6.1 Introduction

E-learning is a combination of learning as well as knowledge management. As depicted in Figure 6.1, the process of developing and effective framework for e-learning should therefore, not only focus on the deployment of specific technology but also the crucial issues of how people communicate and learn in an electronic environment.

![Diagram of the process of developing and effective framework for e-learning](Image)

Figure 6.1
Process of developing and effective framework for e-learning (Melbourne University Publishing Ltd., 2000)

The integration of reflective learning in the educational process requires instructors to become conscious, and appreciate the educational value of such tools, to understand the fundamental pedagogical theories and instructional design and to possess skills for using reflective learning. The pilot use and preliminary evaluation of such environment, developed at this study, revealed the added value in the learning and teaching process and the instructors’ positive attitude in adopting such tools in the instruction.
6.2 System Analysis and Design

System analysis is an essential and important phase in software life cycle that is used to clearly determine all necessary requirements, before proceeding the subsequent phase.

The objective of this project is to develop a website for the Faculty of Computer Science and Information Technology, University Malaya, in order to employ some of the reflective learning methods in its pedagogical system. The website uses blogs, multimedia (voice and video), learning journal, concept mapping and e-portfolio.

6.2.1 System Requirements

6.2.1.1 Functional Requirements

The technical and practical characteristics of the website are described in this section.

- Technical characteristics: Microsoft ASP.NET was used to code the website. The program is divided into 4 WebPages. These pages manage the user interface and display the results. The specifications of the website are described as follow:

  - Input of the forum is the lecture that the trainer is going to give besides comments of the students in terms of text, image, voice and video.
  - Input of the e-portfolio section is the profile and grade of the students that the trainers add to the system.
  - Comprehensive access (discovery and exchange) to comfort in reaching any given learning context.

- Practical characteristics:
Convenient data input and display of the results in Windows® environment.

- Reading the input data files and saving the output files.
- Managing the results
- User guide

6.2.1.2 Non-functional Requirements

- Accessibility- is a general term used to describe the degree to which a product is accessible by as many people as possible. Accessibility can be viewed as the "ability to access" the functionality, and possible benefit, of some system or entity.

- Audit and control- controls the steps of the procedure and prevents the interruptions between the different stages.

- Availability- is the proportion of time; a system is in the functioning conditions.

- Documentation- Documentation is understood as a file in any communicable material (such as text, video, audio, etc., or combinations thereof) used to explain some attributes of an object, system or procedure. It is often used to mean engineering documentation or software documentation, which is usually in the format of paper, books or computer readable files (such as HTML pages) that describe the structure and components, of a system and also its operation.

- Efficiency- To be sure that the resource consumption for given load is sufficient.

- Effectiveness- to assure that the resulting performance in relation is functional.
• Extensibility- The ability of adding features and carry-forward of customizations at next major version upgrade.

• Interoperability- Is used to describe the capability of different programs to exchange data via a common set of exchange formats, to read and write the same file formats, and to use the same protocols.

• Maintainability- The ease with which a software product can be modified in order to correct defects, meet new requirements, make future maintenance easier, or cope with a changed environment.

• Performance- Encompasses the set of roles, skills, activities, practices, tools, and deliverables applied at every phase of the Systems Development Lifecycle which ensures that a solution will be designed, implemented, and operationally supported to meet the non-functional requirements defined for the solution. It uses to increase business revenue by ensuring that the system can process transactions within the requisite timeframe and eliminate system failure requiring scrapping and writing off the system development effort due to performance objective failure.

• Platform compatibility- shows how typical platforms include a computer's architecture, operating system, programming languages and related runtime libraries or graphical user interface companionable together.

• Portability- Portability is the software codebase feature to be able to reuse the existing code instead of creating new code when moving software from an environment to another. The pre-requisite for portability is the generalized abstraction between the application logic and system interfaces. When one is targeting several platforms with the same application, portability is the key issue
for development cost reduction. This can operate well in various operating systems.

- Quality- the efficient production of the quality that the market expects, (e.g. Faults Discovered, Faults Delivered, Fault Removal Efficacy)

- Reliability- is the ability of a system to perform and maintain its functions in routine circumstances, as well as hostile or unexpected circumstances.

- Resource constraints- deals with processor speed, memory, disk space, network bandwidth etc.

- Response time- is the time required for a system to react to a given input.

- Robustness- An algorithm in computer science is robust if it continues operating, despite abnormalities in input, calculations, etc.

- Simple- the website is a system created using simple user interface. In the system, user will be able to master the function provided due to the available simple user interface. A comfortable user interface such as using warm colors and clear browsing ability can provide advantages. Seeing the entire system at a glance and no need of vocabulary knowledge are some of the advantages of the system.

- Scalability- is a desirable property of a system, which indicates its ability to either handle growing amounts of work in a graceful manner, or to be readily enlarged.

- Security- is the degree of protection against danger, loss, and criminals.
- Software, tools, standards compatibility - is applied when products designed for the new standard can receive, read, view or play older standards or formats.

- Supportability - refers to the ability of technical support personnel to install, configure, and monitor computer products, identify exceptions or faults, debug or isolate faults to root cause analysis, and provides hardware or software maintenance in pursuit of solving a problem and restoring the product into service.

- Testability - a hypothesis is testable if there is some real hope of deciding whether it is true or false in real experience. Upon this property of its constituent hypotheses rests the ability to decide whether a theory can be confirmed or falsified by the data obtained from an actual experience.

- Usability by target user community - is a term used to denote the ease with which people can employ a website in order to achieve a particular goal. Usability can also refer to the methods of measuring usability and the study of the principles behind an object's perceived efficiency or elegance.

### 6.2.1.3 Minimum System Requirement

Table 6.1 presents the minimum system requirements for employment of the website designed.
6.2.2 Implementation Framework

Relevant student variables include preferred learning style, cognitive ability and computer skills. It has been reported that instructors’ level of technical proficiency and comfort, in terms of having the ability to control the technology and having positive attitude towards it, can affects learner ratings of instructors and positive outcomes (Hantula, 1998).

6.2.2.1 Instructional Technology

Based on theoretical underpinnings, the quality, reliability, ease of use, usefulness, and accessibility of the technology are important concerns. Students in this design will be provided with number of technologies including:
6.2.2.2 Learning Process

Once the students, instructor, tasks and technology converge, a learning process takes place. The learning process can be positive or negative and can be affected by several issues such as the level of effort spared by the group members, the level of trust among group members, as well as the degree of mutual respect they hold for each other. In technology based educational settings, in the form of coaching and modeling, support students as they develop new skills or new concepts.

6.2.3 Process Modeling

This phase is in which requirements proceeded in system analysis phase are translated in to a representation of the system. This phase will be concerned with architectural design, functional design, user interface design and database design.

6.2.3.1 Conceptual Architecture

Conceptual architecture is a term used to describe certain structures and performs that make use of conceptualism in design. Conceptual architecture is characterized by an introduction of ideas or concepts from outside of architecture often as a means of expanding the discipline of design. This produces an essentially different kind of structure than one produced by the widely held designer as a master-builder' model, in which craft and construction are the guiding principles. The finished design as
product is less important in conceptual architecture, than the ideas guiding them, ideas represented primarily by texts, diagrams, or art installations.

The learning space mentioned in the frame work (Figure 5.1) includes the whole conceptual architecture of the present study demonstrated in Figure 6.2. Within this structure, online weekly seminars and online team projects can be covered. In this architecture, the teacher mentioned in the frame work is the trainer while online users and trainee represent the students. The students can either access the system through internet or intranet.

Figure 6.2
Conceptual architecture
6.2.3.2 Functional Design

6.2.3.2.a Use Case Model

Use cases are narrative description of process that is created early in the development cycle. It describes the interaction between external actors and the system. Use case diagram for the current study is shown in Figure 6.3.

As explained earlier in the frame work the trainer and trainee are in contact through the system. They can login to the system and trainer can evaluate learners’ progress, update e-learning models and manage the contents. Meanwhile the trainee can browse and download contents and also personal progress evaluation. The contact between the trainee and trainer can cover the online weekly seminars and online team project described in Figure 5.1. There are 3 main actors available in this system including, admin, trainee and trainer. In this system trainee and trainer both login through the admin. The trainer initially uploads the necessary items required for a course (i.e. lecture notes, guidelines about projects and group works). The trainees can now browse and download the requirements for their course after login in the system. The trainees can now show personal progress and upload their reflections in different types such as blogs, multimedia, context mapping, text etc. the trainer will then review and mark the reflections of the trainees to have an evaluation on how the progress has been. The results coming out from the evaluation can help the trainer to upload new files or necessary information which lack of them is felt. This cycle can be continued in order to complete the course.
6.2.3.2.b  Domain Model

This is an analysis model which looks at objects and relationship in the real world rather than programming concepts. The Abstract domain model for e-learning WebPortal is presented in Figure 6.4. In the domain model the main criteria would be a course. All the actors should register as a user having a user ID, a password and a name. There would be a login part which is in Boolean system representing either logged in or not logged in. the trainee needs extra information as compared to other actors including email and address. The course is approved by the administrator. The trainer after logging in can upload files, evaluate the students (trainee) and grade their reflections. The trainer can also manage the students by adding new students. After evaluation of the students the trainer can introduce a new course and upload it which should be approved by the administrator.

Figure 6.3
Use case diagrams
6.2.3.2.c Design Model (use case description)

- Use case: Login: The login use case can be specified by the following steps:
  - Logon dialog is shown
  - User enters user name and password and logs in
  - The user name and password are checked and approved
  - The user is allowed in to the system

  Alternative: Logon failed – if at step 3 the user name and password are not approved, allow the user to try again up to four times. If the user name and password do not match the system will require to enter the users email address which has been given while registration. The username and password will be resent to the users email.

- Use case: User management

  System administrator is responsible for managing users, including new user registration, user information editing/deletion, roles and rights assignments.
Administrator will be able to view, edit and delete user information, set/edit different statuses (like: active user, never logged in, etc.).

Teacher would also be responsible for user management, but only in the course web boundaries. Teacher will be able to set the roles of the students, change user information, applicable for the course, form groups of users.

- Use case: Content management and review

The teacher is able to easily upload course material to course website by entering the text directly to the system as well as uploading files (.doc, .xls, .ppt, etc.). The material could be arranged either by chapters or by weeks, depending on the requirements of the teacher. The first page of the course web is always showing sections: course objectives, prerequisites, grading system and other general information about the course.

- Use case: Evaluation learners’ progress

After each assignment and quiz, teacher is able to grade the student/group of students and write comments on their work. After that, students receive the feedback and grade on their record.

- Use case: New/update e-learning Module

Trainers can published a new e-learning module or update an existing one in support of online communities. The e-learning module is an interactive and visual tool which provides case studies and examples of events associated with courses that taught.

- Use case: Personal Progress

Students are able to upload their assignments and what they understanding from course materials to course website by entering the text directly to the system as well as
uploading files (.doc, .xls, .ppt, .jpg, etc.). They also can use chat rooms, email and etc to communicate and discuss with others.

- Use case: Brows and Download content

Students after logging in are able to review the entire material, download the downloadable files and watch video files/listen to audio files directly from the website.

6.2.3.2.d Implementation Model

For implanting the system a model has been presented in Figure 6.5. As obvious in this model the user requests from the application server by using the browser to visit a page. Application server retrieves the data from the data base server. The data base server finds and replies the results back to the application server. The user can see the response from the application server in the browser. And this cycle of sending and receiving information can be repeated.

![Component model](image)

Figure 6.5
Component model

6.2.3.2.e Database model

The design of database is in a great importance as it can have great affect on the performance of the data retrieval, updating and query. Figure 6.6 demonstrates the data
base model used in this study. A Database is an integrated collection of logically related records or files consolidated into a common pool that provides data for one or more multiple uses (http://en.wikipedia.org/wiki/Data_base). Classifying databases involves the type of content. In this data base there are 4 classifications such as forum, contact, user and news. Each of these tables consists of information which are inserted or uploaded by the actors. For example in the news table information including the news ID, name, description, data, time etc. can be available. It is not necessary for each news to complete all the sections of the database.

![Database model](image)

**Figure 6.6**
Data base model employed

### 6.3 System Development

User interface design is very important to the usability of an application. Good graphical user interface should be intuitive besides minimum need for users to memorize things and at the same time an interesting look.
6.3.1 Screen Design

6.3.1.1 Homepage

The homepage screenshot has been presented in Figure 6.7. In this page the user can register and login to be able to use the site facilities. The green and blue colours have been chosen to make a relax environment for easier leaning. A brief description on online learning has also been placed in the homepage.

![Screen shot of the designed website homepage](image_url)

Figure 6.7
Screen shot of the designed website homepage

For accessing the website registration is required. The user can register by filling up the registration form available in the website. Personal information including username, password, email, first name, last name, sex, age, and phone number should be filled. This information is saved in the data base and each time the user can enter the website by keying in the username and password.
6.3.1.2 News page

In the news page all the announcements such as exam dates, call for assignments, session dates etc. can be presented. Figure 6.8 shows the news page screenshot with 3 announces available on that. The announcements can only be updated by the lecturer.

![Screen shot of the designed website news page](image)

Figure 6.8
Screen shot of the designed website news page

6.3.1.3 Forum Page

In the forum page the course materials could be uploaded by the trainer at each session. These materials are such as text, figures, videos, audios, and also link to online quizzes which can be created in available quiz making websites. Students can browse and download these materials read them and also upload their learning outcomes in type of text, image, video or audio and share their ideas by using reflective learning tools
presented before. They can also evaluate their knowledge by taking the quizzes linked by the trainer. Figure 6.9 shows the forum page screenshot.

By clicking on the links available in this screenshot, the contents can be observed. These contents are shown in the coming screenshots. As obvious in the figure students are able to communicate with each other by uploading and downloading different files. They can easily leave comments on the contents of each uploaded file and share their ideas in a way that everyone can see and also comment back. This ability makes this forum a suitable place for interactive learning.

![Screen shot of the designed website forum page](image)

**Figure 6.9**
Screen shot of the designed website forum page
Figure 6.10
Screen shot of the comment link S3 (concept map)

Figure 6.11
Screen shot of the comment link S2 (multimedia)
6.3.1.4 Chat Room

The chat room was used as virtual spaces for exchanging ideas on the specific topic. Each session all the student share ideas in the discussion in the chat room each week by posing pertinent questions that bring out the main issues of the topic, stimulating discussions and encouraging participation by all members. Figure 6.12 reveals the screenshot of the chat room in the designed website.

![Chat Room Screenshot](image)

**Figure 6.12**
Screen shot of the designed website chat room

The chat room can also be used for the students to have discussions by appointing time in the times out of the sessions. The appointment for the chat sessions can be announced in the news section designed in the website.
The discussion archive has the added benefit of being available to students who were unable to attend the session. After the session each week, students submit a short reflection on the session discussions using the reflective tools.

6.4 Reflective learning conclusions

Knowing how to learn makes students more effective learners. Thinking about learning and writing things down helps to clarify thoughts and emotions in this regard. Reflection also helps to focus and actively participate in development as an effective independent and critical learner. Reflection is itself a way of learning that helps to evaluate a learner’s performance by himself. By engaging in reflective learning the learner is taking an active role in learning and recognizing his personal responsibility for his lifelong learning (Coghlan & Coughlan, 2007).

King, (2002) has described reflection as a deliberate process during which the candidate takes time, within the course of their work, to focus on their performance and think carefully about the thinking that led to particular actions, what happened and what they are learning from the experience, in order to inform what they might do in the future. There are some questions which reflective learners continually think about. The implemented system has been evaluated based on these questions to checkout whether the developed prototype can fulfill the demands of reflective learning.

6.4.1 What they are learning

Based on the input of each lesson uploaded by the trainer the subjects the students learn would be different. The system gives the opportunity to the learners to choose what subject they want to join. Also by opening discussions in the forum they can easily get the ideas on the new unknown subjects for them which may be known to others.
They can chat about any subject they want to learn and share ideas by uploading multimedia files and texts.

6.4.2 How they are learning it

Different tools are provided in the system to enhance learning with higher quality. E-portfolio can improve the learning by using electronic evidences such as text (learning journals), electronic files, images (concept maps), multimedia, blog entries and hyperlinks. The log files traced through student learning approximately include system communication, homework, quizzes, online conversations with classmates, history of access learning materials, academic achievements, etc.

6.4.3 Strengths of the system

This methodology has various strengths:

- allows the students to participate in their own learning process, giving them greater opportunities for self-regulation of their effort invested to develop the specific and cross competences;
- allows teachers to have quantitative data to characterize the contributions of each individual of a work group;
- means a substantial improvement respect to traditional methodologies in the ability to evaluate student learning when teachers are not eyewitness of the activities;
- facilitates the personalized tutorship "in time" so each student can realize what aspects he/she has adequately developed, what other aspects have not been adequately developed (and remedy can be put in time);
- Allows teachers to distribute more homogeneously in time the task to supervise, validate or correct and feedback to students.
6.4.4 Learning priorities

In order to investigate the priorities of learning among students a questionnaire (Appendix 2) was distributed among them to mark the effectiveness of remembering methods by percentage. Figure 6.13 presents the average of the given answers for each category. This table shows that in average people believe that more than 80% of learning is with experiencing and practicing followed by discussing with others (72.2%). These results are in great agreement with the results obtained by Baker (2003) showing nearly the same percentage for each method. The system developed in this study can fully cover all the mentioned tasks. The chat room provides the space for discussion, uploading data can fulfill the multimedia based tasks (reading, hearing, seeing), and experiencing and practicing is provided by online tests and quizzes. This makes the system designed a full task place for people with different tastes of learning.

![Figure 6.13](image)

Some statistics
6.4.5 Improve and build upon the learning process?

The improvement in the learning process by the user can be evaluated by taking online quizzes provided by the tutor. Discussion with others can help the learner to find out his place among all other students and to find out his strengths and weaknesses. He can improve his weakness by seeking help from others and can help others improve by assisting them.

6.4.6 Why they are learning it

Multitask system developed, provides a friendly environment for different people with various tastes for learning. This makes it easy for all the students to find the proper way they prefer to learn rather than traditional tuition by and instructor and reading text books. The conventional method based on Figure 6.13 was only suitable for less than 20% of the learners, while the reflective learning in this system can fulfill all ranges of learners.

6.5 System Testing

In system test search, the functional specification or requirement specification is used to drive a test case selection at this level. System testing looks for errors in the end to end functionality of the system, and also in errors in non-functional quality attributes, such as performance, reliability, volume, stress tolerance, usability, maintainability and security.

In order to gauge the capabilities and limitations of the website, 10 users were invited to test and evaluate the system. The evaluation form was designed to obtain feedback from these users. The form consisted of 3 parts:
• Part 1: personal details- It is use to obtain user’s personal particulars such as name, age group and subject they are study.
• Part 2: pilot test on reflective tools
• Part 3: questionnaire on the website

The purpose of this section is to elicit feedback from the users about the objectives, usefulness, capabilities and features of the website. A sample of the evaluation form is included in Appendix 2 for reference. The result of system testing is shown in Table 6.2.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Quality - Frequency and Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poor</td>
</tr>
<tr>
<td>Ease of Use</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Ease of Navigation</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Functions of Links</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Ease of Exiting</td>
<td>0(0%)</td>
</tr>
<tr>
<td>User friendliness</td>
<td>0(0%)</td>
</tr>
</tbody>
</table>

6.6 Conclusion

A website was designed based on the reflective learning requirements to be used in the Faculty of Computer Science and information Technology, University of Malaya. The capabilities of the website were tested in questionnaire form distributed among 10 users. The website showed reasonable performance in all required aspects.