	20	The software provides support for template-based course creation. The system allows administrators to use an existing course or a pre-defined template as a basis for a new course.	15
7.5. Customized Look and Feel	The system provides default course look and feel templates. Instructors can change the navigation icons and color schemes for a course. Instructors can change the order and name of menu items for a course. Institutions can create their own look and feel templates across the entire system, including their 20	20	The system provides default course look and feel templates. Institutions can create their own look and feel templates across the entire system, including their own institutional logos, headers, and footers. The system can support multiple institutions, departments, schools or other organizational units on a single installation where each unit can apply its own look and feel templates as well as	15

	own institutional logos, headers, and footers. The system can support multiple institutions, departments, schools or other organizational units on a single installation where each unit can apply its own look and feel templates as well as institutional images, headers and footers.		institutional images, headers and footers.		
7.6. Instructional Design Tools	Instructors can organize learning objects, course tools, and content into learning sequences that are reusable. Instructors can create linear learning sequences organized hierarchically by course, lesson, and topic. Instructors can reuse courses as templates for future lessons.	20	Instructors can organize learning objects, course tools, and content into learning sequences that are reusable. Instructors can create linear learning sequences organized hierarchically by course, lesson, and topic. Instructors can reuse courses as templates for future lessons.	20
	20				
7.7. Instructional Standard compliance	IMS Content Packaging 1.1.3 IMS Content Packaging 1.1.4 SCORM 1.2		AICC IMS Content Packaging 1.1.3 IMS Content Packaging 1.1.4 IMS Enterprise 1.1 SCORM 1.2	20
	20		12		
8. Hardware / Software					
8.1. Client browser required	System functions with any browser. System functions on mobile technologies System complies with XHTML 1.0 specification	30	System functions with any browser. System functions on mobile technologies System complies with XHTML 1.0 specification	30
	30				
8.2. Database requirements	The system supports MySQL and PLSQL	10	The system supports only MySQL	5
	10				
8.3. Server OS	Windows and UNIX servers are supported	10	Only UNIX is fully supported.	10
	10				
Sum	**700**	**Moodle 1.8.1**	**614**	**Ilias 3.7.9**	**564**

[Modified from http://www.edutools.info/item_list.jsp?pj=4]

10.5   Statutory declaration (German)

Hiermit versichere ich, dass ich die vorliegende Diplomarbeit selbständig und ohne unzulässige Hilfsmittel verfasst habe. Sämtliche benutzte Quellen sind im Literaturverzeichnis dieser Arbeit angegeben.

Stephan Tinschert

Berlin, den 28.09.2007