QUALITY ASSURANCE IN E-LEARNING SOFTWARE SYSTEM WITH RESPECT TO USER EXPECTATIONS
(SUDAN CASE)

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By:
Fatima Mustafa Hassan Amin

Supervisor:
Prof. Awad Elkarim Mohammed Yousif

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Abstract

Software quality assurance (SQA) nowadays is an integral part in software that is established for any purpose, like development process and the quality of the product, and so on. The efficiency, effectiveness of software and response to user’ needs and requirements are the main objective for the success of the products. Software manages information in the form of operating system. Software has two major sections, system software: which control the basic job of the computer, and application software: which handles multiple tasks of the user needs to do. Electronic learning (E-learning), mainly it has given the meaning of use the computer and internet technology to communicate and deliver every things.

This study intends to create E-learning model (The System, Instructor and Student Model (SISM)) with its critical success factors (CSFs) which can achieve software quality assurance in E-learning application, by simplifying the usage of E-learning software and protects the defect in E-learning. The proposed E-learning critical success factors are surveyed and grouped into four categories namely, instructor side, student side, system side and their interactions. The study has implemented the model (SISM) and achieved required software quality assurance by satisfying the requirements and needs easily without defects.

Software application has been developed to considering the factors of the system, student, instructor and the intersection of the model. ASP.NET is used for building the application along with C# programming language. The graphical user interface was build using HTML5. The application was tested over three educational institutions in Sudan. The obtained results were compared to determine if they really satisfy the needs, requirements and acquisition of the right knowledge according to quality assurance. The model has corrected the mistake easily in the previous models and addressed the defects that occurred. The given result was accurate and promising satisfying the model tests. We hope that this model serves as a basis for the evaluation of other E-learning software in the future.
الملخص

يعد ضمان جودة البرمجيات (اس كيو اي) في الوقت الحاضر جزءًا لا يتجزأ من البرنامج الذي تم إنشاؤه لأي غرض، مثل عملية التطوير وجودة المنتج، وما إلى ذلك. تعد كفاءة وفعالية البرنامج والاستجابة لاحتياجات ومتطلبات المستخدم هدف الرئيسي لنجاح المنتجات. يدار برنامج المعلومات في شكل نظام التشغيل. يحتوي البرنامج على قسمين رئيسيين، برنامج النظام، الذي يتحكم في الوظيفة الأساسية للعملاء، وبرنامج التطبيقات، الذي يتولى مهام متعددة يحتاج المستخدم إلى القيام بها. التعلم الإلكتروني، وقد أعطي بشكل أساسي معنى استخدام تكنولوجيا الكمبيوتر والتواصل والتفاوت والاشتراك.

تهدف هذه الدراسة إلى إنشاء نموذج للتعليم الإلكتروني (النظام). المعلم، طالب والنموذج (اس كيو اي ام) مع عوامل النجاح الحالية (اس ام اف). التي يمكن أن تحقق ضمان جودة البرمجيات في تطبيق التعليم الإلكتروني، من خلال تبسيط استخدام برنامج التعليم الإلكتروني ويحمي الخلل في التعلم الإلكتروني. يتم مسح عوامل النجاح الحاسمة للتعليم الإلكتروني المقترح وتقسيمها إلى أربع فئات هي: جانب المعلم، جانب الطالب، جانب النظام وتفاعالاتهم. نفذت الدراسة على النموذج (اس كيو اي ام) وحقبت ضمان جودة البرمجيات المطلوبة من خلال تلبية الاحتياجات والمتطلبات بسهولة دون عيب.

تم تطوير تطبيق البرنامج لدراسة عوامل النظام والطالب والمدرس وتقاطع النموذج. يستخدم اس دوت نت لإنشاء التطبيق مع لغة البرمجة سي شارب. تم إنشاء واجهة المستخدم الرسومية باستخدام اتش تي ام 5. تم اختيار التطبيق على ثلاث مؤسسات تعليمية في السودان. تم مقارنة النتائج التي تم الحصول عليها لتحديد ما إذا كانت تفي حقًا بالاحتياجات والمتطلبات واكتساب المعرفة الصحية. وفقًا لضمان الجودة، قام النموذج بت صحيح الخطأ بسهولة في النماذج السابقة ومعالجة العيوب التي حدثت. كانت النتيجة المعطاة دقيقة وواحدة لإرجاء اختيارات النموذج. نأمل أن يكون هذا النموذج بمثابة أساس لتقييم برنامج التعليم الإلكتروني الأخرى في المستقبل.
Dedication

To my mother who have taken care of me since birth, my whole family who support me at every step and my friends who taught me the essence of love.

God bless you all.
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Grateful to Allah SWT and His Messenger Muhammad SAW, I finally managed to complete this study.

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CHAPTER ONE

INTRODUCTION

1.1 Background and Motivation

Software quality represents the main point for any organization or institute to measure its benefits, ease of use, efficiency and effectiveness. It’s difficult to have Software Quality Assurance because there may be defects and impacts in building the software, so it may be not suited for its proposed requirements. The organization or institute can't compete with others if the product seems to be substandard and the profit they receive does not cover their ambitions. Thus, making the software of great importance.

Software’s are computer programs, procedures, and possibly associated documentation and data pertaining to the operation of computer systems.

The IEEE (Institute of Electrical and Electronics Engineers) definition of software, which is almost identical to the ISO definition (ISO, 1997, and ISO/IEC 9000), lists the following four components of software:

- Computer programs (the “code”)
- Procedures
- Documentation
- Data necessary for operating the software system [1].

1.1.1 Software Quality

According to IEEE, our introduction to software components and to errors and their causes, and our knowledge that errors harm the quality of the software, has prepared us to define our target of the Software Quality as:

1. The degree to which a system, component, or process meets specified requirements.
2. The degree to which a system, component, or process meets customer or user needs or expectations[1].
“Quality means conformance to requirements” [1]. The Quality consists of:
(1) Quality consists of those product features which meet the needs of customers and thereby provide product satisfaction.
(2) Quality consists of freedom from deficiencies” [1].
Quality of the software depends on customer or user needs and requirements, and those may ultimately change their goals over the time with progress in technology. Therefore, the following progress of software quality is initial job.

1.1.2 Software Quality Assurance Principles

The IEEE defines Software quality assurance as:
1. A planned and systematic pattern of all actions necessary to provide adequate confidence that an item or product conforms to established technical requirements.
2. A set of activities designed to evaluate the process by which the products are developed or manufactured, in contrast to quality control[1].
Software quality assurance is a systematic, planned set of actions necessary to provide adequate confidence that the software development process or the maintenance process of a software system product conforms to established functional technical requirements as well as with the managerial requirements of keeping the schedule and operating within the budgetary confines[1].

1.1.3 Quality Assurance (QA)

Quality assurance is defined as planned and systematic process to provide adequate confidence that the product or an item conforms to established technical requirements. It is a set of activities created to assess the process by which products or items are manufactured or developed and also is the systematic and planned activities implemented within the quality system, and appear as needed, to provide adequate confidence that an entity satisfy requirements for quality assurance [2].
The American Quality Society defines quality assurance as the process of evaluating, controlling and researching products, processes and services to make sure those quality standards are upheld. In developing products and services, quality assurance is any systematic process of checking to see whether a product or service being developed meets specified requirements. ISO 9000 is an international standard that many companies use to ensure that their quality assurance system is in place and effective. Conformance to ISO 9000 is said to guarantee that a company delivers quality products and services [1].

1.1.4 E-learning Software Concept

E-learning software is a network or online learning that takes place in a formal context and uses a range of multimedia technologies [3]. With the widely use of internet and development of technology, the multimedia and its tools help progress and widen the use of E-learning or Electronic Learning. Therefore, the education institution gives a lot of attention to E-learning software. It provides the society with access to global information and knowledge where student can access internet from anywhere, such as from home, school, university, café, work and also in airplane. Therefore, E-learning software is convenient and is essential for all students. It became very easy to study and get the knowledge through internet, computer, multimedia, audio or video tape, satellite TV, CD-ROM and others means. The use of E-learning software is becoming more important for universities day by day, widespread in higher education around the world and the effectiveness, attractiveness and cooperation in use makes it desirable for the students. Nowadays, most of the students prefer to use tabs, notebooks, mobile phone, laptops and others technological tools to acquire information's, knowledge's and others skills [4].

The impact of E-learning software has been rapidly growing up compared to traditional learning due to the wide needs for E-learning Software, it's very crucial to be as good as to use. The student prefers to
use E-learning software over traditional learning because there is no travel cost, no travel time, learn anytime and anywhere, interactive and collaborative learning environment, effective and efficient life - long learning so on demand and self-paced learning.

1.1.5 Student’s Expectations Towards E-learning

In the last decade students interacted with E-learning software and they found their ambitions in it. E-learning facilitates education for the students to get knowledge and to interact with institution in an easy and effective way. Students prefer to learn via E-Learning courses because it provides them with greater flexibility to learn at any place and time. The student satisfaction depends on the system quality and information quality, which they achieve on E-learning software. They also agree that one of the disadvantages of using E-Learning is that it would reduce the need for face to face interaction with their friends and instructors.

1.1.6 Instructor’s Expectations Towards E-learning

Instructor expectation towards E-learning environment can be divided to two categories: instructors finds it so difficult to deal with E-learning, because of lack of his/her experience in information technology; cannot deal with the E-learning tools such as multimedia devices; think that he is losing control of classroom and the eye contact as in traditional classroom. Thus, leading to a reduction in the quality of teaching. The other category is that instructor look to it as an easy way to deliver subjects information and knowledge's to student electronically. The effectiveness of internet with respect to the student side helps to get the subjects in time and is available to student at any region.

E-learning environments require significant pedagogical shifts on the part of the instructor. The instructor identifies challenges and successes for other instructors using problem based learning as a tool for attaining learning outcomes in E-learning spaces. The outcome of information quality depends on instructor knowledge of subjects and ability to use
multimedia technology tools. It is clear that instructors exist in a world that continually reinvents itself. The E-learning environment effectively assisted the instructor in establishing a ubiquitous learning environment [5]. As result the instructor agree for using E-learning, because the student reaches the optimal and gets the subjects in right way and in time as he/she wants.

1.2 Methodology of the Proposed Model

In this thesis, we intend to create an E-Learning model with its critical success factors (CSFs) as perceived by university students with which it can achieve Software Quality assurance in E-Learning application, by simplifying the use of E-learning software and prevents the defects in E-learning. The published E-Learning critical success factors are surveyed and grouped into four categories namely, instructor side, student side, system side and their intersection. Our methodology rests upon the implementing the SISM model by using a web application that covers all aspects of the model.

The data for SISM model evaluation were collected from two universities and one school. Meetings were arranged to collect the data and analyze the existing E-learning software. SISM models design factors were divided into student side, instructor side, system side and intersection side.

1.2.1 Student Side

Operations are performed when student visits the E-Learning system through the browser to get information and knowledge, to solve a problem/exercise, to see lectures, textbooks and all data sent by the instructors. Students can share information and knowledge between them.

1.2.2 System Side

System side plays a fundamental role in E-learning. The most attractive feature of E-Learning according to both student and instructor is its flexibility of location and time. Use of specialized media and
technology for telecommunication between students and instructors as well as learning experiences and concepts [6].

1.2.3 Instructor Side

Operation plays a central role in the effectiveness and success of E-Learning based courses. It comprises the common elements within system, student and instructor sides. The ready infrastructure of information and communication technology play critical role in educational environment, the instructor affects the student satisfaction with modern tools he used.

1.2.4 Intersection Side

This side is join the three sides above, contain the shared factors, which are in the others sides, the control of the system is in the intersection side, the side play critical role for system.

1.3 Problem Statement

The quality of E-learning software product is the important part for any organization or institution, so they focus on the quality of software used to reach the optimal level in all aspects. In the last decade all organizations and institutions turned to use technology in all its functions. This led to many problems such as software incompatibility, unacceptable software product and defects in the system used due to the complicated huge data and the technology used that is complex and changeable.

This thesis finds solution for the system problems and defects by creating the new software model (SISM). Its aim is to simplify the work and to reach the customer (student & instructor) and organization requirements, needs and satisfactions. We will Implements the model (SISM) to ensure that the system is applied perfectly by utilizing certain quality measures to obtain software quality assurance with optimal user expectations.
1.4 Objective of Research

Since the software model is important with respect to the institution and any organization system, the software model helps to do the work perfectly, to define the functionality, help to protect, manage the system work and give overview of how the whole system may be. With the increase of technology, the software become more complicated, difficult and has many problems pertaining to maintenance and development of the system. A new model (SISM) was created to achieve real Software Quality Assurance. The model was created especially for E-learning software. The main objective is to create integrated evaluation system for E-learning software’s to help student to get the subjects, solve the exercises, to be more control of their own learning and get knowledge needed easily and in short time. Also instructors can deliver all lectures and knowledge in time and without any hard work in his/her place. Business owners can also benefit from the software by evaluation the software’s available on the market. The interaction between student and instructor will be easier which increases the effectiveness and efficiency of the model quality (SISM).

In this thesis, also our objective is to implement the application of proposed model (SISM) on three institutions software system (A, B and C) and determine which one is working in a proper manner considering user expectations. We hope in future to use the proposed model (SISM) as measure for implementing any suggested E-learning system, to be sure that the quality of a software process may be measured and modifications made to improve process quality.

1.5 Thesis Outline

The rest of this research is organized as follows:

In chapter 2, the concept of E-learning, its history, advantage and disadvantage along with its impact, the technology and the tools which are used for E-learning requirements are mentioned for students and
instructors. In chapter 3, the related works are mentioned and the application and development models of E-learning were discussed. In chapter 4, the user's (student and instructor) expectations from E-learning are illustrated, along with the impact of E-learning. In chapter 5, the ranking institution in E-learning is discussed, the requirements for quality in faculties, the enhancing industry in institution interaction and ranking universities overview. In chapter 6, the proposed model SISM (System Instructor Student Model) is developed which contributes to user satisfactions needs. The SISM factors which help the model to accomplish its task carefully were also illustrated. In chapter 7, the application is programmed and implemented on three existing organizations to measure their effectiveness and efficiency. In Chapter 8, the conclusion, and the recommendations are derived.
CHAPTER 2

E-LEARNING CONCEPTS

2.1 Introduction

E-learning is defined as a way that lets a student manage his/her learning operation online and gets information and knowledge, allows instructor to create and administrate courses, conduct online tests and run live class. E-learning is the learning and teaching of subjects and representation of knowledge with various methods when instructor and student are not in same region. Instructor can also create and view assignments and reports. By using E-Learning multiple students can access at the same time. The function of controlling the E-learning depends on instructor, student and administrator of the system. The E-learning have different usage and view. It offers an opportunity for both students and instructors to exchange knowledge and collaborate online. This helps to make learning more attractive, engaging and accessible for all. With development of internet technology and communication the institutes use E-learning for enhancing learning and teaching. The growth of information technology tools and communication make the popularity of the internet application more attractive and preferable. This assisted in environment quality of learning, also helping the student in finding education more interesting and easy to navigate any subject, get knowledge and solve exercise, meet all needs and expectations.

The E-learning environment plays a critical role in establishing interaction and management between instructors and students. The students need to use E-learning to save time and money because sometimes they cannot reach the institution, and it is difficult to be in virtual classrooms, because of far distance apart, look after children, look after parent, disable people and work in far distance. Using E-learning in many educational institutions brought great changes and innovations in educational field [7]. The learners who use E-learning have ability to change their live and have
ability to get a new job, because they get a new qualification in a flexible way.

In the last decade most of researchers search E-learning domain, the development in infrastructure of information and communication technology in most countries helped in the progression of E-learning.

2.2 A Brief History of E-Learning

E-learning has been in existence since 1991 when the world was first utilized at a Computer Based Training (CBT) system seminar, which require connecting personal computer to other multimedia like CD-ROM. The development of E-learning is connected with development and improves of technical instruments. A program was created to enhance the communication between students and instructors not only to teach. First concept of E-learning was related with issues in modern essays originally of a technical shape. The development of CBT and technology, led to rise of internet and creation of the web system. The roots of origin and its technical base were in United States. In the beginning the information could be delivered in text format, and then the browsers created in nineties, which enhance users to use text by graphics. Internet spread rapidly, because it is price is suitable for middle class. Web system was developed and been well known WWW (World Wide Web). The publication “introduction to E-learning” which was written and published on the event of tenth annual of the E-learning method. The E-learning at 2002 started to be together with pedagogical approach in professional management, and it has a great advantage and effectively in use for the universities and companies, not only for distance learning but also for face to face learning. Meeting of the Council of the European Union in 2002 mapped the current use of electronic forms of learning in Europe. Meeting about E-learning programs in 2002-2006 started. The main goal was to extend knowledge about new shapes of education, especially improve the education system, and they recommended that amount of cost for developing E-learning system. All the member countries applied the recommendation, started a
new form of education enhancements in improving E-learning in universities. The open E-learning network play great role in contact with other countries, to exchange experience in education. The project of E-learning was developed and published to help instructors and students to get benefit from these news forms of E-learning [8].

2.2.1 E-learning Timeline

Before the internet was start, in 1940 a distance courses were presented to provide students with education on particular subjects, Pitman the qualified instructor use the correspondence to educate students, also he send compete assignments to his student via E-mail and send more subjects to be finished. In 1924 first machine for testing were created, which helped student to tests themselves. In 1954 Harvard Professor (Skinner) create machine that help educational programming to manage the students education. Until 1960 the first computer based training program was introduced to the work. The based training program was known as PLATO programmed Logic for automated Teaching Operations [8].

2.2.2. E-learning Today

The E-learning tools and delivery methods expanded in late 20th century with interring the computer in the world, in 1980’s the student have computers in their homes, which easiest for them to learn particular subjects and develop certain skill sets. In the following decade the environments of virtual learning began really succeed, people acquisition access to a riches of online information and learning opportunities. In 2000 the companies began to train the employees by using E-learning, this give employee’s a new opportunity to improve their industry knowledge base and expand their skill sets, at home can access internet to gain offered and ability to earn online Scientific degrees, also enrich their live through expanded knowledge. Today E-learning became more popular than ever to student and others they know the advantages that E-learning can offer to all sectors in general[8].
2.3 Categories of E-learning

E-learning is divided to two categories that help students to take their knowledge from the platform. The way that the student prefers to use usually depends on his/her choice for category. Any one of the two categories has its own advantage and disadvantages, the categories are synchronous and Asynchronous of E-learning [7].

- Synchronous E-learning in it the instructors, students and tutors interact with each other from different geographical region in real time online, the instructor deliver the resources and student receive through mobile, video conference, chat or internet. They can share data, knowledge and ideas during the session and get all solutions to their queries. The benefit of Synchronous E-learning is that the students are in social group because they are not isolated, but there is lack of time. The synchronous E-learning is gaining popularity because of increased technology and internet bandwidth capabilities. The sources of Synchronous E-learning are:
  o Messaging instantly
  o Webinars
  o Audio and video conferencing
  o Virtual classroom
  o Chat
  o Application Charring [7].

- Asynchronous E-learning, the instructor and student cannot be online at the same time, use technologies like eBooks CDs, DVDs and email, the students learn at any time they wanted, can download the subjects document as well as uploads any pending task, can make chat with instructor and with each other’s. The students in general prefer the asynchronous E-learning, because they can learn without affecting their daily time, the Asynchronous E-learning can learn from:
  o discussion forums & group
  o message boards
E-learning types are identified by educational scientists according to learning tools used, others according to different metrics and learning content. The E-learning has ten distinguished type which are:

- Interactive online learning
- Collaborative online learning
- Adaptive E-learning
- Computer management learning
- Computer assisted instruction
- Synchronous online learning
- Asynchronous online learning
- Individual online learning
- Linear learning
- Fixed E-learning

### 2.4 Advantage of Using E-learning

E-learning is more attractive for students, who are employed and want to continue their education. It also helps students for personal accomplishment and to earn professional degree, without sitting in traditional university room. It helped in cutting down the costs like usage of hard copies and other materials. The problem of travel costs is also reduced so you can study anywhere at any time, and there is no need to travel to the university to be able to access it. E-learning is fast delivery, the student can get the course work and materials of subjects electronically by E-mail, online forums and DVD-ROMs or CD, so it helps student to focus in their weak point more than in a traditional classroom where they have to learn according to the pace of the instructor and other students. The tools used in E-learning are provided to be easy to use and suitable for each student. E-learning is convenient as students can be able to access online as long as he/she has a device with internet connection in any part of the world he/she resides in. The flexible nature of E-learning environment increases student satisfaction, so that the decision of the study
is dependent on student discipline and a sense of responsibility and he/she knows the course requirements without supervision. This is possible due to easy access of studying online. No need to go to library or borrow materials for reading, students can just get these materials from the World Wide Web [9].

2.5 Disadvantage of Using E-learning

If the student is not motivated to study, E-learning will not tracked the student who lack of self-discipline, where in traditional classroom study this is handy whereby and student is tracked if he falling behind in his studies. The health problem occurs when the student is always on his computer or tablet, so it causes poor vision and straining problems. The student must be relax for at least 15 minutes every hour, walk around and do some exercises to take care of his mind. The student faces a problem of inability to access technology, if they want to take online course and cannot connect to internet, because of hard access to it. Sometimes the instructor needs to be with student face to face to share their notes, exercise, videos and audios, and this cannot be easily implemented since the student is miles apart.

2.6 Impact of E-learning

E-learning is very modern and important in learning using information and communication technology environments. It provides new opportunities for students to enhance learning and facilities collaborations, creativity and innovation for individuals and organizations. E-learning is also used as an extension for other teaching tools and electronic media, so the use of information and communication technology has the potential to create opportunities of new ways of teaching in universities, thus developing creativity, effectiveness and efficiency in learning. The use of E-learning can support development of public policy for learning change that promotes creative and innovative university that helps the instructors to make training ground for future scientists by making a big impact on
students intellectual process, learning skill, mental ability and creativity so that they can proceed with critical and progressive thinking that enables them to provide solutions to problems. The E-learning is harmonized with new world needs to support the students creativity and academic ability and to provide better thinking skills and ability to prepares them for better understanding of the world and the need for constructive innovations. E-learning could impact on student by creating a sense of involvement, excitement and engagement, also enhance through open and distance learning and assistive media tools for those with special needs. It improves their reading skills in terms of time and place of learning. The E-learning impact on learning is so difficult because it‘s contribution to attainment is isolated and vaguely affect the education. There are other factors which should be considered. Implementation of E-learning in teaching-learning process could be a way to realize this goal [10].

2.7 Learning Technology

Since the technology has been advance rapidly it’s become important for education sector. The instructors need technology tools to prepare subjects notes in the shortest time and in the most effective form. The students also need the technology satisfies their requirement in subjects, and cats the time distance to traditional class and encourage them for self-study. The educational institutions want to get maximum level of education for the student with minimum of investment. LMS is at the top of technological advancements, so it satisfies the instructors and students requirements in education in short sentences we can define the learning management system(LMS) as software based of the platform that facilitates the measurement, management and delivery of an organizations corporate E-learning programs [11].

Todays the enterprise E-learning strategies require smart method that goes beyond the capabilities of traditional tools, the learning management system (LMS) is the solution for the educational institutions. LMS is a fundamental component of an effective E-leering strategy, the
fast development in the educational knowledge’s. New method have been
created to generate education technological in new form easier for both
instructors to drive lessons and knowledge, and also easier for the student
to gain their requirements and needs in education. Today internet was
developed and also E-learning. The E-learning is the best in education,
because of its technological possibilities to obey the student requirements
and instructors and to reach them in their regions. The E-learning system is
at the top of the systems that affected by technological changes and go
through fundamental changes, which are:

- The increasing need of learning and diversity in way of
  learning, individuals seeking for learning throughout their
  lives.
- The instructors have become to guides the student on how
  to study instead of giving them the knowledge.
- The students do not want to be dependent upon a certain
  study method.
- The students are demanding more and more to study at time
  and region they want, and at their own studying speeds.
- The students are demanding more adaptable, personalized
  and easy to reach study methods.
- There is need for students centered education instead of the
  classical instructor centered education

The education technologies present many advantages to instructors
and students by enhancing them to study using interactive and
collaborative techniques. Nowadays internet is offering various tools and
application packages to instructors that can be used at all stages of
teaching, and these tools increase the efficiency and effectiveness of

2.8 Learning Management Systems (LMS)

E-learning education model is the information of a system for the
required delivery of an educational subjects or item. The learning
management system provide special platform of studying, enabling the management monitoring the student, tracking of learning, communication, registration process, scheduling, delivery and testing.

LMSs have number of features that saving time that for convenience to instructors. The LMS provides virtual platform for educational environment and other features for learning management system are:

- Have records for instructors, students and system.
- Have record for examination results
- Collection the homework
- Record for keeping grade
- Student track in all education steps like attendance record
- Students seeing their own education time
- Distributing E-learning contents online
- Sharing knowledge and ideas with students
- Manage the class
- Registration process and scheduling
- Communication between student and instructor.
- Interaction between students and instructors.
- deliver the examination result to the students
- Assessment of students via examinations, homework and exercises.
- The ability of students to do interactive applications
- Delivery of knowledge to students in different forms by using multimedia applications.

There are many types of LMS systems in market which are obtain for free like:

- Moodle
- ATutor
- Claroline, etc.

Others are paid software’s like:
• Blackboard
• WebCT and others

2.8.1 Moodle for E-learning

Moodle is abbreviation for Modular Object Oriented Dynamic Learning Environment, Moodle is an open source LMS system, commonly used, most efficient and easily available. Moodle is a course management system (CMS) used for E-learning system to create and deliver dynamic interactive online courses [12]. Moodle is a software package designed to help instructor to create quality online courses. E-learning system is called sometimes Virtual Learning Environment or learning management system (LMS) [13].

2.8.1.1 Moodle General Properties

• Open source learning management system
• Installation is easy on the network
• Enables instructors to create online subjects
• It has huge wide user group, new versions are announced frequently
• It is available in 75 different languages each one can be used in a given LMS.
• Is used in over two hundred countries around the world
• It is free there is no need to pay license, open source under the General Public License (GPL).
• Moodle is different from other LMS, has been developed with Social Constructionist Pedagogy.
• Instructors can easily load their lecture notes by different format (PowerPoint, PDF, word, MP3).
• Moodle has a big share in the education dominion compete with other commercial packages of LMS.
• Moodle is used by very known establishments
You can easily operate Moodle if you have an account web server provider.
If Moodle is used there is no need to write program.
Constantly new features are added to Moodle and it distributed free.
Moodle is open source package, the security issues are dealt with in shorter times as compared to commercial LMS packages.
Moodle is use for test by huge of users because is free.
Moodle Is a system that based on user

From the above can see that the Moodle is easily used in E-learning educational institution without having to pay any fee [11].

2.8.1.2 Moodle Properties LMS Educators

Moodle supports the Social Constructivist Pedagogy
Use for face to face education and also for E-learning
Moodle require a simple, compatible, effective, low technology internet search engine as interface.
The subject’s lists are sanded over service provider.
The subjects is divided into several categories can be searched as required, the subjects loaded and controlled within the Moodle LMS
WYSIWYG HTML editor used to edit items.

2.9 Tools for E-learning and Requirements

The importance of managing key resources such as people and raw materials has long been recognized by organizations. Information has now moved to its rightful place as a key resource. Decision makers do understand that information fuels business and can be the critical factor in determining the success or failure of a business rather than a by-product of conducting business. Business must manage information correctly to increase its usefulness similar to managing other resources. Managers must
understand the costs associated with the production, distribution, security, storage, and retrieval of all information. Networked computers, along with access to the Internet and the Web, have created an information explosion throughout the society generally and in business particularly. Managing computer-generated information differs significantly from handling manual data. Usually the computer information to administer is greater. Costs related with the organization and maintenance of the information can increase at alarming rates, and users often treat it less skeptically than that obtained in different ways. This chapter examines the various roles of systems analysts, and the phases of the systems development life cycle (SDLC) as they relate to Human–Computer Interaction (HCI) factors; it also introduces requirement analysis and the tools used [14].

2.10 Tools for E-Learning

As users adopt new technologies, some of the systems analysts work will be devoted to integrating traditional systems with new ones to ensure a useful context. This is an essential step otherwise the software system will be obsolete in the market. We will describe some of the new information technologies systems analysts will be using as people work to integrate their E-learning applications into their traditional businesses or as they begin entirely new E-businesses.

2.10.1 World Wide Web:

Many of the E-Learning software’s can be inspired with greater functionality if they are migrated to the World Wide Web or if they are originally conceived and implemented as Web-based technologies. Web applications are popular due to the ubiquity of web browsers, and the convenience of using web browser as a client [15]. There are many benefits to mounting or improving an application on the Web. These include:

1. Increased user awareness of the availability of a service, product, industry, person, or group.
2. The possibility of 24-hour access for users.
3. Improved usefulness and usability of the interface design.
4. Creating a system that can extend globally, thus reaching people over remote locations [14].

The World Wide Web has changed very fast in various ways. Markup languages such as HTML (Hyper Text Markup Language) were used by some physicists to link scientific documents at a group of CERN servers. It was astonishing to see some text somewhere around the world with just a simple program, and the links in the program could magically take you to another page with related information. Text-only interfaces were the norm, and simplicity of accessing information content the most important part of the equation. Text documents with a small set of tags and a simple server setup was all you needed to inform your customers and share the knowledge, independently of whether the system analyst was using his trusty Mac, or was using Unix box, or was using a second or third hand PC running a TCP/IP software.

Nowadays we expect much more than this. We expect a web site with lots of information, and a good presentation, but we do not want to be distracted by a difficult interface. The information should be easy to search, and it should be current. A secure, clean and dynamic web site is a great asset for the user and the information provider. We want information, we want it 5 minutes ago and we want it in the way we like it. A modern web site is not only a web server; it also includes a database and querying (a SQL database perhaps) mechanism for manipulating the requests from the users and retrieving data and reports with the appropriate information. Many options are open to the web developers, but not all of them are the same. A vast difference does exist. One of the important considerations is the rapid development of the website but that doesn’t mean that we don’t consider the requirements despite the changes in hardware or software technology. We should also consider future technology trends, reduction in costs, keep our hardware budget under control, and portability. Security
against malwares, penetrations, attacks and vulnerabilities need also to be considered.

Advantages of server-side processing and generation of web pages over client-side-only technologies include:

- Less network traffic by limiting the need for the browser and server back and forth to each other.
- Makes for quicker loading time since, in the end, we're only actually downloading a page of HTML.
- Avoids browser-compatibility problems.
- Can provide the client with data that does not reside at the client.
- Provides improved security measures, since we can code things that can never be viewed from the browser [16].

Cloud computing is a technological advancement that focuses on the way we design computing systems, develop applications, and leverage existing services for building software. It is based on the concept of dynamic provisioning, which is applied not only to services but also to compute capability, storage, networking, and information technology (IT) infrastructure in general. Resources are made available through the Internet and offered on a pay as you go basis from cloud computing vendors. Today, anyone with a credit card can subscribe to cloud services and deploy and configure servers for an application in hours, growing and shrinking the infrastructure serving its application according to the demand, and paying only for the time these resources have been used. Cloud computing allows renting infrastructure, runtime environments, and services on a pay as you go basis. This principle finds several practical applications and then gives different images of cloud computing to different people. Chief information and technology officers of large enterprises see opportunities for scaling their infrastructure on demand and sizing it according to their business needs. End users leveraging cloud computing services can access their documents and data anytime, anywhere, and from any device connected to the Internet. Cloud computing also provides an opportunity for integrating additional capacity
or new features into existing systems. The use of dynamic IT resources constitutes a more attractive opportunity than buying additional infrastructure and software, the sizing of which can be difficult to estimate and the needs of which are limited in time. This is one of the most important advantages of cloud computing, which has made it a popular phenomenon. With the wide deployment of cloud computing systems, the foundation technologies and systems enabling them are becoming consolidated and standardized. This is a fundamental step in the realization of the long-term vision for cloud computing, which provides an open environment where computing, storage, and other services are traded as computing utilities.

The Web is the primary interface through which cloud computing delivers its services. Contemporary, the Web is comprised of a set of technologies and services that facilitate interactive information sharing, collaboration, user-centered design, and application composition. This evolution has transformed the Web into a rich platform for application development and is known as Web 2.0. It presents a new way in which developers architect applications and deliver services through the Internet and provides new experience for users of these applications and services. Web 2.0 brings interactivity and flexibility into Webpages, providing enhanced user experience by gaining Web-based access to all the functions that are normally found in desktop applications. These capabilities are obtained by integrating a collection of standards and technologies such as XML, Asynchronous Java Script and XML (AJAX), Web Services, and others. These technologies allow us to build applications leveraging the contribution of users, who now become providers of content. Furthermore, the capillary diffusion of the Internet opens new opportunities and markets for the Web, the services of which can now be accessed from a variety of devices such as mobile phones, car dashboards, TV sets, and others. These new scenarios require an increased dynamism for applications, which is another key element. Web 2.0 applications are extremely dynamic. They improve continuously, and new updates and features are integrated at a
constant rate by following the usage trend of the community. There is no need to deploy new software releases on the installed base at the client side. Users can take advantage of the new software features simply by interacting with cloud applications. Light weight deployment and programming models are very important for effective support of such dynamism. Loose coupling is another fundamental property. New applications can be developed simply by building existing services and integrating them, thus providing added value. This way it becomes easier to follow the interests of users. Finally, Web 2.0 applications aim to leverage the “longtail” of Internet users by making themselves available to everyone in terms of either media accessibility or affordability [17].

2.10.2 Enterprise Systems

Many organizations see numerous benefits from the integration of many information systems existing on different management levels and within different functions. Some scientists discuss integration as service-oriented architecture (SOA), which exists in layers. Enterprise systems constitute the top layer. Also called enterprise resource planning (ERP) systems, they are designed to perform this integration. Instituting ERP requires enormous commitment and organizational change. Usually systems analysts serve as consultants to ERP endeavors that use proprietary software. Popular ERP software’s include that from SAP, Microsoft Dynamics and Oracle. Some of these packages are targeted toward moving enterprises onto the Web. Typically, analysts as well as some users require vendor training, support, and maintenance to be able to properly design, install, maintain, update, and use a particular ERP package [14].

Due to the wide availability of huge amounts of data and the imminent need for turning such data into useful information and knowledge, data mining has attracted a great deal of attention in the information industry and in society as a whole in recent years. The information and knowledge gained can be used for applications ranging from market analysis, fraud
detection, and customer retention, to production control and science exploration. Data mining can be viewed as a result of the natural evolution of information technology. The database system industry has witnessed an evolutionary path in the development of the following functionalities Figure (1) *data collection and database creation, data management* (including data storage and retrieval, and database. Since the 1960s, database and information technology has been evolving systematically from primitive file processing systems to sophisticated and powerful database systems. The research and development in database systems since the 1970s has progressed from early hierarchical and network database systems to the development of relational database systems (where data are stored in relational table structures), data modeling tools, and indexing and accessing methods. In addition, users gained convenient and flexible data access through query languages, user interfaces, optimized query processing, and transaction management. Efficient methods for on-line transaction processing (OLTP), where a query is viewed as a read-only transaction, have contributed substantially to the evolution and wide acceptance of relational technology as a major tool for efficient storage, retrieval, and management of large amounts of data.
Since the mid-1980s, database technology has been characterized by the popular adoption of relational technology and an upsurge of research and development activities on new and powerful database systems. These promote the development of advanced data models such as extended-relational, object-oriented, object-relational, and deductive models. Application-oriented database systems such as spatial, temporal, multimedia, active, stream, and sensor, and scientific and engineering databases, knowledge bases, and office information bases, have evolved. Issues related to the distribution, diversification, and sharing of data have been studied extensively. Heterogeneous database systems and Internet-
based global information systems such as the World Wide Web (WWW) has also emerged and play a vital role in the information industry. The steady and amazing progress of computer hardware technology in the past three decades has led to large supplies of powerful and affordable computers, data collection equipment, and storage media. This technology provides a great boost to the database and information industry, and makes a huge number of databases and information repositories available for transaction management, information retrieval, and data analysis[18].

2.10.3 Systems for Mobile Devices

Software analysts are being asked to design a prototype of new systems and applications for adventurous users, including many for wireless and mobile devices such as the Apple iPhone, iPod, or the BlackBerry. In addition, analysts may find themselves designing standard or wireless communications networks for users that integrate voice, video, text messaging, and email into organizational intranets or industry extranets [14].

If potential customers cannot reach your services, they are lost potential customers. Smartphones, tablets, and other nontraditional devices are pervasive in the market. The core responsibility is on developers to help customers get a product anywhere. Whether you’re a content provider, Product Company, or Service Company, expanding product reach is necessary. And one of the most effective ways to reach farther is to simplify a message so that it can be delivered to a wider audience. As it stands, there are really four major development targets. Each of the native frameworks comes with certain expectations and a user base. BlackBerry is often used in education and government, whereas the iPhone and Android user base is far more widespread. Windows Phone 7 being the newcomer is used primarily by developers and hasn’t necessarily hit its stride yet.

iOS, the technology that runs on Apple mobile devices, has benefits and limitations specific to its development cycle. The base language is Objective-C, with Cocoa Touch as the interface layer. Early, iOS can be
developed only using Apple’s XCode, which can run only on a Macintosh. Today it can be developed on windows platform.

The Android framework, on the other hand, is written in Java, and can be developed using any Java tools. The specific tooling recommended by Google and the Android community is Eclipse with the Android toolkit. Unlike iOS, it can be developed on PC, Mac, or Linux. Today, android studio is the common software used to develop a native android application.

Like Android, the BlackBerry device framework is also written in Java; however, it is limited in that the Emulator and Distribution tools run only on Windows at this time.

The newest native framework on the market is Windows Phone 7 and its framework sits on top of the Microsoft’s .NET Framework. The language of choice is C# and the framework lies in a subset of Silverlight, Microsoft’s multiplatform web technology. It also has the limitation that the Microsoft Windows Phone tools run only on Windows.

A mobile website experience is significantly different from the desktop view. With a limited screen size, new usability techniques have been developed to help people view and navigate data. Mobile web browsers do the best job they can, providing rich tools for panning and zooming through a website, but commonly used, complex drop-down menus make mobile navigation troublesome.

Navigation is one of the most important, and often most difficult, areas of mobile website design. It’s common to present users with thinned-down content they can access on a mobile device. When in the planning stages of your mobile website project, plan for time to develop a content strategy.

Benefits of a mobile application includes, but not confined to:

- Make Use of the Native Devices Features: It will always be easier to stretch the hardware boundaries of a mobile app. Great features such as in-app purchasing do not have the same tight integration with the User Interface (UI) and operating system unless you are creating a native app.
• Offline content: Many business apps need to display changing data to the user. Depending on the business domain, a mobile web app may not be a good idea. For example, a mobile application that lists all of the state legislators requires the data of the app to come from someplace.

• Richer User Experience: Users generally provide higher ratings for apps that have the native interface. No matter how nice the iOS interface is, if you create an Android app and provide UI elements from iOS, users are more likely to rate your app lower. Users look for apps that have a UI that is consistent with the rest of the apps on their device. It is possible to create HTML and CSS that provide these interfaces on a mobile web app, but it can get difficult. Many developers opt for creating interfaces that do not resemble iOS, Android, Windows Phone 7, or BlackBerry. It’s a design the developer created on their own. Such a design strategy can work, as long as the correct amount of user interface research has been performed. In most cases, however, it’s best to just stick with the UI you should be working with, which is the native UI for the platform.

• Ease of Discovery: Markets provide a place to present your app to the world. Most users are not using a search engine to find apps for their mobile devices; they are using the built-in search tools within the installed market tool.

• Push Notifications: In recent years, text messages (simple message service [SMS]) have become the preferred communication over instant messaging among young people. An instant notification on your mobile device means an immediate response is expected. Push notifications simulate the same behavior of text messages, but are app based. Push notifications alert users of something that they should be aware of instantly: a new e-mail, a new tweet, or some other bit of information that may be important to the app that was downloaded.
• Increased Customer Feedback: Businesses often hope to build brand loyalty through apps. When loyalty has been achieved, you can capitalize on this loyalty within the app, asking for feedback about your company. Quick polls, short forms, and rich integration with social media services such as Facebook and Twitter can provide a level of feedback that is not seen with mobile web apps.

• Quick Response Codes as in Figure 2: Getting the word out about your app is important, and it’s important to provide the user with a very simple way to download your app while you have their interest. Typing a long URL in a web browser or remembering the name of your app can be problematic for some users. Quick response (QR) codes provide a means for users to scan an image with their mobile device, and then a web browser will open automatically to the URL embedded within the image. QR codes were originally created for use in the automobile industry in the early 1990s, but have gained popularity in other industry use. QR codes are a type of matrix barcode, which is a machine-readable representation of data. QR codes can hold a great deal more data than the barcodes most people are accustomed to seeing. [19]
2.11 Open Source Software

An alternative to traditional software development in which proprietary code is hidden from the users is called open source software (OSS). With OSS, the code, or computer instructions, can be studied, shared, and modified by many users and programmers. Rules of this community include the idea that any program modifications must be shared with all the people on the project. Development of OSS has also been characterized as a philosophy rather than simply as the process of creating new software. Often those involved in OSS communities view it as a way to help societies change. Widely known open source projects include Apache for developing a Web server, the browser called Mozilla Firefox, and Linux, which is a Unix-like open source operating system.

However, it would be an oversimplification to think of OSS as a monolithic movement, and it does little to reveal what type of users or user analysts are developing OSS projects and on what basis. To help us
understand the open source movement, researchers have recently
categorized open source communities into four community types—ad hoc,
standardized, organized, and commercial— along six different
dimensions—general structure, environment, goals, methods, user
community, and licensing. Some researchers argue that OSS is at a
crossroads and that the commercial and community OSS groups need to
understand where they converge and where the potential for conflict exists.

Open source development is useful for many applications running
on diverse technologies, including handheld devices and communication
equipment. Its use may encourage progress in creating standards for
devices to communicate more easily. Widespread use of OSS may alleviate
some of the severe shortages of programmers by placing programming
tools in the hands of students in developing countries sooner than if they
were limited to using proprietary packages and it may lead to solving large
problems through intense and extensive collaboration.

2.12 Requirement Analysis

Software analysis and design, as performed by software analysts,
aims to understand what humans need to analyze data input or data flow
systematically, process or transform data, store data, and output
information in the context of a particular organization or enterprise. By
doing thorough analysis, analysts seek to identify and solve the right
problems. Furthermore, software analysis and design is used to analyze,
design, and implement improvements in the support of users and the
functioning of businesses that can be accomplished through the use of
computerized information systems.

Installing a system without proper planning leads to great user
dissatisfaction and frequently causes the system to fall into disuse.
Software analysis and design provides structure to the analysis and design
of information systems, a costly endeavor that might otherwise have been
done in a haphazard way. It can be thought of as a series of processes
systematically undertaken to improve a business through the use of
computerized information systems. Software analysis and design involves working with end users of information systems to support them in working with technologies in an organizational setting. User involvement throughout the software project is critical to the successful development of computerized information. Software analysts are the other essential component in developing useful information systems.

Users are moving to the forefront as software development teams become more international in their structure. This means that there is more emphasis on working with software users; on performing analysis of their business, problems, and objectives; and on communicating the analysis and design of the planned system to all involved.

New technologies also are driving the need for software systems analysis. Ajax (Asynchronous JavaScript and XML) is not a new programming language, but a technique that uses existing languages to make web pages function more like a traditional desktop application program. Building and redesigning web pages that utilize Ajax technologies will be a task facing analysts. New programming languages, such as the open source Web framework, Ruby on Rails, which is a combination programming language and code generator for creating Web applications, will require more analysis.

2.13 System Development Life Cycle

The System Development Life Cycle (SDLC) is a phased approach to analysis and design that stems that systems are best developed through the use of a specific cycle of analyst and user activities. Analysts disagree on exactly how many phases there are in the SDLC, but they generally laud its organized approach. Usually, the cycle is divided into seven phases, as shown in Figure 3.
Although each phase is presented discretely, it is never accomplished as a separate step. Instead, several activities can occur simultaneously, and activities may be repeated.

2.14 Identifying Problems, Opportunities, and Objectives

This is the first phase of the systems development life cycle, where the analyst is concerned with correctly identifying gaps, problems, opportunities, and objectives. This stage is important to the success of the rest of the project, because no one wants to waste subsequent time addressing the wrong problem. The first phase requires that the analyst look honestly at what is happening in the organization. Then, together with other organizational members, the software analyst identifies problems. Often others will bring up these problems, and they are the reason the analyst was initially hired. Opportunities are situations that the analyst believes can be improved through the use of computerized information systems. Seizing opportunities may allow the business to gain a competitive edge or set an industry standard. Identifying objectives is also an important component of the first phase. The software analyst must first discover what the business is trying to do. Then the analyst will be able to see whether some aspect of information systems applications can help the
business reach its objectives by addressing specific problems or opportunities. The people involved in the first phase are the users, analysts, and systems managers coordinating the project. Activities in this phase consist of interviewing user management, summarizing the knowledge obtained, estimating the scope of the project, and documenting the results. The output of this phase is a feasibility report containing a problem definition and summarizing the objectives.

Management must then make a decision on whether to proceed with the proposed project. If the user group does not have sufficient funds in its budget or wishes to tackle unrelated problems, or if the problems do not require a computer system, a different solution may be recommended, and the systems project does not proceed any further.

2.15 Determining Human Information Requirements

The next phase the analyst enters is that of determining the human needs of the users involved, using a variety of tools to understand how users interact in the work context with their current information systems. The analyst uses interactive methods such as interviewing, sampling and investigating hard data, and questionnaires, along with unobtrusive methods, such as observing decision makers behavior and their office environments, and all-encompassing methods, such as prototyping.

In the information requirements phase of the SDLC, the analyst is striving to understand what information users need to perform their jobs. At this point the analyst is examining how to make the system useful to the people involved.

The people involved in this phase are the analysts and users, typically operations managers and operations workers. The systems analyst needs to know the details of current system functions: the who (the people who are involved), what (the business activity), where (the environment in which the work takes place), when (the timing), and how (how the current procedures are performed) of the business under study. The analyst must then ask why the business uses the current system. There may be good
reasons for doing business using the current methods, and these should be considered when designing any new system.

Agile development is an object-oriented approach (OOA) to systems development that includes a method of development (including generating information requirements) as well as software tools. If the reason for current operations remains as it is, the analyst may wish to improve on the procedures. At the completion of this phase, the analyst should understand how users accomplish their work when interacting with a computer and begin to know how to make the new system more useful and usable. The analyst should also know how the business functions and have complete information on the people, goals, data, and procedures involved.

2.16 Analyzing System Needs

The next phase that the systems analyst undertakes involves analyzing system needs. Again, special tools and techniques help the analyst make requirement determinations. Tools such as data flow diagrams (DFD) to chart the input, processes, and output of the business’s functions, or activity diagrams or sequence diagrams to show the sequence of events, illustrate systems in a structured, graphical form. From data flow, sequence, or other diagrams, a data dictionary is developed that lists all the data items used in the system, as well as their specifications.

During this phase the systems analyst also analyzes the structured decisions made. Structured decisions are those for which the conditions, condition alternatives, actions, and action rules can be determined. There are three major methods for analysis of structured decisions: structured English, decision tables, and decision trees.

At this point in the SDLC, the systems analyst prepares a systems proposal that summarizes what has been found out about the users, usability, and usefulness of current systems; provides cost-benefit analyses of alternatives; and makes recommendations on what (if anything) should be done. If one of the recommendations is acceptable to management, the
analyst proceeds along that course. Each systems problem is unique, and there is never just one correct solution. The manner in which a recommendation or solution is formulated depends on the individual qualities and professional training of each analyst and the analyst’s interaction with users in the context of their work environment.

2.17 Designing the Recommended System

In the design phase of the SDLC, the systems analyst uses the information collected earlier to accomplish the logical design of the information system. The analyst designs procedures for users to help them accurately enter data so that data going into the information system are correct. In addition, the analyst provides for users to complete effective input to the information system by using techniques of good form and Web page or screen design.

Part of the logical design of the information system is devising the HCI. The interface connects the user with the system and is thus extremely important. The user interface is designed with the help of users to make sure that the system is audible, legible, and safe, as well as attractive and enjoyable to use. Examples of physical user interfaces include a keyboard (to type in questions and answers), onscreen menus (to elicit user commands), and a variety of graphical user interfaces (GUIs) that use a mouse or touch screen.

The design phase also includes designing databases that will store much of the data needed by decision makers in the organization. Users benefit from a well-organized database that is logical to them and corresponds to the way they view their work. In this phase the analyst also works with users to design output (either onscreen or printed) that meets their information needs.

Finally, the analyst must design controls and backup procedures to protect the system and the data, and to produce program specification packets for programmers. Each packet should contain input and output layouts, file specifications, and processing details; it may also include decision trees or
tables, UML or data flow diagrams, and the names and functions of any prewritten code that is either written in-house or using code or other class libraries.

2.18 Developing and Documenting Software

In the fifth phase of the SDLC, the analyst works with programmers to develop any original software that is needed. During this phase the analyst works with users to develop effective documentation for software, including procedure manuals, online help, and Web sites featuring Frequently Asked Questions (FAQs), on Read Me files shipped with new software. Because users are involved from the beginning, phase documentation should address the questions they have raised and solved jointly with the analyst. Documentation tells users how to use software and what to do if software problems occur. Programmers have a key role in this phase because they design, code, and remove syntactical errors from computer programs. To ensure quality, a programmer may conduct either a design or a code walkthrough, explaining complex portions of the program to a team of other programmers.

2.19 Testing and Maintaining the System

Before the information system can be used, it must be tested. It is much less costly to catch problems before the system is signed over to users. Some of the testing is completed by programmers alone, some of it by systems analysts in conjunction with programmers. A series of tests to pinpoint problems is run first with sample data and eventually with actual data from the current system. Often test plans are created early in the SDLC and are refined as the project progresses.

Maintenance of the system and its documentation begins in this phase and is carried out routinely throughout the life of the information system. Much of the programmer’s routine work consists of maintenance, and businesses spend a great deal of money on maintenance. Some
maintenance, such as program updates, can be done automatically via a vendor site on the Web. Many of the systematic procedures the analyst employs throughout the SDLC can help ensure that maintenance is kept to a minimum.

2.20 Implementing and Evaluating the System

In this last phase of systems development, the analyst helps implement the information system. This phase involves training users to handle the system. Vendors do some training, but oversight of training is the responsibility of the systems analyst. In addition, the analyst needs to plan for a smooth conversion from the old system to the new one. This process includes converting files from old formats to new ones, or building a database, installing equipment, and bringing the new system into production. Evaluation is included as part of this final phase of the SDLC mostly for the sake of discussion. Actually, evaluation takes place during every phase. A key criterion that must be satisfied is whether the intended users are indeed using the system. It should be noted that systems work is often cyclical. When an analyst finishes one phase of systems development and proceeds to the next, the discovery of a problem may force the analyst to return to the previous phase and modify the work done there.

2.21 Software Interaction Design Incorporation

Recently, the study of human computer interaction (HCI) has become increasingly important for software systems analysts. HCI is defined as the “aspect of a computer that enables communications and interactions between humans and the computer. It is the layer of the computer that is between humans and the computer”. Analysts using an HCI approach are emphasizing people rather than the work to be done or the IT that is involved. Their approach to a problem is multifaceted, looking at the “human ergonomic, cognitive, affective, and behavioral factors involved in user tasks, problem solving processes and interaction
context”. Human computer interaction moves away from focusing first on organizational and system needs and instead concentrates on human needs. Analysts adopting HCI principles examine a variety of user needs in the context of humans interacting with information technology to complete tasks and solve problems. These include taking into account physical or ergonomic factors; usability factors that are often labeled cognitive matters; the pleasing, aesthetic, and enjoyable aspects of using the system; and behavioral aspects that center on the usefulness of the system.

Another way to think about HCI is to think of it as a human-centered approach that puts people ahead of organizational structure or culture when creating new systems. When analysts employ HCI as a lens to filter the world, their work will possess a different quality than the work of those who do not possess this perspective. The demand for analysts who are capable of incorporating HCI into the systems development process keeps rising, as companies increasingly realize that the quality of systems and the quality of work life can both be improved by taking a human-centered approach at the outset of a project.

The application of human-computer interaction principles tries to uncover and address the frustrations that users voice over their use of information technology. These concerns include a suspicion that systems analysts misunderstand the work being done, the tasks involved, and how they can best be supported; a feeling of helplessness or lack of control when working with the system; intentional breaches of privacy; trouble navigating through system screens and menus; and a general mismatch between the system designed and the way users themselves think of their work processes. Misjudgments and errors in design that cause users to neglect new systems or that cause systems to fall into disuse soon after their implementation can be eradicated or minimized when systems analysts adopt an HCI approach. Researchers in HCI see advantages to the inclusion of HCI in every phase of the SDLC. This is a worthwhile approach, and we will try to mirror this by bringing human concerns explicitly into each phase of the SDLC. As a
person who is learning systems analysis, you can also bring a fresh eye to the SDLC to identify opportunities for designers to address HCI concerns and ways for users to become more central to each phase of the SDLC [20].

2.22 Tools for Requirement Analysis and Structured Methodologies

Structured methodologies have been used to document, analyze, and design information systems since the 1970s. Structured refers to the fact that the techniques are step by step, with each step building on the previous one. Structured methodologies are top-down, progressing from the highest, most abstract level to the lowest level of detail—from the general to the specific.

Structured development methods are process-oriented, focusing primarily on modeling the processes, or actions that capture, store, manipulate, and distribute data as the data flow through a system. These methods separate data from processes. A separate programming procedure must be written every time someone wants to take an action on a particular piece of data. The procedures act on data that the program passes to them.

The primary tool for representing a system’s component processes and the flow of data between them is the data flow diagram (DFD). The data flow diagram offers a logical graphic model of information flow, partitioning a system into modules that show manageable levels of detail. It rigorously specifies the processes or transformations that occur within each module and the interfaces that exist between them.

The diagrams can be used to depict higher-level processes as well as lower level details. Through leveled data flow diagrams, a complex process can be broken down into successive levels of detail. An entire system can be divided into subsystems with a high-level data flow diagram. Each subsystem, in turn, can be divided into additional subsystems with second-level data flow diagrams, and the lower-level subsystems can be broken down again until the lowest level of detail has been reached.
Another tool for structured analysis is a data dictionary, which contains information about individual pieces of data and data groupings within a system. The data dictionary defines the contents of data flows and data stores so that systems builders understand exactly what pieces of data they contain. Process specifications describe the transformation occurring within the lowest level of the data flow diagrams. They express the logic for each process.

In structured methodology, software design is modeled using hierarchical structure charts. The structure chart is a top-down chart, showing each level of design, its relationship to other levels, and its place in the overall design structure. The design first considers the main function of a program or system, then breaks this function into sub-functions, and decomposes each sub-function until the lowest level of detail has been reached. If a design has too many levels to fit onto one structure chart, it can be broken down further on more detailed structure charts. A structure chart may document one program, one system (a set of programs), or part of one program [21].

2.23 Object-Oriented Development

Object-oriented development uses the object as the basic unit of systems analysis and design.

An object combines data and the specific processes that operate on those data. Data encapsulated in an object can be accessed and modified only by the operations, or methods, associated with that object. Instead of passing data to procedures, programs send a message for an object to perform an operation that is already embedded in it. The system is modeled as a collection of objects and the relationships among them. Because processing logic resides within objects rather than in separate software programs, objects must collaborate with each other to make the system work.

Object-oriented modeling is based on the concepts of class and inheritance. Objects belonging to a certain class, or general categories of
similar objects, have the features of that class. Classes of objects in turn can inherit all the structure and behaviors of a more general class and then add variables and behaviors unique to each object. New classes of objects are created by choosing an existing class and specifying how the new class differs from the existing class, instead of starting from scratch each time.

Object-oriented development is more iterative and incremental than traditional structured development. During analysis, systems builders document the functional requirements of the system, specifying its most important properties and what the proposed system must do. Interactions between the system and its users are analyzed to identify objects, which include both data and processes. The object-oriented design phase describes how the objects will behave and how they will interact with one another. Similar objects are grouped together to form a class, and classes are grouped into hierarchies in which a subclass inherits the attributes and methods from its superclass.

The information system is implemented by translating the design into program code, reusing classes that are already available in a library of reusable software objects and adding new ones created during the object-oriented design phase. Implementation may also involve the creation of an object-oriented database. The resulting system must be thoroughly tested and evaluated.

Because objects are reusable, object-oriented development could potentially reduce the time and cost of writing software because organizations can reuse software objects that have already been created as building blocks for other applications. New systems can be created by using some existing objects, changing others, and adding a few new objects. Object-oriented frameworks have been developed to provide reusable, semi-complete applications that the organization can further customize into finished applications [21].
2.24 Computer-Aided Software Engineering

Computer-aided software engineering (CASE) sometimes called computer-aided systems engineering provides software tools to automate the methodologies to reduce the amount of repetitive work the developer needs to do. CASE tools also facilitate the creation of clear documentation and the coordination of team development efforts. Team members can share their work easily by accessing each other’s files to review or modify what has been done. Modest productivity benefits can also be achieved if the tools are used properly.

CASE tools provide automated graphics facilities for producing charts and diagrams, screen and report generators, data dictionaries, extensive reporting facilities, analysis and checking tools, code generators, and documentation generators. Generally, CASE tools try to increase productivity and quality by:

- Enforcing a standard development methodology and design discipline
- Improving communication between users and technical specialists
- Organizing and correlating design components and providing rapid access to them using a design repository
- Automating tedious and error-prone portions of analysis and design
- Automating code generation and testing and control rollout

CASE tools contain features for validating design diagrams and specifications.

CASE tools thus support iterative design by automating revisions and changes and providing prototyping facilities. A CASE information repository stores all the information defined by the analysts during the project. The repository includes data flow diagrams, structure charts, entity-relationship diagrams, data definitions, process specifications, screen and report formats, notes and comments, and test results.

CASE tools require organizational discipline to be used effectively. Every member of a development project must adhere to a common set of naming conventions and standards as well as to a development methodology [21].
CHAPTER 3

SOFTWARE QUALITY ASSURANCE IN E-LEARNING

3.1 Introduction

E-learning is the learning and teaching of subjects and representation of knowledge with various methods when instructor and student are not in same region. With the growth of internet, information technology tools and communication, the popularity of the internet applications become more attractive, all this assisted in quality of learning environment. The student finds it more interesting and easily to access any subject, solves the exercises and the knowledge, also meeting needs and expectations, by using multimedia tools, CD-ROMs and DVDs, streaming video or audio, satellite TV, video tape and others. Quality assurance play critical role in E-learning software success. To maintain the quality of E-learning environment they must be an interaction and management between student and instructor. The E-learning software is very important in institution so that students use it to handle information, knowledge and all that they need in their study and learning requirements, especially for student or learner who find it very difficult to be in virtual classrooms, because of the work, the far distance from home, disabled people who cannot go to school and have to look after children or they want to reduce the cost of travel and also need to reduce time of learning. E-learning is dependent on Instructor manageability. Still the concern of using information technology and communication in education remains difficult experiment in spite of wide use technology in different aspect. The instructor must anticipating student needs and expectations from online learning and planning for those needs, the instructor preparation of the materials in clearly state that adjust student expectation towards E-learning and begin to find their way in the E-learning process. Usually, the aim is to get the customer needs and requirements, and can be achieved by means of
the software quality indeed and to reach the optimal expectation for both student and instructor. The importance of E-learning in last decade gave learners chance to get knowledge and information, so in the last decade many researchers wrote about the E-learning.

3.2 Software

Software is important and vital for any product to be beneficial to user utilization in the last decade. It is instructors that make the computer perform the tasks in a good manner. Usually, it is abbreviated as SW or S/W, software is a type of programs that contains a collection of instructions which helps the user to interact with the computer and perform the tasks, also to operate the computer. Software can be downloaded over internet or purchased from computer store, some software is for trial (so you can try it before buy), some are purchasable and other is open source software (freeware). Software type is categorized in to mainly two parts application software and system software. Application software is end user programs, can be single program or an application suite, used by user to accomplish specific task, example of application software are word processor, spreadsheet, payroll system, inventory control and database management system. System software (computer program) provide user with platform to run computer application and hardware. It includes operating system, others utilities which enable computer to perform tasks, open source which available for user with source code that can change its functionality according to their needs, and examples are Ubuntu, MySQL (database), Apache and Firefox. Public domain software which is free to use software, example of it is compiler, loader, interpreter, linker and operating system.

Any product that obeys user needs and requirement must be in high quality. The software must be sufficient, effective, useful, and easy to use. According to the IEEE Software is: Computer programs, procedures, and possibly associated documentation and data pertaining to the operation of a computer system. The IEEE definition classified the software in four
components as: documentation, procedures, computer program (code) and data for operating the software system, so all components are important to assure the quality of software development process. There is causes errors in software which are:

- Faulty requirements definition
- Deliberate deviations from software requirements
- Documentation error
- Client development communication failures
- Shortcoming of the testing process
- Logical design errors
- Coding error
- Non-compliance documentation & coding instructions
- User interface and procedure error [1].

3.2.1 System software

System software is computer program that contain programs that design to manage, control and to coordinate the computer hardware (functions and procedures) itself, it act as platform to other software. The programs are operating system, disk operating system (DOS) and file management utilities, also software system enable functional to interact between software, hardware and the user, ensure that there are communication between the hardware and other software to be in same mode. System software can be categories as following:

- **Operating System (OS):** is the system type that employ as manger between system programing, hardware and applications, is the first thing which installed and loaded in computer memory when is powered up, also can define applications, devices and the functional to accomplish their tasks. The user communicates with operating system through graphical user interface (GUI). The Example of operating system is UNIX, Linux and Microsoft Windows etc.
• **Device Driver (Driver Software):** is computer program that allow computer Hardwar to interact with the higher level computer programs with the help of device drive, also is type of system software, example of device driver keyboard, mouse, network card, printer, display card and sound card.

• **Utility Software:** responsible of optimum task and used to manage functionality of devices and applications, also is type of system software which is position between application software and system, example computer language translators, disk formatting software, antivirus software etc.

• **Firmware:** firmware is the software that operationally attached within ROM, EPROM memory chip or flash to identify the operating system. Know a day firmware is stored in flash to upgrade without swapping semiconductor chips, and all of them are installed by manufactured on the motherboard and accessed through input and output.

• **Programming Language Translators:** is act as intermediate program that responsible of translating from high level language source code to machine language, translate program code at time, allocate data storage for program, when the code rules are not followed provide diagnostic report, list source code and program code. Compiler interpreters and assemblers are most popular programming language translator; they are designed by computer manufactures.

### 3.2.2 Application Software

Is an end user program that has ability of dealing with the user inputs and aids the user to accomplish specific task. Application software is single program or a set of programs that known as an application suite. The user deals first with system software then after that deals with application software. The end user use the application to performed special task and to get his/her expectation from computer.
Examples of application software are: spreadsheets software, graphics, E-mail, presentation and word processing software. Software application with respect to user expectation categorized according to task it accomplish as the following:

- **Simulation Software**: Is an imitation of the environment and operation of real world processes, also is kind of education used for testing training, scientific modeling and video games. Simulation software areas are military application, business process, transportation and traffic, manufacturing applications and health care… etc.

- **Word Processing Software**: word processing is used to handle letters, format the text, write memos, faxes and documents. Is use to beautify and format the text and provides with related word for chosen word or phrase. Example of word processing Microsoft word, word pad, word perfect and lotus word pro.

- **Multimedia Software**: means combination of graphics, text, animation, video and sound. Multimedia is very important for many other software application like presentation, word processing and desktop publishing, so it become more exiting, enjoyable and attractive by adding animations, videos, pictures, music’s and sounds.

- **Spreadsheet Software**: Are user programs that help in the analyze numbers and to perform numerical functions. Also spreadsheet is a file arranged in form of row and column which helps to sort data calculate numerical data, arrange data easily, its ability of calculation makes spreadsheet unique.

- **Presentation Software**: is package of computer software used to display information, in the form of slide show. Presentation software has three important functions, slide show system to display the content, method for inserting and manipulating graphic image and editor that allows text to formatted and inserted. Is used to create slide show for academic presentation or for business.
Example of presentation software are Microsoft PowerPoint, Adobe Persuasion, Apple Keynote, Open Office Impress, Corel Presentation, King software presentation and Flow boar.

- **Database Software**: is defined as set of electronic data that created by the user, the user can use this data later on and manipulate with piece of it and update particular pieces. Example of database software’s is Oracle, Mongo DB, Microsoft SQL Server, MySQL and Microsoft Access.

### 3.3 Software Quality

Quality has different meaning, this depend on target of use. Quality in education can be identified as some for special propose, exclusive and unique, fitness for all subject’s, quality as satisfying student and instructor requirements and needs so that to obey their expectation in learning and teaching. Return good investment for the organization, quality means that improvement and development of knowledge. The software errors are the result in of poor software quality, so must be important to look into the causes of these errors in order to stop them, a software error can be procedure error, documentation error, code error or software error, the cause of all these errors are human.

Software quality is the degree to which a system process and component meets specified requirements or meets customer and user needs or expectations [1].

When developing any services and product the important thing is to assure quality of the product in order to increase it is market value, also to achieving the degree to which software product meets the desired level of the customer and user's needs and expectations. Quality depends upon the degree to which those established requirements accurately represent user wants, expectations and needs.
3.4 Quality Assurance

Refers to the engineering activities implemented in a Quality System so that requirements for a product or service will be fulfilled. It is the systematic measurement and methods, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention. This can be contrasted with Quality control, which is focused on process outputs. Two principles included in QA are: "Fit for purpose", the product should be suitable for the intended purpose; and "Right first time", mistakes should be eliminated. QA includes management of the Quality of raw materials, assemblies, products and components, services related to production, and management, production and inspection processes. Suitable Quality is determined by product users, clients or customers, not by society in general. It is not related to cost and adjectives or descriptors such "high" and "poor" are not applicable. So as, a low priced product may be viewed as having high Quality because it is disposable where another may be viewed as having poor Quality because it is not disposable. The Quality Assurance (QA) role is the role responsible for guaranteeing a level of Quality for the end client, and to help the Software development team to identify problems early in the process. Of course, the role is more than just testing. It's about contributing to the Quality of the final product. The quality assurance (QA) role also is one that is focused on creating a quality deliverable. In other words, it is the responsibility of the QA role to make sure that the software development process doesn't sacrifice quality in the name of completed objectives. The quality assurance consequences increase the users and customers confidence, credibility and satisfactions of the product, this help the product to compete in the market others product.

3.5 Software Quality Assurance

Is a set of activities for evaluating and documenting the Quality of the work products during each stage of the Software development
lifecycle. To perform the activity of software metrics to operational factors and to maintain factors is complex task. The Successful of Software Quality Assurance is highly dependent on Software metrics [22]. The importance of quality assurance in the software development process cannot be overemphasized because its adoption results in high reliability and easy maintenance monitor of the software system and other software products to ensure quality. Software quality assurance includes different activities such as quality control, quality management, quality standards, Quality planning, process standardization and improvement amongst others, so they generate more robust findings that can properly support decision making by the software community. The qualitative research approach, specifically. For the software industry to grow strong and be a viable source of external revenue, software assurance practices have to be taken seriously because its effect is evident in the final product. Moreover, quality frameworks and tools which require minimum time and cost are highly needed [23]. Software Quality Assurance role within an organization always has been critical one, its role is highly developed in all process of the lifecycle of each product in the last decade within all variety of organizations. Uncertainty exists in Software Company over the world. Software Quality problem is leading issues for the software industry. The issue exists for about 50 years long. The industry is suffering and closing for this issue. In this circumstance it is important to address and remove its root cause. Otherwise, day by day industry economic loss will increase. I figure out some vital challenges of software quality assurance and testing which have been faced by software industries so they focused on several small and medium software companies of the world. They represent different category of challenges along with responsible stakeholders. They found out that testing tools are available testing elements are available testing process has improved but still software has some testing challenges, their software engineers have scope to improve & overcome those challenges [24].
3.6 A Brief Overview of Basic SQA Model

There are more and more research interests in Software Quality Assurance (SQA) model because it’s very important in Software product and all activities of human life, also important aspects in development and measuring of software product, so it become a critical task for any organization. Many models have been proposed for variety types of use for quality issues and user requirements satisfaction. The development of technologies helps for building new software for diver's purpose, affected to assess the quality. According to the IEEE Standard Glossary of Software Engineering Terminology, the Quality of Software products are defined as:

1) The degree to which a system, component or process meets specified requirements and
2) The degree to which a system, component or process meets the needs or expectations of a user [25].

SQA monitors the Software Engineering processes and methods to ensure Quality. It is help to verifying or to be sure that whether products and services meet the user expectations and needs or not. SQA is regular process with specific approach and steps to reach the intended goals. Actually, SQA products are increasing in a fast way and are used in almost all activity in human live. Measuring and evaluating the Quality of the Software product has become a critical task for any company or institution. So there are several models have been proposed to help in reaching the users diverse goals. The development of techniques for building Software has influenced the creation of models to assess the quality. The constructions of Software depend on generated or manufactured values and gave rise to new challenges for evaluation quality. These values introduce new concepts, reusability, availability, configurability, reliability, confidentiality, lower cost, optimal quality. So the models are classified in basic components and factors to be Quality modes that satisfy all needs. In the last decade most of researches deal with SQA and it’s important to the society in education, industry, business and also to government.
For the manager's point of view, it is important to know a variety of quality models and measurement methods in order to analyses service quality in the most complex way. Therefore, they begin with the overview of definitions considering service quality in general. Next, they presented the most popular service quality models and measurement tools. Then, the last part describes the research achievements on logistic service quality. Their main aims is to overview and then critically assess chosen models and methods of measuring service quality taking into account the specific feature of logistic service. They based on the research method of systematic literature review and critical analysis of research achievements [26]. To select quality components is not enough to assure software quality in Component Based Software System (CBSS), since a new development software product is considered to be a quality product if it satisfies customer's needs, requirements and has minimum defects, so that different research papers and analyses various techniques discussed to assure software quality in (CBSS). They include an investigation about how to improve the quality of a (CBSS) without effecting quality attributes. The reported information is identified from literature survey. The development of Component based software systems rising as they reduce the development time, effort and cost by means of reuse. After analysis, it has been explored that in order to achieve the quality in a CBSS we need to have the components that are certified through software measure because the predictability of software quality attributes of system depend on the quality attributes of the constituent components, integration process and the framework used [27]. The group of attributes (characteristics, requirements) related to green software is essential part of software quality model. It consists of the two main attributes as a resources (energy) saving and sustainability. Evolution of software quality models is analyzed in context of green and reliability. In particular, well known software quality models beginning from on the first McCall’s model (1977) to models described in standards ISO/IEC9126 (2001) and ISO/IEC25010 (2010) are analyzed according with green and reliability issues. Comparing of the
software quality models are carried out using a special metrics of complexity and technique considering the number of levels and attributes and their semantics. Prediction of complexity for the next software quality model (2020) is fulfilled and variants of green software attributes inclusion in model are proposed [28]. The software quality model passes through different changes happened after some modem developments.

### 3.6.1 McCall's Quality Model

Is the first model established by Jim McCall at 1977 for the USA Air Force to fill the gap between users and developers by focusing on number of software quality factors that reflect both users views and developers priorities, its aim is to improve the quality of software. The basic contribution of the McCall method was to establish relationships between metrics and quality characteristics. While other models were created, McCall model was used as base for the new models[25]. McCall model identified three categories for describing software quality product, are: Product Revision, Product Transition and Product Operation, each of them has its own factors, as shown in Figure 4 [29].

![McCall's Quality Model](image)

**Figure 4: McCall’s Quality Model [25]**
- **Product Revision**: it is about the ability of the product to undergo change, and it includes:
  a- Flexibility: the ease of making changes required by changes in the operating environment.
  b- Maintainability: the effort required to locate and fix a fault in the program within its operating environment.
  c- Testability: the ease of testing the program, to ensure that it is error-free and meets its specification [30].

- **Product Transition**: it is about the adaptability of the product to new environments, distributed processing together with rapidly changing hardware the factors it covers:
  a- Reusability: it is ease of reusing software in a different context.
  b- Portability: it is effort required to transfer a program from one environment to another.
  c- Interoperability: it is the effort required to couple the system to another system [30].

- **Product Operation**: refers to the ability of the product to be quickly understood, efficiently operated and also capable of providing the results required by the user(ability to change) [29], the factors it covers:
  a- Correctness: the extent to which a program fulfills its specification.
  b- Reliability: the system's ability not to fail.
  c- Efficiency: further categorized into execution efficiency and storage efficiency and generally mean use of resources.
  d- Integrity: the protection of the program from unauthorized access.
  e- Usability: the ease of the software [30].

The main weakness of the Call Mac model is the accuracy in the measurement of quality, as it is based on responses of Yes or No. also, the model does not reflect the functionality so that the user's vision is diminished [25].
3.6.2 Boehm's Quality Model

Boehm software quality model was introduced in 1978 by Barry W Boehm. Boehm added new factors to McCall's model and emphasis on the maintainability of software product. The model is used to represent a hierarchical model that structure around high level characteristics, intermediate level characteristics, and primitive characteristics. All these are together results in establishment of a high Quality Software Model.

**The High Level Characteristics:** it represents basic high level requirements of actual use to which evaluation of software quality could be put the general utility of software.

**The Intermediate Level Characteristics:** it represents Boehm's quality factors that together represent the qualities expected from a software system: portability, reliability, efficiency, usability testability, understandability and flexibility.

**The Primitive Characteristics:** it provides the foundation for defining qualities metrics, which was one of the goals when Boehm constructed his quality model. In this model 17 attributes have been considered to define the product quality [30], as shown in Figure 5.

![Figure 5: Boehm's Quality Model](image)

[30]
The high level of characteristics is made to answer the following:

- **Utility**: is to create a question of how easily, reliably and efficiently an as can be utilized.
- **Maintainability**: this aspect decides how convenient it is to understand, change or reevaluate a process.
- **Portability**: this aspect helps in deciding an effective way to change an environment.

The intermediate level of characteristics represented by model display seven quality factors that altogether signify expected quality from a software system, these factors are:

- **Flexibility**: it is very easy to amend the software as per the requirement. Parameters of the software should be so flexible that he can react on numerous situations.
- **Reliability**: software performance should be reliable with zero defects result should be accurate.
- **Portability**: software can run on different computers program.
- **Efficiency**: practical and efficient use of resources or data collected. Optimum utilization of resources should be made.
- **Testability**: software should be tested easily and as result users easily checks that he results are correct, so that they can rely on result blindly.
- **Understandability**: software should be simple to understand for users so that they can use it properly and efficiently.
- **Usability**: users can apply it easily and comfortably.

They are other measurable properties can result from the factors, which are:

- Device independence
- Completeness
- Consistency
- Accuracy
- Robustness
- Legibility
- Self-descriptiveness
- Communicativeness
- Accessibility
- Augment-ability
- Accountability
- Device efficiency

The Boehm model focuses on measuring characteristics and properties in the way that creates complex and nontechnical stakeholders that are involved in life cycle of software. This model is used in widespread manner because of its bottom to top approach of software quality and provides as basic amount of support, also short-lived as far as a solid, but McCall model can't do that.

### 3.6.3 FURPS Quality Model

FURPS model was proposed by Robert Grady and Hewlett-Packard Co at 1987. Its model structure is basically of the same manner like McCall's and Boehm's quality models. This model has been classified in two categories according to the user's requirements:

- **Functional**: defined by input and expected output, include feature sets, security and capabilities.
- **Non-functional**: Non-functional is defined by usability, reliability, supportability and performance [25].
  - **Usability**: include human factors, aesthetics, user documentation, consistency in user interface, wizards and agents and training materials.
  - **Reliability**: include severity of failure and frequency, predictability, recoverability, accuracy and mean time between failures.
  - **Performance**: imposes condition on functional requirement, like efficiency, accuracy, response time, resource usage, speed, availability, through-put and recovery time.
- **Supportability**: include extensibility, maintainability, configurability, installability, testability, adaptability, compatibility, serviceability and localizability [31], as shown in Figure 6.

The disadvantage of this mode is that it does not contain the portability feature, which is so important for application development for software system.

![FURPS Quality Model](image)

**Figure 6: FURPS Quality Model[25]**

### 3.6.4 Dromey's Quality Model

Is presented at 1995 by Geoff Dromey, is more recent model similar to McCall's, Boehm's and FURPS (functionality usability, reliability, performance, supportability) quality model. Dromey is focusing on the relationship between the quality attributes and the sub-attributes and connecting software quality attributes with software product properties. There are three principle elements to this generic quality for this model:

- High level quality attributes
Means of linking the product properties with the quality attributes
Product properties that influence quality.

Dromey’s Quality Model is structured in a five process step:

- Chose a set of high level quality attributes important for evaluation.
- List components or modules in the system.
- Identify quality carrying properties for components or modules.
- Decide who each property affects attributes quality.
- Evaluate the model and identify weakness [31], as shown in Figure 7.

![Dromey Quality Model Diagram](image)

**Figure 7: Dromey Quality Model[25]**

### 3.6.5 ISO 9126 Quality Model

The ISO 9126 software quality model was published in 1991 by the International Standardization Organization (ISO), to the quality characteristic for software product evaluation. The ISO 9126 software quality model consider as the standard reference model. It follows from the McCall’s and Boehm’s model, incorporating the features of both models. It prescribes six quality characteristics (quality requirements): Functionality, Usability, Maintainability, Reliability, Portability and Efficiency to evaluate software quality, as shown in Figure 8.
The quality definition given in this standard is “The totality of features and characteristics of a software product that bears on its ability to satisfy stated or implied needs” [32]. The ISO 9126-1 series of standards (ISO 9126, 2001-2003) address software quality from the product perspective through its four parts. Part I of the model was revised to specify a quality framework that distinguishes three different approaches to software quality: internal quality, external quality and quality in use, as shown in Figure 9. The three approaches in this model can be summarized as follows:

- **Internal Quality**

  It is defined as “the totality of attributes of a product that determine its ability to satisfy stated and implied needs when used under specified conditions”. It can be measured and evaluated by a set of documents, like specification of requirements, architecture, design or piece of software code. This includes characteristics like testability, flexibility and fault tolerance.
• **External Quality**

It is defined as “the extent to which a product satisfies stated and implied needs when used under specified conditions”. It is the quality of the product from the external view, as shown in Figure 9. It can be measured and evaluated by dynamic properties of the product by running the application or simulating the execution of the application in a seemingly actual environment. This is the result of the combined behavior of the software application and the computer system. This includes characteristics like performance, reliability, usability, accuracy and integrity.

![External and Internal Quality](image)

**Figure 9: ISO 9126 model external and internal quality approaches**

[25]

• **Quality in use**

It is defined as “the extent to which a product used by specified users meet their needs to achieve specified goals with effectiveness, productivity and satisfaction in specified context of use”. It can be measured and evaluated by the extent to which the software meets specific user needs in the actual context of use. Quality in use indicates the effectiveness, productivity, safety, and satisfaction of users in using the software in the actual context of usage rather than measuring the quality of the software. The three quality approaches in the ISO 9126 model refer to software operating under specific conditions and context of use. This
illustrates that software quality is not an absolute concept; rather it is
dependent on the situation and context of use. Moreover, all the three
approaches are interrelated [33]. The external and internal quality
characteristics are shown with the three layers in Figure 10 below. As can
be seen from the lists of the quality characteristics, the model shares
similar quality characteristics from McCall and Boehm’s models. Even
though it consists of characteristics, sub characteristics and quality
measures; the quality characteristic list is not complete and fixed. So that
according to the type of the software under evaluation and the reasons
behind the evaluation, necessary characteristics, which are not mentioned
in the model, can be introduced. The ISO model therefore acts as a starting
point for conducting software evaluation; it can be adopted to include
essential quality characteristic of the software product under consideration,
so to speak.

![Figure 10: Quality in use model [25]](image)

3.7 Comparison of SQA Models Factors

There are many models to use in testing and devolving software,
but not all of them are so good. In the last decade the models which are
established was merged with ISO 9126 to create a new model to satisfy the
product needs and requirements, so there are many models for different
purposes. When one model of the models mentioned above, such as
McCall's model, Boehm's Model, FURPS Model, Dromey's model and ISO
9126 model is used the request the quality of it, each model has its own quality characteristic with factors and sub factors. A comparison between the mentioned models factors (attribute), the comparison presented by the Table 1 which shows each model with corresponding number of its factors [29].
<table>
<thead>
<tr>
<th>Model Factor</th>
<th>McCall's</th>
<th>Boehm's</th>
<th>FURPS</th>
<th>Dromey's</th>
<th>ISO 9126</th>
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<tr>
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<td>✓</td>
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<td>Interoperability</td>
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<td>Understandability</td>
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<tr>
<td>Modifiability</td>
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<td>Performance</td>
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<td>Physical requirements</td>
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</table>
3.8 SQA E-learning Model

Communication technology and information technology become important tools in education in the last decade. E-learning is the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance, also is application of information technology in teaching and learning process, educational technology(E-learning) is effective use of technological tools in learning. E-learning takes the place of traditional educational techniques (face to face learning). E-learning is becoming very essential for the academic environment, most institutes and all society, so E-learning help students to be more control of their own learning, allows lecturers to guide more and teach less, allows student to build up knowledge and become part of the teaching process, can provide some really engaging learning experiences, “at risk” students can be identified more quickly and collaborating can be very well supported[34].They examine E-learning quality characteristics, criteria, indicators and standard and present a multi criteria hybrid model for E-learning, by using Analytic Hierarchy Process method, data comparison and trend analysis[35]. The paper is to specify the critical success factors (CSFs) for online distance learning (ODL) in higher education, research methodology was analyzing and synthesizing the literature review. The literatures were reviewed to determine items relevant to online learning success as implementation, criteria and indicator. The results of on the CSFs for ODL can be grouped in to five factors include several important elements that can assist to enhance efficiency of online learning courses in higher education institutions [36]. They investigated the effectiveness of using E-learning in teaching, and in institutions in higher education. The use of modern information and communication technologies for teaching and learning is very essential.

The study illustrated the overviews literature and gave background of how various institutions use E-learning to contributions in concept of E-learning particular in teaching in higher educational institutions. It unveils some views that the users have shared globally on the adoption and
integration of E-learning technology in teaching through survey and other observation [37]. Researcher highlighted the main factors that support the use of E-Learning Software technologies, and the benefit of such applications in developing countries as general and in Sudan as a particular situation, toward the achievement of E-Learning goals, their discusses will be mainly divided into two main categories (technical factors and social factors) [38]. Presents a model of E-learning in higher education, which is supported by gamification (use of game design elements to motivate user behavior in non-game contexts), the model takes into account modern guidelines for the development of web application and E-learning, E-learning management and important elements of E-learning. The element of user experience and phase of development are presented. With certain modifications, the model can also be applied to other areas of E-learning [39]. In higher education E-learning has significant role in instruction of students, so they investigating the strength of the relationship between student's motivation and E-learning among students participating in research, the result are that E-learning is essential in effecting student's motivation, also helpful in developing countries for educational thinkers to better comprehend effects of E-learning on student motivation [40]. Presents the E-learning concepts ecosystem, here the propose an E-learning theoretical theory framework which is based upon three principal dimensions: users technology, services related to E-learning and the classifies the stakeholder groups and their relationship with E-learning system, this theoretical approach integrates learning strategies, technologies and stakeholders [41]. ISO 9126 is the most recognized and applied Quality standard to specify and evaluate attributes of the software product, ISO 9126 is extended with the specific characteristic of the E-learning software product, this extension is done by defining the quality characteristics of the E-learning system and integrating them in the ISO 9126 model, result of this study will serve as a basic for the evaluation of an existing system [42]. The goal is to comprehend categorize and inspect prevailing research in Component-Based Software Development (CBSD)
field from Quality point of view, the paper represented the methodology through which the Quality of component based Software system can be assured. Two main approaches for assuring Quality are taken under consideration: encapsulation and composition rules. In this research, focus is given on two main Quality attributes: predictability and reusability analyze the prior work being prepared for Quality Assurance and compare the work on the foundational of their research methodology. The perfect quality software is important for software stakeholders, software quality product is often not effectively defined. Some quality models have been proposed, but these conventional models cannot measure and evaluate software product quality comprehensively. Moreover quality measured and evaluated based on organization specific quality models cannot be compared to the quality of other software products. To alleviate this problem ISO/IEC defined international standards called the SQuaRE (systems and software Quality Requirements and Evaluation) series for comprehensive quality measurement and evaluation; however, these standards include ambiguous measurements, making them difficult to apply. They proposed a comprehensive quality measurement framework, which includes a clear measurement plan based on ISO/IEC 25022 and 25023. They confirmed the usefulness of their framework by conducting a case study of applying their framework to commercial software product [43]. In higher education the E-learning is important and its demand is rising and competition is increasing. Universities are investing significant resources to improve the quality of their E-learning offering. With their aim the total quality management practices of raising participants satisfactions and continuous improvement, a performance evaluation model was applied in a sample of business participants. The application of the model was useful for selecting the quality items of surplus resource investments, thereby helping to provide the means to minimize resource wastage. There way effective and efficient improvement plan to enhance the efficient use of resources in E-learning and it retch and meet the quality and requirement which recurred [44]. The aim of the paper is to analyses
that the introduction of Moodle E-learning platform is related with participants. Performance, like average grade and the average number of admissions to exams. They also examined the same relationship among different groups of participants the study included a member of the universities in period from 2008 till 2014. The results of the analysis (using a t-test) show a significant improvement in performance at different (participant – faculty – course) levels after introducing the Moodle [45]. The study purpose is to propose quality model for E-learning system keeping software perspective under consideration. The poor quality of E-learning software is the major cause of several failures reported. It is quite difficult to measure the overall quality of E-learning software effectively. Design - methodology - approach - a pragmatic mixed-model philosophy was adopted for the study. A systematic literature review was performed to identify existing E-learning quality model and frameworks. Semi-structure interviews were conducted with E-learning experts following empirical investigations to identify the crucial quality characteristics of E-learning software. To analyze the empirical data many statistical tests were applied like principal component analysis, logistic regression, chi-square and analysis of means. These make it easy to use set of quality indicators by higher education institutions to assure the quality of E-learning software. A sustainable quality assessment model for the information's delivery in E-learning software perspective has been proposed by exploring the state of the art quality assessment or evaluation model for the E-learning system. The proposed model can be used to assess and improve the process of information discovery and delivery of E-learning. The results of this study obtained led to conclude that very limited attention is given to the quality of E-learning tools despite the importance of quality and its effect on E-learning system adoption and promotion, the identified models and frameworks do not adequately address quality of E-learning system from a software perspective [46].
CHAPTER 4

USER EXPECTATION FROM E-LEARNING

4.1 Introduction

With wide use of E-learning there have been various definitions for E-learning to determine what is E-learning, how to use it effectively in the institution organizations or for individual. E-learning is focus on all the educations needs for student and instructor, give education powerful tool to improve quality and efficiency of education. E-learning is a learning process with the combination of subjects contains and with using information technology tools, that deliver to student through internet, CD-ROMM OR others. E-learning contributes to the change from traditional learning (face to face learning) to the use of web technology tools which enhance in using fashion technology to presents new collaborative platform for students and instructors. The development of using technology in education enhances to improve face to face generation’s education and also improve E-learning or distance education generations, they began to use different approaches to reach their goals. Use of computer in student life change all aspects and way of studying and learning. The information technology and communication change the society to the technological society. E-learning play critical role in developing organization in different sights of view[47].

The E-learning has acquired a considerable research attention recently because of important of learning patterns for many student needs educations. In the last decade communication and information technologies have enriched the educating and learning experiences, and have been widely accepted by instructors and students. For the rapidly development of E-learning technology, educational institutes have paid great effort to encourage the active use of E-learning among students and instructors, educational institutes allocated large sum of money to implement better E-learning systems that could motivate the usage by students, as this refer to
the initial acceptance of E-learning by students is critical in achieving E-learning success, really success still depends mainly on student loyalty [48]. The American Society for training and Development (AQSTD) described E-learning as anything delivered, enabled, or mediated by electronic technology for the explicit purpose of learning. E-learning covers a wide type of applications and process, like computer base learning, virtual classroom we base learning and digital collaboration [49].

4.2 Motivations to Learn

The learning activity is known as interaction between a student and environment leading to changing in behavior, in a hope to get a good behavior. This can be seen or recognized. Learning is measurable and relatively continual change in behavior through experience, instruction or study. Learning is helping student to discovering knowledge’s and facts and they become of high experience [49]. Motivation to learn is very important key factor to student success is important for academic growth, also success of instructor in his duty to give the student the correct knowledge with attractive easy way. Instructor play critical role in motivation the student to learn in normal way, and without weariness and boredom from learning. Motivation is the pre-requisite in the process of education and is defined as desire of the student and effectiveness, energy, work efficiency to achieve the goal in education, also his/her ability of to receive education in different, ways and with different type information technology tools. The interested of the student in learning, study, enjoyment of study, participation in lecture and in academic achievement, all this are relevant to the motivation of learn. The best instructor and student raise the academic performance and the student motivation is necessary for student accomplishment. The motivation of student is significant issue in education institutions especially owing to importance of academic performance in their professional life. Learn sometimes becomes constraint than enjoyment, that is why numbers of students leaves learn before graduation, this because unpleasant attitude of student towards learn
very little are actually mentally resent in the education institution. Student motivation is the important factor that leads students’ ideas towards learning process. The student motivation is categorized in to tow extrinsic motivation an intrinsic motivation, the intrinsic motivation happen when student motivated from within, the this type the student attract themselves in learning out of interest, enjoyment, oddity or in order to achieve their goals of education, so the student do not need any reward to complete study, this type of student is more likely to complete the chosen task and eager by the challenging nature of an activity, in intrinsic motivation the student feeling of accomplishment and his own sake for the enjoyment it provides in learning. The extrinsically motivated student Participate in education and intends to obtain reward or non-punishment [50]. There is some components effect in student learning motivation:

- **Curiosity**: so students are naturally curious, they seek new experiments, to enjoy learn new things, they find solve puzzles is more serious Mastering skills, and development of competence. Ask students equations or create problem situation rather the give them the fact statement, this increases students curiosity and interest to learn more about the subjects.

- **Attitude**: in learning environment the attitude of students is specific behavior that demonstrates an attitude. The positive behaviors of the student may be appearing only in presence of instructor, so may not apparent at other times. The behavior is contrary to the attitude.

- **Self-Efficacy**: we can say it is the power of positive thinking. The student that doubts about his ability to succeed is not motivated to learn effectively. Dividing student job of learning and providing student with early success is reason of developing confidence in student. Physiological states are source of self- efficacy.

- **Need**: this component of motivation is of two levels one is low level other is higher level, satisfying the lower level need must be important before the next higher level needs. The students cannot
be ready for learn if they not obey for their lower level needs, example student if they are hungry are not able to learn, so first must satisfy their lower level needs.

- **External Motivators:** active participation provides exciting environment and avoid boredom. Provide deferent presentation style, learning materials, methods of instructions will learn in boring situation provided with motivators like fear, extrinsic goals and pressure. Learning in these environments is often stressful and nervous.

- **Competence:** efficiency is the key motivation for learning that is joined to self-efficacy. Student is very pleaser from doing things well. It is important to give students opportunities to do difficult task to prove that they can achieve. Development skill of student promotes competence in a field of learning. The performance of competence itself becomes the intrinsic motivating.

### 4.3 Major Goals of E-Learning

There are certain goals for using E-learning in last decade, which we can discuss. Also E-learning have various definitions to define what is really means with respect to individual and education institution organization, to satisfy their specific needs, requirements and all expectations in education field. E-learning as we mentioned before is learning process with combination subject’s component that delivered digitally or through face to face learning. The shifts from traditional learning (face to face learning) to E-learning that uses web technological tools, this change the platform of education which enhance the student and instructor to share knowledge easily and collaborative learning. The higher progress of advancement in technology tools have contributed to the enhancements of E-learning. After the developing of E-learning they began to use different approaches to address diver’s goals of learning. The goals of using E-learning increase the quality of learning and teaching, meet the requirements, style of needs and expectations of students. The goals of
using E-learning are also improve the effectiveness, efficiency, time flexibility, instructor accessibility to engage students in the learning process. The E-learning domain is huge and has expanding platform with wide possibilities in higher education. Since there are many challenging which make E-learning so an effective. It is important to student and instructor to know how to manage and access the resources of E-learning. If student fails to access resources in short time and do not know to poses the right map or effective strategy for navigating in, so actually he/she lost the learning contents.

Determining of effective goals for E-learning is important in implementing it, it will help in fulfill good results if they know right use of E-learning. The main success of E-learning is not only to gain goals but to get the right goals. There for it is important to know the types of different goals because each goal has its own targets. Anyway, if the E-learning is created and developed without taking attention to right goals of needs and requirements, it will be waste of time, money and effort of the student, and problems will need to arrange and organized again from other perspective. Therefore, in order to determine the right goals (needs requirements and expectations) from the beginning, it required to know the right goals based on the contents of learning and the technique used in E-learning.

As result from the above we conclude that E-learning is an innovation in the current period of time and it has clearly impact on the education institutions, because is very useful for both students and instructors, becoming more popular, that create active platform for learning, for it is very important to set the main goals to enhance an effective E-learning.

4.4 E-learning Domain

E-learning has deferent domain, its categories depend upon its features and usage, are:
Classification of E-learning types: can be classified in to three types, collective learning, personal learning and virtual classroom.
**Collective Learning:** in it conditions will be put for users to communicate with to E-learning play critical role in developing organization in different sights of view hers and the instructor, there is time for finishing the courses for all student.

**Virtual Classroom:** condition like classroom, but attendance in the physical classroom is an important, instead of blackboard they use video project or conference, sometimes computer for each student, so everyone can communicate with instructor.

**Personal Learning:** the student will select his /her favorite subjects, the environment is only internet.

**Virtual Classroom:** condition like classroom, but attendance in the physical classroom is important, instead of blackboard they use video project or conference, sometimes computer for each student, so everyone can communicate with instructor, it is useful for both instructor and student mobility is not possible.

**Mobile Devices and Digital Tools:** in this educated is offered within mobile devices, and digital tools including tablets [47]. As send before mobile phonies used. It is necessary to provide a telecommunication infrastructure.

**Computer Base Training:** her there is no need to network connection or an internet, except especial cases. Information is stored on an electronic interface, user can make use via computer or other device.

**Web Based Training:** is an internet base, the test and exercise delivery is down through email and web, all documents and subjects are stored in the web.

### 4.5 User Expectation from E-learning

The users are both students and instructors whom they use E-learning or any human want to get knowledge online. The user must be convinced and satisfied from the services of E-learning software. E-learning is used by everyone wants walls free quality learning without too much load. Instructor aim is to create subjects for E-learning software to
be more attractive, effective and enhance in education process for students, who are employed and want to continue their education from home, have children want to look after, have mother or father need to look after also and the student himself may be disabled or paralyzed and cannot move from please to other easily and to travel with high cost. Building good trust within the student is primary task in E-learning environment. The user (student always) expects to find that E-learning is more easy and attractive and the formation is modem. So help them for personal accomplishment and to get higher degree of education, without going to the traditional room in education institute. by using E-learning student or user want to cut down the costs like usage of hard copy and other materials. They want problem of travel costs is also reduced so to study anywhere at any time to study, and there is no need to travel to the university to be able to access it. They expect to enjoy E-learning as fast delivery, the student also need to get the course, all work and materials of subjects electronically by E-mail, online forums and DVD-ROMs or CD, this helps student to focus in their weak point more than in a traditional classroom where they have to learn according to the pace of the instructor and other students. The tools used in E-learning must provide to be easy to use and suitable for each student. E-learning it is important to be convenient as students can be able to access online as long as he/she has a device with internet connection in any part of the world he/she resides in. The flexible nature, attractive and easy way of E-learning environment increases student satisfaction, so like the decision of the study is dependent on student discipline and a sense of responsibility and he/she knows the course requirements without supervision. This is possible due to easy access of studying online. No need to go to library or borrow materials for reading, students can just get the materials from the World Wide Web [2].

4.5.1 Instructor User Expectations

Instructor must communicate his availability with the student, so publish his office hours in the subject syllabus to avoid ambiguity. In E-
learning instructors must be attention to required detailed and descriptive language, also prepare plenty of objectives to explain the difficult points, rephrase the student’s questions to elaborate the content. The instructor should use atone that create estimate and authority of expert. The basic course rules and procedures should be clear and satisfies needs and requires of the students. The instructors establish clear expectations from students, when instructors are able to create better educating strategies to satisfy student’s expectations. Provide determined time required to complete weekly study and deadlines for examinations. This will help students plan their educating according to their occupied schedule. The important message to communicate is the course educating goals. Students need to know what they gain from the course, the course contents should match with requirements, needs and expectations from the course. It is important that the instructor shares their expertise and experience in the real world with the students, this can be done during education moments in group email message, forums, team discussions and any other communication. The good way for instructor to keep students engaged with course and display his experience in the field is to supplement the course with current and external recourses like videos, websites and articles, these help students to get all concepts and explain the importance of your course in class. The instructor availability is critical to fulfill student expectations. Instructor in E-learning it is necessary to show the technological expertise to the student online, by available tools. Mastering the features and functional of the online educating platforms is also critical in order to use multiple education platform. The instructor who has high experience will recognize which tools used to enhance an advance the student education experience. Share tips and tricks to personal knowledge management and skills with the students, the live chat room and video session also increase trustiness and respect for the instructor. When student navigate in online education (E-learning) they have expectations on instructors and courses, so that instructor must keeping these exceptions in mind and create materials that keeps students engaged for more.
4.5.2 Student User Expectations

The student’s first expectation is that to meet all needs from the course, it’s difficult to them to get disappointment, they avoid using E-learning software again, because of this the content should be satisfies students required, objectives are met must be described and ensuring expectations. The responding to student enquiries must be a priority of the instructor of E-learning. Not to waste the students time is second expectation, the period of the course should be consistent with main goal of the course, the learning environment should help students to complete in target date, the feedback to student assignments and arrange should be completed in time, this helps developed better future assignments, in E-learning environment with lack of active dialogue similar to actual classroom, the instructor must be available to fulfill student expectations. Several basic tasks are considered to be waste of time for expectations of students, as example of this: filling forms of personal data, testing video, audio, connecting speed, installing plug-ins, changing password for treatment authorization for the data and privacy policy, all these tasks should be performed if it’s necessary.

The students some time dislike repetitions it seems poring, so it’s better to avoid repetitions in the E-learning environment unless it is important in education. Other expectation to avoid student to be bored of education with E-learning and must have some fun, these also in actual class room not only in online, the instructor need to be sure that the students are interested and focused on the content of the subject, there are great way of strategy to ensure the kind of fun. Students to success in E-learning or online education has to do the following: confirm the technical requirement for E-learning, understanding the technology associated with E-learning, the university post the recommended technical requires for E-learning on their websites including all information’s need to access the courses. Connect with instructors and engaged with your classmates early enhance student to be in social engagement university.
4.6 User Expectation Technologies

If the student is not motivated to study, E-learning will not tracked the student who lack of self-discipline, where in traditional classroom study this is handy whereby and student is tracked if he falling behind in his studies. The health problem occurs when the student is always on his computer or tablet, so it causes poor vision and straining problems. The student must be relax for at least 15 minutes every hour, walk around and do some exercises to take care of his mind. The student faces a problem of inability to access technology, if they want to take online course and cannot connect to internet, because of hard access to it. Sometimes the instructor needs to be with student face to face to share their notes, exercise, videos and audios, and this cannot be easily implemented since the student is miles apart.

Various technologies have been introduced to increase user expectations towards software systems. Implementing such technologies is essential to develop software with latest architecture featuring up-to-date interface design and an increased performance with easy maintenance protocol.

4.6.1 UNIX

The UNIX system has become quite popular since its inception in 1969, running on machines of varying processing power from microprocessors to mainframes and providing a common execution environment across them. The system is divided into two parts. The first part consists of programs and services that have made the UNIX system environment so popular; it is the part readily apparent to users, including such programs as the shell, mail, text processing packages, and source code control systems. The second part consists of the operating system that supports these programs and services [51]. UNIX system has been implemented in various modern industries [52]. The first Linux that was based on a architecture different from the Intel 80386 was the port of Linux to the Motorola 680x0 family that actually got started rather early in
the development of Linux. The Linux design is based on three main design issues that have directly influenced the implementation. The main issues are:

- **Simplicity**: The obviousness of this sometimes means that it is overlooked, but an operating system kernel is a complex entity that has to be able to work in an uncontrolled and potentially even hostile environment. Programming errors in the operating system are much less acceptable than in most normal programs, and the security issues are paramount. A complex design is harder to verify against either errors or security issues, so simplicity of the basic services is required.

- **Efficiency**: The kernel is involved with almost all activity in the machine, and as such the kernel must be efficient enough to never be seen as a performance constraint.

- **Compatibility**: While the basic operations of a kernel are of supreme interest to researchers in the operating system area, most people do not want to know what is going on as long as their programs work. As such, one of the most important features of an operating system is the lack of surprises it offers to the user, be he a normal end-user or a programmer. Even new features should be offered as a superset, rather than instead of functionality that the user is accustomed to.

These design issues, coupled with a very pragmatic approach to programming, has led to a system that shares features of both the traditional monolithic kernel design and of the newer research projects into modern microkernels [53].

### 4.6.2 Material Design

Material design is the process by which artists specify the reflectance properties of a surface, such as its diffuse color and specular roughness[54]. In the last few years, several web technology innovations have allowed software designers and engineers to quickly develop responsive mobile-friendly applications. These improvements include web
Frameworks and libraries which allow quick and user-friendly application development for desktop and mobile devices[55].

4.6.3 HTML5 and CSS3

Only a few years ago, websites could be built at a fixed width, with the expectation that all end users would get a fairly consistent experience. This fixed width (typically 960px wide or thereabouts) wasn't too wide for laptop screens, and users with large resolution monitors merely had an abundance of margin either side. Thankfully, there is a solution to this ever-expanding browser and device landscape. A responsive web design, built with HTML5 and CSS3, allows a website to 'just work' across multiple devices and screens. It enables the layout and capabilities of a website to respond to their environment (screen size, input type, device/browser capabilities). Furthermore, a responsive web design, built with HTML5 and CSS3, can be implemented without the need for server based/back-end solutions [56].

HTML goes back a long way. It was first published as an Internet draft in 1993. The '90s saw an enormous amount of activity around HTML, with version 2.0, versions 3.2, and 4.0 (in the same year) and finally, in 1999, version 4.01. Wanting to take the web platform to a new level, a small group of people started the Web Hypertext Application Working Group (WHATWG) in 2004. They created the HTML5 specification. They also began working on new features specifically geared to web applications—the area they felt was most lacking. It was around this time that the term Web 2.0 was coined. And it really was like a second new web, as static web sites gave way to more dynamic and social sites that required more features—a lot more features. HTML5 is rapidly evolving to address real and practical improvements to the web platform. Today, many developers still struggle to develop consistent web applications that work with older browsers. Internet Explorer 6 represents the harshest of the legacy browsers in common use on the Internet today. But even IE6 has a limited lifetime, as it becomes harder and harder to procure any operating system.
that supports it. In time, there will be close to zero users browsing the Web with IE6. More and more users of Internet Explorer are being upgraded to the latest versions. There will always be an oldest browser to contend with, but that bar rises as time passes; at the time of this writing, the market share of Internet Explorer 6 is under 10% and falling. Most users who upgrade go straight to a modern replacement. In time, the lowest common denominator will include HTML5 Video, Canvas, Web Socket, and whatever other features you may have to emulate today to reach a wider audience [57].

HTML5 isn't some radically new technology. In fact, unlike XHTML, which was in-tended to foster a new way to build web pages, HTML5 is about making sure the Web continues to work the way it always has. Most of the basics of HTML are still in place. Also, HTML5 adds a few new elements, meant to support the way web designers currently build websites. For example, in HTML5, the <header> tag can contain the content you'd usually find at the top of a page, such as a logo and site-wide navigation links; the new <nav> tag encloses the set of links used to navigate a site; and the <footer> tag houses the stuff you usually put at the bottom of a page, like legal notices, email contacts, and so on. In addition, HTML5 adds new tags that let you insert video and audio into a page, and new form tags that add sophisticated elements, like sliders and pop-up date pickers, as well as built-in browser support for form validation (which ensures visitors correctly fill out your forms). Unfortunately, browser support for these new features isn't consistent, and it's difficult to use the new tags without some pretty elaborate workarounds.

Cascading Style Sheets—CSS for short—gives you creative control over the layout and design of your web pages. Using CSS, you can dress up your site's text with eye-catching headlines, drop caps, and borders, just like the ones in glossy magazines. You can also arrange images with precision, create columns and banners, and highlight your links with dynamic rollover effects. You can even make elements fade in or out of view, move objects around the page, or make a button slowly change
colors when a visitor mouses over it. The whole idea behind CSS is to streamline the process of styling web pages.

CSS works with HTML, but it's not HTML. It's a different language altogether. While HTML provides structure to a document by organizing information into headers, paragraphs, bulleted lists, and so on, CSS works hand-in-hand with the web browser to make HTML look good [58].

### 4.6.4 Javascript & AJAX

JavaScript is a programming language that your Web browser understands. JavaScript code can interact with images and text on your Web page — for example, hiding an image, moving text, or changing content after a certain period of time or when a visitor to your page does something, such as roll his mouse cursor over a link. JavaScript code can make an image appear when someone visiting a Web page clicks a button, can make a window pop up 30 seconds after you browse to a Web page, or can check to make sure a visitor to your site filled out a Web form correctly. JavaScript is robust and commonly used to add interactivity and dynamic effects to Web pages. But JavaScript is a complete programming language, and to use it effectively, you have to learn to program [59].

Using Ajax, you can build Web applications with the sophistication and usability of traditional desktop applications and you can do it using standards and open source software with simple techniques involving only HTML and basic JavaScript[60].

AJAX stands for Asynchronous JavaScript and XML. AJAX is not a programming language. It uses a combination of a browser built-in XMLHttpRequest object (to request data from a web server) and JavaScript and HTML DOM (to display or use the data). AJAX allows web pages to be updated asynchronously by exchanging data with a web server behind the scenes. This means that it is possible to update parts of a web page, without reloading the whole page. Using JavaScript and dynamic DOM manipulation on the client side of Web applications is becoming a widespread approach for achieving rich interactivity and
responsiveness in modern Web applications. At the same time, such techniques shatter the concept of webpages with unique URLs [61].

4.6.5 JQuery

jQuery is a popular JavaScript library. jQuery helps in finding and manipulating the Document Object Model (DOM) elements, processing browser events, and dealing with browser incompatibilities. jQuery is an extensible library, and thousands of plugins have been created by developers from around the world. jQuery is an add-on library for JavaScript. Think of jQuery as JavaScript code that's been written for you. In general, all you have to do is include a line or two of code in your page that calls the jQuery code. jQuery does the hard JavaScript coding work for you [59].

The jQuery library provides a general-purpose abstraction layer for common web scripting, and is, therefore, useful in almost every scripting situation. Its extensible nature means that we could never cover all possible uses and functions in a single book, as plugins are constantly being developed to add new abilities. The core features, though, assist us in accomplishing the following tasks:

- Access elements in a document
- Modify the appearance of the webpage
- Alter the content of the webpage
- Respond to user’s interaction
- Animate changes being made to the document
- Retrieve information from a server without refreshing the webpage [62].

4.6.6 Angular & Typescript

Angular JS is a toolset for building the framework most suited to application development. It is fully extensible and works well with other libraries. Every feature can be modified or replaced to suit unique development workflow and feature needs. Angular JS is often used for creating single-page applications, where only certain portions of the page
(sub-views) are updated as a result of the user's actions or data being sent from the server. Angular 5 (or just Angular) is an open source JavaScript framework maintained by Google. It is an evolution of its popular predecessor, Angular JS. Apart from JavaScript, Angular applications can be developed in Dart, or TypeScript. The framework makes it simpler to create custom components that can be added to HTML documents and to implement application logic. Angular uses data binding extensively, includes a dependency injection module, supports modularization, and offers a routing mechanism. Whereas AngularJS was MVC-based, Angular is not. This framework doesn’t include UI components.

4.6.7 Single Page Application

Single-Page Applications (SPAs) are web-based applications which load a single HTML page and dynamically update the page content as the user interacts with the application through menus and side bars. These applications offer a more-native-app-like experience to the user. Fluid and responsive web applications are created, without constant page reloads, using AJAX (Asynchronous JavaScript and XML) technology, which communicate with server-side scripts to receive as well as send information in a variety of formats (usually from/to a persistent storage like database). The applications that uses basic functions of persistent storage namely Create, Read, Update, Delete (CRUD) are called CRUD applications [55].

4.6.8 DevExpress & Syncfusion

DevExpress, a small privately owned business headquartered in California, was founded in 1998 and provides next-generation applications with existing technologies. Windows development is prevalent in today’s applications and .NET capabilities continue to expand, yet Microsoft stopped investing in Windows Forms over ten years ago. DevExpress has partnered with Visual Studio and provides extensions and additional capabilities to controls in Windows Forms, ASP.NET, WPF, Silverlight,
and Delphi VCL. The end-user form provided by DevExpress gives the end-user the capability to design or modify reports. The major advantage to this form is the option for customizing the form to the needs of the user as it is not likely that all features and capabilities that the user will need are included in the default form. The layout of this form is a nice mix between the Microsoft SSRS and SAP Crystal Report solutions. One of the obstacles that reporting services faces in putting the report design and maintenance in the hands of the user is the required knowledge of data sources. Reports must be tied to data source(s) to display data and setting data sources and interpreting field names can be confusing to a non-techie individual. As stated, this form is customizable and a programmer could easily add any needed data sources and apply aliases to field names so that it is user friendly. DevExpress is known more for their development tools rather than their reporting services, but they do provide a nice option of customizability. In order for reporting service solutions to be successful, data must be effectively stored, gathered, and implemented efficiently and effectively into reports for use by business people [63].

Syncfusion has been a firm believer in ASP.NET MVC for web development since its beginning. And now that the use of mobile devices over desktops is skyrocketing, MVC is the most viable option for mobile development. With ASP.NET MVC 4 Mobile Websites Succinctly by Lyle Luppes, developers currently using ASP.NET and MVC 3 can make the move to MVC 4 with minimal effort [64].

4.6.9 Google Materialize

Google’s Material Design libraries is a new library of UI components called Material Design, which may become an alternative to Bootstrap. Material Design is optimized for cross-device use and comes with a set of nice-looking UI components. Material Design is a unified system that combines theory, resources, and tools for crafting digital experiences.
4.6.10 Bootstrap

Bootstrap is the most popular HTML, CSS, and JS framework for developing responsive, mobile first projects on the web. It is an open source library of UI components developed by Twitter. The components are built using the responsive web design principles, which makes this library extremely valuable for web applications that needs to automatically adjust its layout depending on the screen resolution [55].

4.7 Impact of User Expectations Towards E-learning

Education or learning is the important over the entire world, all people they want to develop their country need to educate their pupils. They enter the E-learning as model way for education can use with development of information technology and communication [47]. E-learning is very modern and important in learning with entering information and communication technology environments age. It provides new opportunities for pupils to enhance learning and facilities collaborations, creativity and innovation for individuals and organizations. E-learning is also used as an extension for other teaching tools and electronic media, so the use of information and communication technology has the potential to create opportunities of new ways of teaching in universities, thus developing creativity, effectiveness and efficiency in learning.

The use of E-learning by means to change from traditional teaching methods, that can support development of public policy for learning change that promotes creative and innovative university that helps the instructors to make training ground for future scientists by making a big impact on students intellectual process, learning skill, mental ability and creativity so that they can proceed with critical and progressive thinking that enables them to provide solutions to problems. The continuous evaluation of E-learning requires that all students have necessary skills to use these technologies and to access information for efficient individual.
functioning in the information society. The use of computer change human life, so there will be many changes for the student attitude of live. The E-learning is harmonized with new world needs to support the students creativity and academic ability and to provide better thinking skills and ability to prepares them for better understanding of the world and the need for constructive innovations. E-learning could impact on student by creating a sense of involvement, excitement and engagement, also enhance through open and distance learning and assistive media tools for those with special needs. It improves their reading skills in terms of time and place of learning. The E-learning impact on education is so difficult because it’s contribution to attainment is isolated and vaguely affect the education. There are other factors which should be considered. Implementation of E-learning in teaching-learning process could be a way to realize this goal [10]. The E-learning depending on the epistemology underlying E-learning created and design, students interact with instructors, tutors, other people and with content, the instructor spend hard effort to designing their subjects to be with maximum value of those interactions.

As advantage of E-learning, the investing in E-learning of infrastructure is investment for stakeholders is cost cutting. The students and instructors access the information from anywhere this save time for both. As social cause the education institute or instructors distribute the subjects copy to students free of cost as social responsibility, under right to education policy. Development in knowledge enhance in developing new practices and theories due to participations of students and instructors from various places. The proper use of technology tools and devisees replacing paper and other resources of education which were manufactured by companies is environment protecting. [49]

As disadvantages of E-learning, there of unethical hacking of information and putting virus or unwanted information in students or instructors devices as Cyber Crime. The environment safety, so the policies of development of E-learning are not regulated by stockholders
and the use of small children in electronic industry. For developing E-learning the investment requirement might be very high and the expertise of technical must be suitable. The authenticity and reliability is very important, and is considered as problem with respect to both student and instructor, in the open software access source the information and data of knowledge is shared by multiple of users, and there are chances of unreliable data, outdated information, this led to for wrong educated for student and wrong perception.
CHAPTER FIVE

RANKING INSTITUTIONS IN E-LEARNING

5.1 Introduction

The prevalence of educational software’s in educational organizations along with the spread of online courses made educational content available to students from various backgrounds and learning abilities [65]. E-learning activities across tertiary education institutions are very diverse, with programmes located at different points of the E-learning spectrum [66]. If well designed and managed, E-learning can overcome many hurdles associated with traditional learning [67]. Thus, there is a great demand for personalizing educational content to students in E-learning systems in a way that students fulfill their individual needs. Many educational applications provide a sequence of questions to students ordered by increasing difficulty. The student is expected to first solve easier questions in a given skill, and only after mastering that skill, move on to more difficult and challenging questions. As such, ordering questions by difficulty level is an important task in such applications.

Intelligent Tutoring Systems (ITS) have been used since the 1970s for computer based instruction. Seeking to apply artificial intelligence techniques for "intelligent" computer-based instruction, aims to engage students in sustained reasoning activities and to interact with the student while understanding the student behavior and state. Graesser et. al described the computational mechanism of each type of ITS and the impact of these systems on learning gains. Contemporary, we have seen a dramatic change in the education world towards wide-adoption of online learning technologies (E-learning). The huge amount of fine-grained data being collected and coupled with Big Data and artificial-intelligence mechanisms, can be used to develop learning environments that can adapt to the needs of the individual learner. Commonly used tools include using
Higher educational institution has grown significantly in the era of globalization. The improvement on the country’s economic front, the upscaling of communication technology and the advent of the internet, have vastly leveraged the promotion of education across all verticals. The involvement of private sector in higher education has shown drastic changes in the field. This has accelerated establishment of institutes which have originated over the last decade making India home to the largest number of Higher Education institutions (HEIs) in the world, with student enrolments at the second highest.

In the last decade there has been a particularly high growth rate in student enrolment at a CAGR of 10.8% and institutions at 9%. The main governing body for higher education is University Grants Commission (UGC) which enforces academic standards, advises the government on higher education policy and maintains coordination between the center and the state.

Distance learning and open education also are an essential feature of the higher education system. According to data released by aishe-report-2017-18, out of the total enrolment of 3,66,42,378 (3.6 crore) students, 79.19 per cent students were under-graduates, while 11.23 per cent students were postgraduates. There are 1,61,412 students enrolled at Ph.D. level (excluding 3,110 students enrolled in integrated Ph.D.) i.e. less than 0.5 per cent. Over 57 per cent of all these students are male and 42.6 per cent are female. Enrolment in Ph.D. has gradually increased from 1,07,890 in 2013-14 to 1,61,412 in 2017-18. It still faces challenges on several fronts including low and inequitable access to higher education, shortage of faculty, deficient infrastructure as well as low-quality and inadequate research. The most important thing in knowledge is quality not its quantity. Quality is excellence, perfection, standards, added value, and value for
money, competencies for work, efficiency, effectiveness, consistency and relevance. It is important to realize what is significant and what is not. Higher education plays a distinctive role in society by creating new knowledge, later transmitting it to the students and fostering innovation. In higher education, quality teaching plays the most critical role to justify students learning outcomes. In order to raise quality teaching in higher education, institutions must ensure that the education offered is according to the students expectations and is required by the employer [68].

5.3 Minimum Requirements for Quality Faculty

If you want to be a leading institution then you have to develop overall quality, which is possible if institution have research oriented academic leaders who have the ability to influence and develop research oriented academic environment. Therefore, institutions must hire research-oriented scholars and facilitate them to promote extensive research activities and utilize the acquired experience in transforming other academic participants [68].

Research orientation develops academic skills, analytical skills, efficiency and expertise among the academic network and their achievement is a collective achievement of their respective institution and these achievements give strength to the institution and transform it into leading and world class institution.

Institutions top management is responsible for creating and driving the hiring process. They must make themselves available to talk to the best potential participant personally and to discuss it with their other potent colleague. Head of the institution must be an integral part of the hiring panel. If head of the institution is not prepared or reluctant to control the people who are joining and who are leaving the institution, then decline in institutional status is bound to happen.

It is easy to appoint but tough to keep good professionals. Human Resource department have to take this responsibility by becoming more active in attracting and keeping the best staff. Balance growth opportunity
and equity in responsibility according to the experience and expertise play instrumental role in developing the effective academic environment [68].

Worldwide evidence shows that best academic institutions are led by the outstanding scholars. Quality scholars craft the future of the institution by improving the performance. Academicians are considered as true leaders as they set standards and target to achieve. They become role model for future generations and have an ability and never ending desire to guide and direct the future generation. Thus, institutions must hire scholars who have a leadership quality and have a perpetual desire of producing the quality. Top academic hierarchy is the standard bearer and it’s their responsibility to set the quality environment. If the institution wants to attract good academic people, then they have to control the process. They have to make sure that best professionally groomed and research-oriented people are in selection committee. It is human tendency to select those who are like them or below to them in academic achievements [68].

Creation of professional committee and development of professional associations to advise and facilitate top hierarchy about selection, promotion and probation decisions is mandatory. This process must be monitored by the top academic leaders of the institutions and they must ensure that mediocrity do not have any place in their institution nor racism [68].

5.3.1 Recognition and Reward System

Successful academic institutions are highly commercial, and they are always aware of their most talented staffs. Thus, academic institutions have to maintain a list of their talented researchers, academicians and administrators. Top management must be informed about all institutional achievements. The achievers must be appreciated and recognized by the top management. When institutions reward their achievers then it develops sense of belongingness and confidence among them. Their contribution must be highlighted, and they must be motivated to set the trend for others to follow.
Researchers in their respective field usually get positive feedback from their colleagues. Their work is assessed by their peers and superiors, which leads to publishing, and ultimately it converts into promotion and additional increment [68].

Academic life is lonely, and academicians produce their loyalty to their institutions, in due respect respective institutions must also reflect their loyalty toward them. Attracting and retaining high breed academic staff is herculean task and also expensive process. Institutions must act as parent’s body and develop effective coordination and cooperation with their academicians and importantly must keep them motivating and facilitating [68].

5.3.2 Managing Change

Bringing change in the organization is painful. It hurt the emotions. If academicians want an easy go before retiring themselves then they need not to bother about the strategy of change. Some academicians think that moving up in the ranking is a great idea or achievement but unlikely it is not for others. Tenure ship is painful but should be adopted. Head of the institution must be the person to take tough decisions and if it is been taken then it must be supported by other team members [68]. Committee should be made responsible and accountable to make tenure. The committee should be controlled by the head of the institution. Head of the institution must ensure that committee is having institutions best scholars who have in depth information of institution and about its overall policies and procedures, especially in hiring and promotions criteria. Too much change in institution will impact its overall growth and development. Educational institutions strategy is generally initiated and led by the head of the institutions. Head of the institutions, being a leader, have control of the strategies and the concomitant power to implement them. It is very much known that head of the institution post is limited for few years and thus most of the time they avoid initiating changes. Ultimately, this responsibility is beard by the board. Institutions have to be
consistent in hiring the leaders in order to avoid these situations which have a long-term impact on the organization growth. The hired leader must be given enough time to adjust the existing plan with his future plan. Academic institutions usually take long time to change and to establish leading institution it requires to focus on long term planning with supportive short-term policies, tenacity and time [68].

5.3.3 Competitive Salary System

Salary is one of the important factors or attracting elements that enhance ranking of the institution. Attractive salary structure is essential if wanted to be a leading institution: Top positions are few in academic institutions and to satisfy the competitive environment institution have to hire deserving candidates who have an ability to convert odds into even. This is possible only if institution is ready to pay attractive salary to the hired candidates and more than one term vacation leaves which can be utilized by the top heads to rehabilitate themselves. If the institution has deserving and competitive head, then he must be free to constitute competitive academic team of other heads. By constituting team of best scholars, he will transform institution into world class institution [68].

5.3.4 Promoting Research through Devising Research Incentives

Institutions are not recognized by their physical infrastructure but by the research-oriented teaching and learning. Research oriented institution can survive the growing competition. Research orientation develops a tendency to find out the reasons for all. They are prone toward finding the solution to What, When, Where and Why questions. To develop research strength, head of the institution must promote research activities in aggressive manner. He or She must motivate and attract academicians to conduct research. Incentives must be allotted to the research work. Institution must have the policy to increase the incentives from time to time [68].
Worldwide evidence show that academic institutions who have given longer contract to their leader have performed better in all frontages. Academic leader who has served shorter period in the institution are found ineffective and did not managed to contribute positively to the growth and development of the institution.

Trust is one of the most important tools for smooth functioning, growth and development in all kinds of organization. Both institution and institution leader have to keep faith in them. Without faith and trust nothing can be achieved. Thus for the betterment, institutions must keep faith in its leader. Trust acts as a motivational pill and make leader more confident and responsible. Without trust it is impossible to achieve the mission and vision of the institution [68].

5.3.5 Training the Trainer

It is worldwide accepted fact that good scholar transform into good academic leaders. It is the academic institutions policy to identify potential scholar and train them accordingly. Excessive management education will not fulfill the academic purpose. Research scholars should be given administrative task in their respective departments to which they belong. Most of the universities give extra periods to the research scholars to explore their teaching skills and their administrative potential before being assigned the coordination ship of extra periods or evening classes along with examination responsibilities [68].

Education is a holistic and integrated approach to transform future generations and educational institutions are system of interdependent processes, comprising of highly specialized and efficient faculties associated with functional hierarchy. Role of faculty is very crucial as they are the architect of future generation. They are the real asset of the institutions and institutions achieve their mission and vision through their knowledge and efforts. Faculties are passive contributors and have little autonomy. They are process manager and facilitate students to grow in positive atmosphere and encourage them to set their target and touch the
zenith of their carrier. They convert raw inputs of the institutions into finished output with greater value. Faculties follow a scientific system where head of the institution establishes the system and continuously improves the quality in coordination of faculties. Students acquire knowledge within established systems and faculties continuously work on the system by improving the quality with the support of students. In academic system all participant plays important role and among them faculties have an additional and core responsibility of developing and improving the ongoing teaching and learning process [68].

5.3.6 Enhancing Industry and Institution Interaction

In order to become leading educational institution, it is important to develop industry base academic teaching and learning keeping in mind the long-lasting competition with regard to other institutions. To develop industry base teaching and learning system, institutions have to develop effective relationship with industries. Institutions have to induct industry representative in their academic board and have to encourage them to participate in developing academic curriculum and orientation. Students learning can be improved if industrial training is made compulsory or student take industrial projects according to their specialization. Teachers have to use case studies and industrial reports in teaching in order to train students according to industry requirement. This also builds trust between the teacher and the student. Institutions have to take additional measures to standardize the syllabus and align it with industry demands to constitute quality. A well designed syllabus requires set of goals and objectives, a systematic sequence of topic and study material which are acknowledged, formally approved and collectively designed. Syllabus orientation should be industry oriented not on testing and examination oriented. Future of institutions largely depends upon the success of the students. The purpose of institution will be accomplished if its output is developing respect and goodwill in the society and are getting absorbed with appreciation [68].
No institution can survive if the employees are not loyal to their work. To make them loyal there is need of developing belongingness among them. This is made possible with judicious policies, its implementation, recognition, respect, balance growth and equitable distribution of responsibilities. If employees consider that they are here to earn money pull the time, then they will do only formalities and it will lead to disaster in long term.

Institutions must explore the potential of their academicians. They must optimally utilize their expertise, skills, ability and knowledge. Other institutional resources largely depend upon teachers. If they are qualified and have a potential then institution will develop goodwill and can survive smoothly in hostile environment and adverse conditions. Apart from academicians institutions have to explore student’s potential. Students are silent goodwill ambassador and society has a trust on them. A satisfied student will bring more students; a well taught student will bring laurels, name and fame to the institution. All institutions and organization need solutions to the prevailing conditions and to the unpredictable problems and it is possible only through analyzing why [68].

5.3.7 Improving Training Process

In present competitive environment effective training process is exceptionally important. Without proper training it is not possible to achieve quality higher education. Institutions must select qualified, trained and experienced faculties in higher education. To be competitive, institutions must keep on organizing seminars, symposiums, academic workshops and professional training. Along with this subject orient training, technological know-how training, learner – centric teaching methods facility especially in English language, teaching etiquette, manner and behavior. These training will groom new faculties and refresh experienced faculties and make them more effective and efficient in teaching. Institutions must engage retired teachers who are highly notorious for their teaching to share their knowledge, expertise and
experiences with upcoming academicians and guide them towards excellence. To enhance the quality of teachers’ institutions must also collaborate with highly acknowledged institutions that are reputedly known for their standard curricular and academic strategies [68].

5.3.8 Devising Information System for Transforming Students

Institution in respect to enhance quality in higher education must utilize its resources to transform students rather than only imparting subjective information’s. Student’s commitment and their vision toward higher education play an instrumental role in determining the quality of education. Without quality improvement and proper participation of students all educational experiments are meaningless. Developing a framework to improving the quality of higher educational institution would provide skilled people to the outside world so that we can transfer our country from a developing nation to a developed nation very easily and quickly. It is concluded that delegation and decentralization and redefining the responsibilities of its regulatory bodies and higher educational institutional functionaries will help in promoting research and improving ranking of the institution [68].

5.4 Universities Overview Ranking

Historically and traditionally it is found that quality assurance has two functions. First is to enhance of the quality of educational institutions and its offered programs and secondly the accountability of the results of teaching and learning. Execution of enhancement function is carried out in high degree of trust and accountability function is designed to prevent degradation in quality of institutions and its offered programs along with protecting the beneficiaries of the society.

In order to develop and maintain excellence in educational institutions it is necessary to afford, adopt and execute both quality assurance functions to develop goodwill of the institutions which helps the institution to improve
their ranking which is one of the most important social instruments of institutions success. Ranking of the higher educational institutions remove the fiction of equality among them. But ranking of higher educational institution is highly complex. Universities and other professional education institutions keep on designing and evaluating their strategic plans in respect to consolidate excellence in research and teaching. They do this to challenge agencies those who have to evaluate them on whether institutions are delivering what they promise and meant for. To promote excellence a number of initiatives has been taken by the higher educational institutions. To improve the ranking of University and other Higher Educational Institutions numerous initiatives been taken but most of them failed to achieve the desired result [68].

Higher education is considered an important component for sustainable development. Sustainability demands revising and reorienting today’s education as the entire education is not enough to do things according to custom or habit, that is, to reproduce the existing social system. All these can be achieved by reviving our higher education system based on certain issues and challenges faced in the country. The Standing Committee on Human Resource Development chaired by: Dr. Satyanarayan Jatiya submitted its report on ‘Issues and challenges before higher educational sector in India’ on February 8, 2017. The key observations and recommendations of the Committee were:

- **Shortage of Resources**: Due to shortage of resources, the quality of these institutions suffers a lot.
- **Shortage of Faculty**: Faculties are the backbone of university as well as higher educational system.
- **Accountability and Performance Issues**: At present, there is no mechanism for ensuring the accountability and performance of professors in universities and colleges.
- **Accreditation of Institutions**: for ensuring the quality of education, there is urgent need to focus on process standardization and an effective regulatory system.
- **Lower Enrolment Ratio**: There is a huge gap between those who move out from school and who enroll in higher education system.

- **Lack of Research Centric Approach**: Most of the Indian higher education system lacks strong teaching-learning process and research.

- **Increase in Profit Making Institutions**: The profit intent of these institutions has threatened the very basic foundation of social development goal. This greatly harmed the higher education system [68].

### 5.5 Challenges

The challenges posed by E-learning are better understood and addressed when there is an understanding about its stakeholder’s readiness towards it [69]. The majority of traditional face-to-face institutions remained largely untouched, offering forms of distance provision at the margins and admitting few distance learning innovations to penetrate. Many respondents described “organisational change” in terms of establishment of new equipments/programmes or reaching new clients. Although, this is inevitable in the early stages of E-learning development in many institutions, this diverse interpretation of the question may mean that the full extent of forms of, and reflection on, organizational change at some institutions were not fleshed out in responses. Some institutions included or made available background documents, some of which touched on aspects of organizational change [66].

The challenges contributing to the slow adoption and utilization of E-learning in public universities in Kenya are presented under the two following categories: lecturer-related challenges and student-related challenges.

#### 5.5.1 Lecturer-Related Challenges

Lecturers ranked heavy workloads and insufficient Internet connectivity as the most serious challenges impeding the adoption of E-
learning in public universities. Conversely, inadequate time to attend to the large number of students on the Internet during an E-learning lesson was ranked the least serious challenge.

Availability of time for developing E-learning materials and participating in E-learning course content development are important in the adoption of computer-based learning. 83% of the lecturers pointed out that heavy workload were their biggest hindrance to the adoption and utilization of E-learning. This problem was ranked 1 on an 8-point scale and was attributed to the following factors:

Continuously increasing enrolment and busy university calendar: Many lecturers said that they taught the mandatory 3–4 course units per semester, some of which had an enrolment of over 500 students. They complained that the preparation of course materials, teaching, marking of Continuous Assessment Tests (CATs) and grading of end-of-semester examinations were time consuming. This problem was aggravated by the fact that many universities operated throughout the year with no time for lecturers to take annual leave [70].

Supervision of postgraduate students: In addition to teaching undergraduate courses, lecturers who hold a PhD degree teach and supervise postgraduate students. Lecturers in schools with many postgraduate students reported that they were overwhelmed by the ever rising number of thesis/projects for supervision. In some instances, it was reported that lecturers supervised over 40 thesis and projects per person in an academic year – an activity that they described as time consuming and wearisome.

Administrative duties: In addition to teaching, university academic staff performed administrative duties such as: (i) Headship of Departments, Schools, Directorates, and Institutes; (ii) coordination of examinations; and (iii) chairing university committees [70].

Shortage of teaching staff: Up to September 2012, there were only seven public universities in the country. Since then, this number and that of constituent university colleges has increased to 31 countrywide. The
creation of new public universities has resulted in a severe shortage of qualified academic staff. The few teaching staff members were forced to shoulder the extra workload for the functionality of the universities. This meant that some lecturers taught more than the required three units.

All the public universities had both fiber and wireless connectivity. However, 76% of the respondents reported that the bandwidth as well as the number of hotspots to access the Internet was insufficient. In this regard, lecturers ranked insufficient Internet connectivity the second most serious challenge impeding the adoption of E-learning in public universities.

The senior managers of the universities explained that the cost of Internet was high, prohibitive, and the main reason for the lack of sufficient Internet connectivity in most of the universities. Additionally, the remote location of some areas, far from Internet signals, was described as a major hindrance to Internet connectivity.

Fear of denial of copyright was ranked the third most serious challenge impeding the adoption of E-learning in public universities. Lecturers complained that universities denied them copyrights for the modules that they wrote and uploaded on the E-learning platforms. Listening to the lecturers and university administrator’s talk, there appeared to be a dilemma on this issue. Lecturers, on the one hand, claimed full copyright of the modules that they developed, while, on the other hand, the universities claimed full ownership rights of the same, arguing that lecturers were their full-time employees. On the side of the lecturer, the problem stemmed from the following two concerns:

Poor remuneration for developing E-learning modules: Most universities paid an average one-time off payment of US$1300 for the development of a module. Lecturers described this amount as insufficient with the effort that was required in the development of an e-module. This was considered particularly disappointing in view of the fact that the universities continued to benefit from the proceeds obtained from the sales of the e-modules any time students registered for the course unit [70].
Lack of protection for the developed e-modules: E-materials written by the lecturers were not protected and anybody could use them; not just for teaching, but also for publishing.

On the side of the university management, the predicament on copyright was attributed to the fact that lecturers were employees of the universities regardless of the mode of pedagogy. Lecturers were accused of using university time and resources to develop E-learning modules and teach the same to students registered in the university which employed them and expect huge payment.

Lecturers ranked limited ICT skills fourth among the challenges impeding the adoption and full utilization of E-learning in public universities in Kenya. They explained that the ability and confidence of a teacher in using computers and other ICT technologies in imparting knowledge and skills to their students was imperative for E-learning. This ability was dependent on the teacher’s prior experience in the technology’s use and the level of the acquired skills. In the case where lecturers lacked confidence to utilize technology, they would either not use it at all or use it ineffectively, thus compromising the successful implementation of E-learning.

The findings of this study revealed that the majority of the lecturers (55%) were not trained in the utilization of E-learning and were, therefore, not competent to handle online courses. Indeed, only 17% of the lecturers had undergone formal training in E-learning, the majority of which were trained in-house. About 20% of respondents acquired E-learning knowledge through self-training, while 8% were trained by colleagues.

Incentives are a source of motivation in life. It is a fact that in most cases people who are highly motivated perform better than those who are not provided with appropriate and adequate incentives. This notwithstanding, most lecturers felt that they were not rewarded enough for their effort in developing and using E-learning modules. As a result, they ranked this challenge fifth among the eight challenges impeding E-learning. Their main areas of concern are the low payments for development of E-learning
modules and failure by universities to recognize E-learning modules for promotion.

The availability of personal computers/desktops/laptops is essential for the effective utilization of E-learning since this mode of pedagogy is computer-based. However, this challenge was ranked sixth among the eight challenges impeding the adoption and utilization of E-learning in public universities. This was because only slightly more than a quarter of the lecturers (29%) did not own personal computers or laptops.

It was reported that some departments owned a few laptops and projectors which were shared among staff to prepare E-learning materials, upload them to the university platforms, and teach online. Lecturers argued that reliance on university facilities was difficult since they were restricted to using them during office hours only.

Lecturers and university managers observed that public universities were ill-equipped to handle E-learning. Their argument was that the number of computer laboratories and resource rooms did not match the growing number of students. This resulted in congestion in the laboratories. University managers attributed this problem to financial difficulties that most universities were currently experiencing due to their over-reliance on government funding. According to the managers, funds received from the government were not sufficient for recurrent expenditure and development projects such as hostels, classrooms, laboratories, and offices.

However, lecturers did not consider the problem of inadequate computer laboratories a serious challenge since most of them owned personal computers and/or laptops and could access the Internet from their offices or at their residency. They considered it more of a student problem than a lecturer problem, and were of the opinion that universities were addressing it by providing hotspots. In this regard, lecturers ranked the problem of inadequate computer laboratories lowly, at number seven among the eight problems impeding the adoption and utilization of E-learning.

The timely response to issues raised online by students is vital since it determines the uptake of E-learning as a mode of content delivery. For E-
learning to be effective, lecturers and students should interact frequently online, particularly in discussion forums. This being the case, it then follows that the more students registered for a course, the more the time that will be required by the lecturer for individualized attention.

According to the findings of this study, some universities offered at least three common and compulsory units online that had the highest number of registered students compared to other units. Communication Skills is taken by an average of 1200 students per semester. With such a high number of students, and considering that lecturers teach a minimum of three units, it is doubtful whether any meaningful and effective E-learning could take place. But this problem was ranked the last among the eight challenges hindering the adoption of E-learning in public universities in Kenya [70].

5.5.2 Student-Related Challenges

Students ranked five challenges that were considered likely to affect their adoption of E-learning. Some of these challenges were similar to the ones ranked by lecturers such as insufficient Internet connectivity, limited computer skills, lack of computers/laptops, inadequate computer laboratories, and inadequate time to interact with their lecturers and fellow students online [70].

Insufficient Internet connectivity is one of the major problems affecting the adoption of E-learning by both students and lecturers, especially in low income countries. However, while lecturers ranked it second, students in the other public universities rated insufficient Internet connectivity a very serious challenge. Students pointed out that the problems originating from insufficient Internet connectivity were most critical during university academic peak seasons. Students reported that the Internet was jammed and extremely slow during such times. Students residing off-campus in hostels that did not have Internet connections suffered most.

Most of the students complained that computers were expensive and beyond their reach and, therefore, ranked it the second most serious
challenge impeding the effective use of E-learning in public universities. Although most of the students appreciated the importance of owning personal laptops, over 70% of them did not own any. This category of students relied heavily on university and borrowed computers/laptops. Students ranked the problem of inadequate computer laboratories the third most serious challenge affecting the adoption and utilization of E-learning in public universities. The findings of this study revealed that none of the public universities had an adequate number of computer laboratories. Students complained of congestion in the few laboratories and resource rooms available. In some universities, students woke up early to book space in the computer rooms. Students who missed space early in the morning waited for long hours before space would become available.

To address the problem of limited computer laboratories, some universities controlled the duration of using the computer laboratories by the students. Other universities provided hotspots at convenient locations such as the hostels and dining halls in order to ease congestion from the computer laboratories.

Limited computer skills were ranked the fourth challenge affecting the adoption and effective utilization of E-learning in public universities. The findings revealed that (67%) of the students know computers. They possessed basic computer skills which enables them to navigate their way around university E-learning platforms. Students acquired computer skills from either the secondary schools that they attended, computer colleges, and/or universities where introductory computer courses were taught as core units in the foundation year.

The study established that other than downloading lecture notes and submitting assignments, students rarely interacted with their lecturers and fellow students online. Most of them (72%) said that they downloaded modules and/or printed them and read them as hard copies. This was because a number of them were too busy with assignments and attending to face-to-face (F2F) lectures; a problem further compounded by slow
Internet connectivity. This problem was not considered very serious and, therefore, ranked last [70].

5.5.3 Other Challenges of E-learning

In addition to the ranked challenges, the following three challenges were mentioned by students, lecturers, and university managers as having an impact on the adoption of E-learning in public universities. All respondents agreed that attitude was critical in the adoption of new innovations. It was reported that a few students and lecturers viewed E-learning negatively and were reluctant to adopt it. The elderly lecturers were ruled out as the majority of those who carried negative attitudes towards E-learning. These groups of students and lecturers were described as technology averse, phobic, and conservative [70].

While public universities have made some developments in the provision of Internet facilities, these are only accessible within the university premises and within a certain meters from the servers. Some lecturers and students stressed that they were disrupted during weekends and in the evenings because they could not access university Internet facilities from their residences. Their only choice was the use of modems, cyber cafés, or personal Internet connections which were beyond the reach of some students and lecturers.

On the one hand, some lecturers were afraid that their teaching materials that are posted online will be open to criticism by colleagues and students. On the other hand, students expressed the fear that employers were skeptical about hiring graduates who earned their degrees through E-learning. It was reported that some employers argued that E-learning was not well developed in the country and, therefore, students trained through this mode of study were inadequately prepared for the job market. They feared that certificates obtained from E-learning were inferior compared to those obtained from traditional pedagogical programmes [70].
5.6 Ranking Level

Institutions were also asked about the adoption of E-learning at different levels and for different types of students. Of the 19 institutions, 17 responded to the question, and two did not respond [71].

5.6.1 Undergraduate and Postgraduate Students

Among the 17 responses, two campus-based institutions offered only graduate level courses, one distance-based institution offered only undergraduate courses, and another distance-based institution offered mainly postgraduate courses. Focusing on the remaining 13 institutions (seven campus-based, four distance-based and two mixed), the trend that emerged was that E-learning was more popular at campus-based institutions, and more often used by postgraduate and professional students than by undergraduates, while any such distinction was less marked at distance/mixed institutions. A number of campus-based institutions said that at present they did not offer any fully online programmes at undergraduate level [66].

For campus-based undergraduates, the ideal was seen to be provision of a range of resources and information in electronic form to support on-campus interaction with faculty and other students.

The distance/mixed institutions all reported that there was no difference in their students’ interest in E-learning. This a reflection of the non-traditional character of such institutions where the traditional face-to-face encounter is by definition not central to delivery. Forms of E-learning offer such institutions/students opportunities to enhance traditional distance modalities.

Equally, the undergraduate population at many distance/mixed institutions is less traditional than the campus-based equivalent [66].
5.6.2 Full-Time and Part-Time Students

Greater use of E-learning might enable more individuals to combine full-time work and part-time study. This might create a gradual shift away from the campus-based model of physical attendance. Many distance/mixed responding institutions already have a majority part-time student body, and this is unlikely to change. For campus-based institutions, the common response to this question was that greater use of E-learning was expected to increase flexibility of attendance. It did indicate a move away from the traditional residence-based campus model. This path was also seen as a means to attract additional students, and from a broader geographical area [66].

The University of British Columbia noted a trend towards a combination of full-time study and part-time work, and argued that greater use of E-learning assisted its development. Greater use of E-learning helped some students at campus-based institutions to study full-time, whereas the demands of conventional physical attendance might have made part-time study the only option for those students. The University of South Australia, a mixed-mode institution, mentioned changes to the physical campus to accommodate a more diverse and part-time student body. These included wireless Internet access campus-wide, varied social spaces and computer access. The aim was to enable different kinds of students to gain value from the campus, and to maximize the value of limited or infrequent attendance [66].

5.7 Ranking Currency of Institution

When targeting offshore students, it was interesting that a number of institutions opted to advertise course fees in US dollars [66].

5.8 Companies and Organizations Metrics

A common task when retrieving information is to order a list of results according to their relevance to a given query. Information retrieval
methods are typically evaluated by comparing their proposed ranking to that of a gold standard, known as a reference ranking, which is provided by the user or by a domain expert, or inferred from the data.

EduRank, combines a nearest-neighbor based collaborative filtering framework with a social choice method for preference ranking. The algorithm constructs a difficulty ranking over questions for a target student by aggregating the ranking of similar students. It extends existing approaches for ranking of user items in two ways. First, by inferring a difficulty ranking directly over the questions for a target student, rather than ordering them according to predicted performance, which is prone to error. Second, by penalizing disagreements between the difficulty rankings of similar students and the target student more highly for harder questions than for easy questions. EduRank can be run every time it is necessary to account for effects of student learning on the inferred difficulty ranking. The complexity of running EduRank is low enough to enable EduRank to be run multiple times, depending on the needs of the teacher or education researcher [65].

Assessing the success of E-learning systems was done by using multiple criteria and approaches especially due to the numerous ways of defining the E-learning term. I have identified four such approaches in the academic literature:

- the DeLone and McLean (D&M) model;
- the TAM model (Technology Acceptance Model);
- models focused on users’ satisfaction;
- models focused on the E-learning quality [66].

5.9 Future Trends

The overwhelming view of respondents of the OECD/CERI survey was that E-learning had a broadly positive pedagogic impact. However, few were able to offer detailed internal research evidence to this effect. Indirect evidence, including student satisfaction surveys and retention/attainment data, were widespread but these data may not be
compelling enough to convince the bulk of skeptical students and academics of the pedagogic value of online learning. One reason for the skepticism probably lies in the fact that E-learning has not really revolutionized learning and teaching to date. Far-reaching, novel ways of teaching and learning, facilitated by ICT, remain nascent or still to be invented. The “learning object” model is perhaps the most prominent “revolutionary” approach to date. A learning object can be described as an electronic tool/resource that can be used, re-used and redesigned in different contexts, for different purposes and by different academics/actors.

Redesign – for example through the use of pre-existing software, third party materials, peer/automated feedback – appears to be crucial for E-learning to reap the key pedagogic benefits (and cost efficiencies). Sample institutions expressed considerable interest in this model but were also faced with a range of primarily cultural and pedagogical challenges hindering widespread adoption. These included tensions between the decontextualised object and the contextualised learning encounter/programme, faculty unwillingness to use third party materials and object access, re-use and copyright concerns. Although the OECD/CERI survey reveals that institutions pay a lot of attention to learning objects, they still consider them as immature tools. At present, it appears that E-learning is continuing to grow in scale and significance in the absence of an explicit learning object economy. This partly reflects the influence of a “conventional” course development paradigm, but is also indicative of infancy (and thus poor utility) of any such economy – a situation that may change over time. All sample universities are in the midst of thinking through and negotiating the potential contribution of E-learning in its various forms to their organisational future. For some institutions, and in some countries, key barriers remain. Infrastructure and funding are among the important ones, but stakeholder scepticism about the pedagogic value of E-learning and staff development are probably the most challenging. Institutions are commonly grappling with mainstreaming adoption, mainstreaming funding and are beginning to contemplate
restructuring in terms of staffing, staff development, instructional design and student support. All institutions acknowledged the need to recruit a broader range of staff to complement academic staff, such as technologists, instructional designers, learning scientists, etc. Another challenge, however, lies in engaging current faculty to use and develop E-learning. The general concept of “staff development” is widely seen as key to mainstream and sustainable E-learning in tertiary education. Institutions are struggling with the balance between faculty and “new” staff roles, and the division of labor between the two. Interestingly, commercialization and internationalization were infrequently cited as aspects of organizational change [66].

While faculty resistance can partially be imputed to (at least perceived) pedagogic limitations of E-learning and insufficient maturity of the tools, it can also be explained by a lack of time (or motivation) to carry out what is foremost an additional task, by insufficient ICT literacy, or insufficient pedagogical literacy related to E-learning. E-learning development, with its standardisation aspects, might also conflict to some extent with the professional culture of academics, based on autonomy and a reward system often based on research. Concerns about intellectual property rights (and shared rights between faculty, institutions and technologists) may also be seen as a barrier for E-learning development. The sample institutions illustrate a diversity of methods for developing institutional human resources. Building a community of E-learning adopters within and across institutions and, more generally, knowledge management processes related to E-learning, are clearly crucial for further E-learning developments. The development of faculty-led initiatives appeared to be an important ingredient for success at many sample institutions. However, the scaling up of successful experiments and the sharing and mainstreaming of good practices remain the real challenges. Just as there is no one best model or trajectory for E-learning development for institutions, nor is there a “one-size-fits-all” staff development model for mainstreaming E-learning [66].
Partnerships are certainly a key characteristic of contemporary E-learning that could help institutions to share knowledge, good practices, and achieve benefits such as advanced technology and quality curricula and pedagogy, in addition to enhanced market presence and lower costs. At the sample institutions, partnerships encompassed activities such as building the infrastructure; developing learning management systems and applications; creating E-learning materials; developing joint programmes; joint-marketing; collaborating for research; sharing best practices; and sharing costs of hardware and software. But partnerships also raise potential issues. One is the arrangement under which E-learning materials should be made available to third parties (free or fee-based use?). Another is the attitude towards outsourcing of non-core E-learning activities. The OECD/CERI survey found that the tertiary education institutions saw minimal or short-term value in outsourcing activity and that making learning materials to third parties was rarely given much strategic attention. Partnerships could still be used more effectively to enhance sectoral organisational learning. Building a framework that would help shift E-learning to the mainstream and maximize its impact in the classroom is the current priority. Practical and experimental knowledge of E-learning is too often scattered within and across institutions, so that even successful practices and interesting experiences have limited impact and visibility.

Overall, the results indicate that substantive online learning has not yet touched the mainstream curriculum in the vast majority of universities. Although over 70% of respondents claimed to have implemented an institution-wide online learning platform (see Chapter 4), only 17% are shown to have actually integrated online elements into the majority of classroom activity. This reinforces the important distinction between institution-wide strategy and institution-wide use. Nevertheless, a majority of respondents (56%) affirm plans to effect such integration in the relatively near future and only a small minority view the task to be of low priority (13% of total). According to the implementation strategies of 2004
respondents, in five years, 56% of all universities expect to have incorporated significant online elements into the majority of their mainstream curriculum (63% in low-middle income economies [41% in South Africa], 76% in Asia Pacific [90% in Australia], 58% in the United Kingdom and Canada lagging behind with 31%) [66].

There was a general trend away from technical “how to use this platform” development, and towards pedagogy-led development; and testing of the right balance between central and faculty-located development/assistance.

The provision of staff development shows great diversity. To advance E-learning in staff development, institutions must undertake critical needs assessment, strategic planning tied with the overall institutional mission, careful planning of implementation, and assessment and research to fit their own institution and evaluate impact. It is also important to avoid formal “staff development” where day-to-day practice-based development would be more efficient and effective. To ensure faculty respond to staff development drives, it is critical to reengineer career reward structures. [66]
CHAPTER 6

THE PROPOSED MODEL (SISM)

6.1 Introduction

Software Quality Assurance model (SQAM) is an integral part of the software development process and quality of the product. The effectiveness, efficiency of software and response to user's requirements and needs are the main reasons for the success of the products. Software organizes information in the form of operating system. Software has two main categories, system software: which controls the basic job of computer, and application software: which handles multiple tasks the user needs to do. E-learning or electronic learning delivers learning by internet communication. Therefore, the need for software quality is in demand. With the development of information technology, the software becomes more complicated and is widespread in various and different manners.

In E-learning (also called online learning), a computer or computer network is used along with latest information technology to bring a lot of positive impacts to the human life, such as business, government, manufacturing, and also higher educational institutions. Example of information technology usage is E-learning [1]. E-learning has a significant effect in the student's motivation and participation in researches; it also led to break the monotony of education in the traditional classroom. E-learning technology is new and attractive approach for both student and instructor in university and has replaced traditional face to face education environment. There are two types of interactive sessions; one is a pre-recorded session the other is a live session where student can participate. Live sessions are better as the instructor can assess student participation. There is a great growth of web-based learning media. Quality is most often defined as (fitness for purpose) that is related to the needs of the user wishes and expectations or that the products comply with defined requirements. Also, quality is a functional and artistic measurement used to
specify user satisfaction with a product or how well the product performs compared to similar products [3]. Software Quality is the capability of software product to satisfy stated and implied needs when used under specified conditions (ISO/IEC 25010:2011). Usually, software quality is assessed by means of quality models. Quality can be defined in different ways:

- Excellent with respect to the purpose.
- Satisfies user requirements.
- Suitable price.
- Minimum defects.
- Easy maintenance.
- Faster development.

Software Quality Assurance is very necessary to achieve customer satisfaction and to get a place in the global market. Communications play an important role in the quality of software. The goals of Software Quality Assurance (SQA) is to improve software quality by appropriately monitoring both software and the development process to ensure full compliance with the established standards and procedures.[4] Software Quality model is a defined set of characteristics, and of relationship between them, which provide framework for specifying quality requirement and evaluating quality (ISO/IEC 25010:2011). Quality management system requirements are defined in the ISO9001 standard. The main goal of these requirements is to satisfy the customer needs, which is the measure of quality software product. Quality improvements affect operations performance in various ways, such as increasing revenue, reducing costs and improving productivity. Quality has been regarded as one of the major drivers of competitive strategy in every industry.

The aim for creating this new model is to achieve high quality in E-Learning application, for both instructor and student. The utilization of modern communication and information technology for learning and teaching is very important particularly in higher educational institutions, for both (student & instructor). The instructor found that it is easy to
deliver subjects and interact with students. The students have more interactions in online learning that are essential to get and transfer knowledge. It helps students to have shared globally on the adaption and integration of E-learning technology in education through observations and surveys.

6.2 A model to Provide (SQA)

Software Quality Models are now a well-accepted means to support Quality control of software systems. Many models were proposed that helps to maintain and improve the quality and students can reach required needs easily and instructor also [9]. The model can also decrease the cost and avoids wasting time and can help to follow up the system to minimize the mistakes in the life cycle of system. This aids to perform the corrections early. The SQA can help to prevent defects early and for Standardization (ISO). It was founded in 1946 in order to facilitate international trade, international coordination and unification of industrial standards by providing a single set of standards that would be recognized and respected (Praxiom Research Group).

The ISO 9126 model describing the common characteristics that contributes in the satisfaction of the user’s needs that can be:

- The end user: for whom the usability is the most important quality characteristic.
- The software developer: for whom the reliability and functionality are the most representative quality characteristics of the software.
- The business manager: for whom the Return on Investment and the sustainability are the main quality factors.

The ISO 9126 quality models was proposed as an international standard for software quality measurement in 1992[42].

6.3 The Proposed Model (SISM)

We intend to create a new E-Learning model SISM (The System, Instructor and Student Model) Figure 11 [72] to achieve Software Quality
Assurance which is required and to evaluate its quality with respect to other models in E-learning area. The model created with its critical success factors (CSFs) as perceived by university students, which it can achieve through Software Quality Assurance in E-Learning application, by simplifying the use of E-learning software, protects the defect in E-learning, ease the interaction between student and instructor which increases the effective and efficient of the model quality (SISM). The SISM is proposed to make balance between product and its quality, to test the different factors that effect on the quality of the system as well as increasing the productivity of the system by taking in consideration the system complexity that is found in design and implementation of the system. The published E-Learning critical success factors are surveyed and grouped into four categories namely, system side, instructor side, student side, and intersection of them. The reason for the division is to make the evaluation process easy and more specific. It also helps us to evaluate each sector independently. The critical factors enhanced the proposed model to establish good area for students to be associated with the instructor, to get the lessons, exercise and anything related to their study and knowledge.
Each factor is given a total of ten points. If subfactors exist, the ten points is distributed according to the contribution of each subfactor achieving the total of ten points.

FactorTotalScore = Sum (Subfactors)

Then, the cumulative total is obtained and the average is calculated for each category.

CategoryScore=Average (Sum (FactorTotalScore))

Finally, the average of the four categories is calculated to determine the final score for the software product. The final score serves as a basis for the selection of the E-learning software application.

FinalScore=Average(CategoryScore).
6.3.1 The Model Factors

Software Quality Models factors can be categorized into two different factors; the design factors and implementation factors (As shown in Figure 12.

![Figure 12 Model Factors](image)

6.3.1.1 Design Factors

The design factors are categories into four parts the Student Side, instructors Side, System Side and Intersection side and these are the most important parts in the proposed model. Each one has its own role in our proposed model. The factors work together to help getting the requirements, reach the satisfaction needs of the system, to protect the system from the defects and manage as requested. The requirements specify what program must do, while the design specifies who develops the program. To formalize the process ensuring reliability, good software design must be offered to accomplish the significant software. The
modifications to the system is actually designed, bringing about all present system and documentation of projects, database and existing software and output of the analysis phase. It aims to expand a revised logical and physical design for the change and to design the changes for all of the categories of maintenance [73].

6.3.1.2 Implementation Factors

The implementation factors are categorized into three parts, Product Operation, Product Revision and Product Transition Factor. These factors play critical role for the proposed model. Implementation includes the activities of coding and part of testing, assimilation of the customized code, and analysis, regression testing, integration, and risk. It also includes regression testing and a test-readiness review to assess awareness for the system [73].

Table 2: Implementation Factors

<table>
<thead>
<tr>
<th>Product Operation factor</th>
<th>Product Revision factor</th>
<th>Product Transition factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correctness</td>
<td>Maintainability</td>
<td>Portability</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Flexibility</td>
<td>Reusability</td>
</tr>
<tr>
<td>Reliability</td>
<td>Testability</td>
<td>Interoperability</td>
</tr>
<tr>
<td>Integrity</td>
<td>Privacy</td>
<td></td>
</tr>
<tr>
<td>Usability</td>
<td>Functionality</td>
<td></td>
</tr>
<tr>
<td>Learnability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understandability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Navigability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethics</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.4 Student Side Factors

In the last decades with the widespread of World Wide Web (WWW), the universities and education institutions have been using information technology in their system of education. They use E-learning system which ease and enhance in means of educations.

Student side consists of all operations that are performed when student uses the E-Learning software. It starts as soon as the student visits
the system through the internet browser to obtain information about a
particular query or to solve a problem or exercise. It also occurs when the
student sees lectures, text books and all data submitted by the instructors.
These data ranges from basic texts to complex videos and internet
materials. Know a day’s Students became fond of information technology
and all that is related with opinion and special learning tools. The student
when using E-learning required dealing with hardware\software, learning
abilities (prerequisites), ready learning environment, and to be opened
minded about work, life and educational experience to be as a part of the
system, adaptability with education environment is an amazing human
trait. The student should also be self-motivated and self-disciplined. There
a number of measures for these operations to ensure proper presentation,
usage and learning process. The student factors that affect the E-learning
system are usability, learnability and understandability.

6.4.1 Usability

Usability stands for how easily does the user uses the software, without
undue effort, by the type of user for whom it is designed. This means that it
should have an appropriate user interface and adequate documentation[9].
It usually relies on the general interface design, whether or not
documentation is included and the ease of use. A good interface design is a
key feature for general acceptance of the system. If a UI design is made
reusable, we can achieve the reusability in the development phases because
this coding phase is very much driven from the software design. Reusable
UI design methodology is of special concern with the effort
minimization[74]. The student enjoyable that the system is usable, without
any difficulties, undue effort to use, designed to whom it is used. Towards
more natural interactive experiences, multimedia components such as
audio and video are already being included in current design practice,
going beyond the limits of static visual elements and therefore the student
found it easy to deal with. Ease of use can be analyzed based upon
simplicity, clarity, colors and contents. As shown in Table 3
Table 3

<table>
<thead>
<tr>
<th>Usability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>General Design Interface</td>
<td>4</td>
</tr>
<tr>
<td>Documentation</td>
<td>3</td>
</tr>
<tr>
<td>Ease of use</td>
<td>3</td>
</tr>
<tr>
<td>Simplicity</td>
<td>2/10</td>
</tr>
<tr>
<td>Clarity</td>
<td>3/10</td>
</tr>
<tr>
<td>Colors</td>
<td>2/10</td>
</tr>
<tr>
<td>Contents</td>
<td>3/10</td>
</tr>
</tbody>
</table>

6.4.2 Learnability

Learnability means that student can get the knowledge which needs without any difficulties and system play the role of face-to-face learning in short time and low cost. E-learning establish strong way in education, so that support face-to-face teaching, the courses may vary in structure, examination, assignments, interaction between students and teachers. It relies mainly on the display/layout of the contents, the fonts and the images used. As shown in Table 4.

Table 4

<table>
<thead>
<tr>
<th>Learnability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Display/Layout</td>
<td>6</td>
</tr>
<tr>
<td>Font</td>
<td>3</td>
</tr>
<tr>
<td>Images</td>
<td>1</td>
</tr>
</tbody>
</table>

6.4.3 Understandability

Instructors write the courses in ease way and be suitable for the student level. It assesses how clear the information which the instructors wrote is. Code possesses the characteristic understandability to the extent that its purpose is clear to the student. The information technology enhance for many changes in teaching way, approaches of teaching and techniques. This makes the process of education or study more interesting and
interactive. It relies mainly on the consistency, grammar and spelling, as shown in Table 5.

Table 5

<table>
<thead>
<tr>
<th>Understandability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency</td>
<td>5</td>
</tr>
<tr>
<td>Grammar</td>
<td>3</td>
</tr>
<tr>
<td>Spelling</td>
<td>2</td>
</tr>
</tbody>
</table>

6.5 Instructors Side Factors

Instructor is the teacher who mentors and guides the students via Moderated Discussion Boards (MDBs), exercises, tutorials, exams, emails and other tools. Students seem highly satisfied by the available instructor support. High scores show that instructors are doing well to provide guidance to students in their subjects.

Instructor side plays a central role in the effectiveness and success of E-Learning based courses, determines the benefit subjects are made up to date. E-learning helps instructors who own the knowledge to deposit it into the passive students who attend the class. Instructors group the content into logical modules, which help to flow and modulate the course contents. They should adopt interactive teaching style, which encourage student interaction with the courses. The instructor explain ideas, concepts or other statements using pictures, graphics or any tools to easy the subjects for the students and be attractive. The instructor must consider the balance of graphics and text when designing a subject. Thus, using graphics wisely and correctly is a great way to help student comprehend difficult topics. Instructor use incorporates interactive as the simulations and animations to help students to accelerate the learning process and provide student with visual comprehension of concept presentation. To avoid the navigation to be boring, the instructors must easily navigate in E-learning system to attract the student. If the subject is confusing or frustrating for the students, they will lose interest and will not achieve the learning objective and not succeed to reach the requirements which they need. The student content
engagement in an E-learning starts when he/she interacts with the content of the course. The learning experience is greatly enhanced when exercises or activities are incorporated into learning process and engage student in an E-learning environment[75].

The E-learning provides the student with resources, knowledge and information with just a click of the mouse, linking to additional reference improve learning experience and added more content of the subject. The Instructors factors that affect the E-learning system are Reliability and correctness.

6.5.1 Reliability

A set of software attributes with ability to maintain its specific level of performance under the specific stated conditions for a stated period of time, so that the reliability should not fail in that period of time. Reliability deals with failure to provide service. It determines the maximum allowed software system failure rate, and can refer to the entire system or to one or more of its separate functions. Reliability tests measure the ability of the system to keep operating for a long time without developing failure. In other words, it is the ability to perform the promised service dependably and accurately. It relies on performance and error rate [1], as shown in Table 6.

<table>
<thead>
<tr>
<th>Reliability</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server speed</td>
<td>3.3/10</td>
</tr>
<tr>
<td>Number of users</td>
<td>3.3/10</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>3.3/10</td>
</tr>
<tr>
<td>Error rate</td>
<td>4</td>
</tr>
<tr>
<td>0 - 1</td>
<td>10/10</td>
</tr>
<tr>
<td>2 - 5</td>
<td>6/10</td>
</tr>
<tr>
<td>6 - 10</td>
<td>3/10</td>
</tr>
</tbody>
</table>
6.5.2 Correctness

Correctness measures the extent to which a program satisfies its specifications and fulfills the student’s mission objectives. It evaluates the correctness of information, when finding a fault repair and identifying the cause. It assesses how much of the contained information is important for the student. It agrees the assessment and verify the correctness of the information's [76], as shown in Table 7. It is an evaluative measure.

<table>
<thead>
<tr>
<th>Correctness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluative</td>
</tr>
</tbody>
</table>

Table 7

6.6 System side Factors

Technology plays important roles in delivering learning outcomes because student has more interactions in online learning environments that are essential to be successful. System side plays fundamental role in E-learning. The most attractive feature of E-Learning according to student and instructor both is its flexibility of location and time. We mean by infrastructure the information technology and university support, which are important in E-learning. E-learning system provides student with structured knowledge, information which is needed and intercommunication to suitable environment. Computing was the main problem for students in traditional classes. E-Learning come with new virtual (anywhere - anytime). E-learning system empowers a good collaborative learning environment for both the student and instructor. It can be classified as follows:

6.6.1 Testability

Testability is related to special features in the program that help the tester to detect defects as soon as they are introduced. It depends upon whether or not log files are included, notifications concerning errors/warnings and dashboard, as shown in Table 8. Testability
requirements for the ease of testing are related to special features in the program that help the tester, for instance by providing predefined intermediate results and log files. The goal of increasing the testability of software is not just to detect defects but more importantly, to detect defects as soon as they are introduced. Thus, reducing the cost and time to fix the bug and reducing higher quality each build of the release it is important to be able to verify every requirement, both explicitly stated and simply expected. Testability means the ability to verify requirements.

**Table 8**

<table>
<thead>
<tr>
<th>Testability</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log files</td>
<td></td>
</tr>
<tr>
<td>Notifications (Errors/Warnings)</td>
<td>4</td>
</tr>
<tr>
<td>Dashboard</td>
<td>3</td>
</tr>
</tbody>
</table>

**6.6.2 Flexibility**

Flexibility measures the ease with which a system or component can be modified for use in applications or environments rather than those for which it was specifically designed [72]. It relies on the software architecture. Nowadays, databases play a crucial role in modifying system components easily. Flexibility normally refers to the ability for the solution to adapt to possible or future changes in its requirements. When you design or build a solution you should try to cater for these changes, which inevitably arrive in the future[ 77]. As shown in Table 9.

**Table 9**

<table>
<thead>
<tr>
<th>Flexibility</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database</td>
<td></td>
</tr>
<tr>
<td>Programming</td>
<td>4</td>
</tr>
</tbody>
</table>

**6.6.3 Functionality**

Functionality measures the attributes that satisfy the needs of the user. These features range from online support, responsive designs, control panels, video support, mobile support, backup and recovery, atomicity,
cross platform, etc. It is the ease with which a deployed system can be monitored, repaired, maintained and its contains are upgraded [27]. Functionality is the degree to which the software provides functions that meet needs and requirements of the student when the software is used under specified conditions [25]. It is an evaluative measure as shown in Table 10.

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Evaluative</th>
</tr>
</thead>
</table>

6.6.4 Portability

Portability measures migration of component from one system to another with little or no modifications, consisting of different hardware, different operating system, and so forth [72]. These requirements make it possible to continue using the same basic software in different situation or use it simultaneously in different hardware and operating system situation. Plug and play is the standard measure here, as shown in Table 11. Recently schools and universities have realized the potential of using combinations of technologies to support learning [78].

<table>
<thead>
<tr>
<th>Portability</th>
<th>10</th>
</tr>
</thead>
</table>

6.6.5 Effectiveness

Effectiveness is the ability to perform our tasks quickly and proficiently. It is measured by the software’s correctness and the accuracy achieved while performing specific goals. This can be achieved by taking the maximum time needed to perform the task and comparing it with a scale from 0 - 91 seconds. Scores are provided accordingly, as shown in Table 12. Effectiveness is successful in reaching learning objectives, easy accessibility, consistent and accurate message, easy to use, entertaining, memorable, relevant and reduced training costs.
Table 12

<table>
<thead>
<tr>
<th>Effectiveness</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 30 seconds</td>
<td></td>
</tr>
<tr>
<td>31 – 60 seconds</td>
<td>6</td>
</tr>
<tr>
<td>61 – 90 seconds</td>
<td>3</td>
</tr>
<tr>
<td>91 – above seconds</td>
<td>1</td>
</tr>
</tbody>
</table>

6.6.6 Re-usability

Re-usability deals with the use of software modules originally designed for one project in a new software project currently being developed. Nowadays, this can be achieved by the object oriented programming, DLL(*Dynamic Link Library*) files, modules, webpages, etc. [2], shown in Table 13.

Table 13

<table>
<thead>
<tr>
<th>Re-usability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Webpages</td>
<td>7</td>
</tr>
<tr>
<td>Objects/modules/dll</td>
<td>3</td>
</tr>
</tbody>
</table>

6.6.7 Maintainability

It is the set of attributes that bear on the effort needed to make specified modifications. Easy to understand, modify and retest. It’s easier to maintain the software if its good software design. Nowadays, admin panels play a crucial role in modifications [72] as shown in Table 14. Maintenance and what it means has changed considerably since 1977. Finding and correcting errors is just one aspect of maintenance. Ghezzi*et al.* (1991) divide maintenance into three categories: corrective, adaptive and perfective and only corrective is concerned with correcting errors as suggested by McCall.

**Corrective** maintenance is concerned with removing minor bugs left after development and testing are completed. This process is also involved after other maintenance activities.
Adaptive maintenance is concerned with changing the software to reflect changes in the user's requirements. For example changes in VAT rates (A value-added tax), income tax bands or income tax rates. Or, a user might wish to add more functionality.

Perfective maintenance seeks to improve the algorithms used in the software to enhance performance. Perfective maintenance is often influenced by technological developments.

Maintenance starts from the moment a system comes into operation and continues for the remainder of the product's life. For some products this can be twenty years or more. Maintainability is supported by good practices at all phases during the development life cycle [79].

<table>
<thead>
<tr>
<th>Maintainability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Admin panel</td>
<td>10</td>
</tr>
</tbody>
</table>

### 6.6.8 Navigability

Navigability deals with the ease of student's quick and efficient access to the content, and ease for them to get the knowledge, lectures, exercise and subjects related to their study. Less number of clicks needed to accomplish certain operation is satisfactory. Therefore, the maximum number of clicks needed is compared to a scale of one to five clicks and the scores are provided accordingly [80], as shown in Table 15.

<table>
<thead>
<tr>
<th>Navigability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 click</td>
<td>10</td>
</tr>
<tr>
<td>2 clicks</td>
<td>8</td>
</tr>
<tr>
<td>3 clicks</td>
<td>6</td>
</tr>
<tr>
<td>4 clicks</td>
<td>4</td>
</tr>
<tr>
<td>5 clicks</td>
<td>2</td>
</tr>
<tr>
<td>More than 5 clicks</td>
<td>1</td>
</tr>
</tbody>
</table>

### 6.7 Intersection side
Intersection side comprises the common elements within system, which include student, instructor and system sides. This aspect is very important because it shows that the factors are linked to each other, so the system helped to carry out responsibilities as one thing. The factors which are shared between the three sides work as well as it must do. This satisfies the student requirements from knowledge, lessons and all needs. At the end we can say that the E-learning system satisfies the students in their study and instructors in the way that give the student the right subject using the required tools. The Intersection factors that affect the E-learning system are Security, Efficiency, Integrity, Ethics, Privacy and Interoperability.

6.7.1 Security

Security consists of confidentiality, integrity, non-repudiation, accountability, and authenticity. It refers how the software is able to control the unauthorized access to the services provided to it. The freedom from danger, risk or doubt (Confidentiality, Physical safety, financial safety) [16]. It is assessed by many factors such as user authentication, SSL, DDOS, IDS, cookies and sessions. Security act as protection of the E-learning system factors from accidental or malicious access, use, modification, destruction, or disclosure. It is an evaluative measure as shown in Table 16.

<table>
<thead>
<tr>
<th>Security</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Session Hijacking</td>
<td>3</td>
</tr>
<tr>
<td>System Integrity</td>
<td>3</td>
</tr>
<tr>
<td>Specific</td>
<td>4</td>
</tr>
<tr>
<td>SSL</td>
<td>4</td>
</tr>
<tr>
<td>DDOS</td>
<td>3</td>
</tr>
<tr>
<td>Cookies</td>
<td>3</td>
</tr>
</tbody>
</table>
6.7.2 Efficiency

It is a set of software attributes that represents the ability of the software product to provide relationship between level of performance of the software and the amount of resources that are used under the stated conditions. It is an evaluative measure and relies on the software architecture mainly as shown in Table 17. McCall's view of efficiency is concerned with the efficient use of computer code to establish processes and the efficient use of resources, to do this there are number of technics to achieve the objectives storage [79].

Table 17

<table>
<thead>
<tr>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluative</td>
</tr>
</tbody>
</table>

6.7.3 Integrity

Integrity deals with the software system security, it is the requirement that data and process be protected from unauthorized modification. It relies on data security (encryption, system authorization), SSL, DDOS, cookies and sessions [72]. It is an evaluative measure as shown in Table 18. Integrity also is the extent to which illegal access to the programs and data of a product can be managed.

Table 18

<table>
<thead>
<tr>
<th>Integrity</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security of Data</td>
<td>2</td>
</tr>
<tr>
<td>SSL</td>
<td>2</td>
</tr>
<tr>
<td>DDOS</td>
<td>2</td>
</tr>
<tr>
<td>Cookies/Sessions</td>
<td>2</td>
</tr>
</tbody>
</table>
6.7.4 Ethics

Ethics ensures that the system does not attack a religious community or geographical areas or working on the immorality and corruption and encourage hatred between human. Services serve the human way or optimal content helps to be fraudulent to users and we must be mindful of our ethics offices with all segments of society and his message to be Semitic, and that does not use user information to expose their affairs. And the developers and user are having the same Responsibility [72]. Ethics remains a challenging factor as there is no universal right and wrong.

6.7.5 Privacy

Privacy specifies how data privacy is to be maintained, as the Web provides many mechanisms to interlink data across systems. It is important that it keeps the possibility for users, that want or need it, to keep their personal information private and scattered [2]. Security updates are important measure here as shown in Table 19.

**Table 19**

<table>
<thead>
<tr>
<th>Privacy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Security updates</td>
<td>0 - 10</td>
</tr>
</tbody>
</table>

6.7.6 Interoperability

Interoperability it is attribute of the software that provide a structure of highly independent modules. Interoperability of one system to another should be easy for product to exchange data or services with other systems. It relies on data and system migration as shown in Table 20.

**Table 20**

<table>
<thead>
<tr>
<th>Interoperability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Data migration</td>
<td>0 – 5</td>
</tr>
<tr>
<td>System migration</td>
<td>0 – 5</td>
</tr>
</tbody>
</table>
6.8 Instrumentation

The instrumentation aims at utilizing the common web technologies to provide user friendly software. With the explosive increase of information services using World Wide Web (WWW), the practical application of web-based systems is considerable. HTML5 remains the basic language for building web-pages due to its robustness. Active Server Page (ASP) is a marvelous technology for building web applications especially when integrated with .NET framework offered by Microsoft. It includes large number of classes for web development and deployment. The C# language is intended to be a simple, modern, general-purpose, object-oriented programming language. C# is intended to be suitable for writing applications for both hosted and embedded systems. Here, we used an online web application which we developed using HTML5, ASP.NET and C#.

.NET is designed to provide an environment within which you can develop almost any application to run on windows, while c# is a programming language that has been designed specifically to work with the NET framework. .NET is a framework for programming on the windows platform. Along with the NET framework, C# is a language that has been designed from scratch to work with .NET, as well as to take advantage of all the progress in developer environments and in our understanding of object-oriented programming principles that have taken place over the past 25 years [81].

Along with the explosive increase of information services using World Wide Web (WWW), the practical application of web-based system has shown tremendous growth. Computer-based methods are increasingly used to improve the quality of medical services.

This system was developed using Microsoft Active Server Page, .Net version 4.5 with C sharp (C#) as the programming language and SQL Server 2008 as the backend database. Asynchronous JavaScript and Xml (AJAX) are used to boost the user experience. The methodology aims at utilizing the common web technologies to provide a user friendly system.
ASP.NET is part of .NET Framework and is a technology that allows for the dynamic creation of documents on a Web server when they are requested via HTTP. This mostly means HTML documents, although it is equally possible to create WML documents for consumption on WAP browsers, or anything else that supports the MIME type. In some ways ASP.NET is similar to many other technologies—such as PHP, ASP, or ColdFusion. There is, however, one key difference: ASP.NET, as its name suggests, has been designed to be fully integrated with the .NET Framework, part of which includes support for C#.

Perhaps you are familiar with Active Server Pages (ASP) technology, which enables you to create dynamic content. If this is the case then you will probably know that programming in this technology used scripting languages such as VBScript or JScript. The result was not always perfect, at least not for those of us who are used to “proper,” compile programming languages, and it certainly resulted in a loss of performance.

One major difference, related to the use of more advanced programming languages, is the provision of a complete server-side object model for use at runtime. ASP.NET provides access to all of the controls on a page as objects, in a rich environment. On the server side we also have access to other .NET classes, allowing for the integration of many useful services. Controls used on a page expose a lot of functionality; in fact we can do almost as much as with Windows Forms class, which provides plenty of flexibility. For this reason, ASP.NET pages that generate HTML content are often called Web Forms.

C# (pronounced as see sharp) is a multi-paradigm programming language encompassing strong typing, imperative, declarative, functional, generic, object-oriented (class-based), and component-oriented programming disciplines. It was developed by Microsoft within its .NET initiative and later approved as a standard by ECMA (ECMA-334) and ISO (ISO/IEC 23270:2006). C# is one of the programming languages designed for the Common Language Infrastructure. C# is a general-purpose, object-oriented programming language. Its development team is led by Anders Hejlsberg.
The most recent version is C# 7.0 which was released in January 2016. The C# language is intended to be a simple, modern, general-purpose, object-oriented programming language. C# is intended to be suitable for writing applications for both hosted and embedded systems, ranging from the very large that use sophisticated operating systems, down to the very small having dedicated functions [82].

The .NET Framework is the part of the initiative that makes developing services and applications really easy.

The .NET (pronounced dot net) is a software framework consists of two parts: the common language runtime (CLR) and the Framework Class Library (FCL). The Microsoft .NET Framework allows developers to leverage technologies more than any earlier Microsoft development platform did. Specifically, the .NET Framework really delivers on code reuse, code specialization, resource management, Multilanguage development, security, deployment, and administration. While designing this new platform, Microsoft also felt it was necessary to improve on some of the deficiencies of the current Windows platform. Microsoft also provides a .NET Framework SDK. This free SDK includes all the language compilers, a bunch of tools, and a lot of documentation. Using this SDK, you can develop applications for the .NET Framework.

**SQL Server** is an enterprise-class database management system (DBMS) that is capable of running anything from personal database only new megabytes in size on a handheld Windows Mobile device up to a multi-server database system managing terabytes of information. However, SQL Server 2008 is much more than just a database engine. The SQL Server product is made up of a number of different components. This chapter describes each of the pieces that make up the SQL Server product and what role each plays. Each of these topics is dealt with in more detail later in the book. SQL Server 2008 and SQL Server 2008 R2 provide a suite of tools for managing and administering the SQL Server Database Engine and other components [83].
**AJAX** stands for Asynchronous JavaScript and XML. AJAX is not a new programming language, but a new way to use existing standards. It is used to create more interactive applications. It is the art of exchanging data with a server, and updating parts of a web page - without reloading the whole page. AJAX is about updating parts of a webpage, without reloading the whole page. Examples of applications using AJAX are Google Maps, Gmail, YouTube, and Facebook tabs.
CHAPTER 7

IMPLEMENTING OF SISM MODEL

7.1 Introduction

Once the software application is developed, the E-learning software assessment process starts by collecting the required data for each factor. The research is based on diverse research methods in order to gain as many different perspectives on the topic as possible. Therefore, we used primary as well as secondary data collection in combination with information system and field research. In this research, we took into account the steps and procedures that were followed in the practical study, which aimed to identify the factors involved in software quality assurance. The case study was conducted on three institutions (Organization A, Organization B and Organization C). We studied their practices and methods through observation and personal interviews in the institutions to access and make use of their E-learning experiences.

We used the web-based system as a tool to collect the applied study data to know the role of factors played in the institutions and assess the E-learning model. The data is then entered in our software application for evaluation and the results are obtained for each factor. Finally, a summary report for the E-learning software is displayed.

7.2 Organization A

Organization A is an undergraduate and postgraduate institution that provides diploma, bachelor, masters and doctorate degrees for students. It is located in Khartoum over big area of square meters. It has more than twenty different specialties over this area. They have respectable E-learning software which supports voice messages. The software was built by an information technology company in Sudan.
Organization A scored good grades for reusability followed by effectiveness and testability. The reusability scores were contributed largely by the implementation of master pages for the webforms and the object-oriented design pattern. The scores were 7, 6 and 6 respectively. Maintainability, functionality, navigatability and flexibility had accepted grades contributed largely due to the solid software infrastructure. We hope that they improve their portability in the future by considering plug and play feature Figure 13.

Figure 13: Organization A – System Side

Organization A scored good grades for correctness mainly due to the efficient proofreading techniques implemented. Reliability is acceptable and can be enhanced greatly by upgrading the hardware and network configurations Figure 14.
Organization A has excellent learnability mainly due to the nice and responsive display layout implemented by bootstrap. Arabic fonts can be enhanced to be readable while images can be optimized to a better resolution with a considerable size. Usability was acceptable due to the marvelous interface design made using JavaScript animation and could be better if documentation is included. Understandability scores were good due to the clear contents achieved by good grammar, spelling and consistent contents. Figure 15.

Figure 14: Organization A – Instructor Side

Figure 15: Organization A – Student Side
Organization A scored good grades for integrity and efficiency with acceptable security and privacy grades. The security of data was mainly contributed by good database design and user authentication. Protection against DDOS attacks and hashing of the cookies and sessions should be considered. Regular security updates needs to be implemented to increase the privacy. Security against sniffing and metasploits also needs to be considered. Data and system migration is important to increase interoperability score in the future. Figure16.

Figure16: Organization A – Intersections Side
Looking at organization A, we notice acceptable results for the system, student, instructor and intersections side. A few effort is needed over the intersections and student side by enhancing user interface and including documentation. Hardware and network upgrades needs to be considered along with scheduled security updates Figure17.

7.3 Organization B

Organization B is an undergraduate and postgraduate institution that provides diploma, bachelor, masters and doctorate degrees for remote students. It has more than ten different specialties. It is located in Khartoum over an area of more than eight hundred square meters. They have remarkable E-learning software over the internet serving more than two thousand users.

Organization B scored excellent grades for reusability and functionality. The reusability score was contributed largely by the use of web-pages and the implementation of object oriented programming.
Functionality was excellent due to the excellent requirement analysis made before designing the application. Effectiveness was good achieved mostly by standard hardware specifications. Flexibility was achieved by including a content management system to the application. Lack of an administrative panel, independent modules and sitemap tremendously decreased the maintainability, portability and navigatability scores respectively. Therefore, it should be considered in the next version. The exclusion of log files significantly reduced the testability scores Figure 18.

![Figure 18: Organization B – System Side](image)

Organization B scored good grades for correctness and reliability mainly due to the speed in performance and less error rate per year. Good software analysis leads to good software design which reduces the chances of errors. The server hardware specifications were high and the security policies implemented contributed significantly to the good scores Figure 19.
Organization B has excellent learnability and good understandability. The excellent display layout and the bordered images contributed much to the learnability scores, while the good review of the materials before uploading them contributed to the understandability scores. Providing documentation for the software application helps to increase the usability score, Figure 20.
Organization B scored good grades for privacy mainly due to the timely security updates. Protection against DDOS and 128bit SSL certificates were strategic security measures. Care must be taken for the data and scheduled data migration plan should be established Figure 21.

![Intersections](image)

**Figure 21 Organization B – Intersections Side**

Looking at organization B, we notice good results for the instructor side with acceptable results for the other sides. The high performance and less error rate contributed much to the instructor side scores while reusability and functionality contributed much to the system side Figure 22.
7.4 Organization C

Organization C is an international school that follows British curriculum for secondary school students. It has six branches and more than sixty classrooms. They have respectable E-learning software featuring live boards.

Organization C scored marked excellent grades for effectiveness with functionality, flexibility and reusability. High end server specifications contributed to the effectiveness. Reusability scores were good due to the implementation of web-forms and OOP. The modifiable software application with the help of administrative panel contributed to the maintainability scores. Better design layout must be considered to increase the navigatability scores. Model View Controller (MVC) architecture should be considered for the upcoming versions to increase the flexibility of the system. Independent modules and plug and play feature must be considered Figure 23.
Organization C scored excellent grades for correctness mainly due to the efficient proofreading and verification techniques implemented. Reliability is good mainly due to the high performance achieved by high end hardware specifications Figure 24.

<table>
<thead>
<tr>
<th>System Side</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functionality 2/10</strong></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td><strong>Effectiveness 2/10</strong></td>
<td>8</td>
<td>30 seconds</td>
</tr>
<tr>
<td><strong>Flexibility 1/10</strong></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Reusability 1/10</strong></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Portability 1/10</strong></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Maintainability 1/10</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is it Modifiable?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Is Admin Panel Included?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Admin Panel</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Navigability 1/10</strong></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Testability 1/10</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LogFiles</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Notifications</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Dashboard</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

![System Side Graph](image)

**Figure 23: Organization C – System Side**

![Instructor Side Graph](image)

**Figure 24: Organization C – Instructor Side**
Organization C has excellent usability, learnability and understandability grades. This was mainly contributed by the marked user interface, simple ease of use and excellent user experience. The layout design and interface was latest Figure 25.

![Graph showing usability, learnability, and understandability grades for Organization C]

**Figure 25: Organization C – Student Side**

Organization C scored excellent grades for all intersections design factors except for interoperability. The security configurations were latest considering protection against most attacks with timely updates. Regular backup of the database system was remarkable. Data migration techniques should be enhanced Figure 26.
Looking at organization C Figure 27, we notice marvelous results for the system, student and intersections side. High end server specifications and rich user interfaces and layouts contributed largely to the results.

Figure 26: Organization C –Intersections Side

Figure 27: Organization C
7.5 The Result of Implementing SISM Model

The results of implementing SISM model were accurate and promising. As shown in Figure 28, comparing the three results, organization C has the highest overall score. Second is organization B which has good instructor side. Third is organization A with acceptable results. The evaluation results proved the essence of applying the SISM model to aid decision making and software rating. It covered the recent technologies and addressed the problems associated with software integration. Including the latest measures needed to evaluate latest technologies is essential.

![Figure 28: Comparative View](image)

7.6 Case Study (AL-NEELAIN UNIVERSITY)

This case study was conducted in one of the top governmental universities in Sudan during the period from 2nd of February 2020 to 25th of February 2020. The university was founded in the year 1993 as a vital outcome of the higher education evolution resulting in the sudanization of Cairo University. The Khartoum Branch was founded by the Egyptian government in 1955 with four faculties (Arts, Law, Trade and Science), and continued to function as such until it was renamed Al-Neelain University in 1993 and ten new faculties added to the original four. Continuous development at both horizontal and vertical axes enabled the University to expand further to over 20 faculties, five research institutes and about 30 research centers. This allowed it to become one of the most renowned Sudanese universities, recognized both nationally and internationally. Its curricula and syllabuses cover most of the known educational fields including
medical, technical, science sand humanities. There are around 90,000 students, of which 10,000 are postgraduates. The university has many signed agreements and collaborations with local, regional and international academic institutes and organizations.

The faculty of Mathematical Science, Technology and Statistics is a unique faculty offering programs in both mathematics and statistics. Its graduates are of high caliber, competing locally, regionally and internationally. It retains a satisfactory environment for better learning conditions, and encourages staff members to conduct valuable research. It has an attached Centre for population Studies. The faculty has a text-based E-learning system which was implemented in the year 2016. It contains lecture notes, exercises and textbooks. Moodle (Modular Object-Oriented Dynamic Learning Environment) is the software that is integrated into the system for examination purpose. It is an E-learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalized learning environments. Written in PHP and distributed under the GNU General Public License, the E-learning software is distributed over network clients as needed. User account control provides access for authorized users to the system and use various system components such as question banks for the previous years.

One of the limitations of the system is that the students use the university’s mobile tablets to access the system over the network which has several disadvantages such as increased battery wear level which demands purchasing new batteries from time to time. Another limitation is the frequent electricity cut-off which damages most hardware’s. Another limitation is the absence of video streaming from the E-learning software. They usually use YouTube streaming service which is very limited in terms of bandwidth and time period and costly too. In addition to that, server specification is very limited in terms of bandwidth and the number of users served.

We recommend building an advanced IT infrastructure consisting of a centralized high end server and reliable network specification to address the large number of students from different
faculties during the exams. We also recommend building a complete E-learning system by participating the programmers and designers from the faculty of IT and computer science or purchase an advanced E-learning system that supports video streaming.
CHAPTER 8

CONCLUSION AND RECOMMENDATION

8.1 Conclusion

The software quality assurance has an important impact for any software system. Therefore, a new model is created to achieve high quality, reduce the time for both student and instructor, also reduce effort and cost, and simplifies the usage of E-learning software's. The software quality model factors are dividing into two: design factor and implementation factor. Design factor has four sides: System, Instructor, Student and intersection sides. The implementation factor has three product factors, Product Operation, Product Revision and Product Transition. The implementation of software quality model (SISM) is done by testing the application over three educational institutions in Sudan. The results we accurate and promising and the model has easily corrected the mistakes in the previous models and addressed the defects that occurred. The E-learning models are really satisfying the requirements, needs and acquisition of the right knowledge according to quality assurance.

8.2 Recommendation

The software quality model creation and implementation is complicated task because the needs and requirements are different from model to another. There isn't a single technique or criteria to evaluate E-learning application. We hope that the others develop this model and its application is used as standard for E-learning application in future and recommend regular updates in the model with corresponding advances in technology and address a measure for correctness, efficiency and integrity.
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