



ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
FACULTY OF INFORMATICS
DEPARTMENT OF COMPUTER SCIENCE

**Design and Implementation of a Web Based E-learning
Support System**

(For Technical and Vocational Education and Training (TVET))

By

Dawit Hailemaraim

A Project Paper Submitted to Department of Computer Science in Partial
Fulfillment of the Requirements for the Degree of Master of Science in Computer
Science

August, 2013

Addis Ababa



ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
FACULTY OF INFORMATICS
DEPARTMENT OF COMPUTER SCIENCE

**Design and Implementation of a Web Based E-learning
Support System**

(For Technical and Vocational Education and Training (TVET))

By

Dawit Hailemariam

Name and Signature of members of the Examining Board:

1. Dr. Dida Midekso, Advisor
2. Dr. Solomon Atnafu, Examiner
3. Aot Solomon Asres, Chairperson

Declaration

I, the undersigned, declare that this is my original work and has not been presented for a degree at any university, and that all source of materials used for the project have been duly acknowledged.

Declared by:

Name: **Dawit Hailemariam**

Signature: _____

Date: _____

Advisor Conformation:

Name: _____

Signature: _____

Date: _____

August, 2013

Addis Ababa, Ethiopia

Acknowledgements

I should thank God for giving me strength to complete my graduate studies. I would like to express my gratitude to my advisor, Dr. Dida Midekso, for his professional support and encouragement throughout this project. My efforts would not have been successful without my advisor's useful inputs, helpful comments, insightful comments and most of all his patience with me from the beginning to the end of the project work.

I would also like to thank my family, specially my mother, Almaz Meshesha, who has stood by me all the way without reservation. And my special thanks goes to my friends and colleagues, particularly Eyob Shifreaw, for staying by my side in my trying moments, sharing their experiences, and helping me during my study.

Finally, I would like to thank Addis Ababa University and the Department of Computer Science for their contribution to my achievement.

Table of contents

	Pages
List of Figure.....	Vi
List of Table.....	Vii
Abbreviation and Acronyms	Viii
Abstract	ix
Chapter One: Introduction	1
1.1. Background of The Study	1
1.2. Statement of the Problem	3
1.3. Objective of the Project	5
1.3.1. General Objective of the Project	5
1.3.2. Specific Objective.....	5
1.4. Significance of the Study.....	5
1.5. Scope of the Study	6
1.6. Methodology	6
1.6.1. Data Collection	7
1.6.2. Development of Tools	7
1.7. Evaluation of the project	7
1.8. Document Organization	8
Chapter Two: Literature Review	9
2.1. Overview of Web Based E-learning	9
2.2. Attributes of E-learning	9
2.2.1. Flexibility	9
2.2.2. Electronic Based Resources.....	10
2.3. Usability of the Web Based E-Learning System	10
2.4. Aspects to Consider in Web-Based Learning Development	11
2.5. Related Work.....	12
2.5.1. TVET Portal the Arabic Gate to TVET	12
2.5.2. ETESDA	12
2.5.3. Fe-ConE (Framework for E-learning Contents Evaluation).	13
2.5.4. Bb Learn(Black Board Learn)	13
2.5.5. Coursera	14

Chapter Three :Overview of TVET Training	15
The current TVET Training in Ethiopia.....	15
Chapter four: Requirement Determination and Analysis	19
4.1. Overview	19
4.2. Functional Requirement	19
4.3. Non-Functional Requirements	20
4.3.1. User Interface	20
4.3.2. Availability	20
4.3.3. Performance	20
4.3.4. Security Issue.....	20
4.4. System Model.....	20
4.4.1. Actors	20
4.4.2. Use case Diagrams.....	22
4.4.3. Description of Use Case.....	23
4.4.4. Class Diagram.....	24
4.4.5. Sequence Diagram.....	25
Chapter Five: System Design	26
5.1. Design goals	26
5.2. Architecture	28
5.3. Subsystem Decomposition	30
5.3.1.Learning Subsystem	31
5.3.2.Teaching Subsystem.....	31
5.3.3. Report Generation Subsystem	31
5.3.4. Administration Subsystem.....	31
5.3.5. Notification Subsystem	31
5.3.6. Registration Subsystem.....	31
5.3.7. Event/news Subsystem.....	31
5.4. Deployment Diagram.....	32
5.5. Persistent Data Management.....	33
Chapter Six: Implementation	34
6.1. Overview	34
6.2. Tools and Technologies Utilized for Implementation.....	34
6.3. E-learning Support System for TVET Training.....	34

6.3.1. Administrator Service Interface.....	35
6.3.2. Trainer Service Interface.....	44
6.3.3. Student/Trainee Service Interface	48
Chapter Seven :Evaluation of E-learning Support System	53
7.1. Overview	53
7.2. Usability test	53
7.3. Test Result and Discussion.....	54
Chapter Eight: Conclusion and Future Work.....	58
8.1. Conclusion.....	58
8.2. Future Work	59
Reference.....	60
Annex A Title of Annex / Structured Interview Questions.....	63
Annex B " " / Use Case Description.....	66
Annex C " " / Sequence Diagram	79
Annex D " " / Sample of the Database Script.....	86
Annex E " " / Sample of the Code Behind the User Interfaces.....	87
Annex F " " / Questionnaires for Usability Testing	89

List of Figures

Figure	Page
Figure 4.1 Use case diagram for Administration related task	22
Figure 4.2 Documents and News Related Use Case	23
Figure 4.3 Class Diagram	24
Figure 5.1 Architecture of the TVET E-learning	28
Figure 5.2 Subsystem Decomposition	30
Figure 5.3 Deployment Diagram	32
Figure 5.4 Relationship between Tables	33
Figure 6.1 TVET E-Learning Support Home page	35
Figure 6.2 Administration login Page	36
Figure 6.3 Administrator Service Home page	37
Figure 6.4 Trainer Registration page	38
Figure 6.5 Trainer Edit Page	39
Figure 6.6 Send Notification Page	40
Figure 6.7 Upload Teacher Guide page	41
Figure 6.8 Create Event/News page	42
Figure 6.9 Upload Sample Exam	43
Figure 6.10 Trainer Service Home page	44
Figure 6.11 Assignment Upload page	45
Figure 6.12 Teacher Guide Download page	46
Figure 6.13 Upload Documents page	47
Figure 6.14 Student Login page	48
Figure 6.15 Student Service Home page	49
Figure 6.16 Sample COC and Institutional Access page	50
Figure 6.17 Download Learning Material page	51
Figure 6.18 Download Institutional Document page	52

List of Tables

Tables	Page
Table 4.1: Actor Name and Description	21
Table 7.1: Description of computers used in testing process	54
Table 7.2: E-learning support system questionnaire result summary	55
Table 7.3: E-learning support system questionnaires respondent' result Summary in percent (%)	57
Table B1: Use case description for login	66
Table B2: Use case description for register trainer	67
Table B3: Use case description for register trainee	68
Table B4: Use case description for manage account of tanner	69
Table B5: Use case description for manage account of tanner	69
Table B6: Use case description for Trainees record	70
Table B7: Use case description for View Report	71
Table B8: Use case description for upload learning material	72
Table B9: Use case description for Download teacher guide	73
Table B10: Use case description for create event news	74
Table B11: Use case description for Upload institutional document	75
Table B12: Use case description for Upload sample exam	76
Table B13: Use case description for Upload institutional document	77
Table B14: Use case description for Download sample exam	78

Abbreviation

ASP.NET: Active Server Pages

CBT: Computer Based Training

COC: Certificate of Competency

ILT: Instructor Led Training

ICT: Information and Communication Technology

LAN: Local Area Network

MOE: Ministry of Education

NTQF: National TVET Qualification Framework

OBT: Outcome Based Training

OS: Operating System

POT: Project Based Training

SQL: Structured Query Language

TVET: Technical and Vocational Education and Training

WBL: Web-Based Learning

WWW: World Wide Web or the Web

Abstract

Outcome based TVET training is important in today's development of the economic sector. Young people and technologies should be ready for a country to fit in the dynamically complex learning/training and working environment. The case of Ethiopia is no exception, The country has been in a steady growth in TVET training since its implementation in 2001/02. Compared to other developed countries TVET training in Ethiopia has not yet reached the required level of development. This implies more work should be carried out to meet present and future needs of skilled and well trained man power as per the need of the various training and education fields and the requirement of the labor market.

The purpose of this work was to conduct a study on design and implementation of a web based e-Learning support system for TVET training programs. System requirements have been rigorously collected from the five TVET institutions in Addis Ababa; and consulting related literatures and software products which are used in other countries has been made. The design and implementation of a prototype system was done in accordance with the identified functional and non functional requirements.

The prototype has been tested with data from the five TVET institutes in Addis Ababa. It has been found out that the system enables the trainers and trainees to register, to download proper learning materials, to obtain recent information about the TVET training, to see result (progress chart) for a unit of competency, to send notification by mobile, to download and submit assignment, to download teachers guide, curriculum, TVET strategy documents, and generate various reports.

Key words: *Outcome based training, TVET, unit of competency, progress chart, web based e-learning*

Chapter One

Introduction

1.1 Background of the Study

Web based E-learning is internet-enabled learning that uses network technology to design, deliver, select, administer and extend learning [1]. The world of work has changed dramatically over the past decade. It has become technologically complex, demanding highly sophisticated work skills, and globalization has been expanded over the world. Therefore, supporting the TVET institutions training by e-Learning is a very key issue. Different studies were conducted that shows e-learning is important for vocational training, according to [2] in the context of e-learning, does not lie in its ability to train just anyone, anytime, anywhere, but in training the right people to gain the right skills or knowledge, at the right time. Web-based e-learning applications are in high demand in educational institutions and in corporations that use them to give training [3].

In the 1960s and 1970s, educational computing took place primarily in large universities, using mainframe computers, and was mainly restricted to reading and typing text[4]. The development of the microcomputer in the late 1970s led to a rapid spread of computing in schools, businesses and homes. Interaction with computers became possible via text, graphics, and voice and pointing. The release of personal computers (PCs) in the early 1980s resulted in wide expansion of computer use in both business and industry. The development in computer networks, from LANs to WANs, and to the Internet, permitted the sharing of information and resources. In the early 1990s, the creation of part of the Internet known as the World Wide Web (WWW) or the Web, transformed the entire computing landscape. The web has transformed from a network used by academia and government for exchange of textual material, into a worldwide multimedia

resource. It is used by millions of people worldwide for activities such as learning, shopping, researching, and the exchange of textual, audio and graphic information [4]. Now a day the use of computers for training and education is expanding rapidly, largely because of the popularity of the Internet and the WWW [5]. As many analysts and researchers say that the initial focus of much e-learning has been on asynchronous course delivery, are now predicting a rapid expansion of new synchronous models that enable the delivery of instruction to a group of distributed learners in real time, using a variety of interactive media; in effect a “virtual classroom”[6].

Therefore, the purpose of this project was developing web based e-learning support system. With this service, learning material will be available by trainer in different format audio, video, text. Trainers will have update information about training from the TVET agency. Different notifications from the agency can be sent to trainers by SMS. Trainees also access up-to-date information about the training from the institution the trainer belongs. In addition with this new approach drawback of using traditional TVET training is solved. Hence, this project will try to answer how we develop a web based e-learning support system to give more strengthen the TVET training.

The role of TVET in furnishing skills required to improve productivity, raise income levels and improve access to employment opportunities has been widely recognized. Developments in the last three decades have made the role of TVET more decisive; the globalization process, technological change, and increased competition due to trade liberalization necessitates requirements of higher skills and productivity among workers in both modern sector firms and Micro and Small Enterprises (MSE) [7]. Skills development encompasses a broad range of core

skills (entrepreneurial, communication, financial and leadership) so that individuals are equipped for productive activities and employment opportunities (wage employment, self-employment and income generation activities).

As MOE suggest that, in case of Ethiopia the economic policy and strategy of the country requires technical and professional skills in broad and specific occupational fields. It is with this intention that the government of Ethiopia has put in place a comprehensive capacity building development program aimed at strengthening its human resource potential through TVET. The TVET agency is responsible to control the training that is being given by different institutions, TVET training consists of tasks such as: in school training, cooperative training, institutional assessment, and national assessment.

1.2 Statement of the Problem

In Ethiopia, as the TVET training is being conducted traditionally, outcome based training is not implemented properly. Supporting outcome based training in TVET institution by E-learning has a great positive impact, because outcome based training is self paced training. Outcome based training means that the learning and teaching activity is not conducted in formal way of training, which mean that the training is self pace. As long as learning material (aid) is accessible the training can be conducted anytime and anywhere. Identified competences needed in the labor market will become the final benchmark of teaching, training and learning, and that all institutions, rules and regulations of the TVET system will be (re-)defined so that they support citizens to become competent. Because TVET training is dynamic in its nature, it needs proper outcome based training. The number of industries that need skilled man power is rapidly

increasing in the country. Due to traditional way of teaching and other coupled problems the quality of the TVET training is being challenged at present.

With the development of the Internet, Internet-based computerized learning, known as *e-learning*, has attracted the attention of educators. E-learning is defined as “the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services, as well as remote exchange and collaboration” or “the use of network technologies to create, foster, deliver, and facilitate learning, anytime and anywhere.”[8].

Currently, in Ethiopia all TVET institutions are not supported by e-learning. They all use the traditional way of learning. Such learning activities include the following drawbacks:

- Institutions do not have self paced training.
- Students do not get uniform learning material.
- Trainers do not have access to up-to-date information about trainings.
- Outside the institutions, especially at the cooperative training area, there is no alternative to get up-to-date learning material and information regarding unit of competency.
- TVET agency does not have up-to date information about the status of TVET institutions with regard to learning activity.
- TVET agency does not have central information of TVET training.

Therefore, this study tries to address the following basic activities which are very important for the current TVET training:

- Centralized data which is easy to secure, backup, share and update.
- Increase availability especially for learning/teaching material, at anytime and anywhere.

- Increase accessibility by sending notification by SMS.
- Automatic generation of different reports with different format.

1.3 Objective of the Project

1.3.1 The General Objective of the Project

To design and implement a web based E-learning support system for TVET training at selected TVET institutions in Addis Ababa city Administration.

1.3.2 Specific Objectives

To attain the general objective the following specific objectives were set:

- a. Reviewing relevant literature.
- b. Identifying the requirement of the system.
- c. Selecting appropriate tools for the system.
- d. Developing a prototype to demonstrate the practicability of the designed system on the basis of the identified requirement.
- e. Evaluating the developed prototype against its requirements.

1.4 Significances of the Study

The project's result could be applicable in different areas benefiting different target groups.

- Trainers are the main users of the system to register trainees, upload learning materials, get-up-to date information and receive notification by SMS from the agency, send assignment to trainees, make accessible for trainees progress chart result, post event news to be accessible by trainees.

- Trainees can download learning materials, can get current unit of competency result, and can have up-to-date information about the training. In addition, trainees can download assignment and submit assignment.
- TVET agency whose mandate is to control the training can also use the system to upload teachers guide and other related learning information about the training. For the trainers, agency can send notification whenever necessary by mobile. Post event news for TVET institutions. The agency can also control centrally the performance of the institution.
- Company that provides in-company training can get TVET information easily. Cooperative training supervisor can have information about unit of competency and training plan.
- TVET institutions can give outcome based TVET training and also monitor trainer performance.

1.5 Scope of the Project

The TVET e-learning support system focuses on limited e-learning support system functionalities like, uploading, downloading, searching, updating learning materials, and other functionalities like send notification by mobile, check progress chart result. Thus these functionalities are for TVET institutions specifically for Addis Ababa city administration. Target TVET institutions in Addis Ababa were Misrak, Tegbared, Wenget, Entoto and Nefasselk all of these institutions are well experienced in providing TVET training with different curriculum.

1.6 Methodology

In order to achieve the objective of the project, the following methods are employed.

1.6.1 Data collection

- **Primary Data Source**

For the purpose of requirement elicitation for the new system, primary data from five TVET institutions, and from the Agency, have been collected.

- **Secondary Data Source**

Secondary data collection has been also conducted for requirement elicitation purpose from different angles as follows.

- Relevant teaching and learning document like teachers guides, learning guide
- Institutional and COC assessment tools.
- TVET strategy and policy documents.
- TVET related document in institutions and agency.

1.6.2 Development of Tools

Different tools have been used for different purposes in the analysis, design and implementation of the E-learning support system. Among these tools: ASP.NET for developing the web applications which is more advantageous for security , C# for writing the application's script with Visual studio 2010 .Microsoft SQL Server 2005 data base designer for developing the back end which is compatible with visual studio 2010 and improve security of the system.

1.7 Evaluation of the project

The E-learning support system is regularly tested using windows 7 OS and Firefox browser while the application is being developed. After the prototype is completed, it was tested on various computer OS and browsers. To test the e-learning support system prototype on the actual place, the application is hosted on mistake TVET institutions LAN, which is serving the institutions training.

At last, the usability of the e-learning support system has been conducted by considering different users, computers, OS and browsers. The usability response were collected through questionnaires and analyzed.

1.8 Organization of the Document

This project is organized into seven chapters: including the current one. Chapter Two is a review of related literature. The literature review part gives a summarized report on the state of art in e-learning for TVET in relation to our project. And related work discusses some selected TVET E-learning applications. The focus of Chapter Three is on overview of TVET that provide more information about TVET in Ethiopia. Chapter Four is concerned with requirement determination and analysis and provides functionalities of the system. Chapter Five presents proposed design and architecture to develop E-learning support for TVET training. Chapter Six explains the implementation and evaluation of the system. In Chapter seven, the E-learning support system prototype evaluation that conducted on the actual palace and the usability of the prototype evaluated based on the data collected from the users via questionnaire. Finally, Chapter Eight gives conclusion by giving recommendation and future work in the aspect of our TVET e-learning support system project work.

Chapter Two

Literature Review

2.1 Overview of Web Based E-learning

Web based E-learning is a form of teaching and learning that includes instruction delivered via all electronic media including the Internet/intranets/extranets [9]. The ability to converge a wide range of media including text, sound, images, animation, and video on the Internet has been perhaps the single most important factor underlying the expansion of technology-based learning. The term e-learning is currently used to describe the use of computer technology to support learning. The Internet and the Web have literally “changed everything” by providing a powerful, relatively ubiquitously vehicle for the creation and distribution of learning materials in multiple formats and media, especially for outcome based TVET trainings. Therefore, Ethiopia has to be benefited from this web based e-learning technology to support her TVET institutions for the sustainable development of TVET training.

2.2 Attributes of Web Based E-learning

2.2.1 Flexibility TVET training is conducted as outcome based training not in the traditional way in order to fit the objective of the sector. For this, Som, N agrees that a key attribute of web based e-learning is its ability to enable flexible access to information and resources. At the heart of the concept of flexible access is learner choice. According to [10] Flexible access refers to access subject matter in different media types and use of information and resources at any time, place and pace that are suitable and convenient to individual learners rather than the teacher and/or the educational institutions.

2.2.2 Electronic based resources. In order to implement outcome based training in TVET, preparing learning materials in different media type plays a key role so that trainee can access learning materials according to their pace and preference. Information and communications technology also enables the capture and storage of information of various types including print, audio, and video. Networked information and communications technologies enable access to this content in a manner that is not possible within the spatial and temporal constraints of conventional educational settings such as the classroom or the print mode [11]. In outcome based TVET training, the learners are facilitated by their learning preference. Users have access to a wide variety of educational resources in a format that is agreeable to individual approaches to learning them [12]. Typically, these educational resources could include hyper-linked material, incorporating text, pictures, graphics, animation, multimedia elements such as videos and simulations.

2.3 Usability of the Web Based E-learning System

Usability was formerly defined as “the capacity in human functional terms to be used easily and effectively by the specified range of users, given specified training and user support, to fulfill the specified range of tasks, within the specified range of environmental scenarios”[14]. Other authors also define the usability of a system differently but what they said in common is the satisfaction of the user. The ISO also defines the usability as “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context”.

According to [16], web based learning tools will be simple to learn if they meet certain criteria in order to achieve the goals. In a study to determine the usability of WBL learning tools, Wang y [16] found that WBL tools were simple to use when they were:

- Well designed, easy to use and learn;
- Simple to navigate with a well-designed layout;
- Compatible with other programs and platforms;
- Transparent in their use, so that they do not hinder or frustrate the learner;
- Used to support the course, but not to replace face-to-face contact; and
- Relevant to the course, and its structure and content.

2.4 Aspects to Consider in Web-Based e-Learning Development. Development of WBL applications does not mean just placing instructional materials online. The process requires knowledge of instructional and graphical aspects, as well as basic web design expertise. Other challenges are that every online course is unique, due to factors such as its goals, content, audience, and budget. The development of WBL process requires much more time in planning and structuring than traditional instruction [17].

The three major actors/subjects to consider in educational design are the teacher, the learner and the domain knowledge the learner should acquire [18]. Having this in mind in order to develop successful web based e-learning support system for TVET institutions the above three things must be considered carefully.

Learners are the main target of any learning environment. Any people can be the learners of TVET institutions, so it is important to know and to consider the general characteristics of these young learners for the successful implementation of the system. Some of the issues to consider include

age, affiliation, Internet access, technological skills, educational needs, culture, interests, motivation, and expectations of the learner [19].

The teacher or educator, who is often also the designer, plays a critical role in the generation of any web based e-learning application. In the case of outcome based TVET training the educator plays important role not by teaching but by facilitating the training. In determining what to teach and how to teach it, the role of the course educator or trainer involves the following [20]:

- Designing the overall structure of the course, relationship to the curriculum, and other aspects relating to the smooth running of the course.
- Determining the learner activities, for example, assignments, online discussions and debates.
- Selecting the learning strategies and appropriate media that will assist the learners to achieve the required outcomes.

2.5 Related Work

2.5.1 TVET Portal, the Arabic gate to TVET: The objective of this web based portal is to find a lively community of practice in the fields of Technical and Vocational Education and Training (TVET) and E-Learning in Arab countries [21]. The portal's benefits include:

1. Provision of updated information about TVET and e-learning
2. Provision of information how and where to enroll in different web based internet based e-learning courses both in Arabic and English language.
3. Availability of Forums services for the TVET community.

2.5.2 eTESDA(*e-Technical Education and Skills Development Authority*)

The objective of eTESDA in Pilipino [23] is Expanding Access and Opportunities to Quality TVET through ICT. To accomplish this objective, eTESDA hosts a web based portal which has a service to give e-learning. The e-learning application mainly provides a service for blended courses, which is a course that will be conducted by different learning preferences. Basically, the available service on eTESDA in action is: for blended eTESDA course on line access, for carrier profiling, as Community e-Centers, in jobs bridging, etc.

2.5.3 *fe-ConE (Framework for E-learning Contents Evaluation)*: This project is designed for giving on line course, especially for blended courses [24]. This project uses Moodle. Moodle is a course management software tool which is open source [24]. The objectives of the *fe-ConE* project are:

- The promotion of the e-learning notion across Europe
- The consolidation of experiences (practices and knowledge) for empowering the e learning stakeholders.
- The design of instruments (tools, scenario and frameworks) for the e-content design /developing / decision taking on the use by the end-user.

2.5.4 *Black board (Bb) Web Based Learning* Bb web based learning is a north Arizona university learning management system which provides a secure content repository, a collection of interactive tools [25]. People use the Bb learning management in three ways: web based enhanced materials placed online and no seat time reduction only to supplement the course content, hybrid one which reduces seat time from a face to face class room and the third way is fully online a face to face meeting. Web based learning enables educators to minimize the time they spend on course building and delivery tasks, freeing up their time and energy to focus on

student success, achievement, and retention. According to [26] Basic services that are provided by Bb learn are:

- Course content with hierarchical organization so that students can navigate through content in a logical and sequential way.
- Includes content management module enhancements that enable you to easily upload and manage content across courses and organizations.

2.5.5 Coursera: Coursera is an educational technology company founded by computer science professors Andrew Ng and Daphne Koller from Stanford University [27]. Coursera works with universities to make some of their courses available online, and offers courses in engineering, humanities, medicine, biology, social sciences, mathematics, business, computer science, and other areas. Classes offered on Coursera are designed to help people master the material. When the learners take one of the classes, they will watch lectures taught by professors, learn at own pace, test their knowledge, and reinforce concepts through interactive exercises.

All the different e-learning system discussed above solves the problem of traditional way of learning. These technologies show that we are way behind from where the modern world currently is in giving training. However we still have a chance of solving the problems we are facing, which is traditional way of teaching using. If we start doing this, other people of different discipline can pick it from where we stop and continue to the next higher stage. This way we could reach the desired modern technology, eventually. For this reason, we have solved the problem of the TVET training using e-learning support system. Having studied the related TVET e-Learning based systems developed for the purpose of TVET training one of the limitations we have noticed is that there is no way to see unit of competency result and also no way for institutions to up load their own learning material by their own curriculum centrally to the agency.

Chapter Three

Overview of TVET Training in Ethiopia

In Ethiopia, TVET was established as new in 2004. Article 11 of the “Technical and Vocational Education and Training (TVET)” Proclamation No 20, authorizes the Federal TVET Agency to design, innovate and adopt processes suited for the development of Occupational Standards, and the proper implementation of the Assessment and Certification System[28].

The overall objective of the new national TVET strategy is to create a competent, motivated, adaptable and innovative workforce that plays pivotal roles in the poverty reduction and socio-economic development efforts of the country. This is achieved through facilitating demand-driver, self employment oriented, relevant and outcome based TVET at all levels. That is why the Ethiopian TVET system is reorganized as an outcome-based system. This means that identified competences of the labor market that are described in the occupational standards are the final benchmarks not only for training and learning activities but also for the assessment of competences and certification as well. Moreover, building an outcome-based TVET system creates access for equal recognition of competences acquired through whatever the means and ways of being competent. The overall frame and structure of the outcome-based TVET system is described in the National TVET Qualification Framework (NTQF). The NTQF rationalizes all TVET requirements into a single nationally recognized qualification. It defines the different occupational qualification levels to be awarded. The levels detail the scope and composition of qualification and degree of responsibility a qualified person would assume in the workplace. The outcome of training delivered in the system is measured through a process of verification of a candidate’s achieved competences, known as occupational/competence assessment.

The TVET system in Ethiopia is currently rapidly expanding. The government believes that the present low factor productivity is due to the skill gap, and that left to its own, the industry will provide less training than is socially optimal. Therefore, publicly provided vocational education is seen by the government as the means to close this skill gap. The government of Ethiopia looks at the public TVET as the key in improving the productivity of the enterprises and increasing their competitiveness in the global market.

Government involvement goes beyond mere provision of TVET. The Ministry of Education administers the centralized exam at the end of the primary school, and scores on this exam determine if a student continues to the preparatory school or is placed in the TVET track. This national exam also determines which level of the TVET the individual can join. Furthermore, the allocation of the numbers of places for specialization is also centrally determined. In this regard, TVET system in Ethiopia is essentially command driven, even though the government recognizes the importance of ensuring the system is sufficiently flexible and responsive to demands of industry.

Technical and vocational education (TVET) is institutionally separate from the rest of the education system, and forms a parallel track. Students entering TVET stream after completing grade 10, have five options open to them, depending on the score received in the national exam (level 1, level 2, level 3, level 4, and level 5). Students who complete level 3 of training after grade 10 are considered to have completed first year of college level. Students that attain level 4 and level 5 in TVET can continue to higher education.

Registration and Training: A student who cannot join universities based on the result of the national examination can join a TVET institution. Students choose sector (department) based on the result. Students follow training in the institution for 8 hours a day. The delivery of training is

based on in-school and co-operative training. In In-school training student are facilitated by the trainers and mostly on class room based which is face to face training and trainers always conduct and facilitate training.

Cooperative Training: The training that is provided by the institution, which is in-school training, is not fully supported by practice because of constraint like cost, environment and so on. Therefore, companies play a big role in order to fill this gap. Such training is known as a co-operative training.

Institutional Assessment: Training is accomplished by taking assessment at the end of each level in which the student takes a summative assessment. This assessment is institutional assessment. Institutional assessment is level based assessment. TVET training is given based on LEVEL, as LEVEL 1 up to LEVEL 5. In order to pass to the next level and to take the national assessment, students are expected to take institutional assessment.

National assessments (Competency of certificate (COC)).This refers to an autonomous government organization delegated by the Federal TVET Agency to properly and effectively implement assessment and certification. The COC organization facilitates the dissemination of information for the assessment and certification program in various media platforms; provides candidates and other stakeholders of the TVET with the Occupational standards that are applicable to their occupation, to guide their manpower in their future plans.

Outcome Based Training. Blended learning can be described according to [29]. “a learning program where more than one delivery mode is being used with the objective of optimizing the learning outcome and cost of program delivery” The national TVET system in Ethiopia, in line with many modern TVET systems worldwide, will be re-organized into an outcome-based system. This means that identified competences needed in the labor market will become the final

benchmark of teaching, training and learning, and that all institutions, rules and regulations of the TVET system will be (re-)defined so that they support citizens to become competent.

Another definition of blended learning is used to describe learning that mixes various event-based activities, including face-to-face classrooms, e-learning, and self-paced learning” .When we think of outcome based training, the following basic tasks are performed: students conduct training based on their learning preference, and can take the training based on their own performance, students should not necessarily come to school every time, trainees take pre assessment for choosing department. Currently TVET agency in Ethiopia cannot implement outcome based training properly or blended learning as only face-to-face learning activity is being conducted.

Project-based Learning: Project-based learning offers quite different tasks on the relationship between working and learning and between being a worker and learner. Teachers will give students the task integrate previous learning to using their experience in ‘real’ workplace and try to solve the ‘real’ work problem. It will help students more to expose to real world of work and can be understood as the kind of thing that real workers do [30].

The overall implication of the current training practice at the TVET stream is that it has not reached the expected level to attain the intended goal as stated in the national strategy implementation document. This suggests the need for the training improvement of the situation at the stream so that the objectives of the system can be achieved successfully. And one of the ways of improving the system is conducting research to identify the problems and suggest solutions. Thus, this practical study was initiated to contribute one’s share by designing and implementing a web based e-Learning support system at the selected TVET institutions at the Addis Ababa City Administration.

Chapter Four

Requirement Determination and Analysis

4.1 Overview

This Chapter focuses on the requirement analysis of the proposed system called E-learning support system for TVET training. It also sketches the business model and the specification of the requirement. The work in this chapter was based on the primary and secondary data which is gathered from five different TVET institutions in Addis Ababa. Information about the existing system has been collected mainly through a questionnaire, interview, observation and document analysis method. The details about the questionnaire and interview are given in Annex A.

4.2 Functional Requirement

The system contains the following functional requirements:

- The system should allow to register trainers and trainees
- The system should allow system administrator to /upload teacher guide.
- The system should allow trainees to download learning material based on their preference (audio, video, and text), sample COC Exam, assignment and related documents about TVET.
- The system should allow trainer to upload assignment
- The system should allow trainees to submit assignment by email
- The system should enable trainees Check unit of competency result
- The system should allow to trainer upload sample COC Exam and institutional Exam
- The system should allow system administrator to send notification to teachers by mobile
- The system should to allow system administrator and trainers to create event news based on TVET.

- The system should allow system administrator to generate report based on collected data.

4.3 Non-Functional Requirements

The following list of non functional requirements is expected from the system.

4.3.1 User Interface .The effective usage of the system is highly affected by the user interface, how it is designed. The user interface should be simple and must be attractive in order to be visited by users. In general, web based application must contain other known link, to navigate easily, must contain the user manual to fully use the system. The system should be user friendly.

4.3.2 Availability. The system must be available whenever it is needed by the user. The aim of this project is to give a service at any time and any place learning with self pace. Therefore, the system must be available all the time.

4.3.3 Performance. Since it is a web based system, it runs on any system capable of running a web browser. Although clients run on PC, the server should be powerful which is handling request even high traffic time.

4.3.3 Security Issue. Students and trainers profile should be secured from unauthorized access.

4.4 System Model

The system model is used to analyze the system clearly. Different components in a system are described using UML tools. The main objective of these tools is to design and to understand the system requirement in a better way.

4.4.1 Actors: In TVET e-learning, there are four type of user, as shown in the Table 4.1.

Table 4.1 Actor name and description

Actor Name	Description
Administrator (TVET Agency)	Performs all administration related task, create account, upload document and send notification to user.
Trainer	A trainer is responsible to upload learning material, send notification to trainees.
Trainee	A trainee is a legitimate person who is allowed to get registered for the training
Department Head	Uploads institutional document, register trainees and post event news.

4.4.2 **Use Case Diagrams:** Use case is used to describe the functionality of the system from the actors' point of view.

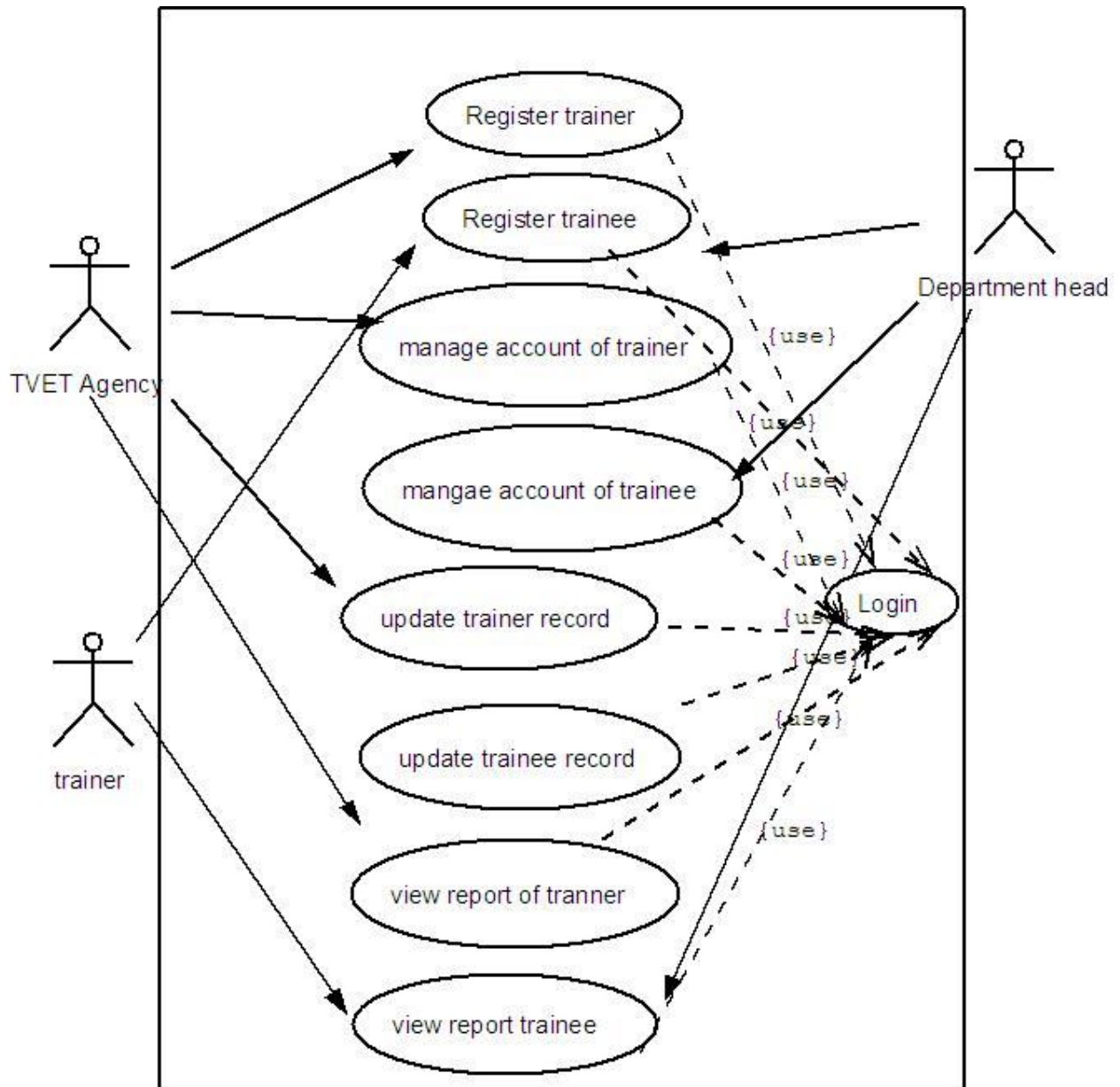


Figure 4.1 Use Case Diagram for Administartion Related Task

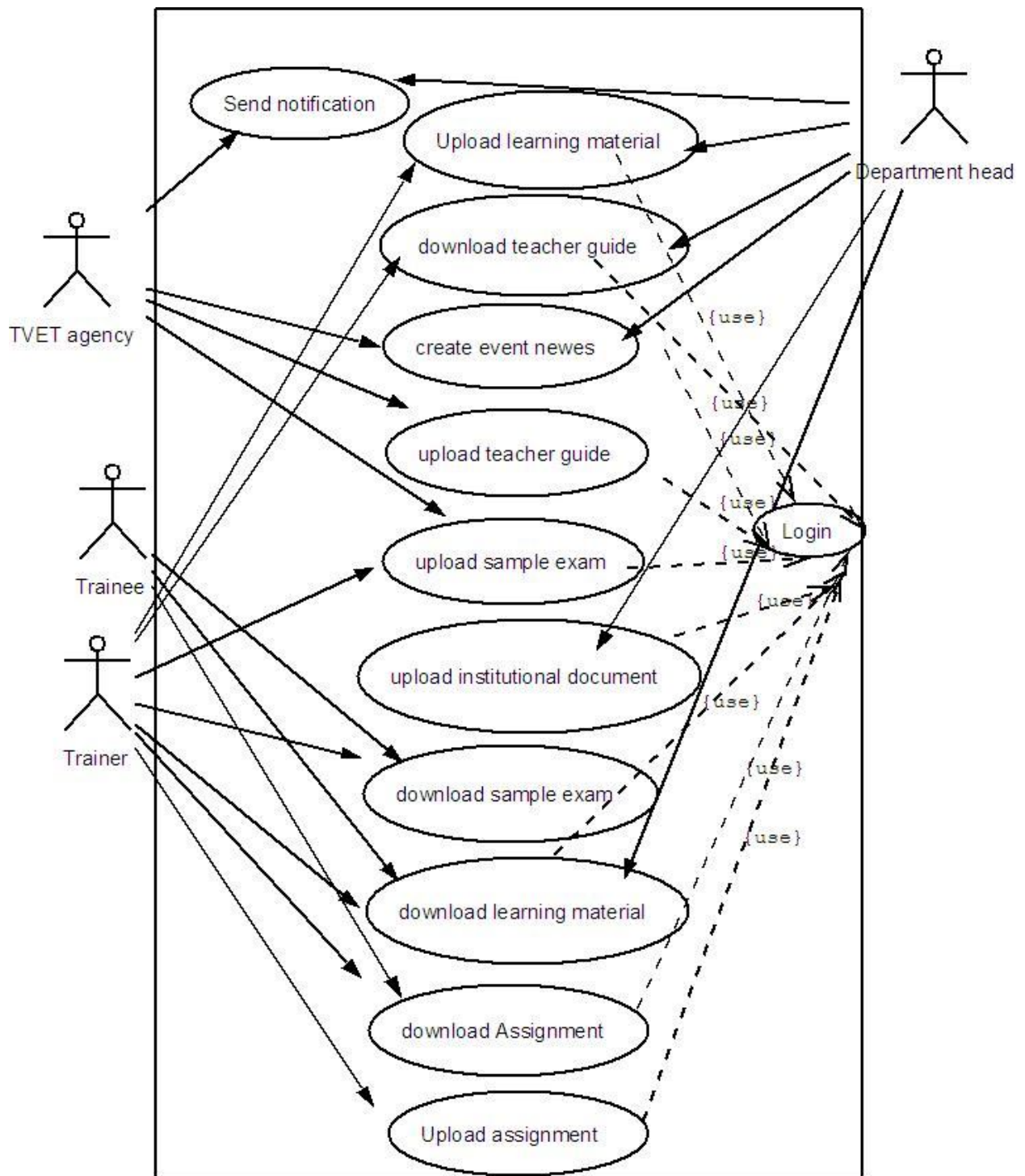


Figure 4.2 Document and News Related Use Case

4.4.3 Description of Use Case: The description is important to show the functionality of the system by using natural language in a step wise manner. The system use case description is found in detail in Annex B.

4.4.4 Class Diagram: Class diagrams are used to describe the structure of a system in terms of classes, attributes, operations, and association of objects in the class. Basic objects of the E-learning for the TVET training are: Trainer, Administrator, Department head, Learning material, Event news, and notification.

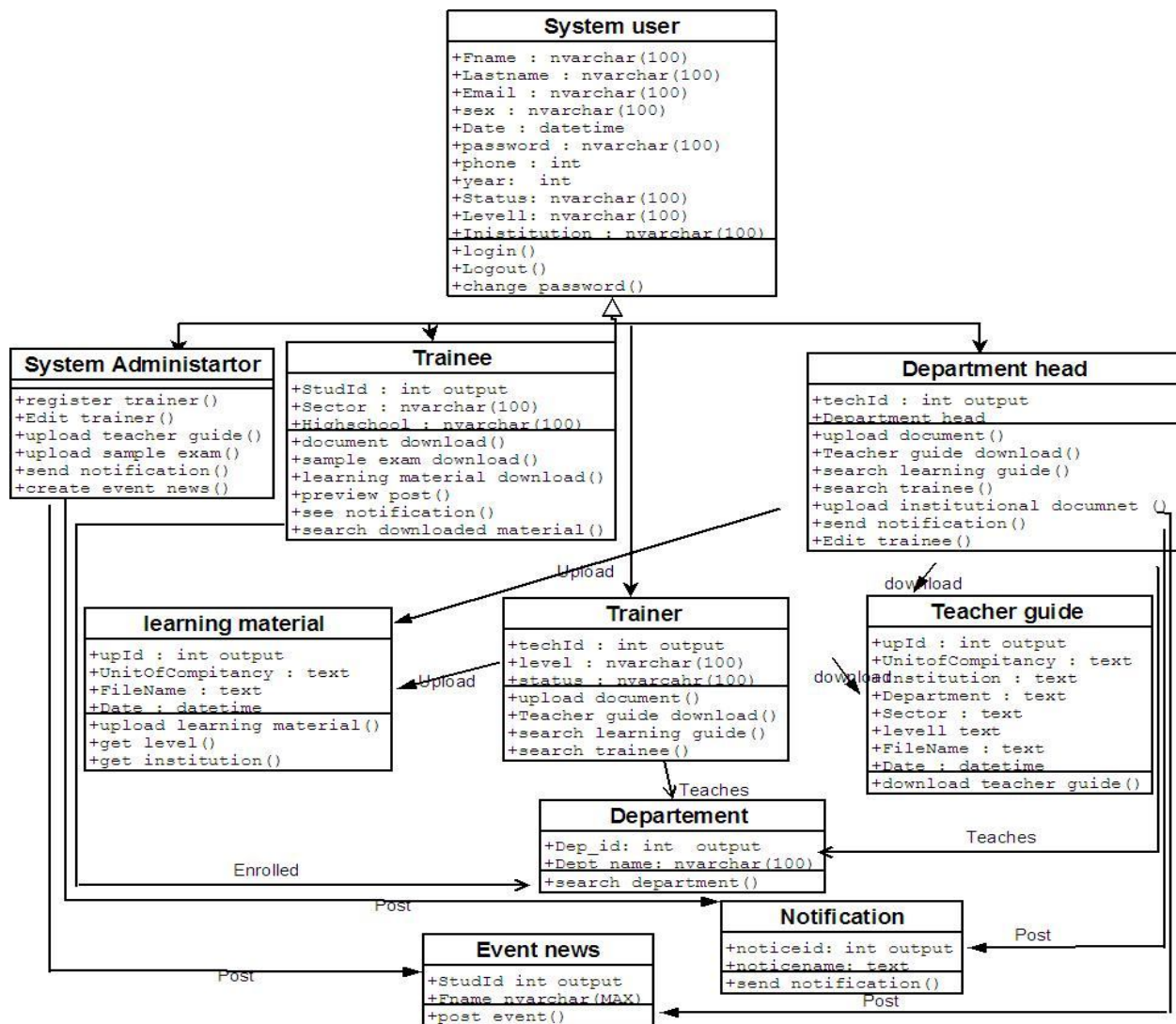


Figure 4.3 Class Diagram

4.4.5 Sequence Diagram. A sequence diagram ties use cases with objects. It shows how the behavior of a use case (or scenario) is distributed among its participating objects. Sequence diagrams for the use case are given in Annex C.

Chapter Five

System Design

The proposed system is designed based on the functional and non-functional requirements and analysis models defined in the previous Chapter. Consequently, the design goals, architecture, subsystem decomposition, deployment diagram, persistent data management of the new system have been identified, designed and presented in this section.

5.1 Design goals

The design goals are derived from the non-functional requirements of the system. They describe the qualities of the system. These goals consider the following criteria.

A. Performance Criteria

- i. **Responsive time:** The system should provide as fast response as possible, at least before the session expires in registering the trainees and give any accessible information. In order to minimize the time it takes to provide response, stored procedure is used in the database and middle-tier processing code is made as efficient as possible.
- ii. **Throughput:** The system should be able to support a number of users at a time using the available bandwidth of the system. The SQL server DBMS used in the system development supports a number of user concurrent accesses of the database without consistency problem.

B. Maintenance Criteria

- i. **Modifiability:** the system should be easily extensible to the need of the TVET agency and to add new functionalities to the system. The system is built from several independent classes which can be used as a standalone application or replaced by other

classes. This makes the system easy to change the existing functionality or add new ones when the need arises.

- ii. **Extensibility:** the system should enable the addition of new functionality without any restriction.
- iii. **Portability:** The system should be easily portable to different platforms. As the ASP.NET languages achieved platform independence through the Common Language Runtime (CLR), the end user can use the system using any browser such as Firefox and Internet Explorer.

C. End User Criteria

- i. **Utility:** The system must address the possible functional requirement of the system users. Consequently, all the functional requirements identified in the preceding chapter have been implemented in the system.
- ii. **Usability:** The system should be user friendly, and easy to learn and use. Moreover the general TVET learning page as well as trainers, trainee's registration page have been made accessible all together from a single main window in a wizard form for ease of usability.

D. Dependability Criteria

- i. **Robustness:** ability to survive invalid user input is assured during data input, updating and deletion of data by providing some information about the error and then the system resets itself to the previous safe state.
- ii. **Reliability:** in order to maintain the difference between specified and observed system behavior we try to test it as much as possible.

- iii. **Availability:** the system should be available for any legitimate users as long as the service provider is available or it is not shutdown by the system administrator.
- iv. **Security:** the system does not allow non-authorized users using a form based authentication.

5.2 Architecture

At a high level, the architecture of an application defines how different parts of the system are organized and logically separated yet ensuring that they work together. The architecture used for the system is three tiers: client tier, middle/web tier and the data tier as illustrated in Figure 5.1. Such an architecture is one of the most commonly used types of architecture for web-based applications as it provides greater application scalability, high flexibility, high efficiency, lower maintenance, and better reusability of components.

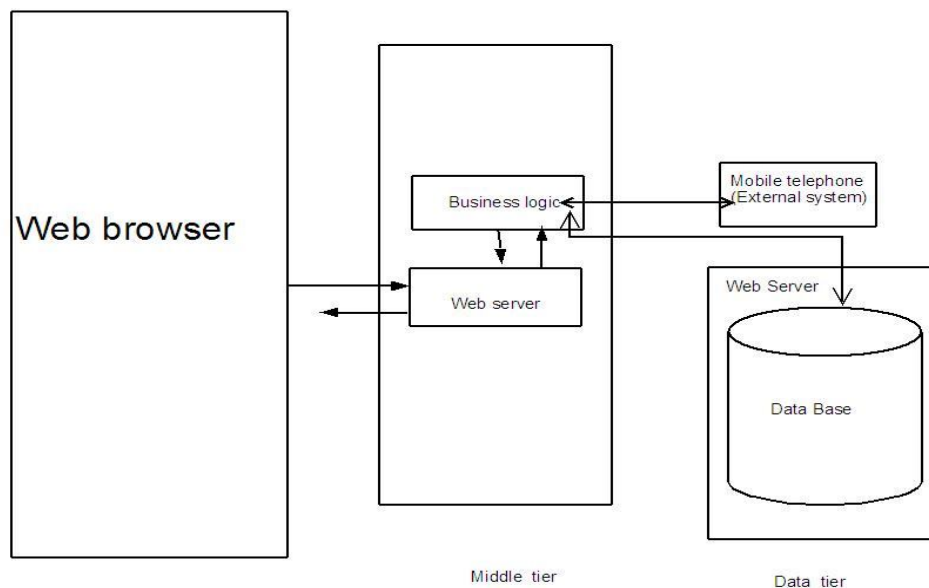


Figure 5.1 Architecture of the TVET E-learning Support System

The client tier is the application's user interface containing data entry forms, report access links and client side application that are running on the web browser of the user machine. The trainees, the trainer and the administrator and other users of the system interact directly with the application through this user interface. It interacts with the web/application server to make requests and to retrieve data from the database. It then displays to the user the data retrieved from the server.

The middle tier contains two parts of the E-learning application, i.e., the web server (application server) and the business logic. The web server (IIS) handles all HTTP requests coming from the client machines. The requests could be a request for adding new records, displaying existing records, or a request for report generation and others. It is also the web server which manages the responses that is forwarded to the client machines. The business logic component is responsible for handling all the core functionalities of the system such as input validation, performing calculations, report generation, access and retrieval of any data required by the client. When the data is submitted from the client machines, first it will be handled by the functions of the web server and then transferred to the business logic for processing. Again, the business logic processes the data and sends it either to the database or back to the web server, this is determined by the type of service required. It also interacts with an external system called Mobile telephone to accept notification information. The data tier layer is concerned with the data storage and persistence issues. It is implemented using SQL Server 2005 database. The database can either be stored on the web server itself or on a different machine; however it needs to be easily accessible by the web server.

5.3 Subsystem Decomposition

In order to reduce the complexity of the system analysis (application domain) tasks of the system we have identified smaller parts called classes in chapter four, similarly, to reduce the complexity of the system design (solution domain) we decompose the system into simpler parts, called subsystems, which are made of a number of solution domain classes. Each subsystem can be represented as a directory containing all the files implementing the subsystem with a set of related operations that share common purpose so as to provide service to other subsystem. Figure 5.2 shows the subsystem decomposition of the system.

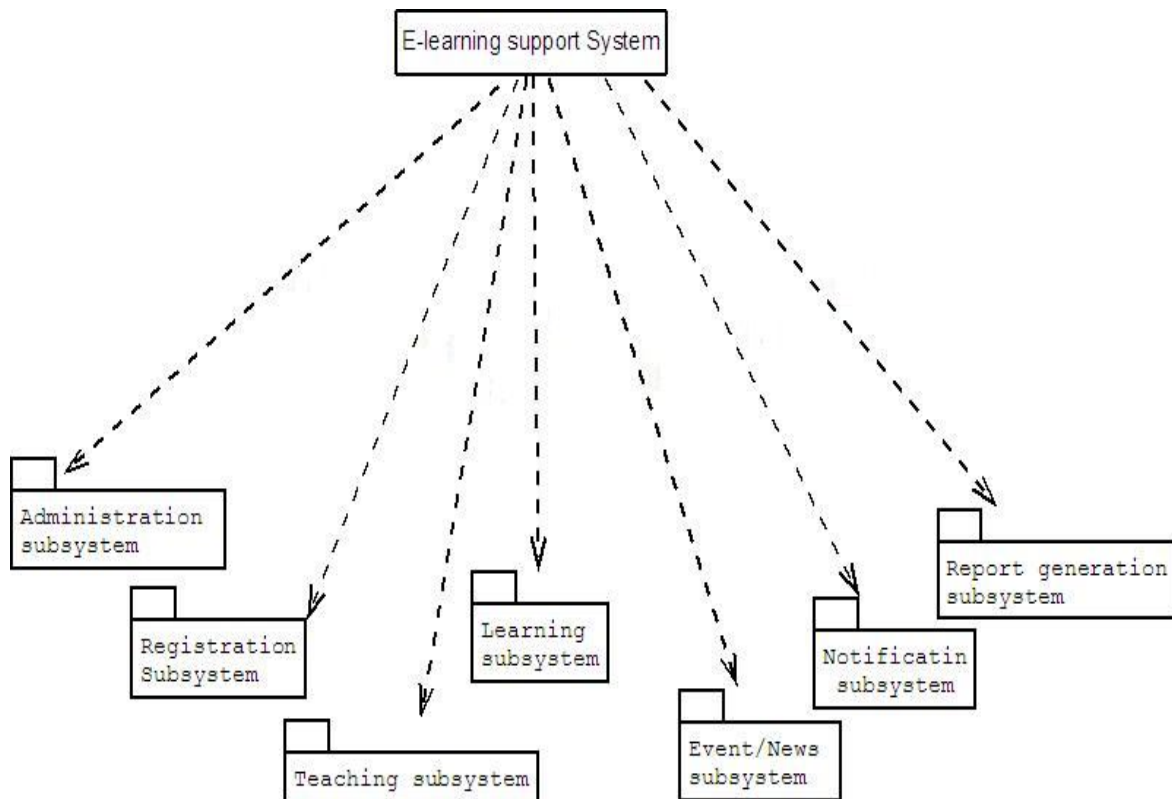


Figure 5.2 Subsystem Decomposition

- 5.3.1 Learning Subsystem:** This subsystem allows Trainees or trainers to make an order for a resource. This subsystem is intended to serves trainers and trainees download necessary learning materials and other related documents. In addition, trainees can check their own results for the unit of competency, which is progress chart.
- 5.3.2 Teaching Subsystem:** This subsystem is intended to give answer for learning material (aid) accordingly by different media types. And trainer also upload other related documents for trainings like assignment, sample COC exam, make accessible unit of competency result for trainees.
- 5.3.3 Report Generation Subsystem:** This subsystem is intended to serve primarily the TVET agency which is managed by administrator of the system, by providing access TVET institutions performance with regard to uploading material, trainer status, and institution status.
- 5.3.4 Administration Subsystem:** This subsystem enables the administrator to manage user accounts. The management includes creation of new accounts, removing the existing accounts and modifying accounts. This subsystem also enables the determination of who has access different page.
- 5.3.5 Notification Subsystem:** This subsystem enables trainers to receive notification by e-mail or mobile phone. The main task of this subsystem is to send updated information about TVET agency for trainer and trainee.
- 5.3.6 Registration Subsystem:** this subsystem is accessed by the department head and administrator to register and to see student and trainers current status information.

5.3.7 Event/News Subsystem: this subsystem is accessed by Administrator and department head. Through this sub system administrator and department head responsible to transmit information with related to news, events or any advertisement.

5.4 Deployment Diagram

A deployment diagram of a system shows the hardware/software mapping. The subsystems (components) of TVET E-learning support system identified in the preceding section are mapped onto the web and server node as shown in Figure 5.3. The client program (the web browser) will communicate with those ASP.NET applications (subsystems) residing on the web-server through an HTTP connection. And those subsystem components on the web server communicate with the data base system through an ASP.NET connection.

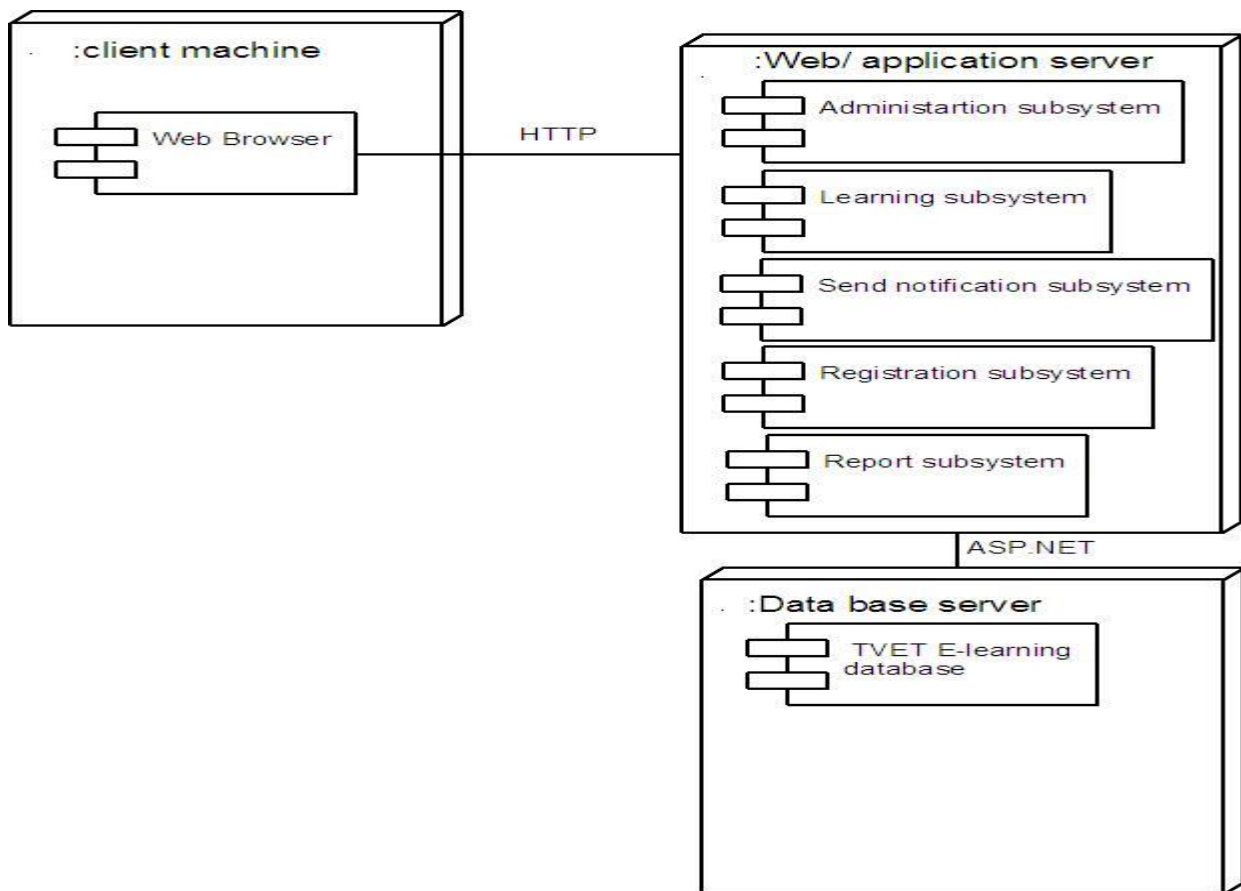


Figure 5.3 Deployment Diagram

5.5 Persistent Data Management

Persistent data management deals with how the persistent data are stored and managed. Information related to trainers, trainees, learning material, notification, and other related information are persistent data and hence stored on a database management system. Moreover, storing data in a database enables the system to perform complex queries on large data sets. In order to store data persistently in a database those class objects identified in the class diagram of TVET e-learning are mapped into tables and the attributes into fields to the respective tables. The tables of the system with their respective fields and the relationships that exist between the tables are illustrated in Figure 5.4.

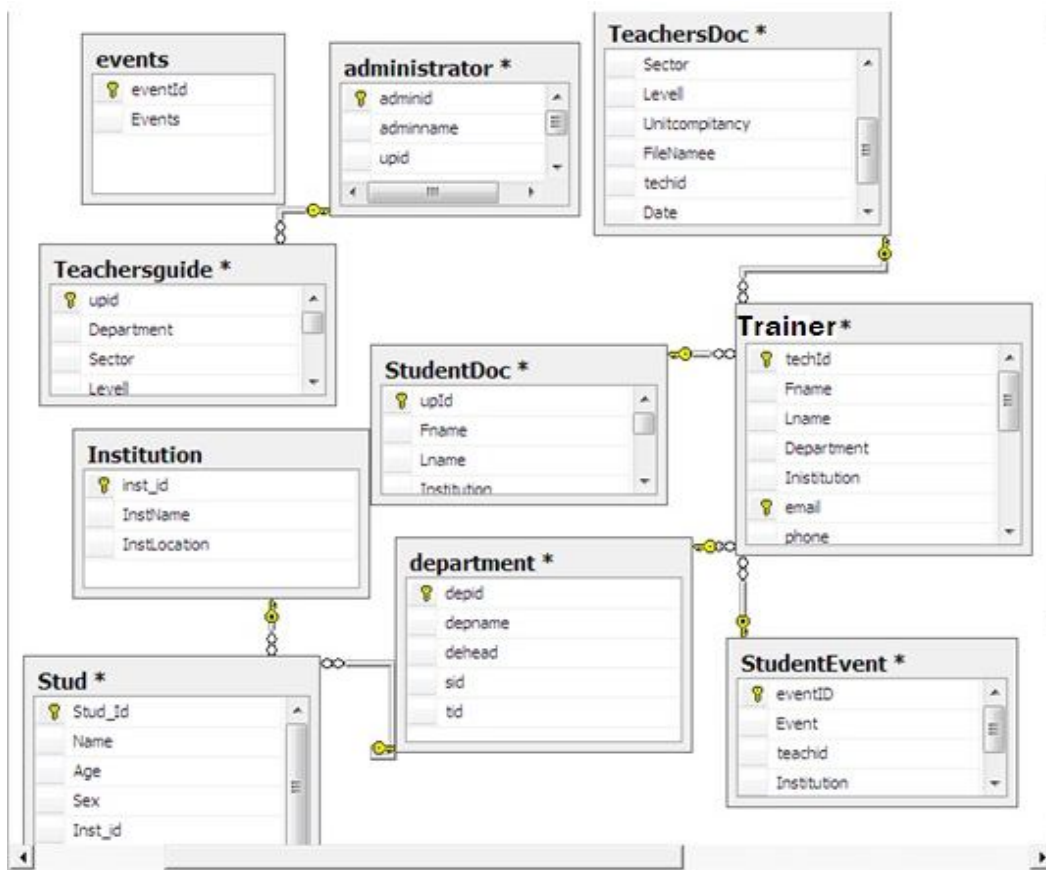


Figure 5.4 Relationships between Tables

Chapter Six

Implementation

In this chapter, the development tools used in the implementation of e-learning support system prototype is presented and the prototype itself is discussed by taking its sample snapshots.

6.1 Tools and Technologies Utilized for Implementation

Several tools and technologies were utilized for the purpose of developing the prototype of TVET E-learning implementation. The following is list of the programming, communication, and database Management and operating environment used in the prototype implementation.

- Visual Studio 2010 version, with the language visual C# and ASP.Net server is used for developing the prototype.
- Microsoft SQL Server 2005 database server is used for persistent data Management on the E-learning server.
- Microsoft Windows 7 operating system is used for the e-learning server.

6.3 E-learning Support System for TVET Training

The implementation of the system consists of the development of a number of web-forms, database entries and store procedures. Every web-form includes one or more data-tables to transact relevant data. According to the relationship between the web-forms, data-tables are created. The interfaces are categorized into three main interface components: Administrator service interface, trainee service interface and trainer service interface. The following section describes the three parts.

6.3.1 Administrator Service Interface

When the system is being activated by the Administrator, the home page of the system is displayed as shown in Figure 6.1

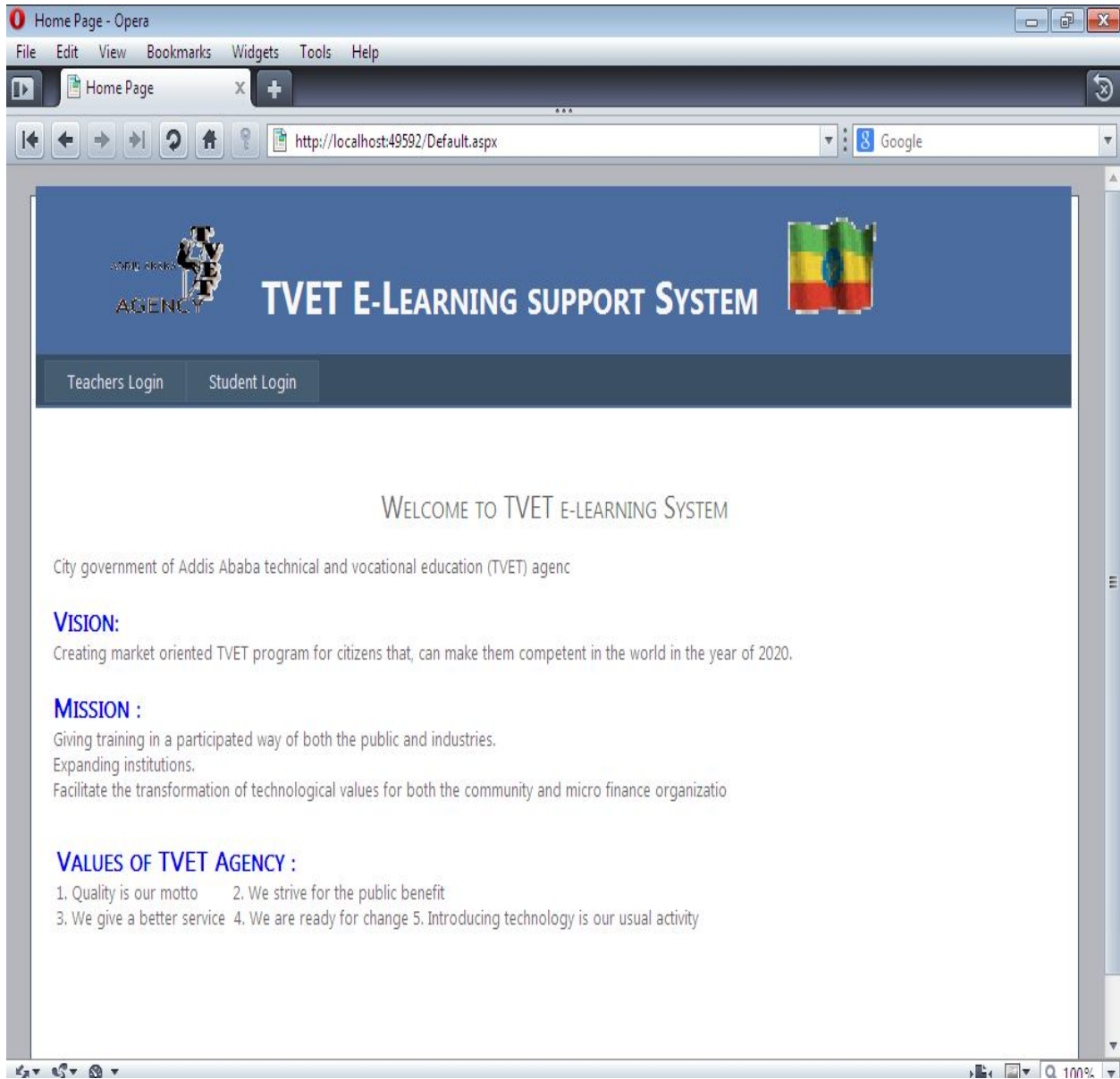


Figure 6.1 TVET E-Learning supports Home Page

Administrator enters the user name and password in order to login into the administrator service home Figure 6.2 shows the administrator login page.

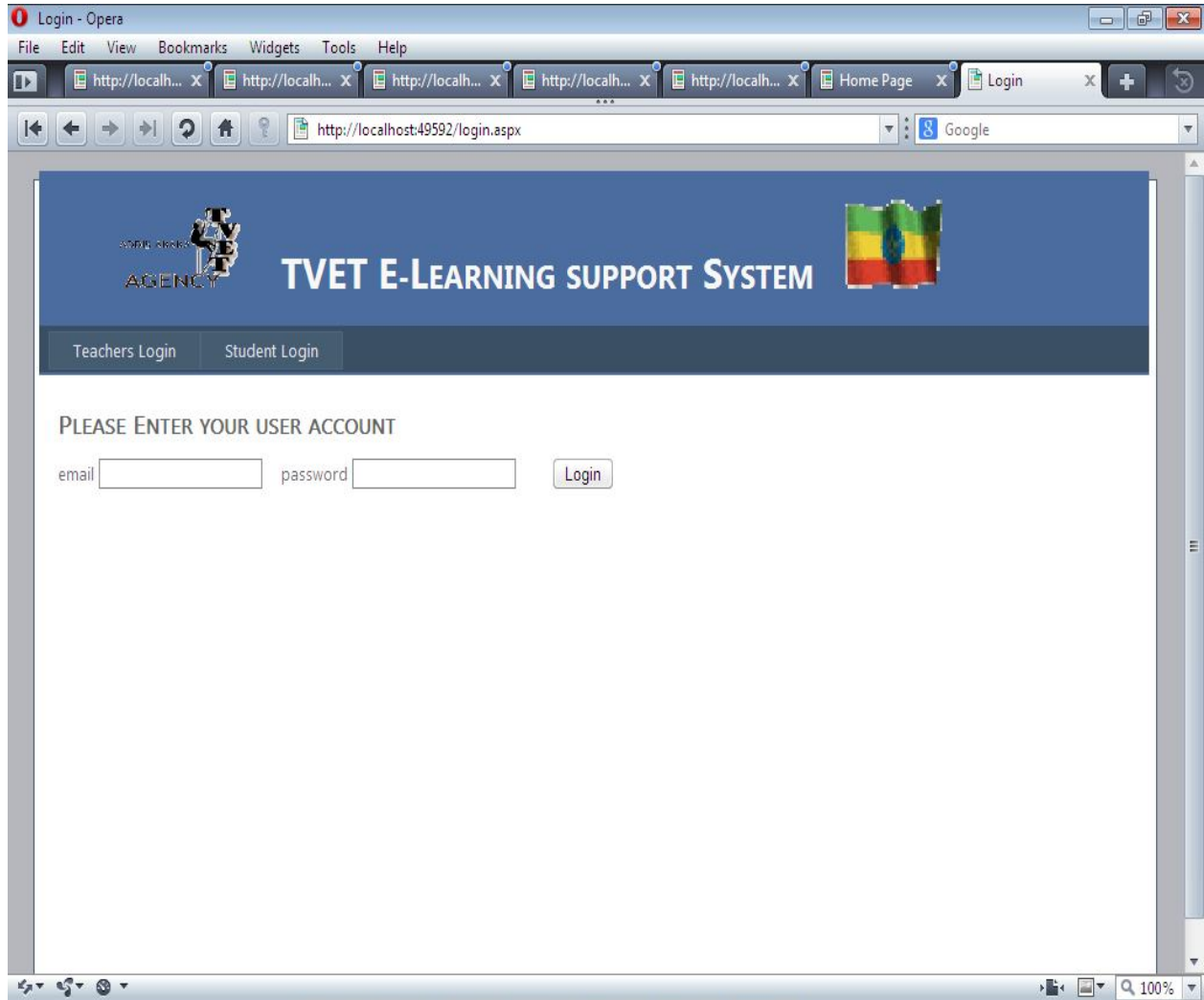


Figure 6.2 Administration Login Page

Administrator of the TVET agency can see now service home page in the Figure 6.3. On this page different services are available.

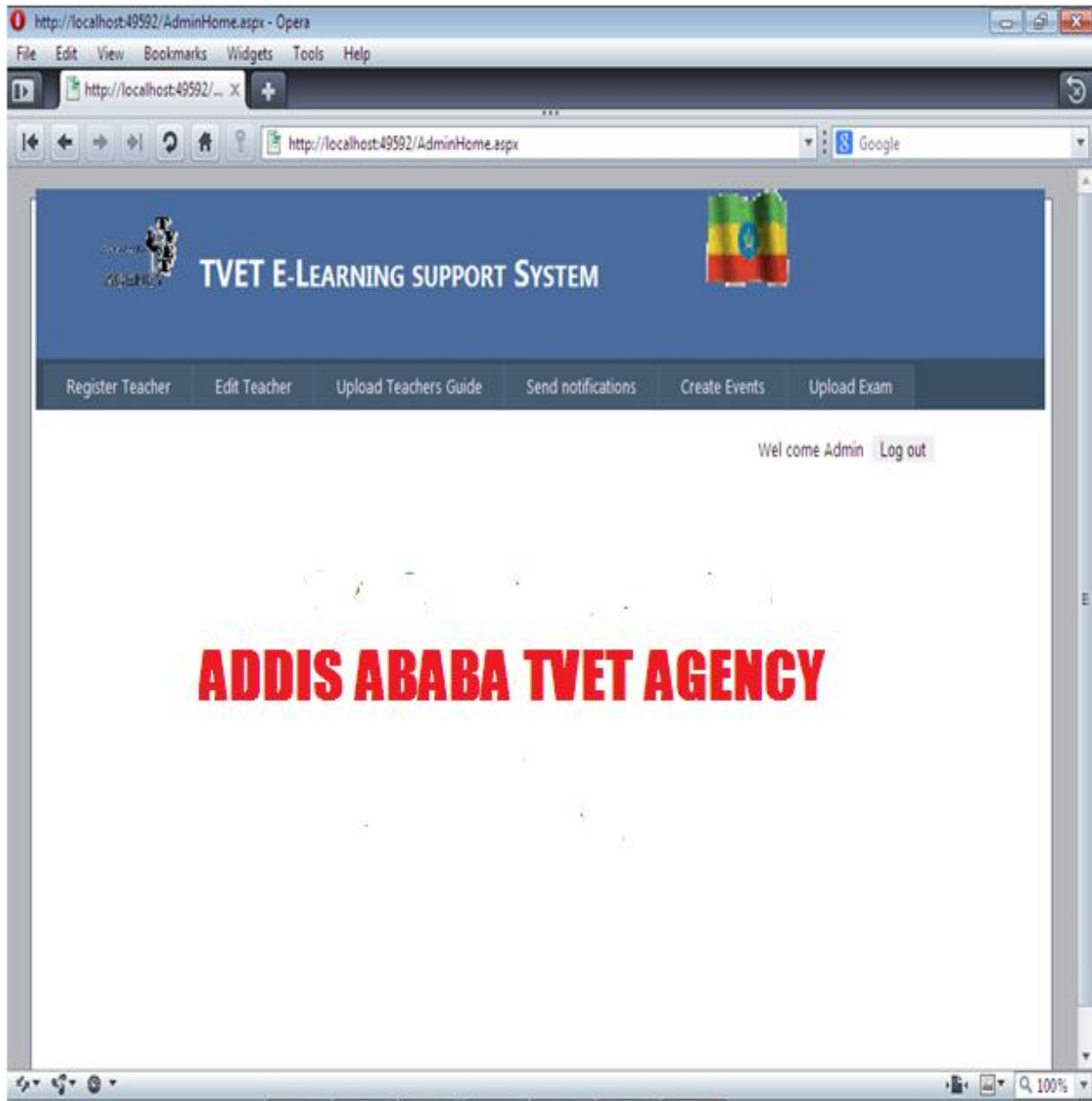


Figure 6.3 Administrator Service Home Page

When administrator wants to register trainers s/he clicks the Register teacher page that displaces as Figure 6.4. Administrator now fills the information of the trainers.

The screenshot shows a web browser window displaying the 'TVET E-LEARNING SUPPORT SYSTEM' interface. The browser's address bar shows the URL 'http://localhost:49592/AddTeacher.aspx'. The page has a dark blue header with the system name. Below the header is a navigation bar with buttons for 'Register Teacher', 'Edit Teacher', 'Upload Teachers Guide', 'Send notifications', 'Create Events', and 'upload exam'. A welcome message 'Wel come Admin' and a 'Log out' button are visible. The main content area contains a registration form with the following fields and options:

- First Name:
- Last Name:
- Department:
- Institution:
- Gender:
- Level:
- Year:
- Email:
- Password:
- Phone Number:
- Department Head
-

Figure 6.4 Trainer Registration Page

If administrator wants to edit the trainer's information, administrator click on the edit teacher link Figure 6.5 shows the edit process.

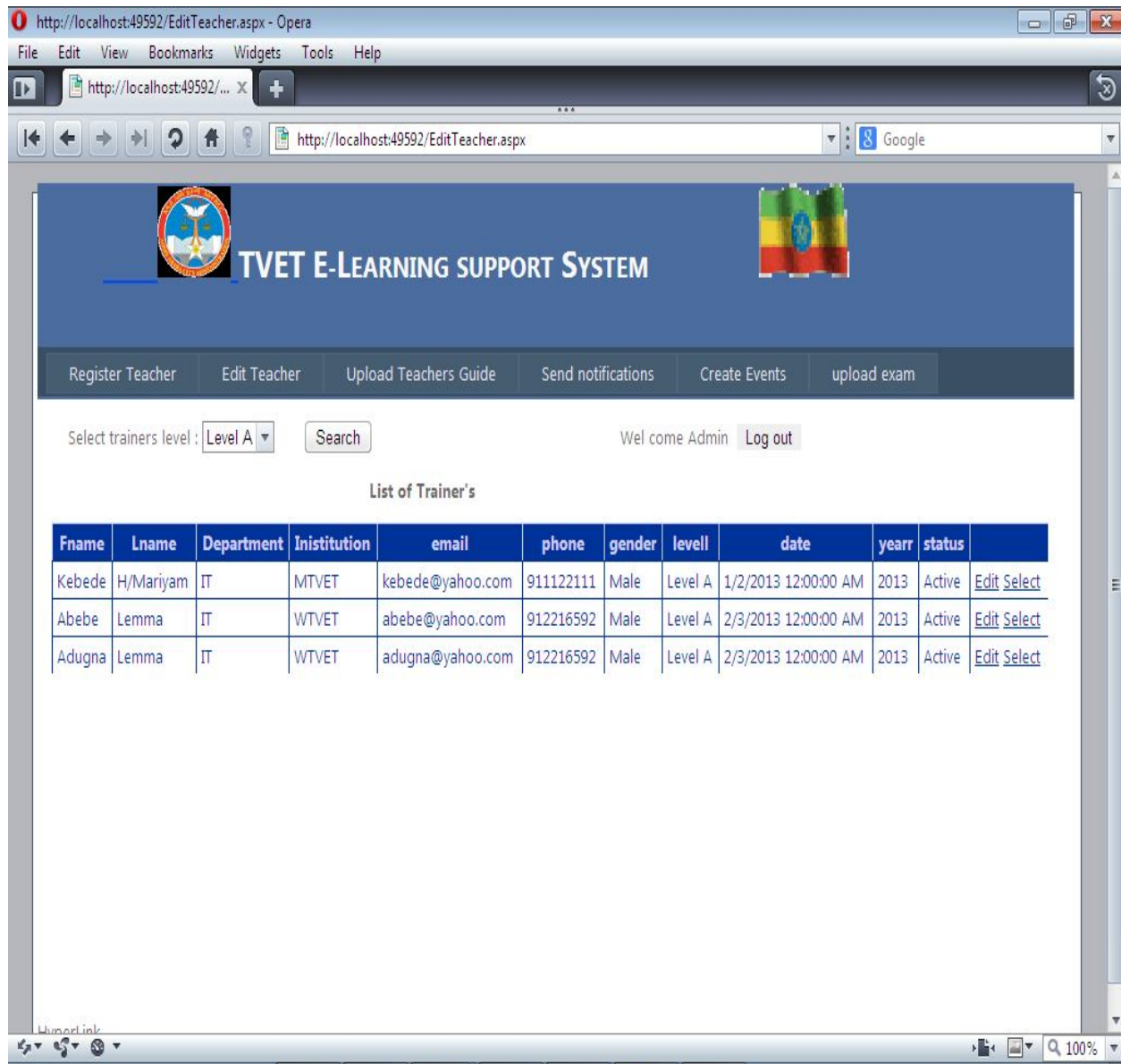


Figure 6.5 Trainer Edit Page

If an administrator wants to send notification to the trainers by mobile, s/he clicks on the send notification link Figure 6.6 shows this process.

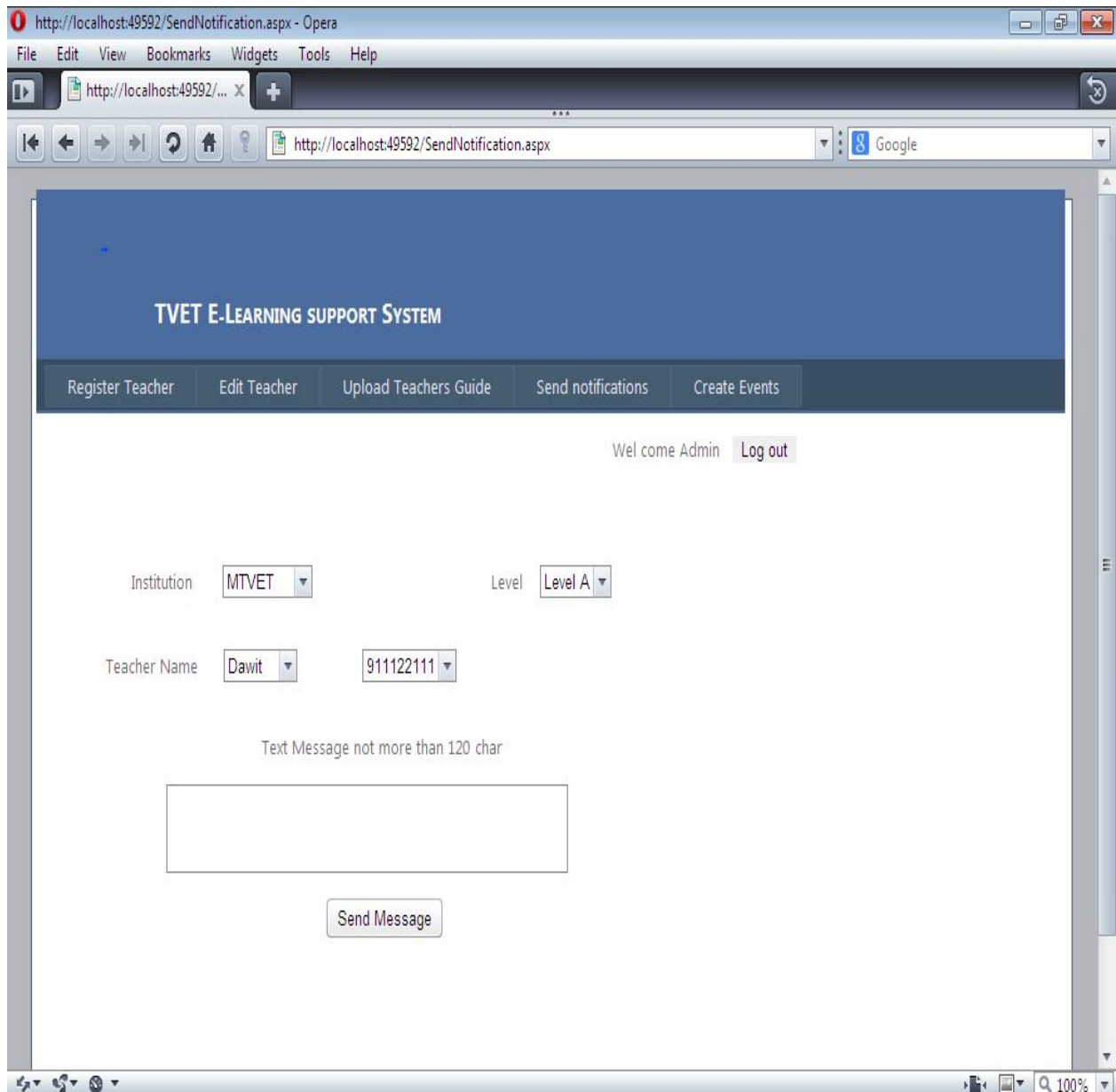


Figure 6.6 Send Notification Page

An administrator uploads teachers guides based on the level by clicking the upload teacher guide link from the administrative service page. The process is shown Figure 6.7

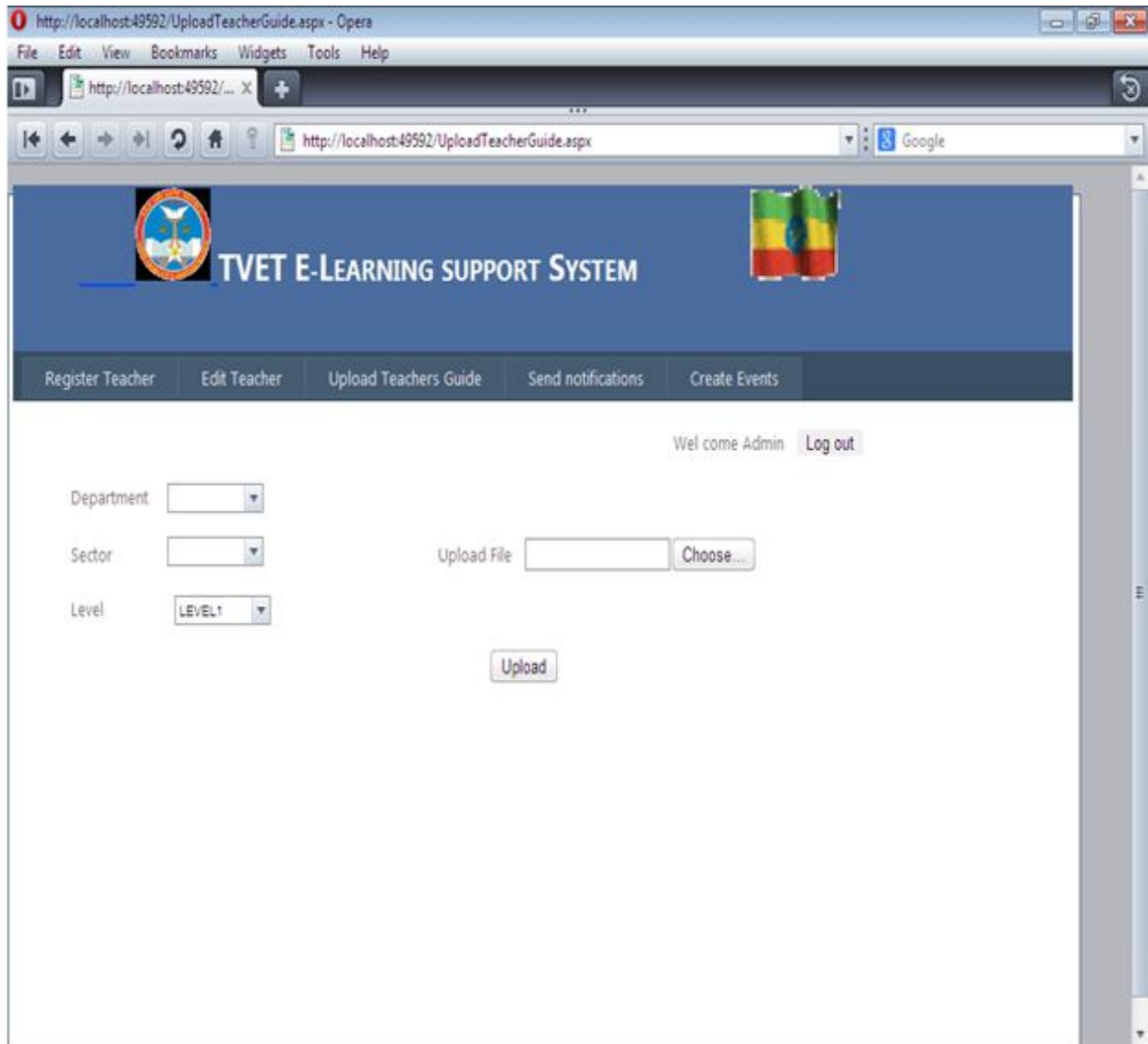


Figure 6.7 Upload Teacher Guide Page

Event or news can be sent to trainers by an administrator, if s/he wants to send event/news to the trainers; s/he clicks the send event link. The process of creating events is shown in Figure 6.8

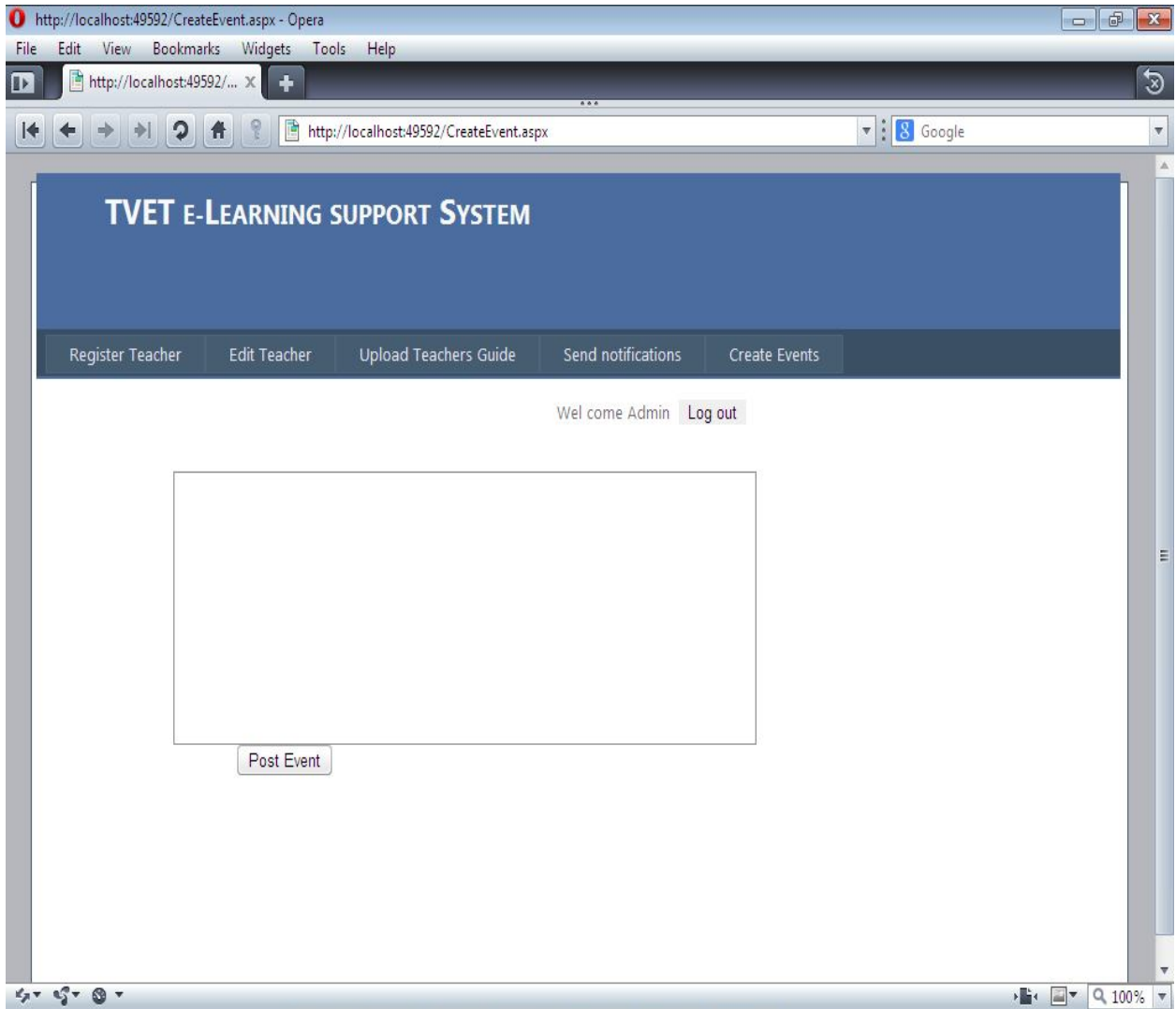


Figure 6.8 Create Event/News Page

If an administrator upload sample exam for the institutions, s/he can click on the upload exam link. Figure 6.9 shows this process.

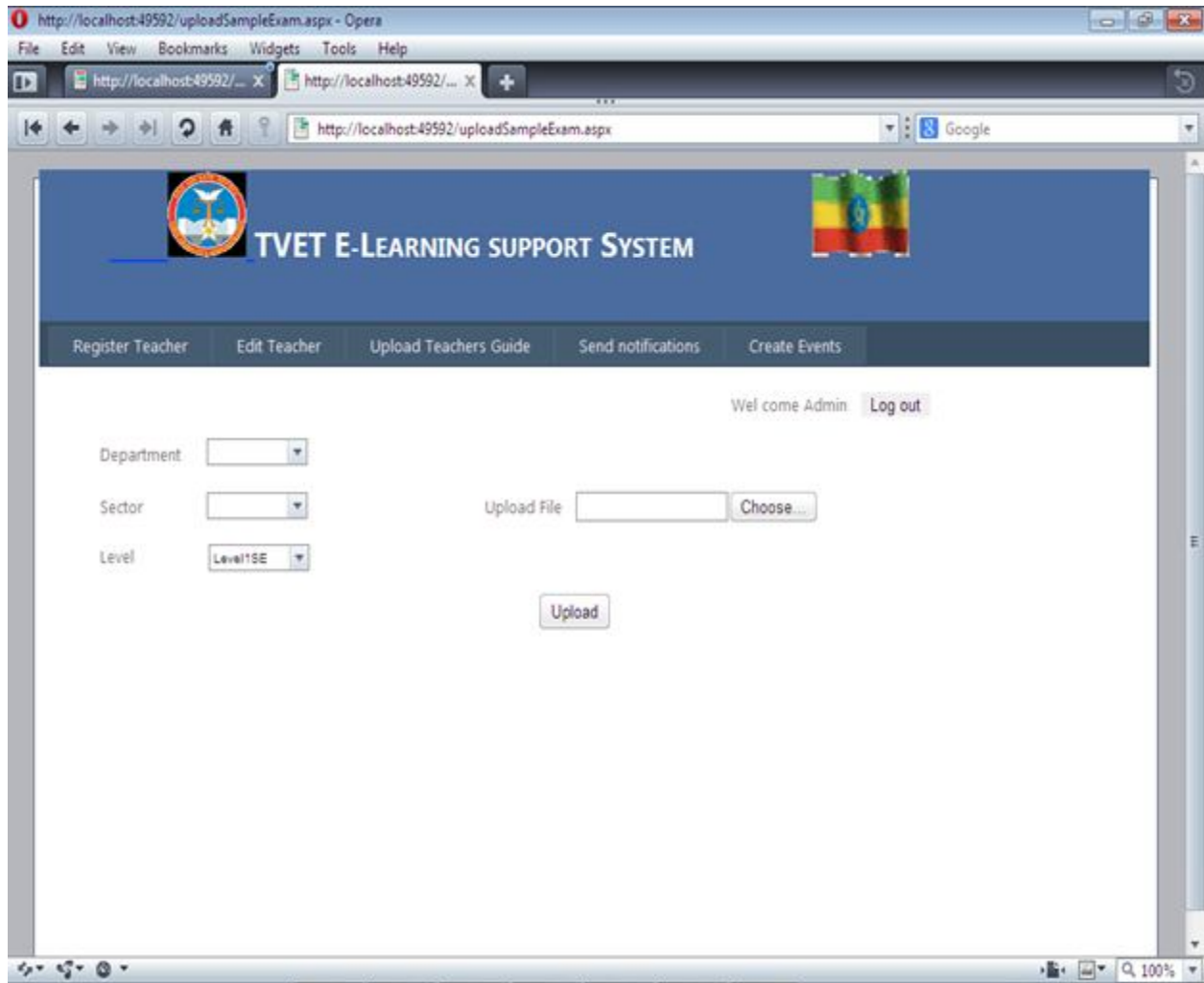


Figure 6.9 Upload Sample Exams

6.3.2 Trainer Service Interface

The system is being activated by the Teacher. The home page of the system is displayed which contains the available services that is provided by the trainer and Event and news from the TVET agency. Figure 6.10 shows this process.

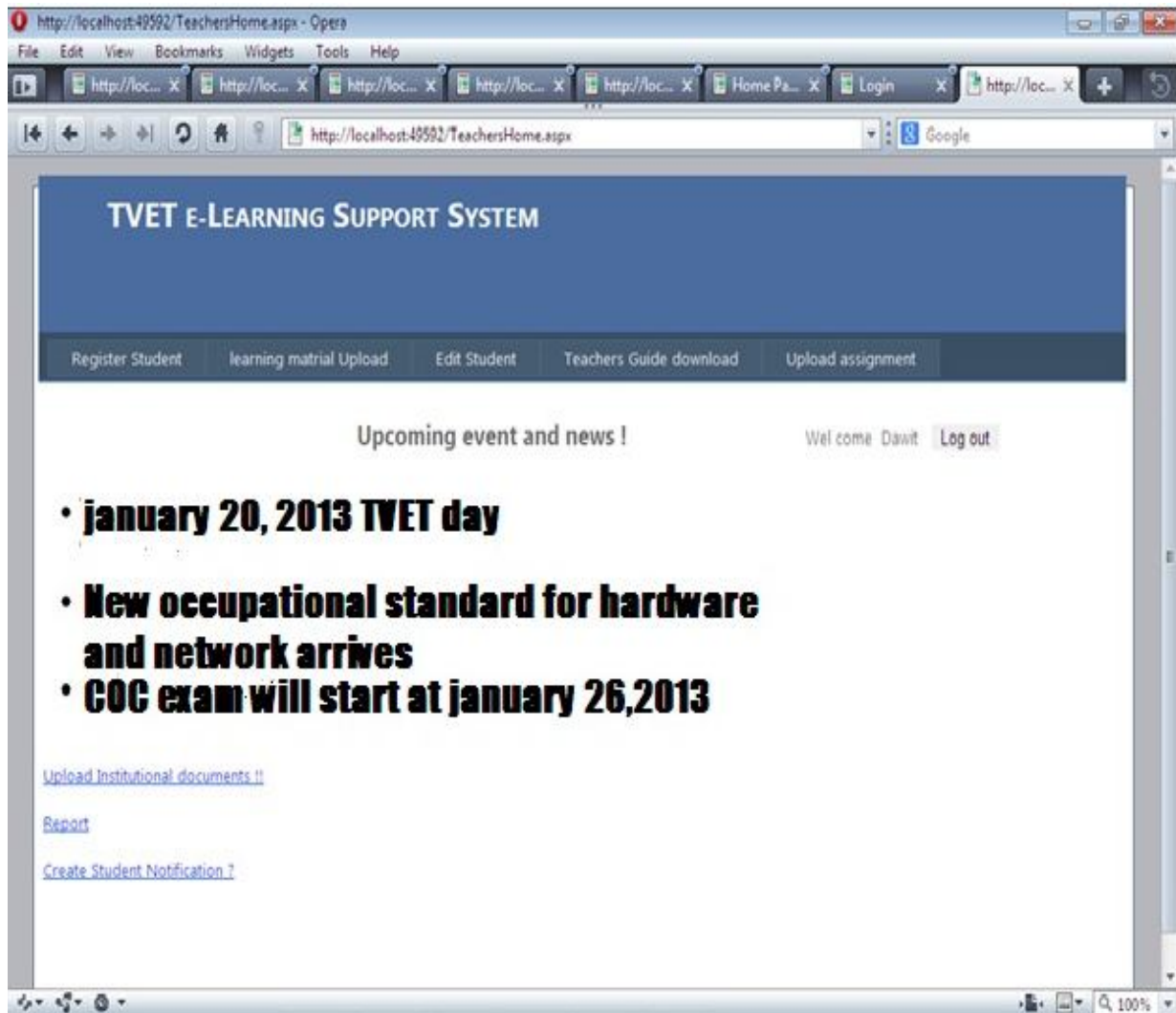


Figure 6.10 Trainer Service Home Page

If the trainer wants to upload assignment for the student s/he clicks on the link for upload assignment. Figure 6.11 shows the process.

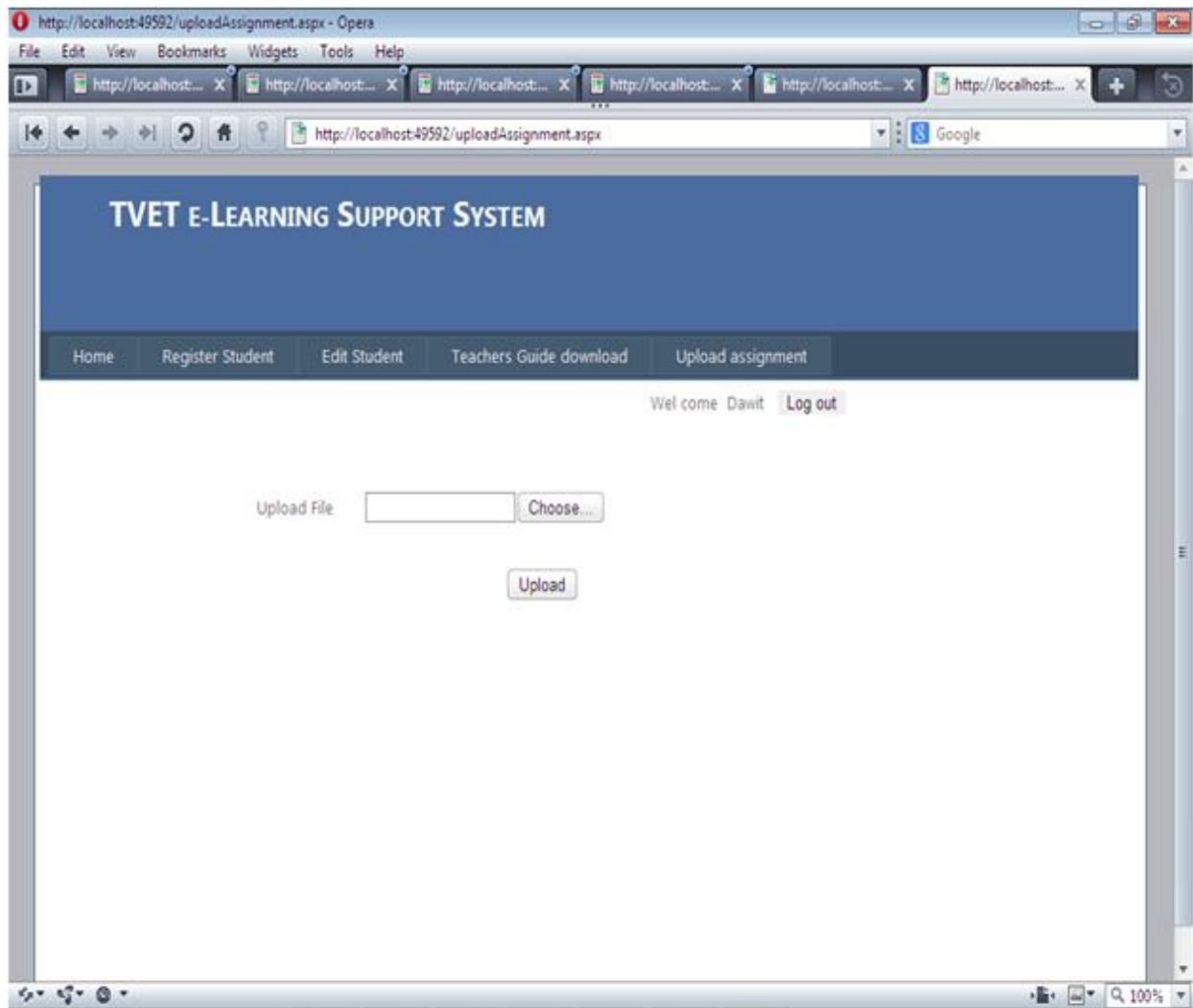


Figure 6.11 Assignment Upload Page

Trainer can also download teachers guide by clicking on download teacher guide link. Figure 6.12 shows the process of downloading teacher guides.

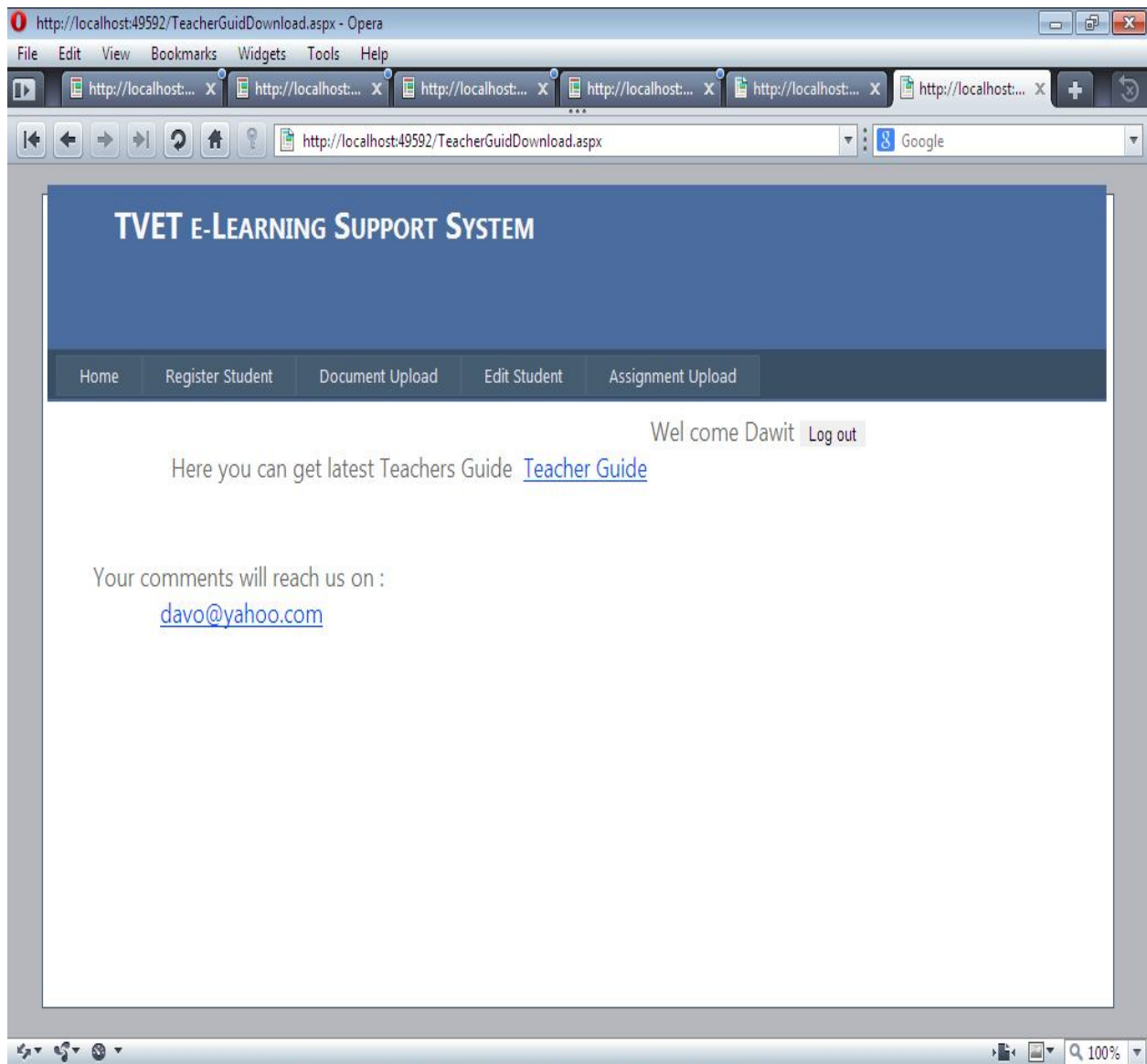


Figure 6.12 Teacher Guide Download Page

Trainers can also upload learning material for the trainers. To upload learning material by different media type trainers click on upload document link. Figure 6.13 shows the process.

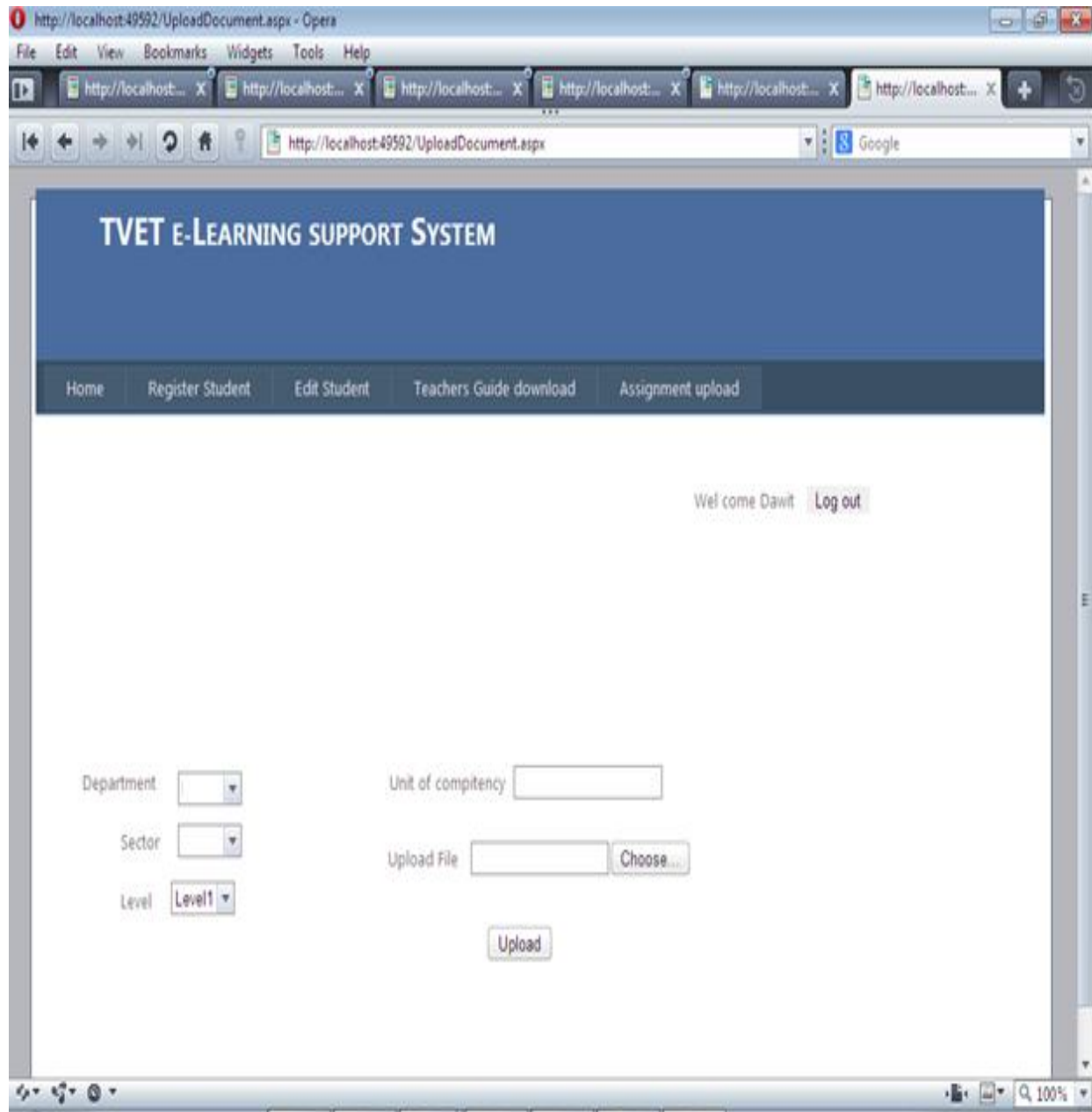


Figure 6.13 Upload Documents Page

6.3.3 Student/Trainee Service Interface

Since students access the services of TVET E-learning system through their computer, after authentication of the user. Figure 6.14, will be displayed.

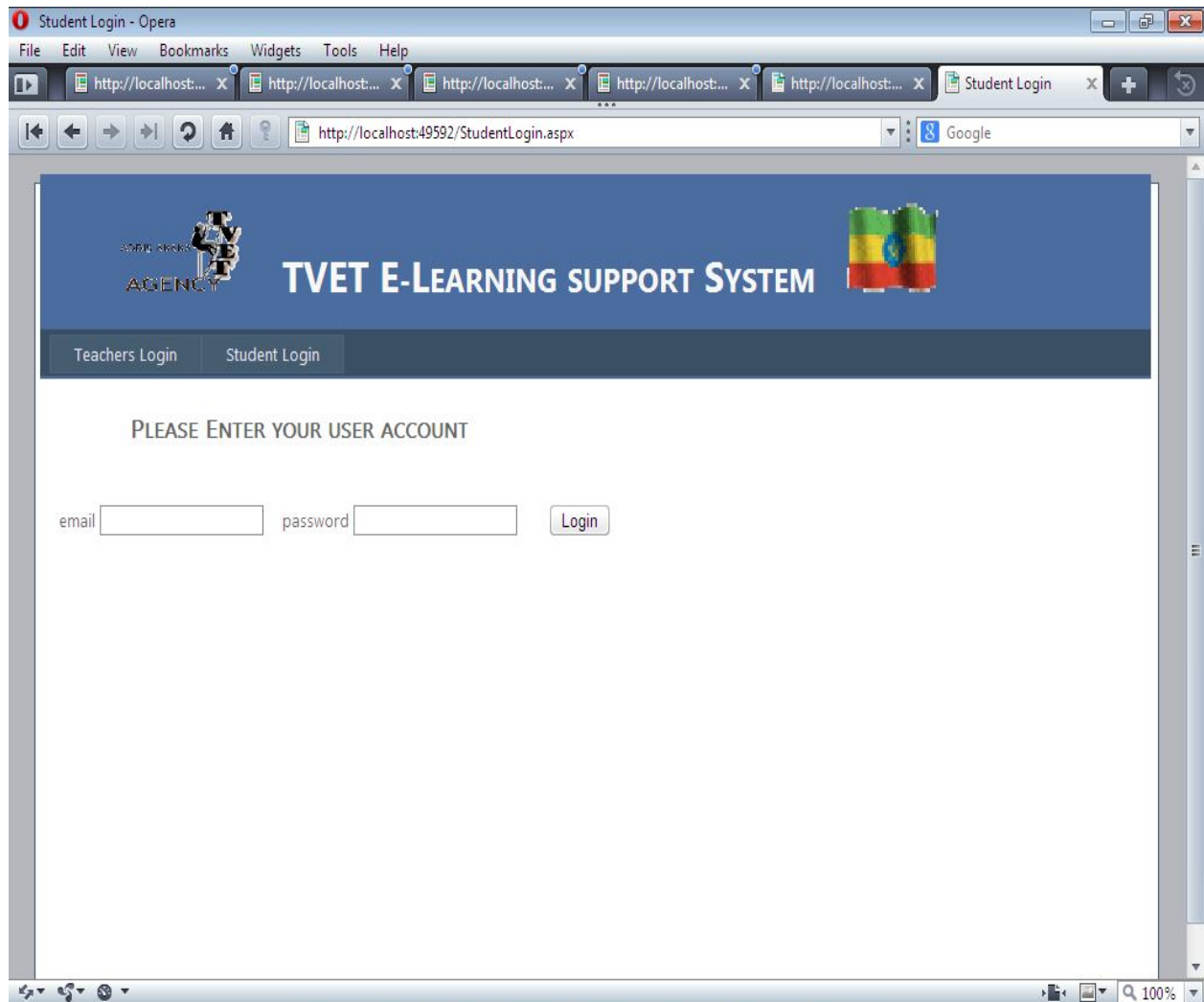


Figure 6.14 Student Login Page

When the student initiate the system, the service home page will be displayed as Figure 6.15 through this page the student can choose the different services that can be delivered to the trainees. This page also contains Events and news with regard to the institution.

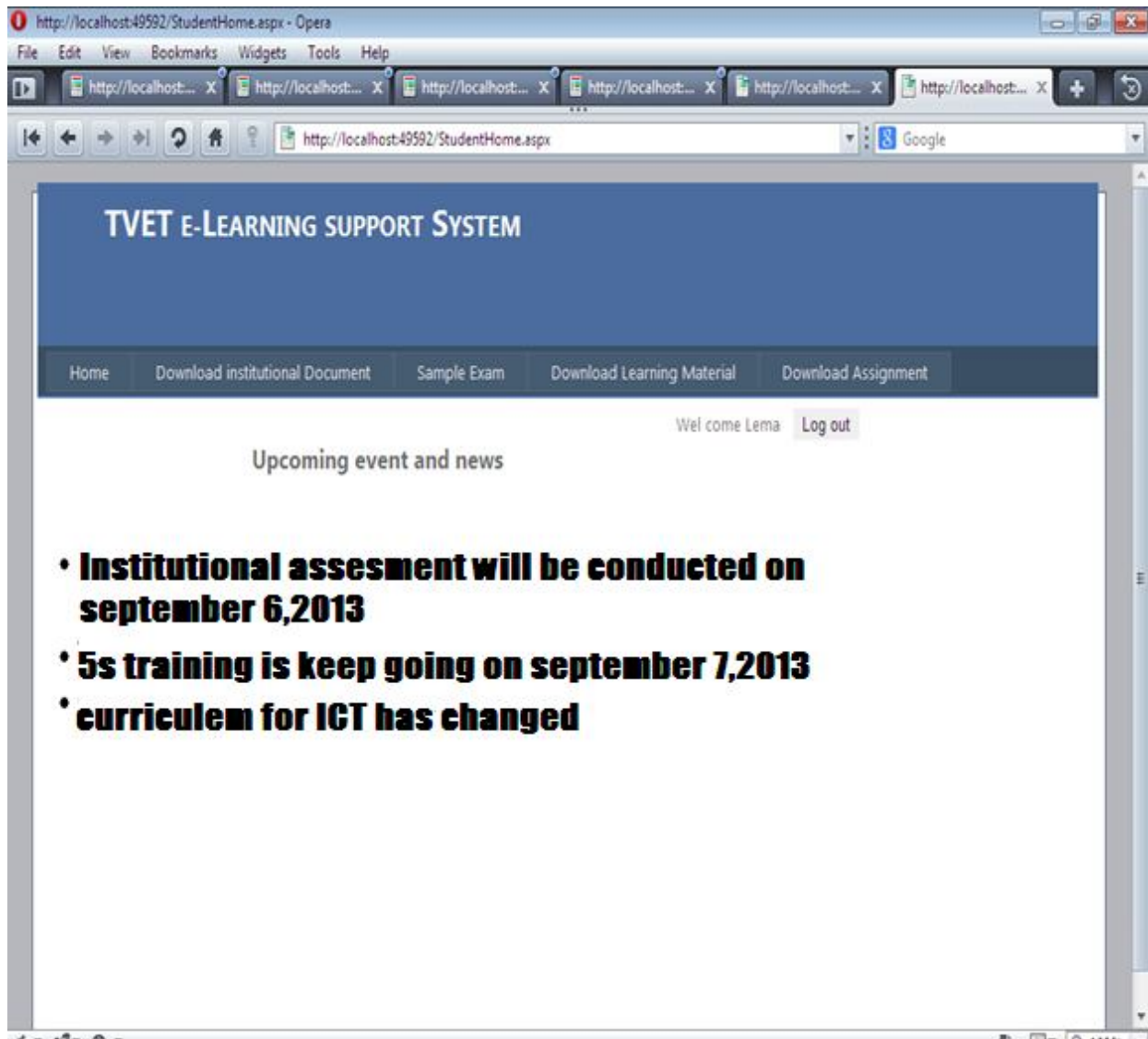


Figure 6.15 Student Service Home Page

If the student wants to see the sample exam that can be COC or institutional s/he can search by the level. To do these click on the link of sample exam. Figure 6.16 shows the process.

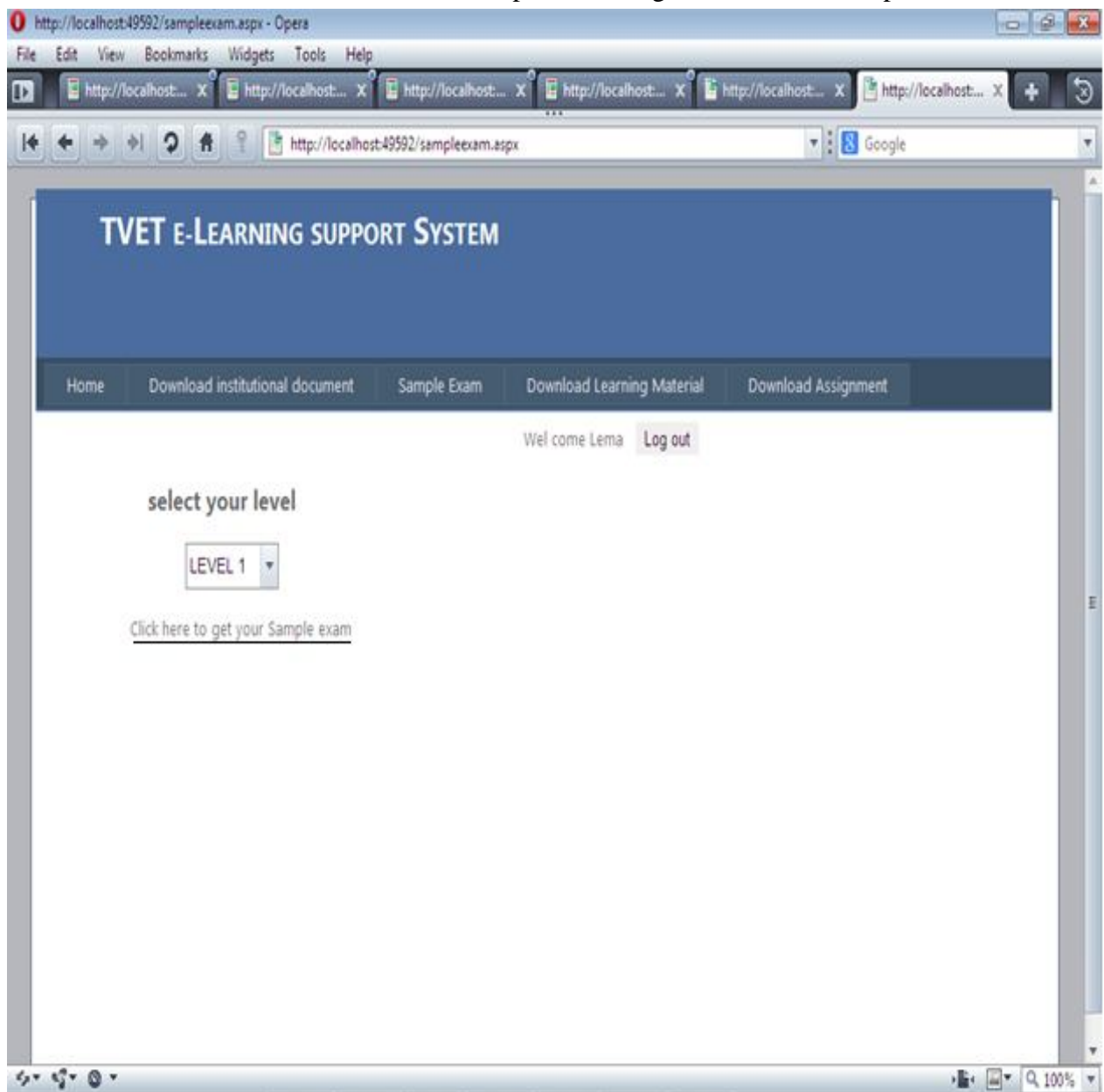


Figure 6.16 Sample COC and Institutional Access Page

If trainees want to download learning materials according to different media types, the student can select different institution and level to which s/he wants to download learning materials by clicking learning material download link Figure 6.17 shows the process.

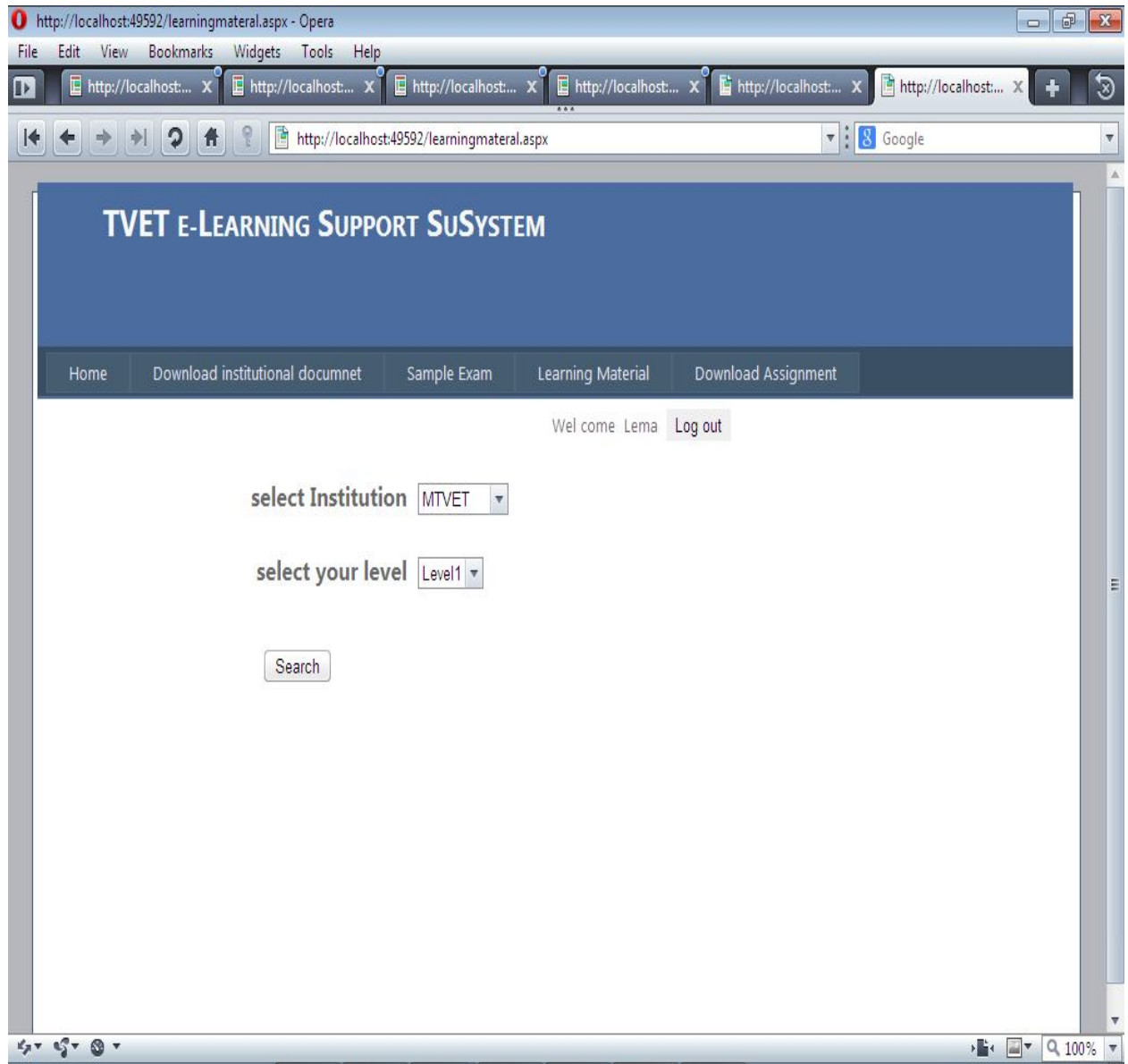


Figure 6.17 Download Learning Material Page

Trainees can also download different institutional document with regard to the institution policy, curriculum, Occupational standard and the like. To do this, trainees click on download institutional document link. Figure 6.18 shows the process.

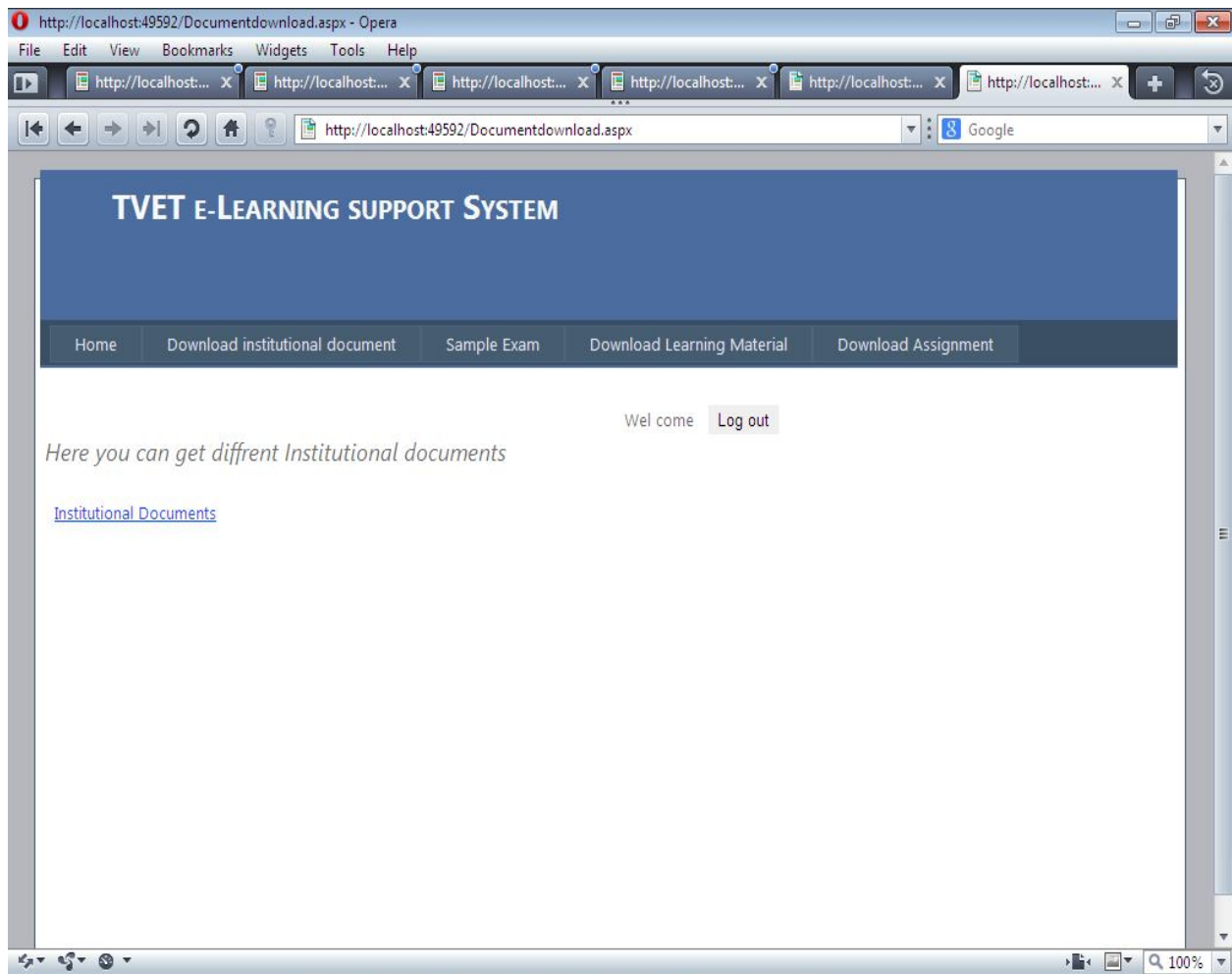


Figure 6.18 Download Institutional Document Page

Chapter Seven

Evaluation of E-learning Support System

7.1 Overview

The e-learning support system is developed to enhance the outcome based training in TVET institutions. In order to evaluate the prototype, different trainers and trainees were involved. The prototype system usability evaluation is performed based on the ISO 9241 usability testing criteria, which is a product that can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction.

The prototype test was conducted on personal computers. After the development was completed, the prototype was deployed on one of the Five TVET institution, which is Misrak TVET institution to conduct a real environment testing on the actual computers used by the trainers and trainees.

The objective of the testing is to evaluate: the compatibility of the TVET E-learning support system prototype on various OS and browsers, the satisfaction of the user and the performance (efficiency and effectiveness) of the prototype while using the TVET E-learning support system.

7.2 Usability Testing

Development of application needs usability testing before application released to the intended place. The general principles of effectiveness and efficiency that contribute to characterize usability as explicitly mentioned in ISO 9241. According to ISO 9241[31] defines usability of the product as the extent to which the product can be used by the specified user to achieve specified goal with effectiveness, efficiency, and satisfaction in specified context of use. Therefore, effectiveness, efficiency, and user satisfaction are the three major usability attributes.

Usability testing is performed by identifying representative users, representative computers (OS and browsers), and representative tasks which are related to the TVET e-learning support system prototype. Totally 14 volunteer respondent are chosen to conduct prototype testing survey with different browser type, different operating system. The questionnaire is prepared based on the three usability attributes. The questionnaire contains 14 questions in two parts as indicated Annex e.

7.3 Test Result and Discussion

In the testing process, 14 respondents are chosen based on the status, which is like level I, level II or level III trainees and in the case of trainers level A, level B and level C. Among 14 respondents 8 of them were male and 6 of them were female. The entire respondent had experience in internet browsing.

Table 7.1: Description of computers used in testing process

No	Computer model	OS used	Browser used	Remark
1	Acer m2 series	Xp service pac 2	Internet explorer	pass
2	Dell 380	Xp service pac 3	Mozilla Firefox	pass
3	Dell 620	Windows 7	Mozilla Firefox	pass
4	Dell 390	Windows 8	opera	pass
5	Dell 390	Windows 7	Google chrome	pass
6	Dell 390	Windows 7	Mozilla Firefox	pass
7	Dell 390	Windows 7	Mozilla Firefox	pass
8	Acer m2 series	Windows 7	Mozilla Firefox	pass
9	Dell 390	Windows 8	Google chrome	pass

No	Computer model	OS used	Browser used	Remark
10	Acer m2 series	Xp service pac 3	opera	pass
11	Dell 390	Windows 7	opera	pass
12	Acer m2 series	Xp service pac 2	Mozilla Firefox	pass
13	Dell 380	Windows 8	Internet Explorer	pass
14	Acer m2 series	Windows 7	Internet Explorer	pass

As shown in Table 7.1, two computer type (dell, acre), four different web browsers (internet explorer, Mozilla, opera, Google chrome) and four operating systems type are used in testing process. Even though most of them are tested on windows 7 and Mozilla Firefox as shown on table 7.1

The client-side script is executed on the client-side and the interaction is very fast especially for the Google chrome web browser. The Google chrome web browser is very fast compared to other web browser. The testing result also reveals that the entire web browser and all operating system can run the prototype without any difficulty.

Table 7.2 summarizes the participant result of the web based e-learning support system questionnaire each question in number.

Table 7.2: E-learning support system questionnaire result summary

Question no.	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
1	8	4	2	0	0
2	6	5	3	0	0

Question no.	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
3	8	4	1	1	0
4	5	4	3	2	0
5	4	3	5	2	0
6	8	4	2	0	0
7	7	6	1	0	0
8	4	6	2	2	0
9	5	4	4	1	0
10	8	4	2	0	0
11	5	4	4	1	0
12	All 14 computers can run TVET e-learning support system prototype.				

For discussion purpose, we categorized the user response into three categories: strongly agree and agree in one group as a good result, neutral, and disagree and strongly disagree in one group as a poor result. According to the participant, the e-learning support system prototype could run in all type of operating system and browser which are listed in table 7.1. As the result shows, the e-learning support system prototype 100% looks good. But, the interaction speed showed different results depend on the browser and the operating system as discussed above.

As shown in the table 7.3 77.29% of the participants were satisfied while accessing the e-learning support system. 17.2 %of the participants' response was neutral and the remaining are disagree on it. Table 7.3 describes in percent which was described in table 7.2.

Table 7.3: E-learning support system questionnaires respondent' result summary in percent (%).

Question no.	Strongly agree	Agree	Neutral	Disagree
1	57.1	28.5	14.28	0
2	42.8	35.7	21.4	0
3	57.1	28.5	7.1	7.1
4	35.7	28.5	21.4	14.2
5	28.5	21.4	35.7	14.2
6	57.1	28.5	14.2	0
7	50	42.8	14.2	14.2
8	28.5	42.8	7.1	0
9	35.7	28.5	28.5	7.1
10	57.1	28.5	14.2	0
11	35.7	28.5	28.5	7.1
12	100	0	0	0
Average	44.11818	28.51667	17.215	5.325

Generally, the prototype evaluation showed that better satisfaction and work in good manner on the specified browser and OS. Finally, this is a beginning work to enable users to use the e-learning support system from any type of browser and OS. Therefore, we believed that the result is good as a beginning work.

Chapter Eight

Conclusion and Future Work

8.1 Conclusion

The development and advancement of computer technology has made computers to be part of everyday human life activities. Education is an area where human are involved in a day to day activity of their life, for it deals with behavioral, attitude and skill changes. The same is true for the use of computer in education. This work has enabled the delivery of learning materials and necessary information for TVET to be efficient and it has also achieved interactivity among students and teachers in Ethiopia.

Education has long benefited from the use of computer, such as laptop, desktop but research in the use of computer in learning is recent. The aim of this project is to look at the possible effects of using computer to support TVET learning.

In developing countries like Ethiopia, people do not have convenient environment to follow education in anywhere and anytime. E-learning is one way to remedy this problem. In traditional e-learning, the minimum requirement is still a personal computer (PC)—consequently an absolute independence in location is not provided.

This problem could be solved by using E-learning support system and available devices such as computer, mobile. Since the majority of students at institution have a computer and internet connection, E-learning could be an important instrument for assisting TVET learning in the future.

In this project work, it is identified that Addis Ababa TVET institutions are not giving successful outcome based training. The primary cause of this is the traditional way of teaching/training activity in TVET institution. Therefore, supporting the TVET institution's training by web based

e-Learning support system can solve the problem of traditional training methodology; so that the outcome based TVET training objective can be achieved. The contribution of this project is to reduce face-to-face communication between trainee and trainer by giving different functionality like uploading and downloading learning materials, looking progress chart (result), send notification SMS by mobile, assignment submit, create event news.

In this project work, it is identified the problem, performed requirement analysis and we have developed a system that makes use of e-learning. The e-Learning support system for TVET training is a web-based application. The e-Learning system was developed using Microsoft visual studio Edition (Visual C#) and runs on a broad variety of computers. The usability test for the system was performed and the evaluation has shown the successfulness of the web application.

8.2 Future Work

This work can be considered as gate opener on E-learning to support TVET training in Ethiopia. But, there are many issues that should be considered when a web based e-learning support system are developed, such as chatting service, forum services, which is a service that the TVET community discussed with regard to the TVET training. Thus, as a future work these two services can be considered to enhance the outcome based TVET training by e-learning. Future research work on the area could come up with solutions for the above issues and related ones. Trends in e-Learning technologies suggest that they have the potential to impact positively on learning in general and TVET in particular. In the near future, it is expected that learning will move more and more outside the classroom and lectures halls into the learner's Environment both in real and in virtually mediated method.

Reference

- [1] Thomas Dietinger , " *Aspect of e-learning environment* " , Graz University of Technology A-8010 Graz Austria, 2003.
- [2] Govindasamy, T. "Successful Implementation of e-Learning Pedagogical", 2002
- [3] Feinberg, S. & Murphy, M. " *Applying Cognitive Load Theory to the Design of Web-Based Instruction Technology & Teamwork* "2000: 353-360. Cambridge: IEEE Educational Activities Department, 2000
- [4] Samuel ssemugabi , " *usability evaluation of a web-based e-learning application* " , University of south Africa, 2006
- [5] Alessi, S.M. & Trollip, S.R. (1991). " *Computer Based Instruction Methods and Development* " Englewood Cliffs: Prentice Hall, 1991
- [6] Geoff Stevens, " *Technical and Vocational in Sub-Sahara Africa changes and opportunities* " , August 2001.
- [7] Bennell, P. " *Learning to Change Skills Development among the vulnerable and Socially Excluded in Developing Countries. , Employment and Training,* " Geneva, 1999.
- [8] " *Communication from the commission to the Council and the European parliament the e-Learning Action plan* " EC (European Commission) Brussels, 28.3. (2001)
- [9] Govindasamy, T. " *Successful Implementation of e-Learning Pedagogical Considerations* " The Internet and Higher Education, 4(4): 287-299, 2002
- [10] Som, N, " *E-learning a Guidebook of Principles, Procedures and Practices* " Australia, The University of Melbourne, 2006
- [11] Dede, C, " *The Digital Classroom: How Technology is changing the Way We Teach and Learn* " Cambridge, MA: Harvard Education Letter, 2000.
- [12] Pea, R. " *Seeing what we build together: Distributed multimedia Learning, Learning / Environment for transformative communications,* " The Journal of the Learning Sciences, 3(3) ,1994.
- [13] Shackel, B. " *Usability - context, framework, definition, design and Evaluation Human Factors for Informatics Usability* " , Cambridge: Cambridge University Press, 1991
- [15] Athanasis Karoulis Andreas Pombortsis, " *Usability Evaluation of Online Learning Program,* " Hershey PA 17033, USA, 2003

- [16] Wang y. "Assessment of learner satisfaction with asynchronous electronic Learning system" information and management (41), 2003
- [17] Vrasidas, C. & McIsaac, M.S. "Principles of Pedagogy and Evaluation for Web-Based Learning," Educational Media International, 37(2): 105-111, 2000
- [18] Kotze, P. & De Villiers, R. (1996). "Factors Underlying the Design and Development of Interactive Computer-Based Learning and Instructional Systems – Non- Computer Related Issues," In: P.M. Alexander (Ed.), Papers Delivered at the Fourth CBE/CBT Conference and Workshop: formation Technology and Effective Education/Training. Pretoria: University of South Africa, 1996.
- [19] Flower, C.S, Audiences and Stakeholders. In: E.A. Dupuis. (Ed.), "Developing Web-Based Instruction: Planning, Designing, Managing, and Evaluating for Results" London: Facet Publishing, 2003
- [20] Valiathan P, "Blended Learning Models"
<http://www.learningcircuits.org/2002/aug2002/valiathan.html>, last accessed on Mar. 2, 2013.
- [21] <http://www.tvet-portal.net/index.php?id=20>, last accessed on March 5, 2013
- [22] <http://www.etesda.gov.ph>, last accessed on March 5, 2013.
- [23] "TESDA free TESDA online course for Pilipino," <http://pinoyteentalk.wordpress.com/about/>, last accessed on March 4, 2013
- [24] Vasilis Daloukas , "moodle," <http://moodle.org>, last accessed March on 8 2013
- [25] Arizona Board of Regents, "Be learn North Arizona University," <https://cas.nau.edu/cas>, last Accessed on March 7 2013.
- [26] Philip John Currie, Betsy Kruk, "coursera," <https://www.coursera.org/#about> , last accessed March 8 2013
- [27] Michael Chasen, <http://www.blackboard.com/learn>, last accessed march 11 2013
- [28] Ecpb, "National Technical and Vocation And Training (TVET) Strategy," ministry of Education (MOE), August 2008
- [29] Singh, H. ve Reed, C, "A white paper: Achieving success with blended Learning" Los Angeles: Centra Software, 2001
- [30] Mohaffyza Mohamad, Muhammad Sukri Saud2, "the need training and re training TVET Teacher Education", Technical Education, University Hussein On Malaysia, 2011

[31] International Organization for Standardization ISO9241, “*Software Ergonomics Requirements for office work with visual display terminal (VDT)*”, Geneva, Switzer, 1998

Annexes

Annex A : Structured Interview Questions

1. What is TVET training in Ethiopian context?
2. How do you describe the existing TVET learning problem system?
3. What methods of teaching learning do the institutions use? (Learning material, assessment methods etc...)
4. Learning materials:
 - I. With what form? (On paper, on CD or other format)
 - II. How is it organized or filed?
5. Data or Information exchange:
 - I. With which institutions?
 - II. With what format? (printouts, meetings, soft copies, Internet, LAN or other)
 - III. How often?
6. Analysis and reporting:
 - I. How is it done? (manually, semi automated, or fully automated)
 - II. How often?
 - III. What type?
7. What problems do you face with the existing reporting system if there are at all?
8. What future plans are there with regard to TVET training?
9. Intervention of curricula changes

10. Could you please provide the major curricular changes made at your institution interns of :

a. Subjects/trades changes	
b. Contents changes	
c .New learning areas/methods changes	
d. Time allocation changes	
e. Professional change	
f. Structural change	
g. Organizational change	
h. Technical or scientific change New media	

11 .In your opinion what are the reasons for the TVET curriculum to be reformed between 2001 and 2010, would you please specify?

12. In your opinion what are the factors that may influence the effectiveness of a TVET system on competence based training? Would you please specify the major once?

Internal factors	External factors

13. What factors do you think that influence the effectiveness of a TVET system based on outcomes based rather than curricula (concept of competences)? Would you please specify the major once?

Internal factors	External factors

Annex B: Use Case Description

Table B1: Use Case Description for Login

<i>Name of use case 1: Login</i>
<i>Actor: user (Administrator, trainee, trainer, Department head)</i>
<i>Description : user to use the system</i>
<i>Precondition: a user must be authorized user</i>
<p>Flow of events:</p> <ol style="list-style-type: none"><i>1. The user initiates the system to login.</i><i>2. The system prompts the user to enter user name and password.</i><i>3. The user enters user name and password and submits.</i><i>4. The system checks the user name and password.[alternative A]</i><i>5. The system displays the first page of the system.</i> <p>Alternative A: <i>if the user doesn't exist</i></p> <p><i>The system informs the user that he/she is not eligible, and the system gives the user an option, which are tries again or cancels action</i></p>
<i>Post condition: The user logs in into the system.</i>

Table B2: Use Case Description for Register Trainer

<i>Name of use case 2: register trainer</i>
<i>Actor: Administrator:</i> <i>Description: to register someone as a trainer of the institution</i>
<i>Precondition: a trainer must be from institution</i>
<i>Flow of events:</i> <i>1. The Administrator: initiates the system to register the new trainer.</i> <i>2. The system displays student registration page.</i> <i>3. The Administrator: fills all the necessary information about the trainer.</i> <i>4. The Administrator: submits the page. 5. The system checks the validation and correctness of filled form. [Alt A].</i> <i>6. The system confirms the registration of the new trainer.</i> <i>Alternative A if the form is not filled correctly:</i> <i>The system redisplay the page and orders the user to fill valid information</i>
<i>Post condition: The new trainer name will be registered into trainer database.</i>

Table B3: Use Case Description for Register Trainee

<i>Name of use case 3: register trainee</i>
<i>Actor: Trainer</i> <i>Description: to register someone as trainees of the institution</i>
<i>Precondition: a trainer must be from a registrar of the institution</i>
<i>Event flow:</i> <i>1. The Trainer initiates the system to register the new trainee.</i> <i>2. The system displays student registration page.</i> <i>3. The trainer fills all the necessary information about the trainee.</i> <i>4. The trainer submits the page.</i> <i>5. The system checks the validation and correctness of filled form [Alt A].</i> <i>6. The system confirms the registration of the new student.</i> <i>Alternative A If the form is not filled correctly.</i> <i>1. The system redisplay the page and orders the trainer to fill valid information</i>
<i>Post condition: The new trainee name will be registered into trainee database</i>

Table B4: Use Case Description for Manage Account of Tanner

Name of use case 4: <i>manage account of tanner</i>
Actor: <i>Administrator</i>
Description: <i>to make active of user account</i>
Precondition: <i>a trainer must be registered</i>
Event flow: <ol style="list-style-type: none"> 1. <i>Trainees want to be register as a trainees of the institution</i> 2. <i>The administrator active the user account.</i>
Post condition: <i>trainer active to use the account</i>

Table B5: Use Case Description for Manage Account of Tanner

Name of use case 5: <i>update trainer record</i>
Actor: <i>Administrator</i>
Description: <i>to update trainer record</i>
Precondition: <i>trainer must be registered</i>
Event flow: <ol style="list-style-type: none"> 1. <i>Trainer must be needed to be updated.</i> 2. <i>Administrator will search the updated data.</i> 3. <i>Administrator will update data.</i> <p style="padding-left: 40px;"><i>If update not performed in the right way [alternate A]</i></p>
Alternative A: <i>The system redisplay the page and orders the trainer to fill again the updated filed.</i>
Post condition: <i>trainer updated</i>

Table B6: Use Case Description for Trainees Record

<i>Name of use case 6: update Trainees record</i>
<i>Actor: trainer</i> <i>Description: to update Trainees record</i>
<i>Precondition: Trainees must be registered</i>
<i>Event flow:</i> <ol style="list-style-type: none">1. <i>Trainees must be needed to be updated.</i>2. <i>Trainer will search the updated data.</i>3. <i>Trainer will update data.</i> <i>If update not performed in the right way [alternate A]</i> Alternative A: <i>The system redisplay the page and orders the trainer to fill again the updated filed.</i>
<i>Post condition: trainee updated</i>

Table B7: Use Case Description for View Report

<i>Name of use case 7: View Report</i>
<i>Actors: Administrator</i>
<i>Description: To view the status of trainers</i>
<i>Precondition: an administrator must be register as administrator of the TVET</i>
<i>Flow of Event:</i> <ol style="list-style-type: none">1. <i>An administrator wants to view status of his/her trainers</i>2. <i>Administrator logs in to the system supplying user name and password</i>3. <i>System displays a form for search criteria for a trainers</i>4. <i>Administrator selects to view the required report</i>5. <i>System displays the appropriate report</i>
<i>Post condition: Administrator view report</i>

Table B8: Use Case Description for Upload Learning Material

<p>Name of use case 8: Upload learning material</p>
<p>Actor: department head</p> <p>Description: to up load learning material by different media format.</p>
<p>Pre condition: The user should login to the system and learning material is available.</p>
<p>Flow of events:</p> <ol style="list-style-type: none">1. The user presses the “Upload learning material” button2. The system prompts the user to select the institution, level.3. The system displays dialog box to select the materials that will be loaded into the server.4. The user selects the file and submits the dialog box.5. The system starts uploading the materials into the server [Alt A].6. The system confirms the successful uploading of the file. <p>Alternative A If error occurred</p> <p>The system confirms the user that error occurred while uploading the file and</p> <p>Informs to reload it or do it other time.</p>
<p>Post condition: learning material will be uploaded into the server and ready to</p> <p>Be downloaded.</p>

Table B9: Use Case Description for Download Teacher Guide

<p>Name of use case 9: Download teacher guide</p>
<p>Actors: Trainer</p> <p>Description: To download the teacher guide.</p>
<p>Pre condition: The user should login.</p>
<p>Flow of events:</p> <ol style="list-style-type: none">1. The user presses the “Download Materials” button.2. The system displays all teacher guides according to the level.3. The user select the teacher guide for the level that he/she want download.4. The system starts to download the file into the user storage. [Alt A].5. The system displays confirmation message when it finish loading. <p>Alternative A If any error found and can not to continue downloading The system informs the user that downloading the materials failed Currently and reminds the user to try again later.</p>
<p>Post condition: teacher guide will be downloaded into user storage device.</p>

Table B10: Use Case Description for Create Event News

<i>Name of use case 10: create event news</i>
<i>Actor: administrator</i> <i>Description: To create event news for the user</i>
<i>Pre condition: The user should be authorized and login to the system</i>
<i>Flow of events:</i> <ol style="list-style-type: none">1. The user initiates the system to post news.2. The system displays post page.3. The user writes required news, notice or any information into the page.4. The user submits the page.5. The system checks the validation and correctness of filled form. [Alt A].6. The system confirms the post. <i>Alternative A: If the form is not filled correctly</i> <i>The system redisplay the form and orders the user to fill valid information.</i>
<i>Post condition: The post will be available on the website.</i>

Table B11: Use Case Description for Upload Institutional Document

<i>Name of use case 11: Upload institutional document</i>
<i>Actor: Administrator</i> <i>Description: to upload different institutional documents for the user</i>
<i>Pre condition: The administrator should login to the system and teacher guide is available.</i>
<i>Flow of events:</i> <ol style="list-style-type: none">1. The user presses the “Upload teacher guide” button2. The system prompts the administrator to select level.3. The system displays dialog box to select the materials, which will be loaded to server computer.4. The administrator selects the file and submits the dialog box.5. The system starts uploading the materials into the server. [Alt A].6. The system confirms the successful uploading of the file. <i>Alternative A If error occurred</i> <i>The system confirms the administrator that error occurred while uploading the file and informs to reload it or do it other time.</i>
<i>Post condition: teacher guide will be uploaded into the server and ready to be downloaded</i>

Table B12: Use Case Description for Upload Sample Exam

Name of use case 12: Upload sample exam
Actor: Administrator
Description: To upload sample exam for the user.
Pre condition: The Administrator should login to the system and sample exam is available.
Flow of events: <ol style="list-style-type: none">1. The user presses the “Upload sample exam” button2. The system prompts the administrator to select level.3. The system displays dialog box to select the sample exam that will be loaded into the server.4. The administrator selects the file and submits the dialog box.5. The system starts uploading the sample exam into the server. [Alt A].6. The system confirms the successful uploading of the file.
Alternative A If error occurred <ol style="list-style-type: none">1. The system confirms the administrator that error occurred while uploading the file and Informs to reload it or do it other time
Post condition: sample exam will be downloaded into user storage device.

Table B13: Use Case Description for Upload Institutional Document

<i>Name of use case 13: Upload institutional document</i>
<i>Actor: Department head</i>
<i>Description: to upload institutional document for the trainees</i>
<i>Pre condition: The department head should login to the system and institutional document is available.</i>
<i>Flow of events:</i> <ol style="list-style-type: none">1. The user presses the “Upload institutional document” button2. The system prompts the department head to select the institution.3. The system displays dialog box to select the materials that will be loaded into the server.4. The department head selects the file and submits the dialog box.5. The system starts uploading the materials into the server. [Alt A].6. The system confirms the successful uploading of the file. <i>Alternative A If error occurred</i> <i>The system confirms the department head that error occurred while uploading the file and informs to reload it or do it other time.</i>
<i>Post condition: institutional document will be uploaded into the server and ready to be downloaded.</i>

Table B14: Use Case Description for Download Sample Exam

Name of use case 14: Download sample exam
Actor: trainees Pre condition: The user should login.
Pre condition: The user should login.
Flow of events: <ol style="list-style-type: none">1. The user presses the “Download sample exam” button.2. The system prompts to search sample exam according to level.3. The user select the sample exam for the level that he/she want download.4. The system starts to download the file into the user storage. [Alt A].6. The system confirms the successful uploading of the file. Alternative A If error occurred <p>The system confirms the department head that error occurred while uploading the file and Informs to reload it or do it other time.</p>
Post condition: sample exam will be downloaded into user storage device.

Annex C: Sequence Diagram

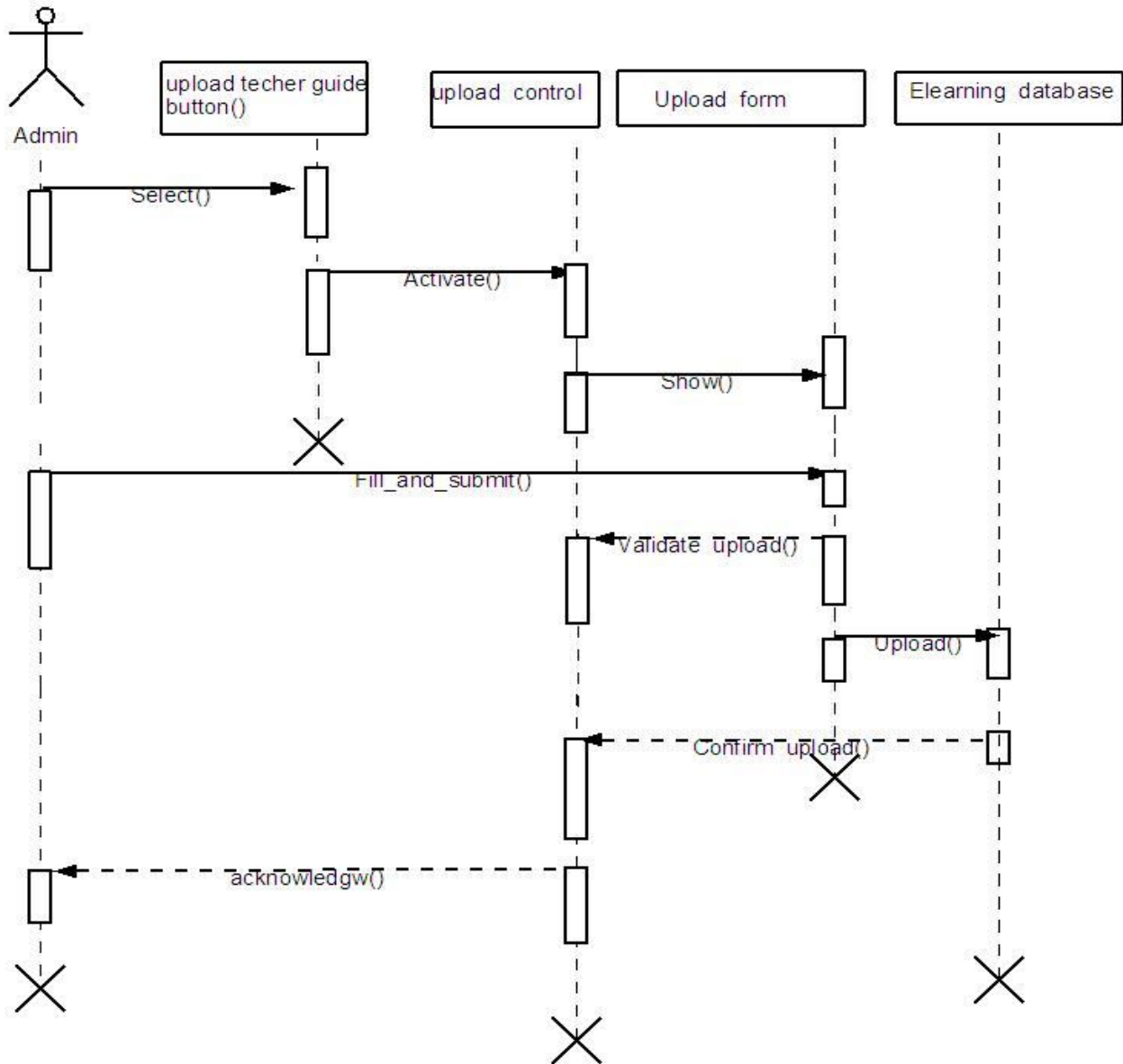


Figure C1: Upload Teacher Guide Sequence Diagram

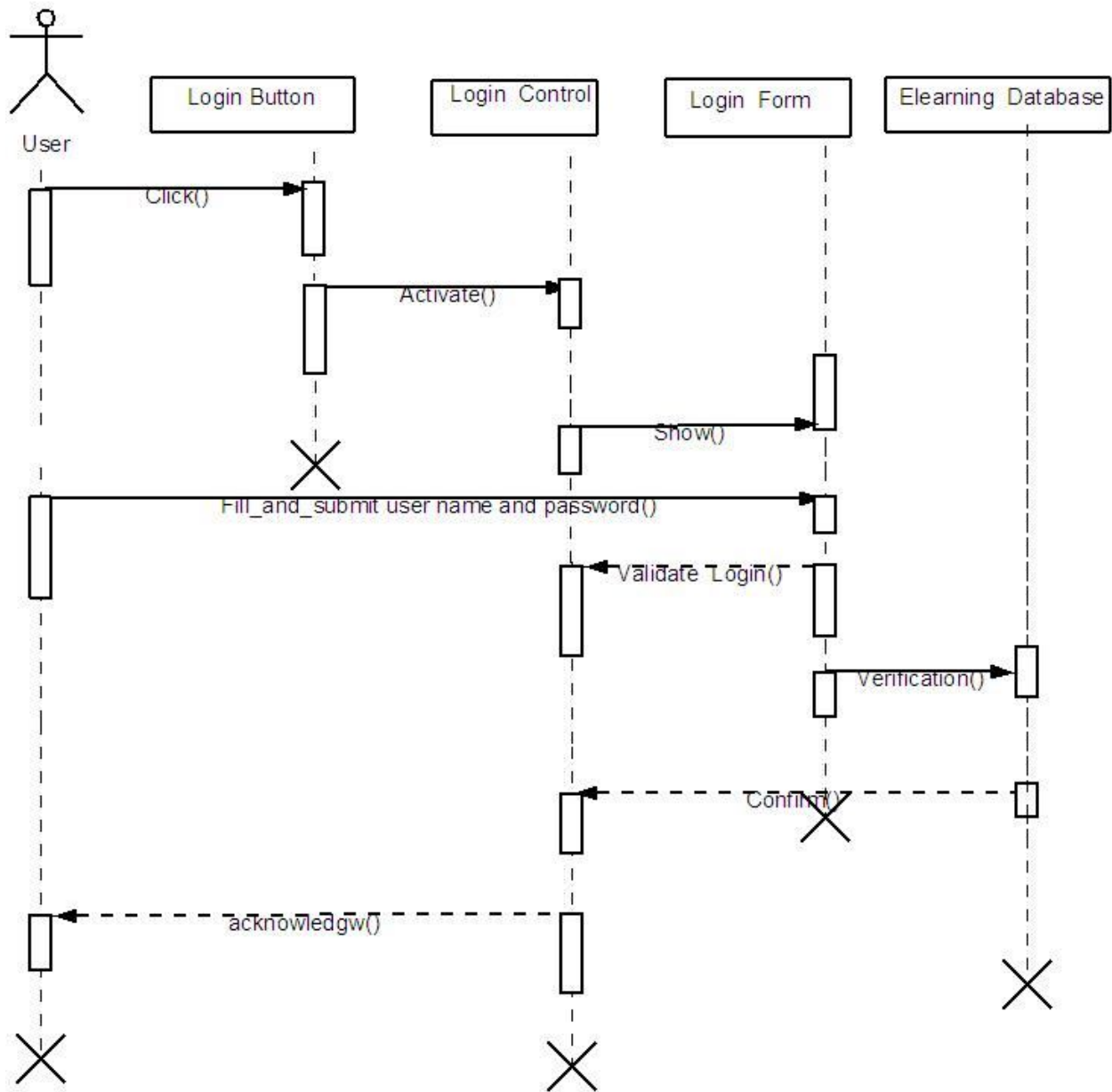


Figure C2: Login Sequence Diagram

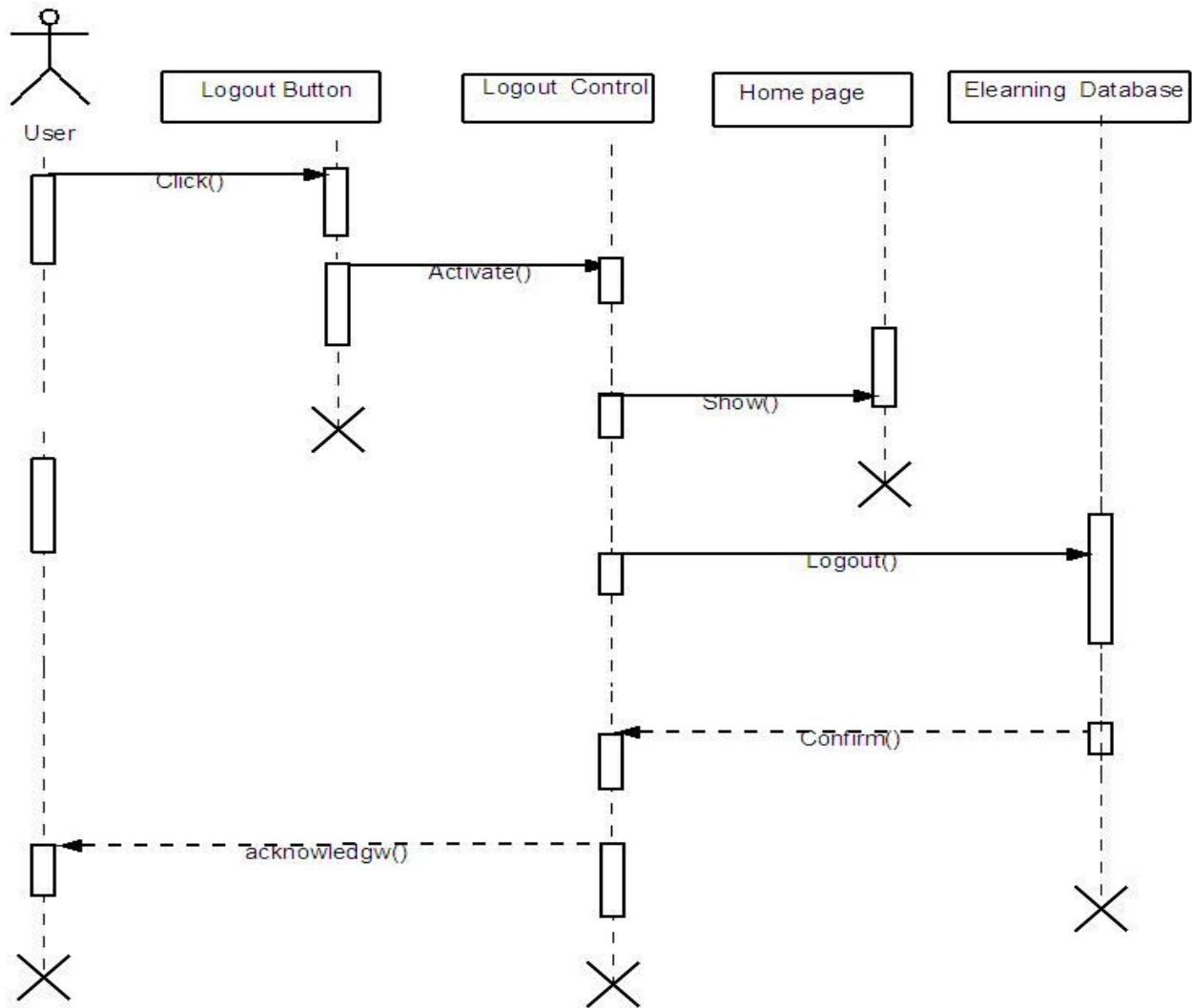


Fig C3: Logout Sequence Diagram

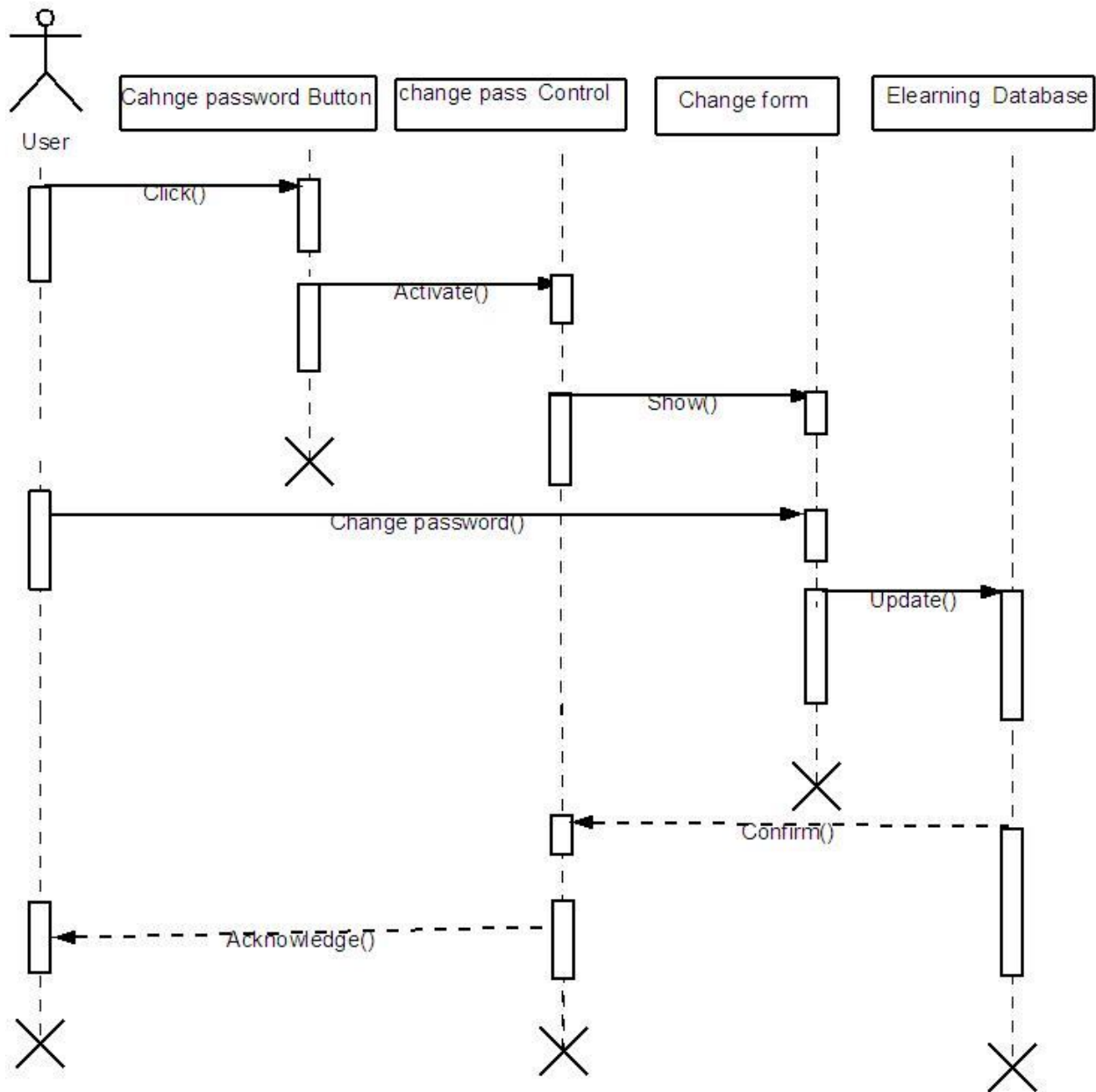


Fig C4: Change Password Sequence Diagram

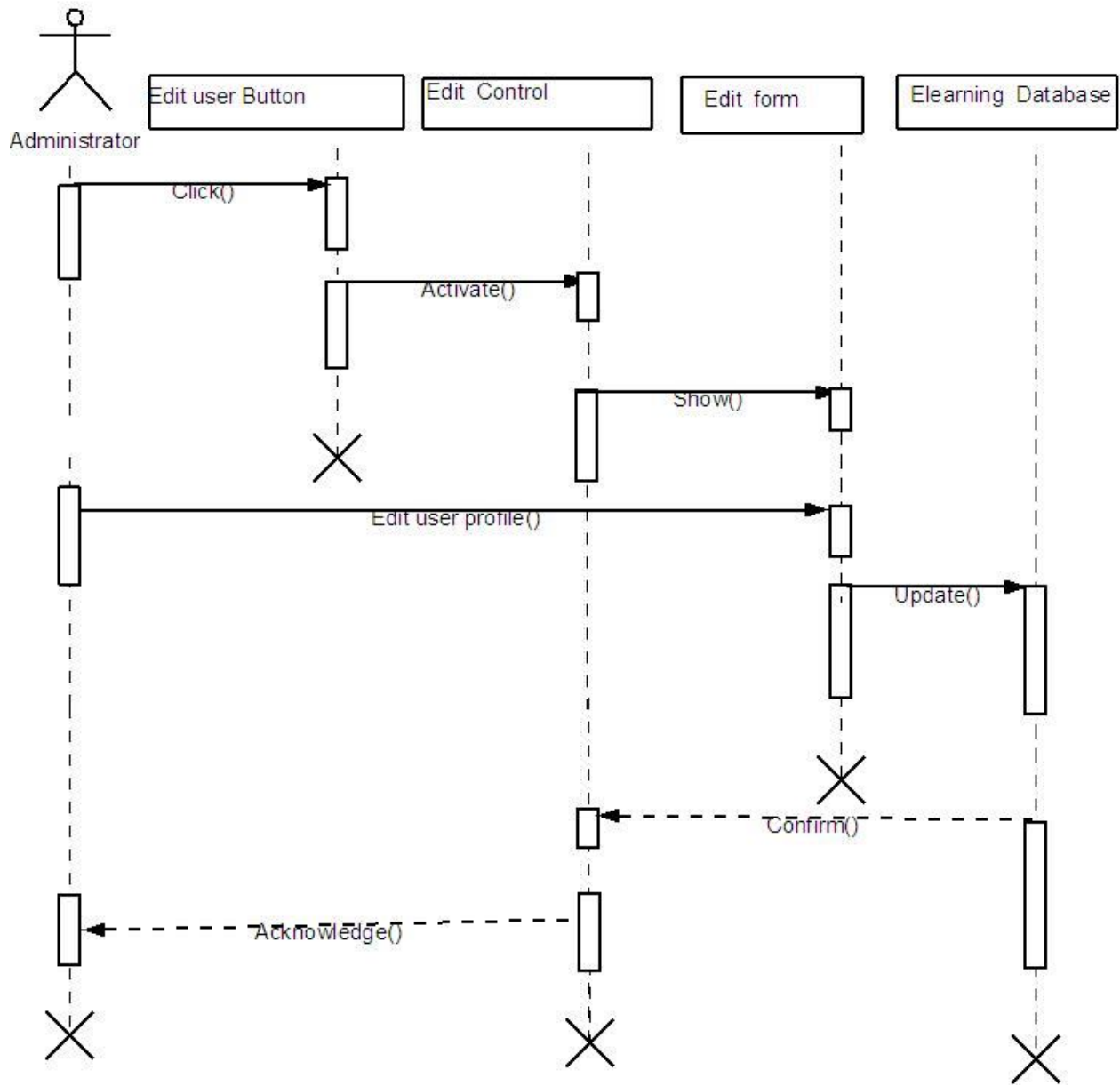


Fig C5: Edit Profile Sequence Diagram

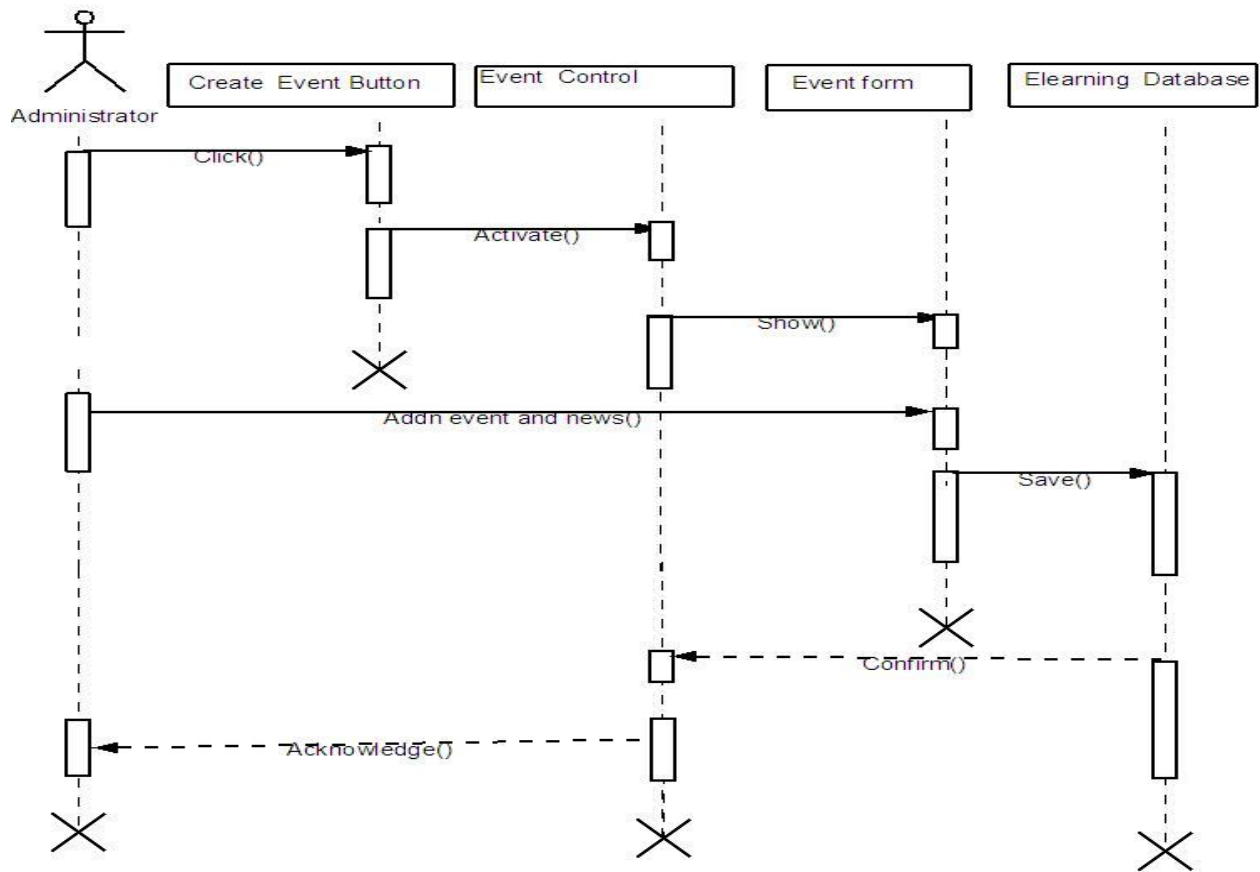


Fig C6: Create Event News Sequence Diagram

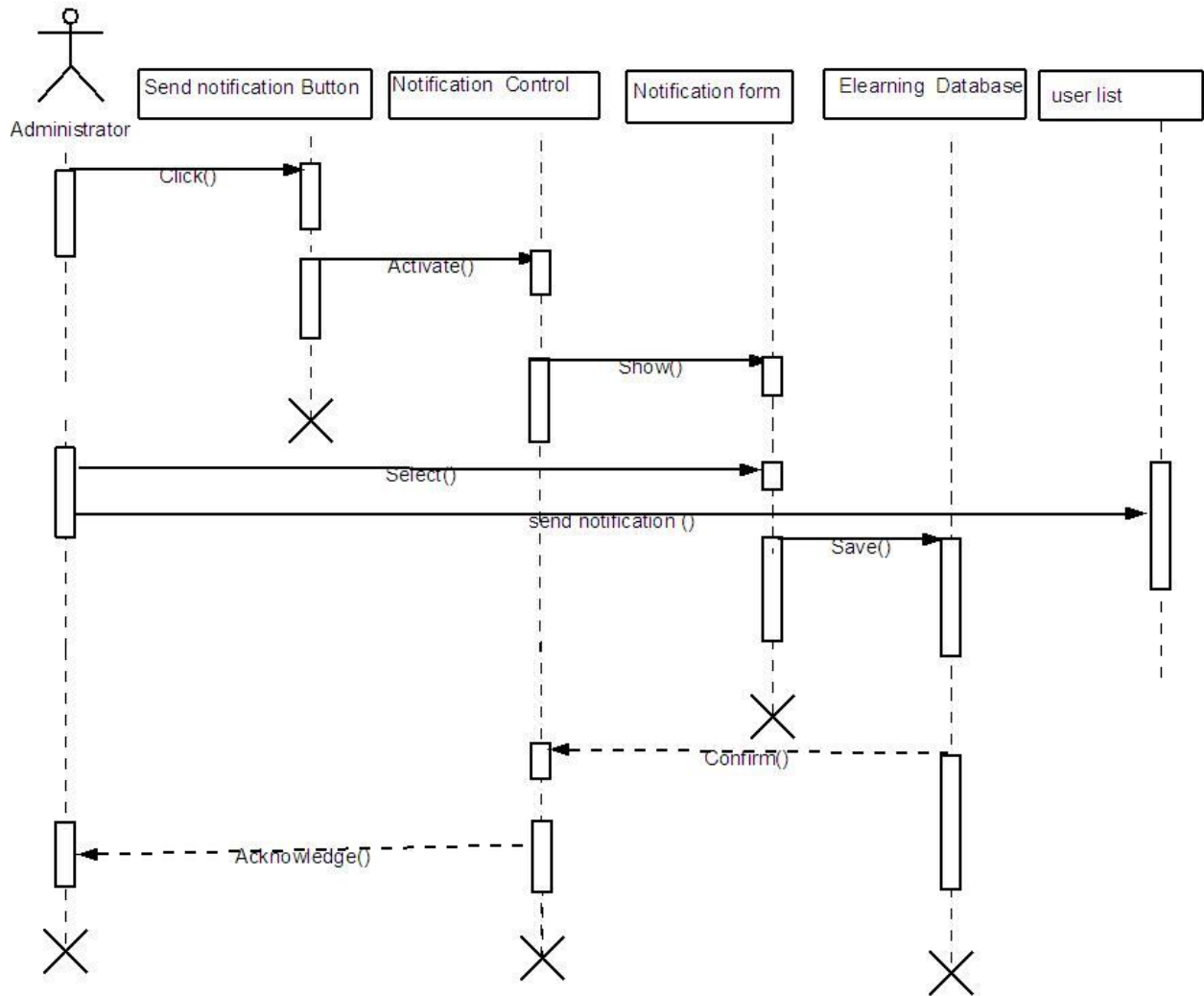


Fig C7: Send Notification Sequence Diagram

Annex D: Sample of the Database Scripts

```
set ANSI_NULLS ON
set QUOTED_IDENTIFIER ON
go

ALTER PROCEDURE [dbo].[addTeacher]
    -- Add the parameters for the stored procedure here
    @techId int output,
    @Fname nvarchar(100),
    @Lname nvarchar(100),
    @Department nvarchar(100),
    @Institution nvarchar(100),
    @email nvarchar(100),
    @phone int,
    @gender nvarchar(100),
    @levell nvarchar(100),
    @date datetime,
    @status nvarchar(100),
    @password nvarchar(100),
    @year int,
    @depHead nvarchar(50)
AS
BEGIN
    insert into
teacher(Fname,Lname,Department,Institution,email,phone,gender,levell,date,pa
ssword,yearr,depHead)
    values(@Fname,@Lname,@Department,@Institution,@email,@phone,@gender,@l
evell,@date,@password,@year,@depHead)
```

Annex E: Sample of the Code behind the User Interfaces

C# code for the Send notification by SMS form.

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;
using System.IO.Ports;

namespace SendNotification
{
    public partial class Form1 : Form
    {
        public Form1()
        {
            InitializeComponent();
        }

        private void cancel_Click(object sender, EventArgs e)
        {
            Close();
        }

        private void Form1_Load(object sender, EventArgs e)
        {
            // TODO: This line of code loads data into the 'el learningDataSet.teacher'
            // table. You can move, or remove it, as needed.
            this.teacherTableAdapter.Fill(this.el learningDataSet.teacher);
            popPorts();
        }

        public void popPorts()
        {
            #region Display all available COM Ports
            string[] ports = SerialPort.GetPortNames();

            // Add all port names to the combo box:
            foreach (string port in ports)
            {
                this.comport.Items.Add(port);
            }
            #endregion
        }
    }
}
```

```

private void Send_Click(object sender, EventArgs e)
{
    int users=10, count;
    count = 3;
    MessageBox.Show("Message sent for " + users + "users ");
    Close();
}

private void fillToolStripButton_Click(object sender, EventArgs e)
{
    try
    {
        this.teacherTableAdapter.Fill(this.eLearningDataSet.teacher);
    }
    catch (System.Exception ex)
    {
        System.Windows.Forms.MessageBox.Show(ex.Message);
    }
}

private void comboBox4_SelectedIndexChanged(object sender, EventArgs e)
{
}
}
}

```

Annex F: Questionnaires for Usability Testing

E-learning support system usability testing questionnaires which helps to know user satisfaction about the services provided.

I. Background information about the devices and the user

- a. Your computer model name _____
- b. Your web browser name _____
- c. Do you have internet browsing experience? A)Yes B)No
- d. Are you familiar with any e-learning applications? A)Yes B)No

II. Prototype

The following items relate the different features of e-learning support system. Kindly indicate your agreement by making “√” in the boxes.

No.	Questions	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
1	Do you think the e-learning support system provides easy navigation?					
2	Do you think searching the educational material is facilitated easily?					
3	Do you think update the educational material is facilitated easily?					
4	Are you satisfied by the user interface of the application?					

5	If an error occurs, do you think the application should provide appropriate support to manage error?					
6	Do you think that the application provide detailed report?					
7	Do you think Activating a link causes a change that confuses you?					
8	Do you think response time for most operations is fast enough?					
9	Are you satisfied by the e-learning support system application service?					
10	Do you think that instructional content, learning tasks, learning aids, are easily accessible?					
11	Do you think the security of user is maintained properly?					
12	Is your computer can run e-learning support system application?					

Please write any other comment about the e-learning support system: _____
