CHAPTER-1 INTRODUCTION

1.1 Background

At its simplest level, e-learning is a term used to describe the application of Information & Communication Technologies (ICT) to the educational context. E-learning involves much more than the simple transfer of information. The merging of computing technologies, telecommunications and the internet has resulted in an "Information Technology revolution" and has made possible the rapid expansion of e-learning options. Technology allows students - both on and off campus - to take more responsibility for their education. This programme of study continues personal research and professional practice in the field of information science, particularly within the area of end-user system accessibility.

Within higher education, there is evidence of constant innovation and changing approaches to provision of online services, however the wide ranging and long term issue of user accessibility has clearly become a secondary consideration. This research should underpin the improved provision of accessible systems for the adult learners.

1.2 Statement of Problem

The educational needs of students are now seen to be more demandable throughout the educational life, as the technology growth regularly brought new changes in terms of technology revolution (O’Neill et al., 2004). Online courses availability has rapidly increased in the past decade. This increase in ratio brings more improvement to online learning. Most of the contents are presented in the same way in different institutions. The accessibility of these contents depends on the institution strategies. E-learning in higher education is not commonly used. The
accessibility ways varies in different higher education institutions. The common phenomena is, that higher education embed web based e-learning to provide better applications for the students to encourage them to learn. But in this scenario there are some major issues raised by students as well as by the people behind the scene, whose job is to provide and embed contents. Staff often reported that they have not enough time to update the contents in terms of productivity and therefore this leads to delay of information on timely manner to end users (Ettinger et al., 2006). The problem states that most of the contents available through sites are not accessible directly to end users. The end user has to go through different steps to reach the contents. In addition, higher education has faced many other issues recently like promoting e-learning on the web, and its accessibility to end users. Moreover, content presentation is always an issue for online learning to implement it in a proper way.

1.3 Research Aim and Objectives

At the baseline, this research will examine the current levels of accessibility in e-learning systems (Virtual Learning Environments) and assess the difficulties faced by users accessing system features, including interactive content, textual resources, navigation features and communication tools.

The empirical research with learners in assessing more fully practices and policies in accessibility support within different e-learning systems including practical investigation (e.g. via system testing using industry standard specifications) and research activities to gain user perspectives on system usability (e.g. via questionnaires). Different modules and websites through universities will be analysed to reflect leading virtual learning environments systems used across the higher
education sector, which will include some key softwares like Blackboard, WebCT, Moodle and Learnwise.

Institutions need to know which features should be included and where, to enable students to access e-learning systems and required features, educationally valuable that can be supported with additional training or other support for learners.

Objectives of the research are:

1. To study and examine the level of accessibility and usability of e-learning systems.
2. To propose a framework for accessibility and usability of e-learning systems.
3. To develop a prototype (system) based on the framework proposed.

1.4 Research Questions

The research questions are:

1. What are the obstacles faced by students and instructors when using online learning system?
2. What are the issues in providing online learning with content rich sources?
3. How can access and usability issues be practically resolved?
4. What framework can be developed to assess the accessibility and usability of e-learning system?

1.5 Delimitations

Recently, the VLE (Virtual Learning Environment) has become an important feature of electronic service delivery within the higher education information services sector, demanding close attention to issues of functionality, sustainability and usability. Whilst some research has begun to examine the functionality of e-learning systems, little attention has been paid to usability issues, in particular to the accessibility of
complex web based interfaces for normal users. Standards for achieving accessibility via technical specifications and interface design have been established for the conventional web, however it is a point to debate that how far e-learning systems are conforming to these standards and where the conflicts takes place between educational features and usability. Therefore, institutions need to meet recent accessibility legislation and fulfil government targets to deliver vast access to higher education, and this can only be achieved by evaluating e-learning system usability and identifying continuing accessibility needs.

1.6 Limitations

Accessibility of e-learning has a wide range of scope to follow by higher education institutions. However, this study will examine the current situation of e-learning in higher education and that what problems students are facing in the context of online learning.

This study will further be centralized to the needs and requirements of students in tertiary education. It will also examine the training needs for end users to adopt, run and use the system.

E-learning will thoroughly be studied in order to analyze the possible issues confronting while implementing the system.

1.7 Significance of the Study

The significance of this research will more concisely explain the problems, usage, and accessibility of online learning. Online web application will be developed to further evaluate the importance of the study. Moreover, application will examine the current culture of online learning and it will be based on the data collected from the users in
the form of questionnaire. Survey tool will be used to further evaluate the current systems and suggestions will be carried out to improve the system. The application aim is to help higher education to improve and bundle the current learning into user friendly, and provide better support for the end users. The study will further utilize the sources of higher education to meet the current environmental changes for online learning.

1.8 Methodology

1.8.1 Research Method

There are many ways to gather data and some of the common ways are:

i- Literature search

ii- Focus group

iii- Interviews

iv- Telephone surveys

v- Electronic surveys

E-mail and internet surveys are new and relatively less used for sampling of data.

For this research quantitative research methodology will be used to identify the study needs. E-survey and questionnaire will be the source for data collecting. Software tools like Microsoft Excel, SPSS will be used for easy tabulation and piloting after analysing the data. The participants of the study will be postgraduate students.

1.8.2 Prototyping

Different approaches are used for web based application development. However, prototyping model is more concise and near to web based applications. This is because the web based applications changes time to time upon technological
advancement and prototyping model focus on iteration in this case. From time to time updates to the system are being made and prototyping model will revise the product development cycle.

1.8.3 Data Sources

The primary data comes though a questionnaire and the secondary source of data will be e-survey. Questionnaire will be distributed and collected on the spot. Description of survey and instruments used are more discussed in chapter three in detail. As mentioned earlier that post graduate students are the source of data in this research.

1.9 Definition of Terms

E-learning

The delivery of a learning, training or education program by electronic means. E-learning involves the use of a computer or electronic device (e.g. a mobile phone) in some way to provide training, educational or learning material. (Stockley 2003)

Accessibility

Accessibility is a term which defines the degree of access to certain things with ease and defines the measures of its access with time spent. It further incorporates with the degree of approach and quality of access.

Usability

Usability describes the usefulness of quality attributes that are involved in the process of user interface design. It generally defines the term ease-of-use during the design process. It pins down the user experience while using the web and a better access level while surfing around over the website. If website design is chaos and hard to find contents users are looking for, the usability measures will automatically drop.
Information & Communication Technologies (ICT)

ICT (information and communications technology - or technologies) is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as video conferencing and distance learning. ICTs are often spoken of in a particular context, such as ICTs in education, health care, or libraries.

Virtual Learning Environment

A virtual learning environment (VLE) is a set of teaching and learning tools designed to enhance a student's learning experience by including computers and the internet in the learning process. The principal components of a VLE package include curriculum mapping (breaking curriculum into sections that can be assigned and assessed), student tracking, online support for both teacher and student, electronic communication (e-mail, threaded discussions, chat, Web publishing), and Internet links to outside curriculum resources.

Open source software

In general, open source refers to any program whose source code is made available for use or modification as users or other developers see fit. (Historically, the makers of proprietary software have generally not made source code available.) Open source software is usually developed as a public collaboration and made freely available.
1.10 Organization of the Dissertation

Chapter-1 Introduction
This chapter outlines the research background, problem statement, research aim and objectives, research questions, delimitations, limitations, significance of the study, methodology and definitions of terms.

Chapter-2 Literature Review
This chapter will explain briefly online learning in higher education and its accessibility and models of online learning. Literature review will more precisely define the different perspective of the study in terms of its usability.

Chapter-3 Research Methodology
This chapter will outline the survey in detail that will be conducted among the postgraduate students. Survey is used as primary data gathering tool for the research. Survey results will be analysed through different software tools.

Chapter-4 Data collection and Analysis
Survey will be conducted to get the feedback from the students. Survey will be also published online to get more and precise results for the analysis from the students. Survey data will be analysed to build and implement such a system which can be easy and more generic to students.

Chapter-5 Framework
This chapter will outline the framework developed for the system. Framework will explain the whole system in a way to use it later in different projects.
Chapter-6 Prototype Development and Implementation

This chapter will outline the system developed. It will cover system analysis and design, system development and system testing.

Chapter-7 Research Summary and Conclusion

This chapter will explore the research findings, research results and recommendations with summary.
CHAPTER-2 LITERATURE REVIEW

2.1 Introduction

E-learning, a term defined in different ways and patterns. Some think it is all about web-based self-study, some think it is about packaged pieces of infrastructure. But in this manner, all agree that e-learning has a strategic importance. E-learning is an effective method that can be blended to corporate learning style.

Rosenberg (2001) suggested the following definition of e-learning,

“The use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance.” (p. 28).

E-learning is categorized into a variety of contexts, such as distance learning, online learning and networked learning. Arabasz et al. (2003) in their research categorize it in the same way:

- Fully online: Refers to online learning with full functionality.
- Hybrid: Mixed learning including tools and techniques.
- Technology-enhanced traditional: Traditional learning mixed with technology.

From above three mentioned categories, technology enhanced is the most common style to adopt. All of the terms represent a different scenario in a different meaning in terms of accessibility. E-learning can be simplified more by its consistency of contents, learner control, and ease of modification and reduction of costs to approach and attend events.

Rosenberg (2001) described it further as that e-learning has the ability to reach unlimited people virtually; contents presented are the same to all at the same time. Software ability has to change contents according to different set and group of people.
Virtual Learning Environment (VLE) and Managed Learning Environments (MLEs) were the key learning modules, which gave introduction to e-learning in digital learning era.

According to Allan (2002), there are many doors for effective learning through web which includes Cdrom, telephone, videotape, World Wide Web (www) and some others. The effective tools which are more in consideration are: emails, discussion (bulletin boards), chat, white board and video-conferencing.

The accessibility issues which could mainly be focused by the online resources. Some issues arise by not following the standard HTML as set by W3C. Software used by the staff to create the resources some time did not produce valid html code which cause problems while accessing the resources. The provided interface some time lack of rich text editors to use simple html coding which the back end script cannot perform. File types like word, pdf etc are some time not accessible on the right time with updated features and contents.

E-learning is the way to make ease the navigation, information, contents which are presented to user, as Kuhlmann (2008) mentioned in his latest paper. Course contents should be implemented that way, where user can use it upon necessity and have freedom to manipulate it the way they want. This depends on how a course is build, which should make it easy to follow and content provider will provide feedback where it is necessary and appropriate to user needs. Contents presented to students depend on the media interaction between the interface and students, which also define the usability of it.

E-learning needs a strategic plan to overview and implement in a way accessible in every aspect through technology. Strategic planning is the base for implementing a
successful project. All the content should be event driven and from more reliable sources.

Urdan and Weggen (2000) describe e-learning as a subset of distance learning and containing online learning and computer based learning as shown in Figure 2.1.

![Figure 2.1- Subsets of Distance Learning (Urdan & Weggen, 2000)](image)

### 2.2 History of E-learning

There are four decades of e-learning mentioned by Muhlhauser (2003).

**First Decade (65-75)**

This decade presented e-learning in a content presentation way, followed by tests. The end results were not satisfactory because of the limitations of computers with simple monitors.

**Second Decade (75-85)**

In this decade model-based learning was introduced which was called ‘e-worlds’. It included intelligent systems and simulations.
Third Decade (85-95)
The third decade improves the skills of the learners, while providing better facilities. Most of the work was self driven instead of being guided. Multimedia was used to improve the quality of learning as hope of success.

Fourth Decade (95-2005)
The fourth decade brings new innovation to learning in context of virtual learning. Computer based training was introduced. Virtual universities came into existence to change the teaching style. Furthermore World Wide Web was used efficiently to make the contents centralized. Different web facilities were bring into work to enhance the learning model.

Current Decade
Current decade starts from 2006, which hardly have 4 years of revolution to make the technology more accessible and superior than the previous decades. Enhancement occurred in the field of virtualization which more sophisticatedly engage the current learning environment on a bleeding edge. Many things changed like technology, internet speed, and computer approach, use of electronic contents since last decade which make the online learning environment more usable and reachable in this current decade.

2.3 E-learning Products
In this section, some of the existing e-learning products were identified. These products differ not only in their focus, but also in their breadth and depth in characterizing the nature of e-learning. Most of the e-learning products focus on the web as the medium of interaction and learning.
2.3.1 WebCT
WebCT was introduced by educators at British Columbia. WebCT is a popular tool used for creating web educational materials. WebCT can be accessed by students as well in a browser like Internet Explorer, Firefox etc. WebCT can be used to create a complete course or complete classroom based course. WebCT is a learning management system, which enables administrators and lecturers to create and manage the course. There are different tools available to work with. Some of the features of WebCT are that course materials can include text, graphics, audio and video. Students can add their notes and can monitor their grades and progress throughout the academic session.

2.3.2 Blackboard
Blackboard is web based software which enables lecturers to conduct web based classes. This software has greater ability to be redesigned. New tools can be added upon requirement of the time. Blackboard has easy to use navigation system with organized contents. It has also the immediate feedback system, where students can get the feedback to assess their progress. It also provide case studies, simulations, problem based activities which keep engage the students in the learning cycle. There are some restrictions which blackboard forces like file upload size restriction. The system will not allow uploading a file above specified size.

2.3.3 Examulator
Examulator is an online exam tool based on Moodle application. It has features like chat rooms, forums etc.
Examulator does not provide quizzes, it is a student self-based exams, where student conduct tests with a highlighted answers to choose from.

There are more products which provide the same environment of learning.

### 2.4 E-learning Model

Engelbrocht (2003) discussed about a model driven by MacDonald (2001), that how the framework should be implemented to achieve the required goals.

Models of e-learning are attempts to create and develop frameworks for pointing out the issues which learner face and the challenges by technology which are important to implement online learning effectively. In long term and strategic planning process these models are very useful for evaluating online learning programs and determining critical success factor.

The model shown in Figure 2.2 is called ‘demand-driven learning model’ and was developed in Canada as a collaborative effort between academics and experts from private and public industries (MacDonald et al 2001). The model discusses the technology learning management system, contents and services. The technology is a support or a tool to achieve the desired learning outcomes in a cost-effective way.
2.5 E-learning Classification

In order to understand the difference between classifications, it is important to differentiate between content delivery and content access.

Negash and Wilcox (2008) has classified e-learning into six types. Figure 2.4 demonstrates the classification of e-learning.
**Type I** (Face to Face) represents traditional classroom learning. The traditional face-to-face classroom is classified as e-learning because of the prevalence of e-learning tools used to support instruction delivery in classrooms now-a-days.

**Type II** of e-learning is a self-learning approach. Learners receive the content media and learn on their own.

**Type III** represents a format where instructor and learner do not meet during content delivery and there is no presence, neither physical nor virtual; presence is therefore classified as “No”.

**Type IV** is a synchronous learning also known as “Real-time learning”. In this classification tutor and learner did not meet physically however they always meet virtually for the delivery of contents.

**Type V** is blended or hybrid e-learning, tutor and learner physically meet occasionally for content delivery.
Type VI, this format of e-communication is used extensively just like with a synchronous format. Some physical classes are conducted to meet as well as meet virtually through technology.

2.6 E-learning in Higher Education

Singh in Darling (2002) stated that,

“For higher educational institutions, an effective strategy does not assure success, as the technical issues in distance learning delivery will always be significant. Possibly, this point highlights the inexperience of universities with regards to incorporating technology effectively, and justifies the need for external partnerships and alliances.”

For a competitive improvement, virtual campuses play an important role by motivating the students in a highly technology enabled environment. The enhanced technology improves the teaching style, without removing the role of the instructor, teacher and lecturer from the teaching style. It still demands a need to further accomplish the set goals. However, technology with the passage of time improves the teaching style and changes it from white board to electronic learning and communication. The new teaching tools provide a better potential to equip lecturers in higher education with a high rate of emerging and changing courses with day to day new IT enhancements.

The accessibility is measured by quality not by quantity as Joung & Jang (2004) states that process centered quality management approach is required for quality management activities from the early stage which will be performed continuously for better results.

The development of courses to meet the required criteria is very important.
ICT (Information, communication & technology) technologies support many different types of capabilities. Diana Laurillard (2006) stated that e-learning applications could be exploited within higher education in different forms, which could be technology driven in terms of ICT:

- Electronic access to digital versions of materials not available local
- Fully authorized access to search and transactional services
- Enhanced tutorials and interactive media
- Interactive educational games
- Remote control access to local physical devices
- Personalized information and guidance for learning support
- Simulations or models of scientific systems
- Communications tools for collaboration with other students and teachers
- Tools for creativity and design
- Virtual reality environments for development and manipulation
- Data analysis, modelling or organization tools and applications

The available scope and range of technologies are very broad, but it is not easy to implement it basis on daily changes. While implementing and coping one technology now with some possible results, another application is available as an alternative with more possibilities. One of the common examples is 3G mobile phones, which are changing rapidly.

E-learning depends on the new technology or applications in the service of learning and support of learners. E-learning make difference in the higher level education in context of how learners learn, how quickly learners adopt and master a skill, how easy it is to study, and significantly that how they are interested to learn and follow the pattern of E-learning. Such type of learning will impact the experience of learning:
**Cultural** - In context of cultural, defines whether students are comfortable with E-learning methods; the way information, forms, communication methods and search tools are presented to them.

**Intellectual** - Technology offers a new mode of interactivity in form of material and online.

**Social** - Reduction in social difference will affect the students for taking responsibility of their studies.

**Practical** - E-learning shares quality resources among the participants across networks.

Bentley and Wilsdon (2003) stated that the need of such system will increase which can reconfigure itself to an automatic process and create new sources of public value. This means that different layers and functions of governance, not searching for a static blueprint that predefines their relative weight would be brought into interactive linking.

Cisco Systems CEO John Chambers predicted that E-learning will be the next internet application and that e-learning industry will make use of technology with the passage of time and it will become bigger and bigger that email will be a small rounding error in front of it. The most recent Gartner Higher Education E-learning survey stated that E-learning is changing Higher Education, not as replacement of the physical class but as a supplement of classroom.

In Gartner survey it is stated that nearly 40 percent of instructional staff used e-learning technologies to supplement their teaching in 2003 with compare to 12 percent in 1999 and 30 percent in 2002. 50 percent of students participated and respondents expected this number to rise nearly to 59 percent in the coming 12 months.
Gartner further stated about a prediction for 2009, that more than 50 percent of all courses offered will be a hybrid of face-to-face and online learning.

Singh et al. (2005) in their journal explore the links of higher education with industry as a business-focused approach. Many previous works have identified that a more business-focused approach to higher education in conjunction with improved technology has resulted in an increased number of universities to business alliances. Henry (2002) explains that in today’s information age traditional universities must compete with other educational providers, such as education centers and corporate universities, if they are to attract and retain suitable students and to improve the quality of education online. In contrast, whilst such substitute educational sources are increasing steadily, conventional universities should distance themselves from these developments and focus more on internal development and improvement (Shapiro 2000). Fry (2001) offers that universities are driven to E-learning as a marketing tactic to attract and enroll part time students and to maintain market position, and the rise of alliances with other organizations is inevitable due to social demands for knowledge and the lack of public and government funding in higher education.

The range of E-learning providers is increasing rapidly and Henry (2002) suggests that the number of corporate universities may outnumber traditional universities within five years. Teare (2000) debates the credibility of such corporate universities, which offer product specific training within a specific number of disciplines and debates that they only seek alliances with other normal and traditional universities in an attempt to take advantage of universities respected reputations. While other traditional higher institutions are keen to learn more about implementing and adopting e-learning from external organizations, they are extremely cautious with regards to connecting themselves to potentially precarious organizations (Dobbs 2000). Due to
social demands for flexible learning, the business marketplace is now progressing on the more traditional realms of higher education (Teare 2000), and if traditional institutions and universities are to remain in the competition as an education provider and advance technically they must embrace the knowledge and experience of external clients in the new online and distance learning revolution (Jones 2000).

Catherall (2004) further debate about the learning modules and said, e-learning and related technology based systems used to enhance and support learning and teaching is rapidly becoming an important and necessary feature of the fast changing climate in higher education.

In recent years W3C (World Wide Web Consortium) has managed to approach more software developers, accessibility organization and other stakeholders for cooperation to strengthen and develop a strong industry based standards for web (Catherall 2004). E-learning has been utilized effectively in universities for teaching and administration. Laurillard (2006) further explain it as, students on different courses in many universities now find they have web access to the lecture notes, resources and selected digital resources in support of their study, they have personalised web environments in which they can join discussion forums with their class or group, and this new kind of access gives them much greater flexibility of study. Part time students can more easily access the course and this in turn supports the objectives of wider participation, removing the traditional barriers to higher education study.

Laurillard (2006) further stated with the analysis as, there are other possibilities like a design and editing program would enable students to explore the effects of music on audience interpretation of a film scene to achieve a goal of producing a combination that generates a specific effect when tested with the selected audience. Art students can thoroughly investigate the principles of composition of paintings and collages
with the goal of using them to draw and illustrate certain visual effects can be produced. Other students like drama could investigate the effects of the timing of pauses in a monologue with the goal of directing a given script to produce their desired and chosen interpretation.

E-learning could do more things upon the need of requirements. The computer could be used to give students an alternative way of writing as a form of active contribution in knowledge building. It can model real-world systems and transactions, and can therefore create such an environment in which learners can explore, learn, manipulate, and experiment. The features of the technology environment are controlled by the program so that it can be designed to offer as much or as little freedom to the learner as is appropriate to their level of mastery. A simple example can be a mathematical model of a well-researched and organized system, such as population dynamics in biology, or unemployment fluctuations in economics. An interactive simulation enables students to explore how the model behaves according to the way they change parameters of the system. The instructor can set challenging problems, such as finding the combination of changes in inflation and exchange rate that produces a sudden rise in unemployment. Students can inspect, examine, experiment to build and test hypotheses, and generate a rich sense of how this model behaves, i.e. how every economic theory works. The instructor could extend this further, as they become more knowledgeable, by noting that the model fails to account for a recent set of data, for example to offer and make variation in the model which students must then further investigate, examine and interpret in real-world systems.
2.6.1 Technological change and the learning experience

Common Spreadsheet software can perform a lot of functions. It is not just hold and save data but also have different ways of calculating data to represent in a different behavioural of a system.

Laurillard (2006) states about the technological changes and analyze it this way, that the sequential technological change in interactive technology has been a historical accident driven by curiosity, the market, the organizations, the politics; it was never about the learners needs. Learning technologies have been developing haphazardly, and a little too rapidly for those of us who wish to turn them to advantage in learning. This becomes clearer if we compare and analyze these technological developments with the historical development of other key and demanding technologies for online education.

Laurillard (2006) further discussed the change in technological behaviour of learning in tabular form to explain the change in more challenging way.
<table>
<thead>
<tr>
<th>Date</th>
<th>New Technology</th>
<th>Old technology equivalent</th>
<th>Learning Support function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970’s</td>
<td>Interactive computers</td>
<td>Writing</td>
<td>New medium for articulating and aging with ideas</td>
</tr>
<tr>
<td></td>
<td>Local hard drives and floppies</td>
<td>Papers</td>
<td>Local storage with the user</td>
</tr>
<tr>
<td>1980’s</td>
<td>WIMP interface</td>
<td>Content, Indexes, Page Numbers</td>
<td>Devices for ease with access</td>
</tr>
<tr>
<td></td>
<td>Internet</td>
<td>Printing</td>
<td>Mass production and distribution of contents</td>
</tr>
<tr>
<td></td>
<td>Multimedia</td>
<td>Photography, sound and film</td>
<td>Elaborated form of content presentation</td>
</tr>
<tr>
<td>1990’s</td>
<td>World Wide Web</td>
<td>Libraries,</td>
<td>Wide access to extensive contents</td>
</tr>
<tr>
<td></td>
<td>Laptops</td>
<td>Published books</td>
<td>Personal portable access to the media</td>
</tr>
<tr>
<td></td>
<td>Email</td>
<td>Postal services</td>
<td>Mass delivery of communication sages</td>
</tr>
<tr>
<td></td>
<td>Search Engines</td>
<td>Bibliographic services</td>
<td>Easier access to extensive contents</td>
</tr>
<tr>
<td></td>
<td>Broadband</td>
<td>Broadcasting, telephone</td>
<td>Choice of elaborated contents</td>
</tr>
<tr>
<td>2000’s</td>
<td>3G Mobiles</td>
<td>Paperbacks</td>
<td>Low-cost access to elaborate contents</td>
</tr>
<tr>
<td></td>
<td>Blogs</td>
<td>Pamphlets</td>
<td>Personal mass publishing</td>
</tr>
</tbody>
</table>

Table 2.1 - New media and delivery technologies for information processing and communications compared with their functional equivalents for reading and writing

(Diana Laurillard 2006).
There is one very attractive point about Table2.1. The improvement and development in information and communication technologies over the last three decades is quite comparable and equal with the improvement in information and technologies over the last three millennia. There also attractive ways of presenting Table2.1, but the point of information and technology is likely to be very common to any sort of analysis of ICT (Laurillard 2006).

2.6.2 E-learning and its constraints in terms of accessibility

Alsultanny (2006) explains three types of basic remuneration of e-learning. E-learning enables companies to update sites and study materials and information across the whole enterprise keeping contents fresh, available and relevant. This is especially important as product development cycles continue to reduce, as well with product modifications frequently and company infrastructure, organization and policies become more important and volatile. E-learning course can be broken into different one-hour modules instead of daylong and weeklong programs to offer flexible environment for training. Employees can adopt training sessions to their own lives and style of learning, accessing material whenever it is convenient to review and analyze course material. Last is to globalize e-learning within global corporations with different time zone peoples, it will save cost of travel and delivery schedule.

Catherall (2004) further debates about this and says,

“The characteristics of this new global educational market are characterised by distance learning, student-led study approaches and use of VLE systems to provide communication, collaboration and content delivery functions.”

Rosenberg (2001) explained this further in table 2.2.
### Features

<table>
<thead>
<tr>
<th>Features</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information is consistent or customized, depending on need</td>
<td>Everyone gets the same content, presented in the same way. Yet the programs can also be customized for different learning needs or different groups of people.</td>
</tr>
<tr>
<td>Content is more timely and dependable</td>
<td>Because it is web-enabled, e-Learning can be updated Instantaneously, making the information more accurate and useful for a longer period of time. The ability to upgrade e-Learning content easily and quickly, and then immediately distribute the new information to users is extremely time efficient.</td>
</tr>
<tr>
<td>Learning is 24/7</td>
<td>Students can access e-Learning anywhere and at any time of the day. It is “just in time – any time’ approach makes the learning process ubiquitous.</td>
</tr>
<tr>
<td>Universality</td>
<td>E-Learning is web-enabled and takes advantage of the universal Internet protocols and browsers. Concern over differences in platforms and operating systems is rapidly fading. Everyone on the Web can receive virtually the same material in virtually the same time.</td>
</tr>
<tr>
<td>Scalability</td>
<td>E-Learning solutions are highly scalable. Programs can move 10 participants to 100 or even more participants with little effort or incremental cost (as long as the infrastructure is in place).</td>
</tr>
<tr>
<td>Builds communities</td>
<td>The Web enables students to build enduring communities of practice where they can come together to share knowledge and insight. This can be a tremendous motivator for learning.</td>
</tr>
<tr>
<td>e-Learning lowers costs</td>
<td>Despite outward appearances, e-Learning is often the most cost effective way to deliver instruction or information. It cuts travel expenses; it can also reduce teaching time, and significantly reduces the need for a classroom/teacher infrastructure.</td>
</tr>
</tbody>
</table>

Table 2.2 - Constraints of e-Learning (Rosenberg, 2001)
2.6.3 Accessibility for Students

Singh et al. (2005) discuss the accessibility from a different perspective; the most important attributes of e-learning technique and delivery are that they potentially give students more freedom of accessibility to education, while comparing it to the traditional way of learning. Hemsley (2002) express his ideas that both full time and part time students can now participate in their chosen degree course from different locations, giving an alternative way for those who travel or relocate in the form of easily accessible learning experience. By use of advanced technology which provides online learning which was not available previously for higher education (Salder-Smith 2000).

Singh et al. (2005) further enlighten the accessibility, that there are some good points which make the accessibility to higher education but also beside that it enables users to make use of technology like computers which is an effective way of e-learning courses (Ribiero 2002). There are others reasons while using networked computers which may have a good source of learning experience but it could be fail for higher education due to students not being able to afford or again access to a computer (Shaba 2000). Hence students with no computer at home cannot benefit from e-learning environment. This may be a costly way for those who came from low income backgrounds and have little disposable income to purchase computer. Hence the increased reliance on technology to define online learning in higher education may lead to further divisions in society (Shaba 2000).

2.7 E-Learning Motivations and Concerns in context of Higher Education

In an organizational point of view, a stakeholder is a constituency of an organization (Thompson and Strickland, 2001). Each of these stakeholder groups is described in
the following sections, along with their motivations to use e-learning and their concerns about it.

2.7.1 Students

Students are the consumers of e-learning and they access the contents provided to them. In the context of higher education, they are undergraduate or graduate students enrolled at a university or college.

**Motivations:** Students are motivated to use e-learning to gain access to higher education for further studies. For students, it may be a component of a traditional course; while for others entire courses may be provided completely online. Particularly for the second group of students, E-learning may create access to higher education that they would not have otherwise because of geographic or time constraints (Huynh et al., 2003; Kabassi and Virvou, 2004).

**Concerns:** E-learning presents an entirely new learning environment for students, thus requiring a different skill set to be successful (Romiszowski, 2004). Critical thinking, research, and evaluation skills are growing in importance as students have increasing volumes of information from a variety of sources to sort through (New Media Consortium, 2007). Students in online courses tend to do as well as those in classrooms, but there is higher incidence of withdrawal or incomplete grades (Zhang, Zhou and Briggs, 2006). Simulations and digital game-based learning may be better suited for this group. Research has linked higher levels of interactivity and learner control with increased student satisfaction in e-learning (Zhang et al., 2006).
### 2.7.2 Instructors

In e-learning, instructors guide the educational experiences of students of traditional classroom learning. Depending on the mode of e-learning delivery, instructors may or may not have face-to-face interaction with their students, which depends on the mode of study.

**Motivations:** Instructors may be motivated to use e-learning in their courses for different and meaningful reasons. For example, they may be encouraged or pressured by their institutions; they may wish to reach a broader audience of students; or they may have an interest in the benefits of technology mediated learning.

**Concerns:** E-learning technologies bring as much change to instructors as they do to students, again requiring a new set of skills for success (Jones, 2003). In the e-learning environment, instructors shift from being the primary source of students’ knowledge to being the manager of the students’ knowledge resources (Romiszowski, 2004). In contrast, in a technology only asynchronous e-learning environment, the instructor is more of a coordinator of the content, which students then peruse at their own pace (Teo and Gay, 2006). E-learning requires technical sophistication from instructors as well as other learners (Jones, 2003). Studies have shown that the main and demanding challenges of technical support for e-learning initiatives include lack of knowledge of how to alter instructional design to be more effective for online courses with technology and lack of confidence in using these applications to teach (Arabasz and Baker, 2003). Studies have found that perceived usefulness and perceived enjoyment are very important for the adoption of e-learning applications by students. In order to increase perceived usefulness and enjoyment, teachers should change the types of content, and modify it, create fun, provide immediate feedback, and encourage interaction to increase acceptance (Lee et al., 2005). The amount of
time that it takes instructors to create, update and administer e-learning courses is another very likely important consideration. While some promote that the delivery of e-learning courses is less labor intensive, a 2003 study found that faculty and support staff spent almost twice as many hours providing online versions of courses compared to traditional delivery (Doughty, Spector and Yonai, 2003).

2.7.3 Educational Institutions

Educational institutions, in the context of higher education, include colleges and universities. In addition to the traditional list of other institutions, the rise in popularity of e-learning has lead to the creation of new, online only educational institutions.

Motivations: Educational institutions integrate technology into classrooms to facilitate lecture delivery and create new technology mediated learning opportunities for students beside the traditional learning environment. They provide distance learning, including e-learning, to develop access to a larger pool of students. As e-learning now more widely accepted and more courses are offered online, geographic boundaries between institutions and students are almost removed (Young, 2001).

Concerns: Often, budgetary restriction is a primary issue for institutions (Huynh et al., 2003). There is a tendency for individual departments to develop and implement their own solutions, which may not be consistent with the rest of the institution (Sun Microsystems, 2003). Depending on the technological infrastructure in place at an institution, the implementation of e-learning courses can involve very costly technology upgrades (Weller, 2004). E-learning systems require several different components which includes sufficient bandwidth, content availability, site accessibility, course management systems, technology equipped classrooms, and
adequate computer facilities for student use (Arabasz and Baker, 2003). This increase in technology change generally requires a corresponding increase in support staff as well (Young, 2001). An e-learning implementation can only be considered effective if learning took place in a manner which results give positive aspects. The tendency of organizations to focus on accessibility can encourage cheaper program development, at the expense of learning effectiveness (Weller, 2004).

Many faculty members firmly believe that e-learning is more useful than face-to-face instruction (Huynh et al., 2003). Studies have shown, however, that there is no significant change between the performances of students in the two methods (Huynh et al., 2003). But however e-learning still need better management in sense of its accessibility and further its improved usability.

### 2.7.4 Technology Providers

Technology providers develop the technology that enables e-learning delivery. This category consists of a broad range of services, from the facilitation of individual distance learning courses, to complete Learning Management Systems (LMS) provided by companies such as Blackboard.

**Motivations:** Similar to content providers, technology providers are motivated to provide learning environments that will result in effective learning for students.

**Concerns:** Technology standards are an important consideration for this stakeholder group as well. Since educational institutions often have different solutions time to time implemented by various departments, adherence to common standards facilitates interoperability (Young, 2001; Friesen, 2005). Constant evolution in hardware and consumer expectations creates pressure for technology providers to rush to market with new product offerings (Huynh et al., 2003). In order for these businesses to be
sustainable, the cost of pursuing this constant innovation must be controlled (Dalziel, 2003). Many business experts attribute the shortcomings of e-learning to technological issues (Woodill, 2004). It is discussed that many products are not developed on proven educational principles and thus do not take the different ways that people take into thought for (Woodill, 2004).

2.7.5 Content Providers

In the higher education context, online course content may be created by instructors or acquired from external sources like organizations with educational background. The growth in e-learning has created a market for commercialized educational content creators, particularly for more introductory courses that are offered consistently at multiple institutions.

**Motivations:** Whether the content provider is the instructor or an external source, their motivation is to provide content modules that will result in effective learning. Commercial content providers are motivated by profit to develop content modules that are flexible enough to be readily utilized across institutions with minimal adaptation efforts and more flexible in terms of implementation.

**Concerns:** The main concern for content providers in e-learning tends to be intellectual capital rights (Huynh et al., 2003). Technology values are another related concern for this stakeholder group (Teo and Gay, 2006). It is equally important to make certain that the content provided is consistent with the learning methodologies in use at various institutions and thus being more likely to result in successful learning (Greenagel, 2002). Learning can be impacted by the type of content, the learning environment, and even the characteristics of each learner (Zhang et al., 2006).
learning content providers need to take this into consideration when developing content.

2.8 Accessibility of E-learning

McLoughlin and Luca (2001) discussed the role of web sites this way, there are many forms of teaching a course such as pedagogical re-engineering in which the key element to use is media and make different scenarios for the students to contribute actively by gaining and exploring their knowledge. By implementing such an idea of assigning new roles and enabling students to contribute for learning resources and contents create an environment which can be called learner-centered. Students can share URL’s and other activities on the course site and other students can participate in the discussion to evaluate it.

Chumley-Jones et al (2002) analyzes the web-based learning from this angle; web-based learning (WBL) represents a further evolution of computer-assisted and electronic based instruction. Technical advantages of web-based learning include universal accessibility, availability of contents on time, ease in updating content, and hyperlink functions that permit cross-referencing to other resources. These technical advantages, specifically hyperlink and searching capabilities, fit the constructiveness learning theory, where learners do searching and make their own knowledge bases.

However, as was evident with computer-assisted instruction, potential advantages may not translate into significant improvements in educational outcomes.

Harasim (2000) stated, the real value of web-based learning lies not in accessing knowledge at any time, any place, and for anyone, but helping the right students to acquire the right skills and knowledge at the right time in order to function as active,
self-reflected and collaborative participants in the information based society. Which further broadening the online learning usability in terms of the collaboration. Hadjerrouit (2006) discuss system scope and its learning environment as a learning development. A very important concern in web-based learning development is the scope of the system being developed and implemented. The system scope makes sure that the requested changes do not go beyond the accepted scope. The system scope can be determined through the identification of the learning environment that directly affects web-based learning.

![Figure 2.5 - Learning environment and system scope (Hadjerrouit 2006)](image)

Hadjerrouit (2006) further explain Figure 2.5 in terms of learning environment. According to Hadjerrouit the learner dimension refers to the learners characteristics that affect the development and use of web-based learning. Learners have different knowledge backgrounds, skill levels, adopting, and learning styles. They hold opposing views in how they view the learning environment.
The legal and ethical dimension refers to the legal and ethical environment of web-based learning since any system is affected by legal constraints and ethical conventions, including copyright protection of knowledge producers, as well as security against knowledge manipulation and all forms of cheating (Graf, 2002).

The technical dimension refers to the information technology infrastructure, which relates to the hardware and the software environment of web-based learning. In contrast to traditional software systems, which are built using a homogeneous technology infrastructure, web-based learning systems run in a heterogeneous computing environment that includes and can run on multi platforms, multi browsers, and multi software and with multimedia support. This heterogeneous environment has web programming languages, automated web authoring tools, and many other means of implementation such as HTML, XML, JavaScript, CGI scripts, Java Servlets, PHP, Perl, web editors and databases.

2.9 Usability of E-learning

There are many applications of e-learning providing good and nice interface for usability of online learning systems. Moodle is one of the application adopted by many institutes. The pedagogical dimension is one of the major forces behind web-based learning, because it directly affects its implementation (Govindasamy, 2002; Hamid, 2002; Motschnig-Pitrik & Mallich, 2004; Nocols, 2003; Watson, 2001). Thus, it must create the very basis for web-based learning development.

The usability dimension refers to the user interface dimension, which is a central feature, because web-based learning systems are built-in interactive.

Rugg-Gunn (2008) enlightens the delivery of learning in the form of availability and its accessibility. From the learner’s point of view some applicable points are:
- 24/7 access to instructional and supporting material
- Learning at one’s own pace with options
- Contents customized to different learning styles with ease of content styling
- Learning in a comfortable and relatively stress free environment

For the organization or system manager the benefits of delivering online are quite impressive, this can be a reduction of expensive cost based materials and with increased work capacity for learners.

Web-based learning on the whole is more advantageous and effective rather than the traditional classroom based learning. Looking to the web-based learning from the perspective of ‘blended learning’ it is more sophisticatedly effective. By mixing both web-based and classroom based learning, web-based was more precisely effective 13% than classroom (Rugg-Gunn 2008).

Rugg-Gunn (2008) gives more attention to quality instructional design. The researchers strongly expresses that it is the quality of instructional design that is the important factor to great learning and development. In this case web-based learners’ works best where:

- They are in control of the materials (e.g. contents, privacy, and adopted environment).
- The design of site enables them to practice the skills they are learning.
- They are undertaking a long course of instruction rather than a momentary interruption in regular routines.

Knight (2005) discuss the web-based learning in context of VLE (Virtual Learning Environment) as, the main advantage of a VLE is that it easily allow lecturers to create a course website online (without the need for any sort of web page skills) and populate it with course materials. It may also include some communication and
collaboration functionality. Students will be required to log in to the system to access course and communication tools which provide security for the students while using the system.

Knight (2005) explain and analyze the functionality of learning environment as an assessment tool. It is the best way to upload contents to make it available for all to use as course material by the instructor and create courses too. It helps to create online tests for the students and offers navigations for the students throughout the contents. This type of learning environment also supports communication tools between students and teachers. It has the ability of password protected pages which make sure to not use the contents without any permission. The accessibility of the learning tool provides more sustainability for the system users and its use on a tracking base shows the system availability and its maintenance mode.

2.10 Users Roles

Different online learning applications were studied thoroughly where it is suggested different roles for users via different modules. There are three primary roles defined by applications like Moodle. Every user of the system has different actions and tasks which differ from each other while performing the tasks. The following roles are identified:

- Users with complete authority on the system usually known as system administrators.

- Primary users are the users who use the system with provided protocols and actions. These users perform different tasks in the system like lecturer and student have different tasks and actions.
- Secondary users of the system who interact with both primary and system administrators’ users normally known as system maintainers.

These roles will be further classified and studied in the system development phase.
2.11 Summary

The purpose of this chapter was to study the e-learning models, classifications, implementation, adopting, accessibility and its usability. The goal was to achieve the clear picture of e-learning in context of higher education. The features were studied by the researcher to analyze the learning process through World Wide Web. Focus was on web-based learning which gives more clear idea of problems faced by the students. The interaction between the lecturers and students were studied to more initialize the process of development and framework. Literature review has been analyzed thoroughly to accomplish the task of feature rich web-based learning system and study the current issues. The term accessibility referred to the electronic means of study, from 2000 and onwards the use of internet increased which further help to access different materials on time. But there are still things which need to be considered. Most of the higher education students some time do not have access to electronic resources or either the institute does not provide any mean of source for the students. Some areas which need consideration are contents availability, timely updates, one window operation, easy to use navigations, avoid cross site contents, avoid cross site linking, integrate latest technology from time to time. Higher institutions could arrange a survey from time to time among the students and staff to know the new trends and needs, which could help in implementing the new technology and enhancements. There are some factors studied in this chapter which lead to new applications and framework development, where the interaction between the students and lecturer became easier, meaningful and access resources on timely manner. There are also some other factors which lead to uncertainty to use e-learning systems such as the right technology installation, secure and fast web access. As the wireless net became more popular, that make the net more accessible within the
higher education institutes. Certain lack of provision for integration of applications some time lead to more complex learning scenarios. Usability factor is more commonly dependent on the interface provided by the application. Hence the appearance of every module may be different from others, to eliminate such things, a centralized system required to be developed and implemented. Figure 2.6 shows interaction between the system users and e-learning applications.

Figure 2.6 – Interaction of users within the system
CHAPTER-3 RESEARCH METHODOLOGY

3.1 Introduction
The aim of this chapter is to give an introduction about the general research methodology used in this study together with specific tools used in data collection and analysis.

A method is a tool, a way to solve a problem to reach and discover new knowledge (Holme and Solvang, 1997).

The method used will increase the possibility of gaining appropriate answers for the research questions.

The survey based research is a research in which a survey is used as the main or the primary source of data. The main objective of a survey research is to answer the questions such as in case of e-learning that what is happening in e-learning world, how some issues can be practically resolved in terms of accessibility and usability.

3.2 Research Method
There are different types of research methods used in scientific work, qualitative and quantitative are most common to use. The main difference between these two is, quantitative research more focus on a situation that can be generalized, while qualitative research focus on situation in a deeper understanding.

According to Creswell (2003), quantitative research is a research in which the researcher focus on use of positivist claims for developing and discovering knowledge (i.e. cause and effect thinking, minimizing of variables and hypothesis and questions, use of instruments and observations, and analysis of theories), employs strategies of
inquiry such as experiments and questionnaires and collects data on specific instruments which gives statistical data in terms of percentage.

Quantitative research method is frequently referred to as hypothesis-testing research. Quantitative research is purely based on mathematics and statistical analysis. It will be based on objectives which are represented by mathematics.

In this research quantitative research method will be used to identify the study needs. In quantitative research method results are put in numbers rather than words for the data analysis. The focus of the study is to identify the factors of learning online and describing the issues in more detail. Postgraduate students will be chosen from different courses to gather the data, and finding out the way to use e-learning in daily basis in their study duration for every group of users. Most of the research work will be, to find out the users opinion about e-learning and its accessibility and usability in a timely manner during their study. Survey questionnaire will be used as a tool and instrumentation to gather data. By using the survey as a data collection will be analyzed to obtain knowledge, which will be described and discussed through this research. Findings will be discussed in details to obtain the outcomes from the data gathered.

3.3 Research Strategy Design

In this part of research strategy design will take place. The design is divided to two parts, one is tabular form and another one is graphical form. The graphical form will make the data flow easy to understand and follow. Tabulation will be performed to accomplish the most important part of the design. Tabular form presentation will make it easier to follow the data gathered into a readable form to users, and to understand the data in an easy manner. Statistical analysis of data gathered by survey
questionnaire will examine the nature of the findings, and will interpret the outcomes to discover underlying meanings and pattern of relationship between the data. The results will be summed up and will help in conclusion. Tools like Microsoft Excel and SPSS will be used to analyze and pilot the data after the data collection. A specific model will be chosen to help to clarify the work of the research and implementation

### 3.4 Data Collection Technique

Data collection technique is an important aspect of any type of research study. Inaccurate data collection technique can impact the results of a study and ultimately lead to invalid results. There are number of data collection techniques like:

#### 3.4.1 Survey Questionnaire

Survey questionnaire include paper-pencil-questionnaires, web based questionnaires, and many others. It is the most common form of data collection in which the investigator selects a sample and then conduct surveys.

In this study survey questionnaire will be used as data collection technique. Two type of distribution will be used, one is online survey most commonly known as e-survey and another one is a traditional hard copy. Questionnaire copies will be distributed among postgraduate students, and e-survey links will be sent to students through university web based mail.

E-survey is new and inevitably growing methodology which make of use of internet based research. This would mean receiving an e-mail on which student would click on an address that would take him/her to a secure web-site to fill in a survey questionnaire. This type of research is often quicker and less detailed.
3.4.2 The Instruments

The questionnaire is divided into six parts as described below:

I- Overall information about respondents: This section collect the general information about the students like age, student type, gender.

II- Access of e-learning: This section attempt to gather data from students in regard of e-learning access, that how the student access the online data through different sources. This section is more about collecting information about learning modules students are using in their studies.

III- Use of different tools: In this section students are asked to mention, which technologies they are using during their studies, in this scenario most commonly tools presented to them by the researcher are email, forums, blogs, chat.

IV- Use of content management system: This section attempt to get the feedback from the students regarding use of any system which came under content management system such as Moodle, Webcast.

V- Technologies using for current semester: This section of the survey is to gather data from the students for the current semester asking them about the technologies they are using. They are asked to use Yes or No for the specified fields in the survey.

VI- Suggested features and feedback: This section covers the most important part of the questionnaire where students are asked to suggest any features they want to be part of the system. Researcher gives them option in one question to choose from and in the last two questions asked for features and comments.

3.5 Data Analysis Technique

There are different methods to analyze data. In this study of research two methods will be used which are commonly used for data analyses.
I- Valid percentage

In valid percentage missing data are excluded from the total count, which make the analysis more accurate. Most of the tabular data will be analysed in this form to achieve better results.

II- Cumulative percentage

In cumulative percentage each new data percent of the running tally of the total percentage added to next data percent. Which make the data set more understandable and accurate.

3.6 System Development Methodology

Whitten et al., (2001) states that, a system development methodology is a very formal and precise system development process that defines a set of activities, methods, best practices, deliverables and automated tools for system developers and project managers to use to develop and maintain most or all information systems and software.

There are many web development methodologies available. One of them is Object-Oriented Hypermedia Design Method (OOHDM), which is selected for this study of research to build a framework and system.

This methodology is used for complex hypermedia applications such as complex web sites, interactive multimedia applications.

3.6.1 Justification of the Object-Oriented Hypermedia Design Methodology

OOHDM was originally developed by Daniel Schwabe and Gustavo Rossi in 1998. The basic goal of the methodology was to approach hypermedia applications including web-based applications.
According to Schwabe and Rossi (1998), Hypermedia applications typically include complex information, and may allow sophisticated navigation behaviour. The Object-Oriented Hypermedia Design Method (OOHDM) uses abstraction and composition mechanisms in an object-oriented framework to, on one hand, allow a concise description of complex information items, and on the other hand, allow the specification of complex navigation patterns and interface transformations.

Object-Oriented Hypermedia Design Methodology typically consists of five steps, which are requirements gathering, conceptual design, navigational design, abstract interface design and implementation. In the methodology each step focus on a specific design and an object-oriented model is built upon it.

3.6.1.1 Step-I Requirements Gathering

The first step is to gather requirements of the system. In the requirements gathering step use cases are used and actors of the use case are identified with tasks performed by the actors. The use cases are presented in user interaction diagrams, which provide a brief and concise representation of the interaction between the users and system. In this step iteration occurred if necessary for the system. Users are identified in this process of the research, postgraduate students and lecturers are the main actors interacting with each other and admin play the role of system administrator to maintain the system.

3.6.1.2 Step-II Conceptual Design

OOHDM uses its own modelling tool, however according to Schwabe and Rossi (1999) any object-oriented model tool can be used to build the system.
Aggregation and generalization/specialization hierarchies are used to build conceptual classes, users and tasks, and will not be affected in the whole process except application domain semantics. Conceptual schemas further produce sub-systems, classes and relationships (Schwabe and Rossi 1998). System users are further classified into groups in the system and the classes and relationship between them are explained to enhance the system functionality.

### 3.6.1.3 Step-III Navigational Design

Navigational design describes the hypermedia application in terms of navigational contexts as links, nodes, and indices. Navigational design depends on conceptual design. It is a very essential step for every hypermedia and web-based system. Therefore it allows the developers to build regarding to different users profiles (Schwabe and Rossi 1998).

Conceptual schema and different navigational models to be build to represent views of the same domain. Step-1 more precisely describes the links derived from the conceptual relationships. Nodes and links can lead to a model movement in the navigation space (subsets of nodes where users’ interaction occurs) regardless of conceptual model (Schwabe and Rossi 1998). This phase explain the system navigational design and roles of each user in the system, three main roles identified in this step in this research are student, lecturers and system admins.

### 3.6.1.4 Step-IV Abstraction Interface Design

Interface design layer is to describe the user-interface of the hypermedia application system by using Abstract Data Views (ADVs). The focus in step is on dynamic user-
interface, which can be further explained in a hierarchy way. Interface behaviour takes place to specify the handling of the external and user generated events, and describes the communication between the interface and navigational objects. In this phase all the gathered data from the students will take place in action, this will also lead to the system implementation and how the system will look like. The main focus is to gather the data in the survey, analyse it and present it in the form of interface design.

3.6.1.5 Step-V Implementation

In this final step of the methodology all the components are joined by the end nodes and the constructed models are implemented. The implementation step doesn’t need any specific platform; it is a cross platform step. In this last phase of the methodology implementation occurs of the system. Every system nodes connected to each other and form a model which leads to a complete system.
3.7 Summary

The data collection method and technique is generally described in this chapter, which can be useful for the researcher to precisely look into the small components of the system. Research methods are described briefly in this chapter, which led to choose quantitative method by the researcher. Survey Questionnaire has selected for data gathering as a data collection method. Object-Oriented Hypermedia Design methodology has been chosen by the researcher to carry out the system design process, where the methodology offers to design a complex web-based application with multimedia contents. Methods are studied by the researcher to implement such a system, which will be user driven and dynamically changes occur from time to time.
CHAPTER-4 DATA COLLECTION AND ANALYSIS

4.1 Introduction

In this chapter, data will be analysed which is collected through e-survey and hard copy questionnaire. Two type of data collection method are used:

- e-survey
- Hard copy questionnaire

For the purpose to collect data from sources which cannot be reached through distributed questionnaire, e-survey pages were build up to get more responses from students. The data analysis will guide the researcher to the right direction to build a system and framework in the next chapters.

4.2 Response Rate

Total of 50 hard copy questionnaire were distributed among postgraduate students, 45 were received back from the participants, and 5 went missing. In total of 45, 9 were rejected due to incomplete filling up the questions. 36 were accepted for analysis and were complete to proceed with.

So the response rate for collected 45 out of 50 questionnaires is 90%. The response rate for accepted questionnaire 36 out of 45 is 80%.

On the other side of the survey which is published online to get more response from other students which are not in reach and the total received responses were 63, which counts 100% because no participant response was rejected. All data was correct at the time received from the user.

The total distributed questionnaire and online survey counts are 113. The received response rate reaches to 95.57 % (96%) in count of 108 responses. The valid response
rate is 87.61 % (88%). To avoid the duplicate entries by the same user, web based survey was analysed through different IPs, location, date and time. Hard copies were distributed among the students and received after filling it up which took them less than 10 minutes to complete.

4.3 Data Analysis

4.3.1 Overall Information about Respondents

The overall information on respondents is categorized into three parts which are:

- Gender, which is categorized as Male students and Female students.

- Age, which is open numerical value further categorized as: less than 25, 25-30, 31-35, above 35.

- Student analysed as part time and full time.

In Table 4.1, the valid percentage of male is higher than female 57.6% and 42.4% respectively. The difference between both genders is 15.2%. The cumulative percentage is the same as valid percentage. This further concludes that the respondent ratio of male is higher than female for this specific survey.
Table 4.1 - Gender

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Male</td>
<td>57</td>
<td>57.6</td>
<td>57.6</td>
<td>57.6</td>
</tr>
<tr>
<td>Female</td>
<td>42</td>
<td>42.4</td>
<td>42.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.1 describes the age arranged in different ranges. Figure 4.1 also indicates that the highest percentage of student's age range is 25 to 30 followed by less than 25. The lowest figures of age range are 31 to 35. The chart shows that most of the post graduate student age range is between 25 and 30.

Figure 4.1 - Age

Table 4.2 describes student status as part time and full time. Valid percentage of full time students are 69.7% which shows the highest rank for full time students compared to part time students which is 30.3%.
Table 4.2 - Student

<table>
<thead>
<tr>
<th></th>
<th>Valid</th>
<th>Full time</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>69</td>
<td>69.7</td>
<td>69.7</td>
<td>69.7</td>
<td>69.7</td>
</tr>
<tr>
<td>Part time</td>
<td>30</td>
<td>30.3</td>
<td>30.3</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>

4.3.2 Access of E-learning

In this section, researcher tried to explain the accessibility of e-learning among the students. Figure 4.2 demonstrate that 75% of students are using e-learning in different forms in their studies, while 25% are not using e-learning in any form of it.

Table 4.3 shows very important data sets for e-contents, students were asked either they use any e-contents for their studies or not. The valid percentage is high at 91.9% which shows that most of the students are using internet during their studies to access
contents for their courses. While 8% were in the negative side of using any form of contents for their studies.

Table 4.3 - E-contents

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Yes</td>
<td>91</td>
<td>91.9</td>
<td>91.9</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>8</td>
<td>8.1</td>
<td>8.1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>99</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.4 represents the data set achieved from Table 4.3, in which students chooses how they access and able to use these contents. The highest ranked is website which valid percentage is 42.4%, followed by website, email at 28.3% and email at 27.2% respectively. Lowest valid percentage is carried by website, email and specify. In this case most of the student did not mention about extra accessibility feature by using specify field. While there are also some missing data, which indicates the negative response for Table 4.3. The 7% of missing data represent null values.
Table 4.4 - Access of E-contents

<table>
<thead>
<tr>
<th>Valid</th>
<th>Website</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website</td>
<td>39</td>
<td>39.4</td>
<td>42.4</td>
<td>42.4</td>
<td></td>
</tr>
<tr>
<td>Email</td>
<td>25</td>
<td>25.3</td>
<td>27.2</td>
<td>69.6</td>
<td></td>
</tr>
<tr>
<td>Website, Email</td>
<td>26</td>
<td>26.3</td>
<td>28.3</td>
<td>97.8</td>
<td></td>
</tr>
<tr>
<td>Email, Specify</td>
<td>1</td>
<td>1.0</td>
<td>1.1</td>
<td>98.9</td>
<td></td>
</tr>
<tr>
<td>Website, Email, Specify</td>
<td>1</td>
<td>1.0</td>
<td>1.1</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>92</td>
<td>92.9</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Missing System | 7 | 7.1 |
Total          | 99 | 100.0 |

Table 4.5 explains course contents delivery at one point, where the valid percentage for yes is high with 76.8% and on the other hand no has 23.2% of valid results. This shows a big change in demand for course contents should be available at one point for access. That also demonstrates that most of the students prefer to download the tutorials, notes, assignments etc through provided website with a secure login procedure.

Table 4.5 - Course Contents at One Point

<table>
<thead>
<tr>
<th>Valid</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>76</td>
<td>76.8</td>
<td>76.8</td>
<td>76.8</td>
</tr>
<tr>
<td>No</td>
<td>23</td>
<td>23.2</td>
<td>23.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
Figure 4.3 describes the use of virtual learning environment, where most of the user did not use it. The majority of users’ response was negative towards virtual learning environment. 75% of users are not using virtual learning environment according to the survey, while 25% are using it. This shows that most of the students are either unaware of any virtual learning environment or they have not provided any virtual system for use.

![Bar chart showing VLE (Virtual learning environment) usage](chart.png)

**Figure 4.3 – VLE (Virtual learning environment)**

### 4.3.3 Use of Different Tools

In this section, the researcher arranged different questions for the students to know which tools they are using during their studies. This is an important part of the survey which will further lead to the new features during the design phase of the system.
Figure 4.4 summarize the discussion tools used by the post graduate students. The higher mark in the figure represents that most of the students are either using some of the tools or they are familiar with it. Only 14.5% of students are not using the tools while 85.5% are which shows the positive rank for the online tools to use for the purpose of study in their studies. That also shows that most of the students are using different sort of online tools like email, forums etc to communicate and accomplish other study needs.
<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Email</td>
<td>36</td>
<td>36.4</td>
<td>42.4</td>
<td>42.4</td>
</tr>
<tr>
<td>Forums</td>
<td>4</td>
<td>4.0</td>
<td>4.7</td>
<td>47.1</td>
</tr>
<tr>
<td>Phone texting</td>
<td>1</td>
<td>1.0</td>
<td>1.2</td>
<td>48.2</td>
</tr>
<tr>
<td>Blogs</td>
<td>1</td>
<td>1.0</td>
<td>1.2</td>
<td>49.4</td>
</tr>
<tr>
<td>Email, Forums</td>
<td>16</td>
<td>16.2</td>
<td>18.8</td>
<td>68.2</td>
</tr>
<tr>
<td>Email, Phone texting</td>
<td>7</td>
<td>7.1</td>
<td>8.2</td>
<td>76.5</td>
</tr>
<tr>
<td>Email, Blogs</td>
<td>4</td>
<td>4.0</td>
<td>4.7</td>
<td>81.2</td>
</tr>
<tr>
<td>Forums, Phone texting</td>
<td>1</td>
<td>1.0</td>
<td>1.2</td>
<td>82.4</td>
</tr>
<tr>
<td>Forums, Blogs</td>
<td>2</td>
<td>2.0</td>
<td>2.4</td>
<td>84.7</td>
</tr>
<tr>
<td>Phone texting, Blogs</td>
<td>1</td>
<td>1.0</td>
<td>1.2</td>
<td>85.9</td>
</tr>
<tr>
<td>Email, Forums, Phone texting</td>
<td>1</td>
<td>1.0</td>
<td>1.2</td>
<td>87.1</td>
</tr>
<tr>
<td>Email, Forums, Blogs</td>
<td>7</td>
<td>7.1</td>
<td>8.2</td>
<td>95.3</td>
</tr>
<tr>
<td>Email, Phone texting, Blogs</td>
<td>1</td>
<td>1.0</td>
<td>1.2</td>
<td>96.5</td>
</tr>
<tr>
<td>Email, Forums, Phone texting, Blogs</td>
<td>3</td>
<td>3.0</td>
<td>3.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>85.9</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Missing System</td>
<td>14</td>
<td>14.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.6 provides summary of discussion tools which students are using frequently. As the table demonstrates, the highest technology used by almost every student was Email in all forms of their studies. 42.4% of valid percentage indicates the importance of technology use. Email is the only technology used by students with every other technology they were asked of. The next highest ranked technology is forum with email which 18.8% valid percentage shows the usage of it in high node. The missing percentage is 14.1% which indicates null values for the answers from the users. The lowest percentage ranked technology is phone texting and blogs which equally share 1.2% of usage respectively.

Total of 14 statements have higher priority for email which make it 75 out of 99 entries followed by forums with count of 31.

Figure 4.5 - Access of Discussion Tools
Figure 4.5 comprehensively lists all the levels of accessibility for the students which they are using. The graph demonstrates that most of the postgraduate students are using the technologies listed in Table 4.6 everyday followed by few times a week respectively. The lowest part in the pie graph shows the rarely/never answer which states that few of the students use the technology in rare cases. Table 4.6 missing values describe the rarely/never option in the question quite clearly.

![Bar chart showing usage of e-learning websites]

Figure 4.6 - E-learning Websites

69.5% of students stated that they are using e-learning websites during their studies, which is a positive note in sense of using learning websites for study materials. While 31.5% of students said, they are not using any form of e-learning websites in their study time period. This also shows that the facility provided as a learning website is not accessible to all students or it is not provided by the institute itself. In that case students are using external free e-learning websites during their studies.
Table 4.7 - Usefulness of E-learning Websites

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Yes</td>
<td>89</td>
<td>89.9</td>
<td>89.9</td>
</tr>
<tr>
<td>No</td>
<td>10</td>
<td>10.1</td>
<td>10.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.7 summarize the e-learning websites usefulness. Where researcher needs to know, how much percentage of student think it is or it will be useful for them. In Table 4.7 the valid percentage is quite high in positive manner for usefulness of e-learning websites providing online contents, information which shows level of 90% for Yes and on the other hand only some of the students think that e-learning websites are not that useful in sense of contents availability. Figure 4.6 demonstrates the usage of e-learning websites during the course taken, which illustrates that e-learning websites have high rank in the students who are used to it.

4.3.4 Use of Content Management System (CMS)

Students were asked whether they are familiar with content management system. Students were given multiple choices to select their answer, where 78 replies were in negative note followed by 21 answers with yes.
The bar is very high for the case of No, which illustrate that most of the postgraduate students are not familiar with the content management e-learning systems like ANGEL, WebCT, Blackboard, Sakai, OnCourse, and Moodle, but some of students are familiar with CMS.
Referring to Figure 4.7 researcher asked the students if they are using content management system, then how often they access them. In the response of 21 replies in Figure 4.7 shows high bar for weekly. Most of the students who are using content management systems, they regularly access them on weekly basis followed by never and once per year respectively. The lowest mark is for daily and monthly access by the students.
Table 4.8 - Use of Wikis

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Never</td>
<td>27</td>
<td>27.3</td>
<td>27.3</td>
<td>27.3</td>
</tr>
<tr>
<td>Once per year</td>
<td>7</td>
<td>7.1</td>
<td>7.1</td>
<td>34.3</td>
</tr>
<tr>
<td>Once per semester</td>
<td>12</td>
<td>12.1</td>
<td>12.1</td>
<td>46.5</td>
</tr>
<tr>
<td>Monthly</td>
<td>1</td>
<td>1.0</td>
<td>1.0</td>
<td>47.5</td>
</tr>
<tr>
<td>Weekly</td>
<td>40</td>
<td>40.4</td>
<td>40.4</td>
<td>87.9</td>
</tr>
<tr>
<td>Daily</td>
<td>12</td>
<td>12.1</td>
<td>12.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>99</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Most of the students are using wikis on weekly basis which marks 40.4% of valid percentage. While 27.3% of students are not using any form of wikis during their study. The middle tier is taken by once per semester and daily basis, which shares 12.1% each. The lowest score belongs to monthly basis which covers only 1% of the total. These results shows that most of the students are not aware of any tools in their degree level studies, it could be of any reason specified below,

- No access to internet
- Lack of knowledge about applications
- No proper implementation of online sites
- Lack of technology knowledge
- Lack of proper infrastructure
In this section the last question was asked whether the usage of e-learning improve the quality of learning during their studies for the students or not. The highest bar indicates in Figure 4.9, that most of the students were agree with the researcher for improving the quality of learning. While almost ‘Agree’ as illustrate in the Figure 4.9, there were students who are neutral at that stage. Only 13 counts were for strongly agree, which shows that some of the students has got good improvement in this type of learning. The minimum results for the two options disagree followed by strongly disagree are very minimal with 1 and 2 respectively, these indicates that most of the users find e-learning useful in their studies.
4.3.5 Tech Tools Using by the Students

Many of the students use web technologies like email for course contents and communication whose ratio is high with respect to other technologies. Table 4.9 mainly focus on technologies and online tools used by students for during their studies.

Table 4.9 - Technologies Using for Current Semester

<table>
<thead>
<tr>
<th>Technology</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email</td>
<td>90</td>
</tr>
<tr>
<td>IM</td>
<td>41</td>
</tr>
<tr>
<td>Presentation softwares</td>
<td>90</td>
</tr>
<tr>
<td>Course website</td>
<td>59</td>
</tr>
<tr>
<td>Programming languages</td>
<td>30</td>
</tr>
<tr>
<td>Webcast</td>
<td>8</td>
</tr>
<tr>
<td>Blogs</td>
<td>37</td>
</tr>
<tr>
<td>Other social networks</td>
<td>40</td>
</tr>
</tbody>
</table>

Presentation softwares equally share the same count with email which shows that most of the students are using these tools regularly in their studies. Course websites also ranked top position in the table, which demonstrate that 60% of the students are accessing contents and information from the course websites, which is updated by the course lecturer or either by faculty. The lowest ranked technology used by the student is Webcast; in this case it shows that most of the students are not much familiar with this application. Students tend to use social networks for communication cum blogs at the same ratio for reading and accessing articles and information.
4.3.6 Suggested Features and Feedback

There were three questions in the survey asking the students for suggestions and comments. One of the question was to know about the features student wants to see in the online learning websites.

Figure 4.10 – Features
The researcher asked the postgraduate students in this question for the suggested features to improve the communication between the students and lecturers. In the graph the three high bars represents that students are more keenly interested to get their course content from lecturers to sent to their emails with choosing online live help from lecturers respectively. But on the other hand, most of the students are agree to the options given to them by the researcher, which shows the high flow of count in the graph. The suggested features given in the question are:

- IM (Instant messaging)
- Sending course content to all students (SCCS)
- Online live help from lecturers (OLHL)
- SMS alert system
- Online Alert System (OAS)

Table 4.10 shows the suggested features from the students for a learning website.

Total of 48 features were listed by the students, which are filtered to 16.

<table>
<thead>
<tr>
<th>No.</th>
<th>Suggested Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The illustrations</td>
</tr>
<tr>
<td>2</td>
<td>Lecture notes</td>
</tr>
<tr>
<td>3</td>
<td>Authorized sources</td>
</tr>
<tr>
<td>4</td>
<td>Easy and fast search as a Search Engine</td>
</tr>
<tr>
<td>5</td>
<td>User friendly interfaces and multi categorizing</td>
</tr>
<tr>
<td>6</td>
<td>E-books, Papers, E-databases, E-articles</td>
</tr>
<tr>
<td>7</td>
<td>Download full lecture notes and upload assignment</td>
</tr>
<tr>
<td>8</td>
<td>Blogs, Wiki, Forum, Gallery, Online help</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>9</td>
<td>Interactive multimedia</td>
</tr>
<tr>
<td>10</td>
<td>Online tutorials</td>
</tr>
<tr>
<td>11</td>
<td>Broadcasting, friendly, Content management, Employ video and sound</td>
</tr>
<tr>
<td>12</td>
<td>External links</td>
</tr>
<tr>
<td>13</td>
<td>Dynamic update</td>
</tr>
<tr>
<td>14</td>
<td>Good modules arrangement</td>
</tr>
<tr>
<td>15</td>
<td>Ability to discuss, Clarity on the problematic matters, Simple approach</td>
</tr>
<tr>
<td>16</td>
<td>Availability, Updated information, Minimizing paperwork</td>
</tr>
</tbody>
</table>

There was a comment question in the survey where students were asked to leave any notes they wish to be reviewed and part of the system to improve the quality of learning websites.

Table 4.11 shows the comments from the students. Total of 20 detailed feedbacks were received from the students, in which 8 were selected to be part of the survey findings and the rest were removed due to incomplete data.
<table>
<thead>
<tr>
<th>No.</th>
<th>Suggestions and comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The access to e-learning facilities should be upgraded.</td>
</tr>
<tr>
<td>2</td>
<td>I actually like to suggest video or documentary based teaching which actually shows the reality of what we are learning and not just the theory of it....for example, the genome project discovery documentary will help a lot in understanding about DNA and genes rather than reading only notes. These kinds of things should be available online to enhance understanding.</td>
</tr>
<tr>
<td>3</td>
<td>Still in infancy stage. Need to improve.</td>
</tr>
<tr>
<td>4</td>
<td>Downloading lecture notes and uploading assignment online (such as through Moodle) are very much useful. Blogs and forum are not very much used (or not at all).</td>
</tr>
<tr>
<td>5</td>
<td>It is more interactive for learning if student can on line with their lecturer and can get the feedback simultaneously.</td>
</tr>
<tr>
<td>6</td>
<td>Provide students with the upcoming journals and conferences related to their research. This service also can be added to keep students up to date.</td>
</tr>
<tr>
<td>7</td>
<td>Should be open access for all students.</td>
</tr>
<tr>
<td>8</td>
<td>A formal module of training that will expose post graduate students to all facets and aspects of e-learning be conducted. This will help them what is available and ensure that it is used effectively and optimally. Information in hard copy form also is available for starters who may not be very computer literate.</td>
</tr>
</tbody>
</table>
4.4 Summary

A set of questions were distributed in form of a survey targeting post graduate students. The survey was distributed among 50 students in the form of hard copy and was published online. Links were sent to all postgraduate students through UM mail. The main goal of this chapter was to know the students view about e-learning during their studies. The response rate was quite positive and encouraging. Most of the students were agree to use e-learning through web and make it accessible for every one. Students pointed out some very good features to be implemented in future in the e-learning systems. This will make the interaction between the students and lecturers more useful and innovative. According to the results from the survey most of the students were using technologies in different forms to make use of electronic sources and for better communication and exchange of information rather than paperwork.

The following new features are derived from the filtered suggestions and feedbacks received from the students.

- SMS Alert System
- Digital Library
- Video Library

Beside the above main new features there are other features which are part of the development system:

- Organizing students into multiple groups
- Reporting Module
CHAPTER-5 FRAMEWORK FOR ACCESSIBILITY AND USABILITY OF E-LEARNING

5.1 Introduction

This chapter will explain framework for the research. Framework which is an important part of a research will cover the strategic flow of the application. Framework will be created for e-learning for the accessibility and its defined features. This chapter will underpin the flow from data analysis and literature review which gives more insight for building a framework.

Different frameworks were studied before implementing the idea of a new framework in this chapter, which gives more valuable information in the process of a new framework. Different approaches are used for web based applications development. Prototyping model is more concise and near to web based applications. This is because the web based applications changes time to time upon technological changes, and prototyping model focus on iteration in this case. On time to time new changes to the system are being made and prototyping model will revise the product and its production cycle.

The focus in chapter is to create a framework which can be used for application development and easy to implement and use. Application development factors are identified in literature review and later more precisely achieved from data analysis.

E-learning features were studied which are currently provided online through different type of websites. Survey was the source for findings to build the system upon the feedback received. Accessibility of an online system was studied beside the current features and it further led to a framework focusing on the learning modules and system architecture.
5.2 Mian E-learning Architecture

Zhengfang et al., proposed a learning framework as “web services oriented framework with multiple tiers for dynamic e-learning system”, which were studied thoroughly to understand the learning systems framework and design of the architecture. Mian framework is a complete new framework designed after reading other frameworks for online learning systems. “Framework of Learning Methods” from Sabine et al., was also studied for more reading. Figure 5.1 describes Mian e-learning architecture which will lead to a complete framework for the system.

Figure 5.1 – Mian e-learning Architecture
5.2.1 Interface Layer

Interface layer describes the user interaction between the system and application such as, surfing video library, using forms, search the site, which is also part of usability measures.

5.2.2 Protocol Layer

Protocol layer define the sessions and security measures between the server and user based on application.

5.2.3 Application Layer

Application layer takes control of the system which will be presented to the user. All the backend data will be synced directly to user from application layer to interface layer through protocol layer.

5.2.4 Physical Layer

Physical layer consist of two sub layers which are,

5.2.4.1 Physical Layer-I

Physical layer-I describe the physical architecture of the system, which consist of web server with database server storing the data.

5.2.4.2 Physical Layer-II

This layer has data storage mediums, and keep the data for long term as backup which can be used in future in case of lost or damage of the physical layer-I.
5.3 Mian Framework for accessibility and usability of e-learning

Figure 5.1 describes the main architecture of the Mian framework. While Figure 5.2 discuss the framework in details with extended component which are part of the system.

Each layer has its own multiple components which describe the layer in more concise way. Based on Figure 5.2 the following framework components will be discussed further.

a) User Authorization and Interface
b) Action Protocols
c) Access Levels
d) Learning Modules
e) Learning Objects
f) Learning Management
g) Web Server
h) Database Server
i) Backup Policies

The features which are obtained from the survey are part of the Mian framework application layer. The following are the implemented features in the system:

- SMS
- Video Library
- Digital Library
- Organizing Groups
- Reporting Module
- IM/Messaging feature
The above components are sub components of application layer components, which will be discussed in this chapter. The basic term used for this component is ‘Learning’, which describe these components into four more components while adopting the above new features in the framework. System development phase precisely explain the above features in a usable format, where all students and instructor can make use of the features.
Figure 5.2 – Mian Framework for accessibility and usability of e-learning
a) User Authorization and Interface

In simple words Interface is known as GUI, abbreviation of Graphical User Interface. This is presentation of computer backend logics to users in the form of some meaningful designs. In interface data is presented in such a way where user can understand the logic presented to them. Interface is the interaction between users and computer hardware, which translate the user input to readable format in the form of output. User interface is part of the design component.

User interface can described this way also, user interface which is also called human interface or man machine interface (MMI) is the aggregate of means through which users interact with the system, devices, computer programs or other complicated tools.

UI provides mean of the following components:

- Input: allowing the users to manipulate and run the system
- Output: allowing the system to show the effects of users manipulation

Authorization by means is allowing users to complete different tasks within the assigned privileges. Every user interface has different level of authorization which differentiates between the users at certain medium. Medium is defined at the backend to which user interact through provided interface. Each interface has different levels which keep authorize user at different levels in different stages of the interaction.

b) Action Protocols

Action protocols are part of protocol layer, which is combined with access levels and browsers and technology. Action protocols take care of system wide changes in the users’ data. Each action took time from the user side to complete and wait for the calls from the system to accept the protocols. The response time of the action protocols are
important in the processed time, where system change the actions from different protocols to others.

c) Access Levels
Access levels refer to access policies, both terms have similar definitions. Access levels describe the users level of access, which can be further divided to many levels. Access levels categorization depends on the application usage. In this case administrator has the control over the application and can manage the application from every perspective. It strengthens the application security measures, and users have provided different access levels upon their usage of the application. It is necessary for the application to make secure the data files from unauthorized access. Different sessions are handled by the system to differentiate between the users access levels to the data files.

d) Learning Modules
Learning modules are the learning contents of different courses provided by the institutions. Learning modules can be divided into multiple sources per course. Each module contains an introduction, learning objectives, content chapters, additional resources etc. Modules are mostly provided and offered online through Web. Users can perform practice on different modules through a specific practice guidelines and standards.

e) Learning Objects
Learning objects are small chunks of data presented to users in different forms. Most common of them are Flash objects, JavaScript functions, XML layout, Animated
programs, PHP classes and functions objects. Each learning object is part of the interface of the system. Learning objects are published with more precise description in a global repository for indexing purpose and later can be used for searching, retrieval and usage by other remote applications.

f) Learning Management

Learning management applications are programs or functions that are available throughout the system and are easily accessible for usage. These functions and programs are mostly provided by the educational management or any businesses which is involved in the creation and maintaining of the system such as designing course, course administration, user management, testing and assessment of the system, data verification services etc.

g) Web Server

Web server is a place where all the contents, data, files are stored and available online. Web server consist of different web technologies such Apache web server, PHP scripting language, ASP, ASP.net, MySQL database, HTML, CSS, Ajax etc. Web server is a computer program that serves contents in form of web pages using the HTTP (Hypertext Transfer Protocol). This term can also be refined as a computer or virtual machine running the program.

There are also other sorts of explanation for a web server which can be explained this way, web server serves users’ content rich pages through HTTP protocol. All the contents are presented to users in a meaningful way, where all the process of presenting this data is accomplished in the web server. Web server takes the user request and transforms it to a readable output for users.
Any computer can be used as a web server by installing web technologies like IIS or Apache server with other programming languages such as PHP, Ruby on Rail, Python, Perl, ASP, and ASP.net.

h) Database Server

A web server uses a database system for storing data. It is also known as back-end system, which performs multiple tasks such as data analysis, storage, data manipulation, archiving, and some non-user tasks. There are different types of databases such as Flat file database servers, Relational database servers, Object database servers, Object relational database servers. The most common and popular one is relational database management systems (RDBMS), but as the technology grows, there are chances that object database servers will overtake RDBMS in future, which provide better storage system than RDBMS. There are many open source and closed source databases available for use, the most common open source database used is MySQL.

The main database for the system stores the user data which can be retrieved later for usage.

i) Backup Policies

The important part of any web service system is to backup a system on regular basis. There are many ways to backup the data files, web server data, and database data.

In a traditional system implementation all the data are stored on a server, which create backup on the same system on daily or weekly or monthly basis. But in this case the data can be misused in case the server authentication is compromised.
In this framework, a new conventional backup system is designed, which have different storage mediums on different locations and are connected to the main web and database server over secure SSH connection to perform a secure transaction over the internet. There are three types of backup servers introduced on a remote location. A database server which will store a backup of the main database, a data server which will store the web server files and data, a remote temporary server which will store all the data files and database transactions for a specific time to reduce the load on the server.
5.4 Summary

The researcher took a step ahead by presenting a new framework for an online education system portal by using object-oriented hypermedia design methodology called Mian framework. The framework is designed to justify an online education portal which can be used an e-learning model for institutions. The researcher used web based approach for the framework to centralize the learning system for the students who are the users of the system to make the system more effective and precise. Open source technologies are base of the system which will be defined in next chapter are taken as main components of the framework in physical layers. Prototyping will take place for designing and implementation in the next chapter which depends on the framework. The derived features are part of the Mian framework which is analyzed in the data analysis part. After literature review the accessibility and usability of e-learning systems were more keenly studied during the creation of new framework development.
6.1 Introduction

The system developed in this chapter is dependent on the framework. Framework describes the basic components of the system which is used in the development phase. An online portal will be developed for the students/users which will be similar to Moodle but with enhanced features. The interaction between students and lecturers is the focal point of the system. Object-Oriented Hypermedia Design Methodology is used for the system development. The system main phases in this chapter include system objectives, system development, system scope, learning modules.

6.2 Tools used for System Development

In this section of the chapter tools which are used for the system development will be discussed. Open source softwares are utilized for the process development.

6.2.1 Open Source Softwares

Open source softwares (OSS) are softwares which are made available for the users with source code, so users can participate in improving it. These softwares are freely available to everyone for use with different licences. Snippets from dwheeler.com, OSS/FS are programs whose license gives users the freedom to install and run the program for any desired purpose such as to analyze, study, modify, redistribute original or modified version without paying royalty to the original developer.
The following OSS/FS softwares are used for the prototype development by the researcher.

6.2.1.1 PHP Programming Language

PHP stands for Hypertext Preprocessor is a widely-used open source general-purpose scripting language that is especially suited for web development and can be embedded into HTML. PHP was designed in 1994 by Ramus Lerdorf as a small set of binaries, which were used to collect site traffic data. It was rephrased in 1997 while getting more attention from the developers to write libraries for it, but the main phase was when the parsers were rewritten to give it a professional look. PHP is designed such a way, where it is called by a browser through HTTP/HTTPS request to generate embedded HTML pages. PHP is a server sided language, where all the processing are done on the server (web server) and send the requests back to the browser to show the processed data. PHP can be used with any database like MySQL, PostgreSQL, SQL server side by side to generate dynamically database driven web pages.

6.2.1.2 MySQL

MySQL development was started back in 1994 and was released for internal use 1st time in May 1995. MySQL is a powerful relational database management system which is more likely used with PHP to build a database driven websites rather than file systems. MySQL is a cross platform database system. MySQL is specially designed for small enterprises. MySQL is used as a main database system for websites, which provide better platform than files systems do. MySQL mostly used in Linux as part of a LAMP stack, which stands for Linux Apache MySQL PHP/Perl/Python. Most of the web servers use it because it is fast, reliable and easy to
use. There are many front end softwares available which provide easy setup for the
databases and its tables.

The MySQL Database Software is a client/server system that consists of a multi-
threaded SQL server that supports different back ends, several different client
programs and libraries, administrative tools, and a wide range of application
programming interfaces (APIs).

6.2.1.3 JavaScript

JavaScript is the Netscape-developed object scripting language used in millions of
web pages and server applications worldwide. JavaScript is a client side scripting
language which is procedural as well is object oriented.

6.2.1.4 CSS

CSS was first developed in 1997, as a way for Web developers to define the look and
feel of their Web pages. CSS is an acronym for Cascading Style Sheets. CSS is a
styling language which is used to define HTML layouts. HTML is used to structure
contents while CSS is used for formatting structured contents.

6.2.2 System Requirements

To support and run the softwares mentioned in the previous pages, a high
performance system is required to manage the traffic on the server. Here are some
specific details listed, required configurations:

- Operating system: Windows OR Linux
- Memory (RAM): at least 2GB
- Hard disk: 80GB
• Processor: single core with 2MB cache

Recommended configuration:

• Operating system: Linux
• Memory (RAM): 4GB
• Hard disk: 320GB
• Processor: Dual Core with at least 6MB cache

6.3 System Objectives
The prototype building main objective is to provide an interface for users which can help them to communicate easily with tutors and with other students. By implementing such a system will enable the users to work effectively. The distributed survey is the main theme for the system, in which most of the users give feedback and suggestions to improve online learning for post graduate students. The objective is to centralize all the services to the students and tutors online, where they can communicate and enhance the education merits. The ideas given by the students will be implemented in the system to make the system more efficient. System will track the activities for the log purpose and to make this possible to retrieve timely data from the database by the management. Learning modules will be more precisely implemented in such a way to enhance the modules as well the learning style.

6.4 System Scope
System will provide features with enhanced services for the users which are required during their academic life. The following main areas of the system are briefly covered in the development phase,

• Interaction between users
• Activities tracking
• Information sharing
• Learning modules usage
• Real time support
• SMS functionality

6.5 System Development

System development phase is thoroughly combined with the methodology used by the researcher. The developed system will be able to be redesigned and updated on timely manner upon the technology change.

6.6 System Development Methodology

The researcher was keen to select a methodology which can fulfil the desired system life cycle phase and which can enhance the life cycle of the application. Which can possibly provides better support for the development of the system and can be helpful in the research area later. For such a real time system researcher choose Object-Oriented Hypermedia Design Methodology which consist of the following phases:

a) Requirements Gathering
b) Conceptual Design
c) Navigational Design
d) Abstraction Interface Design
e) Implementation
a) Requirements Gathering

The first phase of the methodology determines the requirements gathering which can be in the form of surveys, questionnaire, and interviews. Data was gathered to further analysis the system and make a road map for building the system. Data analysis provides system requirements which were discussed in chapter 3. Previous systems were studied before gathering the data such as Moodle and the researcher put all the efforts to redefine the old features and assemble it with new features which are necessary for the students and the system. The important requirements provide a platform to integrate it beside the old features, but in this case all the new and improved features will be implemented which were gathered in the data analysis part.

b) Conceptual Design

A brief design of the system can be made, which will be part of different classes. A stand alone tool such as MySQL workbench and Netbeans are used to design the conceptual design of the system. Conceptual design briefly explains the relationship between the entities of the system interacting with each other. For the current system, all the entities were put in a different status which later combined to make the system more understandable.
Figure 6.1 describes the conceptual design of the system in details with basic classes and relationships. In the Figure all the users are categorized into a specific group, which has specific roles to perform. Administrator of the system has upper hand on all other users, who is also can be a management person to evaluate others on reports and assigned roles basis.
c) Navigational Design

After conceptual design the next step is to draw the navigational flow of the system. Navigational design consist of nodes, links, indices which all interact with each other and make the flow of the system more reliable for future use. More functions can be integrated into the system which will make possible the flow easy to move around in the system and users can go to other pages without confusion with the links provided.

Figure 6.2 – Nodes and Links

Figure 6.2 describes the relationship between the nodes and links in the context of navigational menu. Each link has different nodes with different actions to perform. All the nodes and links are distributed such a way where user can find the links available less than one navigational menu. Visibility of the nodes and links depends
on the user authentication provided by the administrator. Each group has different roles and authority and access level.

**d) Abstraction Interface Design**

User interfaces are defined in this phase, where all the conceptual designs are put into interfaces. Data is presented in a meaningful way which user can browse through for the information needed. PHP will be used as a scripting language to create web pages while HTML will be used to render the pages to users. MySQL database will store data while some of data will be stored in files. GIMP is used for graphics designing. The design phase will be tested thoroughly to remove bugs and errors to implement a stable system.

**e) Implementation**

This is the crucial and important phase of the system where all the phases will be combined to make a useful system, where interface design will play the important role beside the objectives of the system. The system will be updated upon new arrival of new technology to provide on top and leading edge features to the users. This phase is the final stage where the web development team takes care of the system on daily basis. New features can be added later by getting feedback from users from time to time.
6.7 User Interface Modules

User structure module consist of four modules, which are named as Visitor, Student, Lecturer, Administrator. Researcher further describes each module with a data flow and authorization diagram in detail.

6.7.1 Visitor Module

Visitor module describes system basic functionality which can be viewable to every user. There are some fundamental functions which will be accessible to the visitors, while the system will track the activities of the visitor with some information like timestamp, IP, browser, operating system etc. Visitors can use links which are allowable to use like Home, About us, Contact us, External links. Figure 6.3 describes the visitor modules with the authenticated privileges to use the system.

![Visitor Module Diagram](image)

Figure 6.3 - Visitor Module
6.7.2 Student Module

Figure 6.4 describes the student module activity flow. Students are divided into groups in the system, where each group has required an instructor to moderate it. All the features will be available to the students in the group that has been assigned by the lecturer.

Features like assignments, tutorials with last dates to submit with details, video library where they can download the video instruction for a course to follow, SMS system where students will be able to contact the lecturers through SMS module and will get
response from the lecturer, real time IM system where students can communicate with
others and do a group discussion online including lecturer. All the activities will be
tracked by the system for reporting to the administrator. Administrator will be able to
check all the students’ activities through different links.

6.7.3 Lecturer Module
Lecturer module consists of features which will provide more sophisticated mean to
the interaction between students and lecturers. Lecturer can make reports of the
students and analyze them later for students’ assessment; management can track all
the activities between lecturer and student and can make decision upon where
necessary. Lecturers activities are under administrator control, where admin can track
almost every activity and can respond to it in a real time. Lecturers can use most of
the system features which directly connected to students. Figure 6.5 shows the
activities performed by the lecturers beside the students’ progress and monitoring.
6.7.4 Administrator Module

The administrator of the system has complete control on the system while performing every job assigned. The duties of the administrators are more keenly seen as a moderator for the system, who check the lecturers and students interaction and take action against the responsible body. View and analyze the reports on a timely manner, provide system support where it is in necessary.
6.8 Prototype Components

The system components are converted to messages interaction between the features of the system. Researcher examined the operation carried out by different functions in the system, and use UML modelling sequence diagram to explain the interactions.
The approach of the sequence diagrams are used for different features of the system like Login, Organizing groups, Video library, Messages, Reporting module.

### 6.8.1 Login Module

Login module responds upon user requesting for certain function to execute. There are two type of communication occurred between the system and user which are request and receive. Figure 6.7 describes the flow of login through different stages to authenticate the user.

![Login Module Diagram](image)

**Figure 6.7 - Login Module**
6.8.2 Organizing Groups

This module has two phases, which are based on student perspective and lecturer. Figure 6.8 shows the interaction of creating groups, while Figure 6.9 describes the organization of groups to students’ category. Students are assigned groups depend on the lecturer course.

Figure 6.8 - Organizing Groups
6.8.3 Video Library

Administrator and lecturer have the authority to upload contents to video library for different groups. Flash contents have been used to play the video/audio and further more has to download and keep share the videos with others. Figure 6.10 shows the interaction between the interaction response from the lecturers and students.
6.8.4 Messages

Messaging system make use of the contents in a resource rich way, like enhance the communication between the users on different protocols, and providing more opportunities to use the system in a controlled manner for better study system. Figure 6.11 describes more closely the communication protocols.
6.8.5 Reporting Module

Reporting module is the superior module provided to all users of the system. Administrator acts as a moderator for the reporting system. Lecturers can report students’ progress to management and student can report the other students and lecturers evaluation. Figure 6.12 shows the reporting module in detail view.
6.8.6 Digital Library Module

Digital library module consists of all the digital papers required for study purpose.

Digital library module has the following features:

- E-databases
- E-articles
- E-journals
- E-white papers
- E-conference papers
- E-thesis
- E-books

Figure 6.13 - Digital Library Module
6.9 System Interface Design

The framework explains in detail the system overview to provide vital and valuable functions while using the centralizing idea. All of the components can be found in one place, while giving more freedom of using such functions. The features provided are not distributed into many links, where user can be lost. The system builds upon the idea ‘Keep it Simple’. The interface design figures describe each and every function in action.
Welcome to E-learning Portal

This is our official e-learning platform, which is fully integrated with other applications. With this integration, you can now sign-in using your regular username and password. After signing in, you should see all the courses that have been assigned to you by management and lecturer through group.

Your comments and feedbacks on the new system are appreciated. Please inform us at elearning@domain.com or 01-1234 5678 / 01-1234 5679

There are some on-going development for some coming events. Feel free to contact the development team for the suggestions.

This website is fully integrated with other website of the organization. All the services provided to students are fully functional and usable. All new services announcement for students will go here, so keep reading this page.

E-learning System Co.
Chartered Road 13245
Email: info@domain.com
Phone: (123) 456-7890
Fax: (123) 456-7980

Figure 6.14 – Home Page before Login
Welcome Home 'Lecturer-1'

This is our official e-learning platform, which is fully integrated with other applications. With this integration, you can now sign in using your regular username and password. After signing in, you should see all the courses that have been assigned to you by management and lecturer through group.

Your comments and feedbacks on the new system are appreciated. Please inform us at elearning@domain.com or 01-1234 5678 / 01-1234 5679

My Widgets

SMS : You have (0) new sms in the sms list. Go to list.
SMS Status : You have (0) pending sms in the list.
Messages : You have (1) message(s) in the list. Go to list.
Reports : You have (0) report(s) in the report list. Go to list.
Events : There are (0) unread events in the event list. Go to list.
Quick Links: Assignments | Tutorials | Digital Library | Video Library

SUPPORT

Our support team handle questions on the use, configuration, and functionality of this system. In addition, support team can help to identify software issues, develop creative solutions, and document enhancement requests for consideration in future product releases.

DEVELOPMENT

There are some on-going development for some coming events. Feel free to contact the development team for the suggestions.

STUDENTS SERVICES

This website is fully integrated with other aspects of the organization. All the services provided to students are fully functional and usable. All new services announcement for students will go here, so keep reading this page.

Figure 6.15 – Home Page after Login
Figure 6.16 – Different Functions in the Menu

Figure 6.17 – Error on Accessing Unauthorized Area
### System Users Login History

<table>
<thead>
<tr>
<th>User Fullname</th>
<th>IP</th>
<th>Status</th>
<th>Login Datetime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrator</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>23-02-2010 22:35:03</td>
</tr>
<tr>
<td>Lecturer-1</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>23-02-2010 22:32:56</td>
</tr>
<tr>
<td>Student-1</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>23-02-2010 23:02:09</td>
</tr>
<tr>
<td>Student-1</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>22-02-2010 18:54:24</td>
</tr>
<tr>
<td>Administrator</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 23:35:12</td>
</tr>
<tr>
<td>Lecturer-1</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 23:26:13</td>
</tr>
<tr>
<td>Lecturer-2</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 23:10:07</td>
</tr>
<tr>
<td>Administrator</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 22:09:22</td>
</tr>
<tr>
<td>Administrator</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 23:08:59</td>
</tr>
<tr>
<td>Administrator</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 22:27:26</td>
</tr>
<tr>
<td>Lecturer-1</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 22:19:52</td>
</tr>
<tr>
<td>Lecturer-2</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 22:19:16</td>
</tr>
<tr>
<td>Lecturer-1</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 17:30:26</td>
</tr>
<tr>
<td>Lecturer-2</td>
<td>127.0.0.1</td>
<td>Successful</td>
<td>21-02-2010 16:42:51</td>
</tr>
</tbody>
</table>

---

**Figure 6.18 – Login History as an Administrator Tool**

### Manage Reports

<table>
<thead>
<tr>
<th>Performer</th>
<th>Module</th>
<th>Action</th>
<th>Datetime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer-1</td>
<td>SMS</td>
<td>Sent SMS to Student with ID 2</td>
<td>21-02-2010 17:42:32</td>
</tr>
<tr>
<td>Lecturer-1</td>
<td>SMS</td>
<td>Sent SMS to Student with ID 2</td>
<td>21-02-2010 17:42:59</td>
</tr>
<tr>
<td>Lecturer-1</td>
<td>SMS</td>
<td>Sent SMS to Student with ID 2</td>
<td>21-02-2010 17:54:23</td>
</tr>
<tr>
<td>Lecturer-2</td>
<td>SMS</td>
<td>Sent SMS to Student with ID 2</td>
<td>21-02-2010 22:19:32</td>
</tr>
</tbody>
</table>

---

**Figure 6.19 – Administrator Reports Area**
Figure 6.20 – Course Groups

<table>
<thead>
<tr>
<th>Group ID</th>
<th>Group Name</th>
<th>View Details</th>
<th>View Group Permissions</th>
<th>Assign Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Information System</td>
<td>View Details</td>
<td>View Group Permissions</td>
<td>Assign Group</td>
</tr>
<tr>
<td>2</td>
<td>Programming</td>
<td>View Details</td>
<td>View Group Permissions</td>
<td>Assign Group</td>
</tr>
</tbody>
</table>

Figure 6.21 – SMS List

<table>
<thead>
<tr>
<th>To/From</th>
<th>Header</th>
<th>Status</th>
<th>Datetime</th>
<th>View details</th>
<th>Reply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student-2</td>
<td>test</td>
<td>Sent</td>
<td>21-02-2010 17:39:10</td>
<td>View details</td>
<td>Reply</td>
</tr>
<tr>
<td>Student-2</td>
<td>test2</td>
<td>Sent</td>
<td>21-02-2010 17:40:32</td>
<td>View details</td>
<td>Reply</td>
</tr>
<tr>
<td>Student-1</td>
<td>test2</td>
<td>Sent</td>
<td>21-02-2010 17:41:11</td>
<td>View details</td>
<td>Reply</td>
</tr>
<tr>
<td>Student-1</td>
<td></td>
<td>Sent</td>
<td>21-02-2010 17:42:07</td>
<td>View details</td>
<td>Reply</td>
</tr>
<tr>
<td>Student-1</td>
<td></td>
<td>Sent</td>
<td>21-02-2010 17:42:32</td>
<td>View details</td>
<td>Reply</td>
</tr>
<tr>
<td>Student-1</td>
<td>Student-1</td>
<td>Sent</td>
<td>21-02-2010 17:42:50</td>
<td>View details</td>
<td>Reply</td>
</tr>
<tr>
<td>Student-1</td>
<td>ggf</td>
<td>Sent</td>
<td>21-02-2010 21:54:23</td>
<td>View details</td>
<td>Reply</td>
</tr>
</tbody>
</table>
Figure 6.22 – Sending SMS Page

Figure 6.23 – Digital Library
Figure 6.24 – Video Library

<table>
<thead>
<tr>
<th>File Name</th>
<th>Format</th>
<th>Viewed</th>
<th>Downloaded</th>
<th>Submitted by</th>
<th>Datetime</th>
<th>View</th>
</tr>
</thead>
<tbody>
<tr>
<td>information system</td>
<td>mp4</td>
<td>13</td>
<td>4</td>
<td>Lecturer-1</td>
<td>16-02-2010 20:12:34</td>
<td>View</td>
</tr>
<tr>
<td>Information Science</td>
<td>flv</td>
<td>24</td>
<td>12</td>
<td>Student-1</td>
<td>12-02-2010 10:12:34</td>
<td>View</td>
</tr>
<tr>
<td>C++ Basics</td>
<td>dat</td>
<td>37</td>
<td>25</td>
<td>Lecturer-2</td>
<td>14-02-2010 03:11:34</td>
<td>View</td>
</tr>
</tbody>
</table>

* Click on the filename to download the file.
6.10 Summary

Open source technologies are used for the system implementation, which save cost for the project. Researcher keenly studied the features provided by online portals to the students and lecturers, and added administrator module to provide more control over the system with enhancing the current portals and adding new features, which can be helpful for both students and lecturers. Features like sms, video library and digital library are added to the developed system.

The developed and proposed system will help the students and lecturers to communicate through proper channel and provide more usability and accessibility for the management.
CHAPTER-7 RESEARCH FINDINGS, SUMMARY AND CONCLUSION

7.1 Introduction

This chapter will explain the findings of research. Furthermore, it will provide overall conclusion of the dissertation regarding the findings from the survey, literature review, research methodology, and data collection and analysis. In this chapter objectives of the research will be discussed and will be explained regardless they are achieved or not. This chapter will also examine the new directions, while providing an overall conclusion for the research.

7.2 Summary of Findings

The motive of the research is to achieve the objectives which are:

7.2.1 To study and examine the level of accessibility and usability of the e-learning system

The researcher used a quantitative research method to obtain the findings of the research. This provides more precise use of data collection to get the opinions of students while stating their problems they faced. The students’ suggestions are given importance, because they are the users of the system. This makes it easier for the researcher to come up with a new application for online learning portal.

Data collected through questionnaire survey provides more precise understandings of the problems with current situation of the features provided by different portals.

The findings of the data analysis are as follows:
Accessibility of the portals in students’ point of view

Data collected demonstrate that most of the students delude while using online learning portals. The accessibility of the right contents deemed inappropriate which most of the students don’t know. The contents are not properly arranged and categorized that can help students in their search for data. Furthermore, survey shows that students commonly need to know each and every link they want. This keeps the students away from the portals that provide distributed contents over hypermedia.

Some of the key problems the students stated are:

- Slow update
- Contents availability
- Access to specific data
- Long waiting time for relevant files in need
- Lost in navigations
- Media control
- Lack of proper materials for study

7.2.2 Development of new framework for online learning

The researcher has studied other researchers’ work and came up with a new framework for online learning with multi phases called Mian framework. Researcher used Object-Oriented Hypermedia Design Methodology to solve the problems faced by the system users.

System parts are well organized in the framework to interact efficiently and make the system more reliable and usable. All the system parts are combined through different levels of interaction that makes the framework more useful for complex hyper media applications in future.
7.2.3 Development of Prototype based on Framework

The framework leads to the development of a system that describes the application in more detail. Prototyping explains the system architecture and provide better map of the interaction of the system components.

The researcher used a well designed methodology that provides better system organization for the application. The new features selected ranked highly and some of the existing features are part of the system after enhancing them. The researcher builds the system in a well structured way, where students and lecturers can fully access the system without interacting and knowing the backend of the system.

The designed prototype will help in the future to develop a feature rich application that could be more effective and efficient. The implemented features and services make the system centralized that turn it into a “one window operation”.

7.2.4 Use of New Interactive Features

From data analysis it is clear that most of the students wanted a system that could provide data and contents at one point also called centralization of information. The focus of the study materials in the survey was the main point. Upon different students point of view there are still things which need consideration are:

- Availability of content rich forums
- Frequently use of wikis
- Digital library
- E-databases
- Use of educational blogs properly
- Video library as a hypermedia contents
7.2.5 Broader View of Current Features beside New Features

Most of the students agreed to make use of the new enhanced features like stated above in 7.2.4 beside current system features. In this case the researcher build an application where all the current features are under one menu link, from where students can use the current features with newly developed system. The questionnaire and e-survey findings are put into consideration for future research, because some of the features not only need time and more research to be enhanced but also clear picture for the implementation.

7.2.6 Ease of Contextual and Navigational Links

Providing links in a centralization based system are very necessary in any web based application. The links organization mostly complained by the students, and they do not seem to find useful site map in the application, that can help them to use informative e-databases on cost of time saving. The problems students faced in navigational browsing are:

- Lost in links
- Improper presentation of links
- Not up to date links
- Back and forth moving in links are not properly maintained

7.2.7 Results Analysis

The results obtained from the sources are more focused on web technology where students and lectures search different materials for the academic purpose. The questionnaire prepared was based on the web based applications used for studies. The results obtained are more focused because of the student’s interaction with the current
systems they are using. They came up with the specific issues they face during their study period and provide comments with new features and positive thoughts that they think might be useful for the interaction between students and lectures and also among different tutorial based classes. These are the positive notes of the survey, this helped the system to grow bigger and provide the features that might needed and asked for.

7.3 Conclusion

Some of the online portals provide very well managed information based learning in terms of self study. This research was intended to provide new and enhanced features, and provide a platform for the current applications to integrate the new infrastructure into the online systems. But there are still places that can be enhanced and improved. Researcher noticed that most of the students face problems while going online and retrieve some information.

Most of the time students lost their way and forgot what they are looking for and at the end they did not get success to achieve what they want. Researcher thoroughly studied all these problems by studying the previous literature, journals, and articles and then distributed the questionnaire and e-survey to obtain the desired results from the students and transform them into a real application.

Hypermedia methodology helps the researcher to build a complex system. The developed and proposed prototype is able to provide the required features that are cost effective, time saving, user friendly GUI and well managed.
7.4 Summary

This chapter briefly explains the findings of the research with the focused objectives. Researcher deemed to describe each and every feature and problem with details. Most of the features implemented through system prototype. The framework design helps the researcher to diagnose the problem in broader way. Furthermore, hypermedia methodology is used for the proposed prototype. This chapter also describes the problems and suggestions from the students in more precise way. Accessibility and usability are thoroughly answered from the student’s point of view.
References


Chaney, E.G. (2002). Pharmaceutical Employers Perceptions of Employees or Applicants with E-Degrees or Online Coursework, Indiana State University, USA.


Landsberger, J., Thoughts on Convergence in Instructional Settings ..., E-Learning by Design, 48(3), 1-4.


Sabine S., Ulrike L., & Katarina S., A Reference Model for Online Learning Communities, University of St. Gallen Müller Gallen, Switzerland.


Faculty of Computer Science and Information Technology University of Malaya

Survey for Accessibility and Usability study of Electronic Learning Systems

Dear Participant,

This questionnaire will be used to help select learners for the E-learning and is based on what you come across online through World Wide Web. The contents of this questionnaire are absolutely confidential and no other learners will be able to see your data. Your feedback will be used only by the researcher and the information provided will not be disclosed.

Please tick the relevant boxes and provide comprehensive answers where necessary.

**Q-1:** Gender (Please tick one)
- Male □
- Female □

**Q-2:** Age (Please enter a numerical value only) __________

**Q-3:** Student (Please tick one)
- Full time □
- Part time □

**Q-4:** Are you using e-contents during your study.
- Yes □
- No □

If Yes, how you access them?
- Website □
- Email □
- Other, specify __________________

**Q-5:** Do you use any form of electronic learning (e-learning) as part of your educational program? (Please tick one)
- Yes □
- No □

**Q-6:** Do you think that all the courses content should be available at one point?
- Yes □
- No □
**Q-7:** Do you use Virtual Learning Environment (VLE)? (Please tick one)

Yes ☐ No ☐

**Q-8:** Do you use any discussion tools like: email, forums, phone texting, blogs. (Please tick one)

a) Yes ☐ No ☐

If Yes:

b) Which do you use?

____________________________________________________________

c) How often do you use these tools? (Please tick one)

Every day ☐ Few times a week ☐

Occasionally ☐ Rarely/never ☐

**Q-9:** Do you use any specific electronic learning (e-learning) website for your educational program? (Please tick one)

Yes ☐ No ☐

**Q-10:** Did you find the electronic learning websites useful? (Please tick one)

Yes ☐ No ☐

**Q-11:** What features you think are useful while using learning websites.

Specify ______________________________________________________

**Q-12:** Do you think the following features will help students in studies, please choose.

☐ IM (Instant Messaging)

☐ Sending course content to all students.

☐ Online live help from teachers, lecturers, professors.

☐ SMS alert system

Others, please state _____________________________________________
Q-13: How often do you access or use wikis? (Please tick one)
Never ☐ Once per year ☐ Once per semester ☐
Monthly ☐ Weekly ☐ Daily ☐

Q-14: Are you familiar with course management system (ANGEL, WebCT, Blackboard, Desire2Learn, FirstClass, Moodle, Sakai, OnCourse, etc.)? (Please tick one)
Yes ☐ No ☐

If your answer to above question is Yes then proceed to question 15, if No then question 16.

Q-15: How often do you access course management system? (Please tick one)
Never ☐ Once per year ☐ Once per semester ☐
Monthly ☐ Weekly ☐ Daily ☐

Q-16: Does the use of E-learning in your courses have improved your learning. (Please tick one)
Strongly disagree ☐ Disagree ☐ Neutral ☐
Agree ☐ Strongly agree ☐
Q-17: Are you using any of the following technologies in your courses for the current semester? Please use 'Y' for Yes and leave it blank for No.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Not using this semester</th>
<th>Using this semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instant Messaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentation Software (Power Point, keynote etc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Website</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programming Languages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Webcast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blogs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online Social Networks (Facebook etc)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q-18: Do you have any other comments regarding the accessibility and usability of E-learning in Higher Education for post graduate students?

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Thank you for your time to complete this questionnaire.

Please do not hesitate to contact me for any queries on this email address: mmarif4u@yahoo.com
This section will cover the basic structure of the tables used for the development of the system database. Prefix e is used with the table names as a structural design of the database.

Database Name: **e-learning**

**Table: e_d_lib**

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>Id</td>
<td>INT(6)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>Title</td>
<td>VARCHAR(100)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>Author</td>
<td>VARCHAR(100)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>Type</td>
<td>VARCHAR(100)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>Isbn</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>Status</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>Datetime</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>add_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>edit_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>

**Table: e_groups**

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>g_id</td>
<td>INT(4)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>group_name</td>
<td>VARCHAR(150)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>
Table: `e_groups_assigned`

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>INT(4)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>g_id</td>
<td>INT(4)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>lec_user_id</td>
<td>INT(6)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>active</td>
<td>VARCHAR(2)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>last_edit_date</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>datetime</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>add_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>

Table: `e_groups_users`

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>INT(6)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>g_id</td>
<td>INT(4)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>lec_user_id</td>
<td>INT(6)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>std_user_id</td>
<td>INT(6)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>last_edit_date</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>datetime</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>add_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>edit_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>
### Table: `e_login_history`

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>INT(8)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>user_id</td>
<td>INT(6)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>ip</td>
<td>VARCHAR(20)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>status</td>
<td>VARCHAR(20)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>datetime</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
</tbody>
</table>

### Table: `e_news`

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>INT(6)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>header</td>
<td>VARCHAR(250)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>msg</td>
<td>TEXT</td>
<td>Allow Null</td>
</tr>
<tr>
<td>active</td>
<td>VARCHAR(2)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>last_edit_date</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>datetime</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>add_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>edit_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>

### Table: `e_newsletter`

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>user_id</td>
<td>INT(6)</td>
<td>Not Null</td>
</tr>
<tr>
<td>active</td>
<td>VARCHAR(2)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>
Table: e_sms

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>INT(6)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>to_user_id</td>
<td>INT(6)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>from_user_id</td>
<td>INT(6)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>msg</td>
<td>VARCHAR(200)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>header</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>status</td>
<td>VARCHAR(10)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>datetime</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>active</td>
<td>VARCHAR(2)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>icdel</td>
<td>VARCHAR(2)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>add_by</td>
<td>VARCHAR(30)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>edit_by</td>
<td>VARCHAR(30)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>last_edit_date</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>inbox</td>
<td>VARCHAR(25)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>outbox</td>
<td>VARCHAR(25)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>

Table: e_system_activities

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>INT(6)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>user_id</td>
<td>INT(6)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>module</td>
<td>VARCHAR(250)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>action</td>
<td>VARCHAR(150)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>datetime</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
</tbody>
</table>
### Table: e_user

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>user_id</td>
<td>INT(6)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>title_id</td>
<td>INT(2)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>cat_id</td>
<td>INT(6)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>gender_id</td>
<td>INT(2)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>address</td>
<td>VARCHAR(250)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>email</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>name</td>
<td>VARCHAR(100)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>phone</td>
<td>VARCHAR(20)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>mobile</td>
<td>VARCHAR(20)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>regdate</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>active</td>
<td>VARCHAR(2)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>icdel</td>
<td>VARCHAR(2)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>

### Table: e_user_cat

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>cat_id</td>
<td>INT(6)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>cat_type</td>
<td>VARCHAR(100)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>

### Table: e_user_gender

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>gender_id</td>
<td>INT(2)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>gender_type</td>
<td>VARCHAR(20)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>
Table: `e_user_tiltle`

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>title_id</td>
<td>INT(2)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>title_type</td>
<td>VARCHAR(20)</td>
<td>Allow Null</td>
</tr>
</tbody>
</table>

Table: `e_user_login`

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>user_id</td>
<td>INT(6)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>username</td>
<td>VARCHAR(30)</td>
<td>Not Null</td>
</tr>
<tr>
<td>password</td>
<td>VARCHAR(30)</td>
<td>Not Null</td>
</tr>
</tbody>
</table>

Table: `e_v_lib`

<table>
<thead>
<tr>
<th>Column Name</th>
<th>Data type</th>
<th>Null / Primary key</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>INT(6)</td>
<td>Not Null / Primary key</td>
</tr>
<tr>
<td>filename</td>
<td>VARCHAR(200)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>format</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>viewed</td>
<td>VARCHAR(20)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>download</td>
<td>VARCHAR(20)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>add_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>edit_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>submit_by</td>
<td>VARCHAR(50)</td>
<td>Allow Null</td>
</tr>
<tr>
<td>datetime</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
<tr>
<td>last_edit_date</td>
<td>DATETIME</td>
<td>Not Null</td>
</tr>
</tbody>
</table>