TALLINN UNIVERSITY OF TECHNOLOGY
School of Information Technologies

Syed Muhammad Umair Faridi

184573IVGM

USABILITY EVALUATION OF INTERACTIVE DIGITAL LEARNING PLATFORM - A CASE STUDY OF GOVERNING WOMEN EDUCATION SYSTEM IN PAKISTAN

Master Thesis

Supervisor: Ms. Sidra Butt

Co-Supervisor: Assoc. Prof. Dr. Ingrid Pappel

TALLINNA TEHNIKAÜLIKOOL
Infotehnoloogia teaduskond

Syed Muhammad Umair Faridi

184573IVGM

INTERAKTIIVSE DIGITAALSE ÕPPEPLATVORMI KASUTATAVUSE HINNANG - JUHTUMIUURING NAISTELE SUUNATUD HARIDUSSÜSTEEMI JUHTIMISEST PAKISTANIS

MAGISTRITÖÖ

Juhendaja: Ms. Sidra Butt

Kaasjuhendaja: Assoc. Prof. Dr. Ingrid Pappel

Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

Author: Syed Muhammad Umair Faridi

10.08.2020

Abstract

The purpose of this research study is to analyze the impact of interactive learning for women in a developing country like Pakistan and discover the main problems of low implementation of existing e-learning systems and propose the effective implementation of digital learning. This exploration aimed to identify the heuristic usability and design constraints in the prevailing platforms and propose preeminent characteristics which facilitate design choices in the development of digitally govern progressive higher education learning system for females. Consequently, distinct research methodologies were undertaken in this study which includes USE questionnaire for usability analysis and students interview which were used to perform thematic analysis using an open source tool (RDQA). Additionally, this research will potentially empower synchronize learning in women and serve as an enabler to design robust platforms which incorporates distance learning and substantially improve women literacy rate in Pakistan respectively.

This thesis is written in English and is 74 pages long, including 7 chapters, 19 figures and 3 tables.

List of Abbreviations and Terms

e-Learning	Electronic Learning
AL	Active Learning
AL	Agile Learning
API	Application Programming Interface
AL	Asynchronous Learning
BL	Blended Learning
BYOD	Bring Your Own Device
CBT	Computer-Based Training
CBT	Classroom-Based Training
Cloud LMS	Cloud Learning Management Systems
CMI	Computer Managed Instruction
CMS	Content Management System
CL	Cognitive Load
CL	Content Library
CB	Course Builder
CC	Course Catalogue
IL	Interactive Learning
F2F	Face to Face Training
ID	Instructional Design
ILT	Instructor-Led Training
IC	Interactive Content
LCMS	Learning Content Management System
PLP	Personalized Learning Path
LP	Learning Portal
LMS	Learning Management System

LRS	Learning Record Store
m-Learning	Mobile Learning
MOOC	Massive Open Online Course
OA	Online Assessment
OL	Online Learning
SaaS	Software as a Service
UI	User Interface
UX	User Experience
IL	Interactive Learning
DL	Digital Learning
HCI	Human Computer Interaction

Table of Contents

List of Figures

List of Tables

1 Introduction

Since the inception of 21st century, there have been tremendous developments experienced across the globe. Emerging technologies bring tech-savvy innovations which would develop enormous fascinating products in the arena of information and communication technology (ICT) sector that are truly captivating and received immense appreciation throughout the world. The chief idea was to envisage and make superior contribution towards humanity and accommodate episodic life challenges by means of technological expansions. As a result, distinct innovative products and services were built and meticulously transformed the approach of doing businesses substantially. Similarly, due to distinctive socio-economics challenges, servicing industry were advent to these charismatic advancements and public operations manoeuvres its traditional services and adapt the conceptual framework of digitization which is commonly referred as e-governance and convincingly delivered renowned services for instance Tax to e-tax, Voting to i-Voting, Health to e-health, Business to e-Business or e-Commerce, and School to e-School respectively. Likewise, the phenomena of digital learning (DL) or e-learning postulates differential challenges and opportunities which includes incremental diversity of learners, interactive content creation, technological expansions, user interface (UI) hindrances, usability constraints and adequately elaborating the context of use in interactive learning (IL) applications are more composite than ever [30].

Usability is known as one of the most crucial factors for the success of e-learning because if the e-learning system has poor usability then users would not be able to use e-learning optimally and there would be high probability that users would avoid engaging with such system. Moreover, high usability rate guarantees the effectiveness, efficiency, high functional and other constraints such as safe to use and easy to learn for the end users [42]. In an educational context, usability is considered as the most significant factors when high level interactions occur and used to evaluate the quality of system user interface [43]. It is also revelated in various studies that colour, font, layout and buttons of digital learning applications are the elements that may assist to evaluate the usability of system. The ambiguities in such elements may lead to dissatisfactory interactions between distinct stakeholders such as student to student, student to instructor and student to content and make learners drop out of the course [44].

Educational technology contemplates the utilization of mixed assets and architecture which includes software, physical hardware and instructive academic theoretic to empower learning, and cultivate performance enhancements by effectively managing industrial practices, processes and robust resources. In addition to that, it comprises of distinct domains such as computer-based learning, m-learning (mobile learning), interactive learning etc. Therefore, there are numerous discrete aspects to demonstrate the intellectual and technical progress of learning technology:

- Educational Technology refers to the theoretical and practical principles of learning.

- EdTech, deployment of media and essential technical apparatuses such as Massive Open Online Course (MOOC) platform, which facilitate the exchange of informative content over the web, development of tools and interoperability of systems.

- Implementation of Learning Management System (LMS) to facilitate learning technology, for instance technique to incorporate students and programme management, and Education Management Information System (EMIS)

- Learning Record Storage (LRS) is another essential method in educational technology to empower the data analysis and storage respectively. Additionally, Training Management System may also utilize to support back office operations, related to budget allocation.

In the past, several e-learning platforms were established to overcome this issue in Pakistan and offer an opportunity to these under privileged individuals to continue their higher education and gain technical knowledge, but these platforms could never gain such popularity and failed to contribute in the promotion of literacy rate subsequently. However, numerous studies proved that these digital learning platforms have inordinate potential to bring change in the society, and lead to progressively increase in the literacy rate of developing countries [28], but this is not the case in Pakistan.

1.1 Problem Statement

It has been studied that most of the e-learning or distance learning platforms ended to be ineffective to fulfil its purpose due to inadequate usability considerations while developing a platform. Similarly, system developers and UI/UX designers often overlook the importance of integrating the cultural design elements and usability factors in the development phase which leads to fragile user experience and subsequently impact the overall literacy rate for women in Pakistan. In this research particularly, will study distinct usability components, cultural dimensions, end user experiences and propose roadmap that facilitate the e-learning system in accordance to the cultural values of Pakistan.

1.2 Research Objectives

- To identify the critical problems and recognize significant barriers which substantially hinder and constitutes in lower implementation of interactive learning system in Pakistan

- To examine the potential design factors from end user's perspective that diminishing the implementation of digital learning and correlates to human computer interaction (HCI) which comprises of system usability, user experience (UE) outlook and usability evaluation in the context of e-learning

- Data analysis with the help of USE questionnaire surveys and F2F interviews with learners.

- Recommendations for design elements based on data analysis outcomes.

1.3 Significance of the Study

Digital learning platforms or e-learning is a permutation to govern higher education in the society digitally by implementing information and communication technology (ICT) solutions in order to optimize the quality of education, facilitate distance learning programs, bring socio-economic awareness in the youth, develop and train competitive future leaders which enables prosperity, empathetic of future needs and address possible challenges that will be faced by the nation respectively.

This research can have a significant impact to improve female higher education rate in Pakistan which subsequently contributes as an emerging support in the developing economy. Furthermore, it can also benefit in a broader perspective like an axiom says: *"Give me an educated mother, I shall promise you the birth of a civilized, educated nation."*

1.4 Research Questions

In this section, the research horizon related to usability evaluation of digital learning management system will be explained. The significance of this study refers to the pattern of an interdisciplinary approach that includes concepts such as usability of cultural oriented e-learning platform, user experiences, design choices and barriers related to learning management system.

Q1 - What is the overall user experience regarding the usability of distinct Learning Management Systems in Pakistan?

In this reasearch question, the main idea is to investigate the usability of distinct learning management systems that are deployed in the higher education universities in Pakistan via USE Questionnaire. In addition to that, the personalized user experiences of distinct aspirants will be capture through interviews and conduct thematic analyis for assessment. Likewise, user experiences of distinct users have been gathered in order to estimate the main issues related to the prevailing learning systems could be identified. The purpose of this research question is to record the shortcomings of the current e-learning systems implemented and could possibly transform the approach towards e-learning in Pakistan.

Q2 - What should be the best design choices and usability considerations for the potential interactive digital learning system?

In this research question, the essential design components of digital learning system that includes visibility of the system, site navigation, learnability, accessibility, error prevention, recovery, support etc will be examined. Moreover, the cultural dimensions in the context of design choices to facilitate potential interactive learning system will also be discussed so the reliable improvements can be proposed. These suggestions would be based on the cultural dimensions study, interviews and questionnaires prepared to understand the end user perspective.

Q3 - How to effectivelty implement an e-learning system for women in Pakistan?

In this research question, the potential barriers that effect the implementation of e-learning such as cultural hinderances, technical obstacles etc related to LMS will be discussed and propose guidelines on the basis of this usability study to design and develop an effective learning management system in Pakistan will be proposed in the form of roadmap and recommendations.

2 Literature Review

The chief objective to conduct the literature review is to seek the holistic domain knowledge in the context of digital learning systems, research about best industrial practices and comprehensively understand the methods that are relevant and persuasive for research in the arena of usability evaluation of interactive learning systems. In order to envisage the efforts, systematic approach is highly desirable to explore the literature relevant to the topic of interest substantially. There are numerous libraries that would consider robust in order to acquire research studies such as journals, books, research papers and e-libraries that are closely related to the subject of research respectively. In addition to that, there are distinct key search terminologies that plays a vital role towards identification the relevant research material that are published by numerous renowned scholars and researchers respectively. The primary aim is to envisage a traditional literature and facilitate in an appropriate context towards the study and possibly learn from extensive work done previously by other scholars in the domain [6].

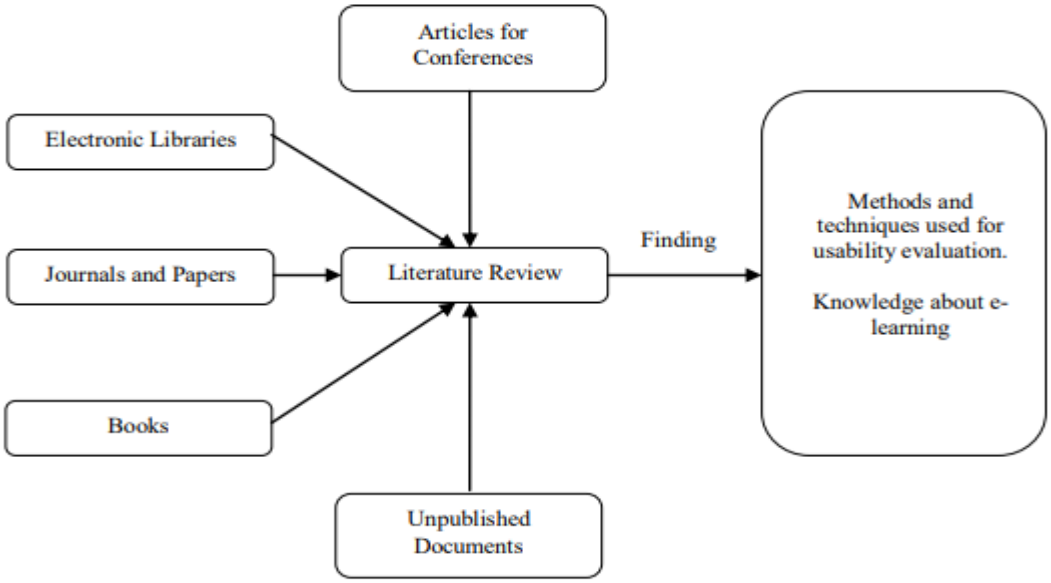


Figure 1: Literature Review

2.1 Usability

The term usability cogitates as a technical terminology which defines the collaboration and interaction between the users with application system. The usability of application

platform is one of the essential elements of successful implementation [37]. It's often correlates and measured by the ability of how convenient the use of system and learnability. Furthermore, whether the user is pleased with the application system or vice versa. In general, according to International Organization for Standardization (ISO) defined usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use [14]. The table below define distinct industrial standards that are related to usability.

❖ "The ease with which a user can learn to operate, prepares inputs for, and interprets outputs of a system or component." [12].
❖ "The capability of the software product to be understood learned, used and attractive to the user, when used under specified conditions." [15]
❖ "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." [14]

Table 1: IEEE / ISO Standards Related to Usability

Nielsen suggests that usability has a subsequent portion in application system satisfactoriness and develop an individual perspective about usability. In a border viewpoint, system competence enlightens the systems credibility by which adequately meeting the needs and requirements of the user at the reasonable level [21]. The figure below illustrates his standpoint which is broadly acknowledged in information and communications and technology (ICT) domain related to usability [21][22].

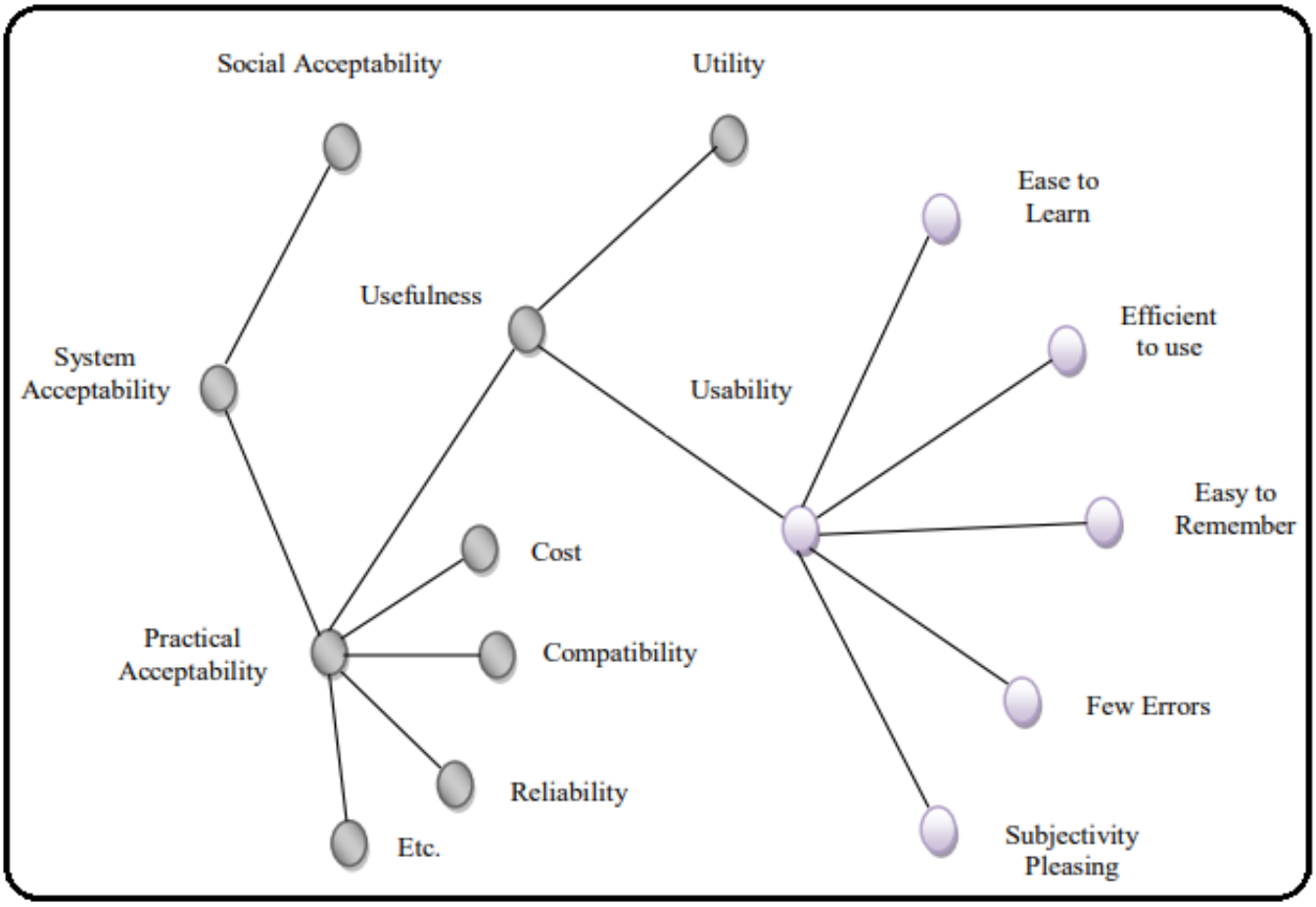


Figure 2: System Acceptability in Perspective of Usability by Nielsen

Usability is largely constructed on the succeeding parameters such as learnability, effectiveness, memorability, efficiency, utility and safety. Briefly demonstrate the indispensable factors of usability are as follows:

- Learnability is largely concerned about how flexible or stress-free to learn and ease of system use [23].
- Effectiveness chief objective is related to how reliable a system is in order to perform dedicated tasks.

- Memorability is a crucial factor that deals with how convenient to learn and remember the usage of system, once scholarly [23].
- Efficiency envisage the system's capability and drive relationship between system support with user related to task-friendliness.
- Utility accommodate the user demands and manage the precise functionality and reduce the risk of system malfunctioning.
- Safety is highly essential feature which aims to protect users from unavoidable circumstances and other offenses related to cyber space [23].

2.2 Usability and User Experience

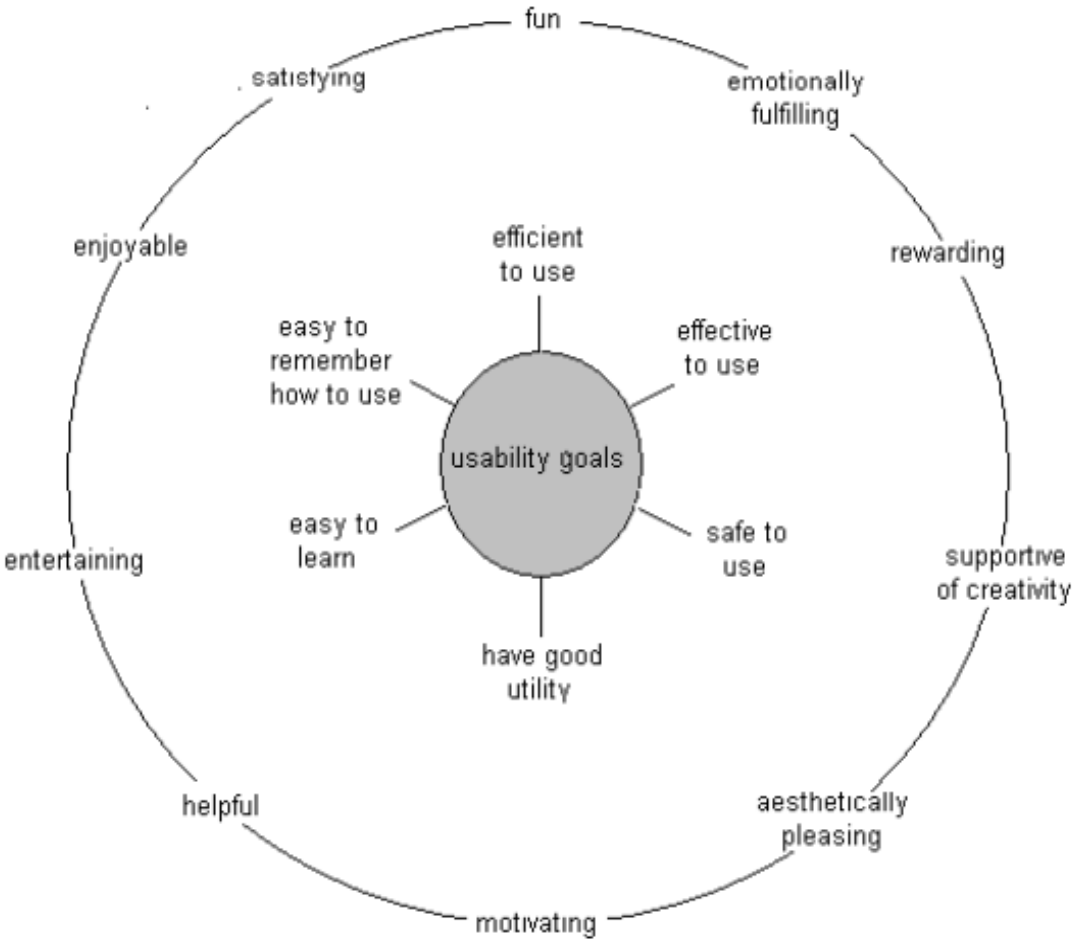


Figure 3: Differentiating Usability and User Experience Goals [23]

The principle ambition of usability framework is to enhance the user experience (UE) with the digital systems. As a matter of fact, improvising user experience employ distinct features for diverse systems such as heuristics that function as a procedure in designing and examine HCI based digital systems that largely suffice the need such as error prevention, consistency and clear feedback acquisition [21][22]. Similarly, the primary job of usability experts is to identify and adapt best industrial practices in system design to examine and evaluate the system rationally that are undertaken for evaluation. Digital learning systems has no exclusion from this regulation and generally they are potentially more complex and vivid in nature in terms of feature examination for experts. In addition to that, e-learning system applications are very heterogeneous and unique in attributes because of diversified content along with ICT literateness which demands to employ educational psychology and customized the progression of usability framework related to the evaluation of specific system respectively [19].

2.3 Usability Evaluation in the context of e-Learning

The emphasis of usability evaluation in accordance to the digital learning (DL) are considered highly essential because there are enormous challenges reported towards designing of educational technological platforms [2]. For instance, limitation of pedagogical support in an academic system for the women in Pakistan. Similarly, cultural barriers, language constraints and complications experienced by distinct aspirants while doing active learning (AL). These explanations may possibly develop potential hinderances and encounter to become a valid narrative for the endurance of distance learning application and courses. According to research conducted by ACM illustrated that lack of quality assurance and heuristic usability evaluation testing has been undertaken during the design and development of the course curriculum and the framework of interactive learning technology, characteristically because of timeline limitations and professed minimal importance of usability. Secondly, ideally there is a dire need to concentrate on how to implement useful and usable tools and platforms in order to enhance pedagogy, rather encapsulate the focus limit only to the technology arena. Lastly, there is a conservative approach and immense uncertainty at the authority level in terms of usability challenges [25].

According to distinct research studies conducted on this subject validate the above-mentioned issues related to active learning context [11][16][17]. The approach to develop an environment would be user friendly and pedagogy should be incorporated while designing usable digital learning curriculum. A definite “usable” course is the one in which taught knowledge would address the needs and meeting the expectations of the learner. Furthermore, aspirants should receive the value which they anticipate at the time of enrolling the e-learning course [9]. Therefore, it is highly recommended to estimate the student’s requirements, choice of interactive content, learning methodology preferences and etc in order to scrutinise the context in which they live, work and study. Subsequently, digital design, research methodologies and practical used case needs to be considered on previous experiences, knowledge and conclusions in distinct ICT arena, specifically human interactions in instructional design, computing and system analysis and design. According to Squires, the role of HCI practitioners should be encourage and outlay the knowledge of recent developments of digital learning theories. Human Computer Interaction (HCI) professionals and EdTech innovators hardly interact with each other and discuss problem areas in order to optimize the interactive learning platform. In addition to that, EdTech aspirants and educational computing content is dysfunctional due to lack of awareness and interpretation of system design challenges, and in most cases authors of HCI literature seems to be uninformed of the substantial developments that are carried out in context of learning theories [27].

Another essential area that requires significant concern is to estimate and evaluate the extent at which the courses and other curriculum choices are usable. To develop a clear understanding and seek transparent insight to address the critical problem in terms of examine the succinct description of e-learning context of use is highly desirable. In HCI, no. of users, tasks descriptions and other environmental related parameters establish the context of use [13]. The following section will endeavour a discussion about examine the general framework of context of use in the digital learning landscape.

2.4 Defining the Context of Use - The User is a Learner

A significant assessment is obligatory in order to define the context of use as a learner perspective is decisive to examine the dual persona of the user. According to Smulders perspective, majority of the challenges in interactive learning design are related to modest

usability evaluation due to the reason that most of distance learning education provider wouldn't distinguish the difference between the role of the learner and the user in the digital learning platform. In addition to that, majority of interactive learning courses are developed for learners by ignoring user's perspective. However, on the other hand distinct e-learning courses endeavour vice versa. As Smulders further illustrated that the transformation between the learner and the user perspective could be mature enough by considering the content (learning material) against issue of form (User Interface) [26]. The distinct persona substantially corelate the user perspective and it consist of form of learning and the aspirant perception is highly relatable to the content. However, it is refrained to judge that the content is not essential in other contexts for instance electronic commerce sites, e-shops etc. Likewise, the distinction empowers and highlight the importance of content in accordance to digital learning platforms. Content plays a vital role and has greater impact in human computer interaction such as active learning. The content of an electronic trading platform is not relatively significant question. Model number, product description, cost etc such information are largely based on market analysis. According to Bauhaus principle suggests that form follows function is relatively more prominent in an e-learning design development.

2.5 E-Learning Theoretical Framework

A framework is defined as classification of essential factors required in the development of information systems and these factors are highly associated with the successful implementation of such systems. Theoretical Framework is usually a set of interrelated theories based on the question and not necessarily succeeded but support to provide a direction in research. [32]

In most of the cases, e-learning theoretical framework consists of three main components i.e. people, technologies and services. People are usually the different stakeholders that are interacting with the system directly or indirectly. Technologies offer support in providing collaboration, facilitate communication and integrate contents. The services in this context are basically e-learning activities based on instructional strategies and pedagogical models. [32]

Education as a Service

In the context of e-learning, Education as a service defines as a delivery model to meet the requirements of current students. Students themselves be able to assess their own competencies to secure relevant job and work on the resulting gap to improve their knowledge and skills with the help of educational bodies.

In this regard, the contents in the system should be updated with the latest trends and real time connection with corporate workplaces to train users to be successful in their work lives and face uncertain situations. The main advantages of such services are affordability, personalization and rapid scalability. In terms of affordability, the cost can be saved for transport and individual choices for courses while in terms of scalability, the application and content are delivered through the cloud which can be extended and accessed across the regions depends on the requirement. The flexibility for personalization offers greater access of relevant learning to them according to their pace. [33]

E-Learning Governance

Learning governance can be defined as the formal framework to manage decision related to learning and development. In addition to that, good governance of learning includes the following:

- ❖ Assigning accountability
- ❖ Defining priorities
- ❖ Allocation of budget and resources
- ❖ Actionable decision making
- ❖ Facilitation of transformation and change management [35]

The term “e-learning governance” is particularly defined as the responsibilities, activities and practices carried out to:

- ❖ Offer strategic direction to the initiatives of e-learning institutes.
- ❖ Ensure the achievement of set objectives

- Risk Management
- Allocation of resources in an appropriate way

In addition to that, the role of e-learning governance is the application of regulations in the delivery of content, knowledge and skills and ensuring the cost effectives, quality, ethics and security [34].

Usability of Cultural oriented e-learning System Development

The cultural oriented e-learning system development framework is proposed by Mavetera in 2011 focusing on cultural oriented learning. This framework considered several aspects such as involvement of students, clear understanding of their expectations, clear intention to develop cultural oriented system for developers with direct link between components and cultural factors and relationship between stakeholders in the e-learning development [4].

The framework consists of 7 cycles and each cycle consists of a component explained below:

Learning Style – The first cycle of this framework is Learning style and its component is consultation. The learning style is associated with demands and expectations of the learners and these expectations and needs are gathered by developers during consultation process which includes interviews, surveys etc.

Cultural Component – The second cycle of this framework is cultural component itself and focuses on the cultural influences. In this cycle, the developers must gather knowledge about students' cultural identities such as language, symbols, icons and other design preferences. This can be also achieved during consultation process.

Content Factors – This cycle is associated with the quality of learning materials such as video lectures, assignments, e-books etc. which can directly affect the users learning process and satisfaction. The quality of the content in this framework can be achieved by design plan, system development methodology and technology (DPSDM) approach. The design plan is basically the architectural design which includes system layout and information flow from one point to another in the system. SDM is a component used

during development and ensures users requirement are fulfilled in the design by using object oriented and agile approaches.

Activity/Exercise Factor – This process is in relation with uploading and downloading study materials and this cycle covers the components of teacher/lecturer, community/students and generic/diversification. Basically, this factor is focusing to build stronger relationship between stakeholders. Community factors are also responsible for the communication and collaboration among learners. The generic factor also highlights the learners having different cultural backgrounds and use of features that are suitable for every individual using the system [3].

Support Centre – This cycle is associated with the support centres working in different educational institutes. This cycle can enrich the e-learning help function by providing better coordination for technical issues and quality feedback. It also helps to facilitate the relationship between teachers and students by providing positive feedback and motivation to students during the courses.

Adaptive System – This cycle works with the flexibility of the new system in regard to culture. It provides greater scale of flexibility and customization of features to make adaptation of new system easier for users [4].

Culture Oriented System – The last cycle of culture-oriented system aims to achieve the overall purpose of this framework. In this cycle, the outcomes of the system are evaluated and validate if the deliverables are matching with the expectations of the system.

3 Research Methodology

This chapter consists of the research materials and methods that have been used for this thesis.

3.1 Selection of Sample e-Learning Systems

For this research, the leading existing e-learning systems in Pakistan are studied for usability evaluation. The results will be useful for the improvement of existing approach in the development of e-learning system specifically for the females willing to pursue higher degree in Pakistan.

At the initial stage, while using keywords on Google search, several online platforms have been identified that are providing distance and online education to the individuals in Pakistan. The keywords used for this search were “E-Learning Pakistan”, “Digital Learning Pakistan”, “Distance Learning Pakistan” and “Online Learning Pakistan”. 19 results came out after an extensive search for the mentioned keywords. To refine the research, only platforms that are offering undergraduate and graduate online degrees courses have been chosen and this number has been reduced to 9. Moreover, those e-learning or interactive learning systems have been chosen who have at least 35,000 registered students and those platforms have been excluded that are not associated with any institute affiliated with higher education commission (HEC) of Pakistan. In this way, the selection criteria have been reduced to 5.

In the end, the target was to select only top 3 e-learning platforms functioning in Pakistan at this moment. For this purpose, the higher education commission university ranking list has been used to identify top 3 distance learning universities from the remaining 5 for this study [29]. At the final stage, the three e-learning platforms that have been selected for this study are “Virtual University Learning Management System”, “Virtual COMSATS” and “Allama Iqbal Open University Online Learning”. All these selected e-learning platforms were quite similar in multiple ways and based on LMS platform.

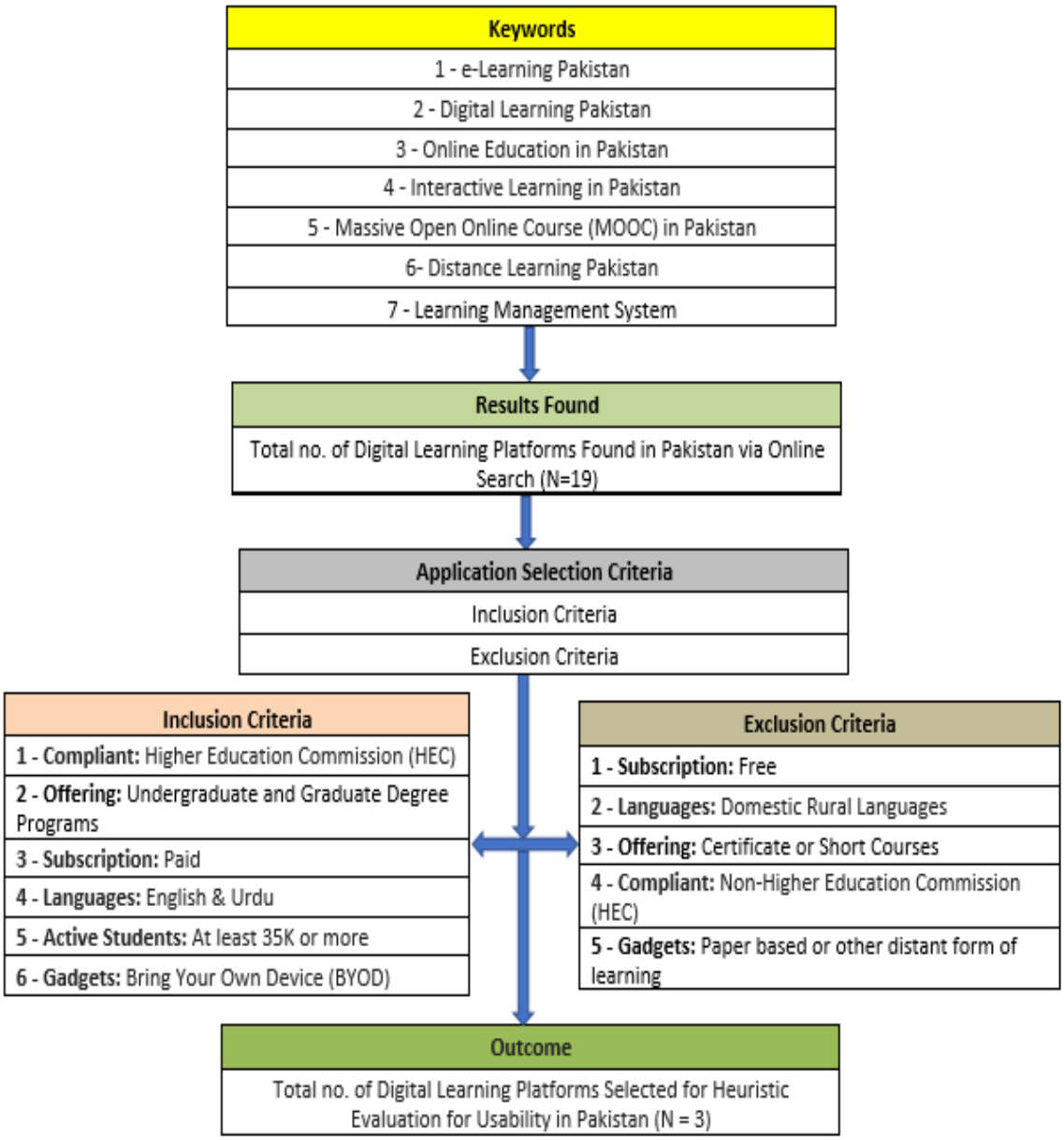


Figure 4: e-Learning Platform Inclusion Exclusion Criteria

3.2 Interviews

Interview is one of the most effective approaches for the qualitative data analysis and commonly known as source of primary data for any research. For this research, open ended questions were designed so the interviewees would be able to express their opinions, perspective and expectations for the current e-learning systems openly. Each interview was conducted for 45 minutes from the end users of the system which are basically students and detailed information was gathered in order to conduct thematic analysis using RQDA.

3.3 USE Usability Questionnaire

The main objective of questionnaire was to acquire survey data from the end users and analyse both strengths and weaknesses of different e-learning platforms used in Pakistan. For this purpose, different usability questionnaires have been analysed that would be helpful in the design of questionnaire for this study.

The questionnaire used for this study is based on the research conducted and method proposed by Lund Arnold for the assessment of usability with the help of defined factors and parameters known as USE questionnaire. This questionnaire consists of 35 close ended and 2 open ended questions. The 2 open ended questions are kept to query end users' personal opinions and recommendations [18]. This questionnaire is also based on 8 groups of design principles and usability assessment factors developed by Jakob Nielson. After completion of the design of questionnaires, the hard copy of questionnaires was provided to 50 end users of each selected university and overall 150 questionnaires were distributed in January 2020. The statistical analysis from the data collected from these questionnaires has provided in this study as the comprehensive outcome.

Usability Factors of Interactive Learning System

In order to examine the usability of interactive learning system, there are certain factors that are widely considered to evaluate the overall learning management system offered by distinct universities and Institute in this research study. Following are the eight usability factors:

- Visibility of System Status and Content
- Site Navigation, Organization and Structure
- Learnability and Accessibility
- Consistency and Relevance
- Efficiency and Flexibility
- Effectiveness and Satisfaction
- Error Prevention and Recovery
- Help and Support

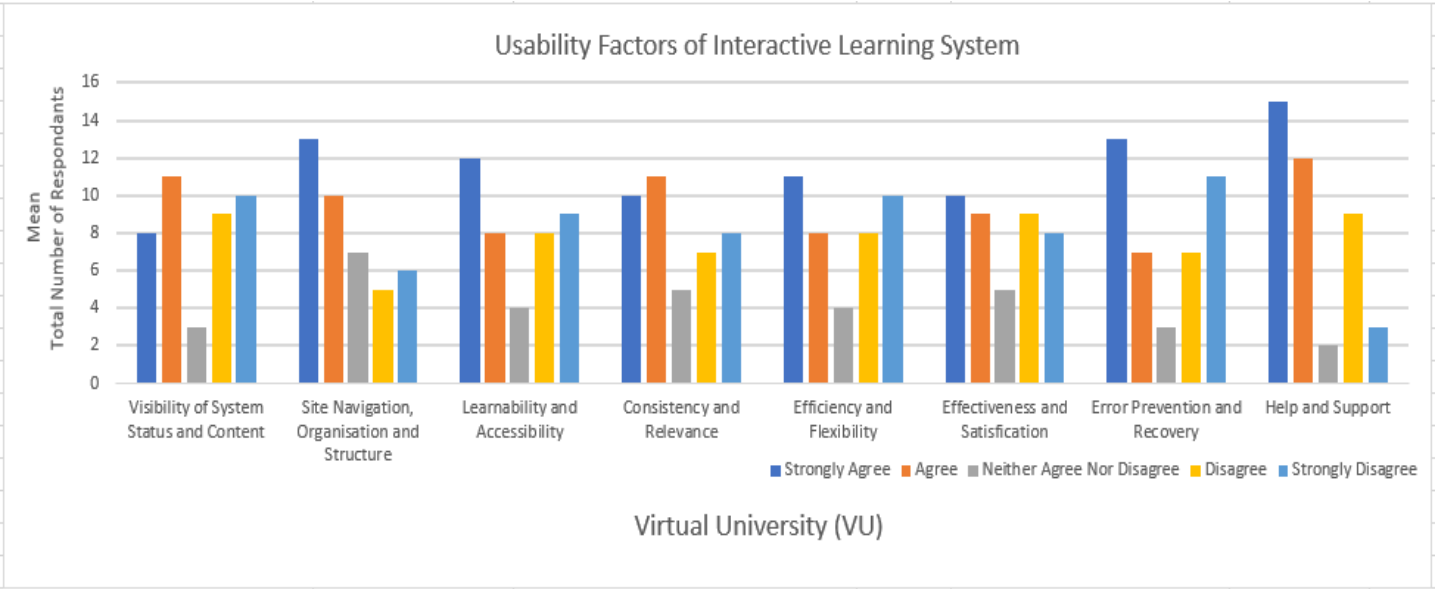


Figure 5: Usability Factors of Interactive Learning System of VU

The above figure represents the usability factors of interactive learning system of 41 aspirants of Virtual University. Furthermore, it also depicts the mean of total no. of respondents participated in the questionnaire and share their perception on the Likert scale about the e-learning experience at VU.

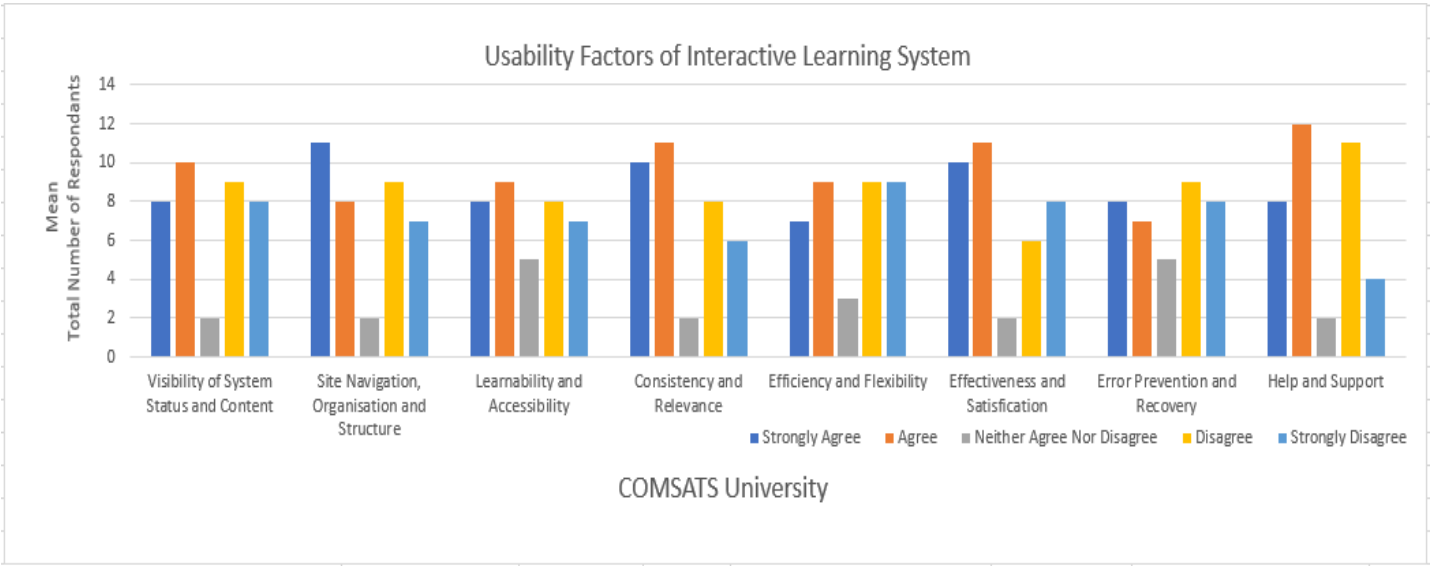


Figure 6: Usability Factors of Interactive Learning System of COMSATS

The above figure demonstrates the usability factors of interactive learning system of 37 aspirants of COMSATS Institute of Information Technology. In addition to that, it also illustrates the mean of total no. of respondents contributed in the questionnaire and segments their opinion on the Likert scale about the digital learning proficiency at COMSATS.

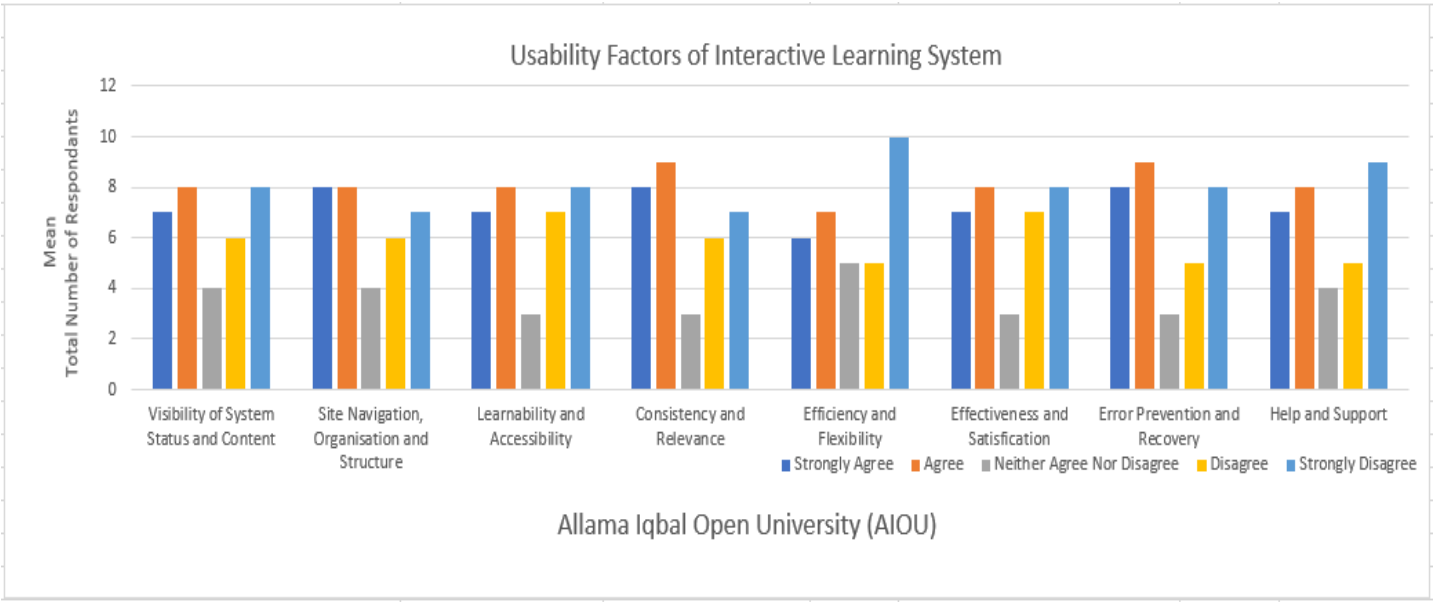


Figure 7: Usability Factors of Interactive Learning System of AIOU

The above figure exhibits the usability factors of interactive learning system of 33 students of Allama Iqbal Open University (AIOU). Likewise, it also exemplifies the mean of total no. of respondents registered their perspective in the questionnaire and slices their opinion on the Likert scale about the online learning aptitude at AIOU.

The table describes the detailed questionnaire provided to the registered users: (Please check Appendix 1)

3.4 End User Participants

As stated above, three e-learning programs have been selected for the usability evaluation. All participants selected for this study were females and random sampling was used for the selection of participants. For each university, 50 individuals including students and faculty members were provided SUS questionnaire and then asked to answer each question about the experience of using e-learning system. Overall, score was calculated based on data acquired from those questionnaires. Total 150 forms were distributed for data collection and the response rate was 111 (N=111) respectively. Eligibility criteria for the participant included are as follows:

- Registered with one of the selected e-learning platforms
- Pursuing a higher degree i.e. undergraduate or graduate level
- Own a personal computer with internet connection
- Understanding of using software applications
- Consent to participate in research.

The demographic details have been also asked from the end users such as age, gender, university name, role such as student or faculty for the research purpose.

3.5 Targeted Audience

At present, there are 31 women universities and colleges in Pakistan who are offering undergraduate and graduate degrees to female students. In these institutes, only female students are enrolled, and this study can facilitate these institutions to implement digital learning in efficient and productive way. In a survey conducted in 2010, it has been showed that 79% of the individuals prefer their daughters or female family members to study in female only institutes [41].

4 Case Description

Pakistan is a developing nation where pursuing higher education for women considered as extravagance convention rather than elementary rights. Similarly, the overall literacy rate in Pakistan is not really astonishing in comparison to other under developing neighbouring countries. So, the significant question arises, why female education is lacking in Pakistan and how it can be improving by means of digital channels such as e-learning.

There are three major challenges which create interference and caused lower enrolment rate for female academic education in Pakistan. Following are the principles obstructions that effects women education in Pakistan:

- Barriers influencing women education in Pakistan.
- Cultural factors that hinder female education.
- Usability challenges of e-learning platform that deprive overall user experience.

4.1 Barriers influencing women education in Pakistan

Education is the fundamental human right of every individual in this world but the literacy rate in Pakistan for females is only 58% i.e. only half of the female population [7]. Another report “Shall I feed my daughter or educate her” published in 2018, stated that several cultural and socio-economic barriers are significant issues that affected the literacy rate in females. This study also indicated that only 13% of females never get an opportunity to enrol in 9th grade and 21% of females could not continue their education due to early marriages [19][1]. Furthermore, this literacy rate is quite low in Pakistan because these females have no access to education due to political instability, repression of society, lack of educational institutes, poor quality and standard of previous education, gender discrimination by families, early marriages and lack of interest of government to invest in education sector. These individuals are highly affected and repressed in the society due to cultural norms and barriers and cannot continue their education even after having high interest to develop better opportunities in the future [1].

Travel Freedom

According to exploratory studies which establish the general perception that due to travel freedom and long distances to academic institutions hinder the higher studies of women because fragile transportation network, travelling and accompany costs, physical and opportunity associated budget and higher cultural constraints on the agile movements of adolescent women in the society [19].

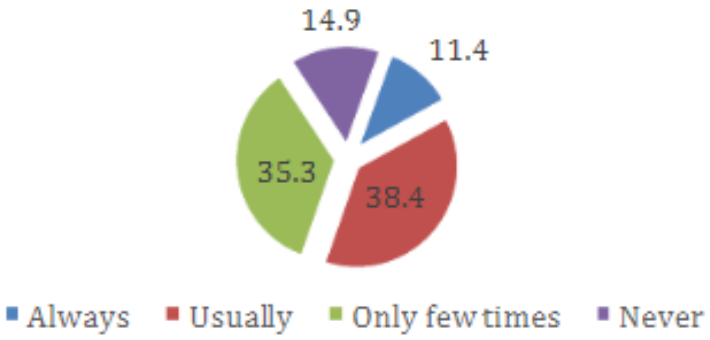


Figure 8: Travel Freedom [19]

The above figure illustrates the mobility of women in Pakistan to attend higher education. According to the statistics 38.4% women responds usual travel freedom, whereas 35.3% mentioned they managed only few times. Furthermore,14.9% women registered that they never went to the academic institute without any guardian support. Practically, only 11.4% women students were having travel freedom from home to academic institution which shows that mobility is one of the major problems that affects literacy rate in Pakistan.

Lack of Family Support and Opposition towards Women Higher Education

Principally educational support and opposition are directly associated with the family. Traditional norms and political influence served as the secondary barriers in the society. Similarly, it is vividly witnessed that educated guardian prefers their daughter to pursue higher studies meticulously, whereas illiterate or uninformed parents create hindrances on female education irrationally. Despite being an independent country and assimilation with distinct emerging nations, Pakistan progressively reforms its presence from conventional to liberally govern the role of women education in the context of socio-economic perspective. However, traditional models are fairly predominating in remote villages and countryside jurisdictions respectively [1][19].

Gender Discrimination

In general, due to gender biasness women often suffers with discrimination problems. The situation is not quiet appealing in Pakistan too and because of distinct cultural paradigms the status of women is expressively segregates across regions, classes and the urban / rural division. Considering the unequal socio-economic progression and impact of feudal, ethic, religious and other social developments constitute fragility in women empowerment. Largely, Pakistan is a male dictating or ruling society and normally holds an argumentative behaviour towards women. Likewise, gender discrimination caused lower enrolment proportion for girls even at primary school as well as for women at higher academic education [1][19].

The below figure illustrates that 62.2% participants were convinced that gender discrimination caused lower enrolment size of women higher education in Pakistan. In contract to that, 37.8% respondents were not agreed with the narrative. However, comprehensive findings strongly believe the opinion in majority and hence claim that due to inequal gender parity women higher education suffer extensively and if authorities favourably controlled the inequality there are astonishing outlooks for greater enrolments of women in higher education in Pakistan.

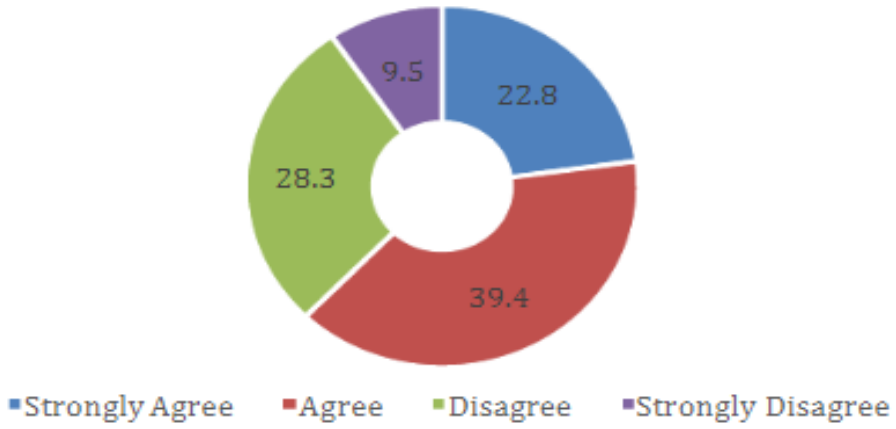


Figure 9: Gender Discrimination [19]

Early Marriage

In general, due to traditional, religious and other societal reasons early marriages is quiet trendy in Pakistan. The girl's matrimonial ceremony is the most anticipated event in Pakistan and associated with lots of protocols. Similarly, due to distinct rituals, customs and conventional marriage approach demands subsequent budget, hefty dowry arrangements, monetary gifts and other financial securities was managed by bride parents. Principally, after marriage most women are expected to perform household responsibilities which includes home chores, raising kids and look after their family considerably which won't allow them to pursue higher education substantially [1][19].

4.2 Cultural Influencing Factors

Pakistan's Cultural Index Table Based on Hofstede's Dimensions

While designing and developing prototype for any country specific system, it is crucial to understand the culture of targeted users as every culture has its own distinct behaviours, values, perceptions to perceive and communicate certain entities. It has been studied that several design elements such as colour, metaphor, language, page layout and others are associated with customs. Furthermore, it has been researched that there is a high impact of culture on students' learning and cultural differences highly influence in the adaptation of online learning management systems as digital learning users have their own way of interaction with teachers and other students [8]. To understand this in more detail, Hofstede's cultural influencing factors on e-learning have been discussed in the table below:

High Power Distance	Low Power Distance
▪ Prefer to participate in discussions ▪ Logos, slogans, visuals represents nationalization ▪ Limited accessibility and flexibility with fixed rules and principles ▪ Formal Layout ▪ Simple, informal, less structured, organized.	▪ No preference about discussions ▪ Logos, slogans and visuals must be adapted according to universal standards. ▪ Broader access and choices for interaction. ▪ Guidance and support for errors ▪ Complex, highly organized and categorized.

High Individualism	Low Individualism
▪ Focus on individual success and prospects. ▪ Focus on learning quality rather than methods ▪ Reluctant to ask help and engage with instructors and ask help from peers instead. ▪ Try to avoid discussions ▪ Prefers more content where single person story and success is emphasized	▪ Focus on national and institutional objectives. ▪ Focus on traditional methods of learning ▪ Promotes teamwork and peer to peer discussions ▪ Engage with instructors easily ▪ More localized content ▪ Pay more attention to elements that represent other people opinion such as comments section
High Masculinity	**Low Masculinity**
▪ Clear visibility and prominence of masculine roles and choices by adapting masculine themes, visuals such as boxing, men's sports etc. ▪ Use of soft colours ▪ Results oriented ▪ Women avoid or hesitate face to face interaction with peers ▪ Restricted the instruction to online access	▪ Clear visibility of female roles by adapting design choices such as feminine themes and visuals such as family, women empowerment etc. ▪ Use of vivid colours ▪ Practical and functional ▪ Emphasis on social interaction ▪ More cooperative and supportive
High Uncertainty Avoidance	**Low Uncertainty Avoidance**
▪ Clear message in the content ▪ Simple and clear ▪ Limited choices ▪ Resist to adapt new system ▪ Proper and strict guidelines for navigation, interaction and use. ▪ Use of site indicators such as site map, search engine and breadcrumbs. ▪ Need guided instruction in a case-based learning activity ▪ Detailed description	▪ Presence of indirect meaning in content ▪ Innovative ▪ Flexible and alternative choices for interaction ▪ No use of site indicators ▪ No need for detailed descriptions. ▪ Complex navigation structure ▪ Wide range of choices ▪ Pop up window suddenly opens.

Table 2: Culturally Based Web Design Factors [10] [38] [39] [40]

With the help of above table indicators, it is easier to understand the differences between societies based on Hofstede's cultural dimensions. As the proposed system will be developed for the women of Pakistan, it is important to study the cultural index table of Pakistan proposed by Hofstede. The following table represents the index table for cultural dimensions proposed by Hofstede for Pakistan:

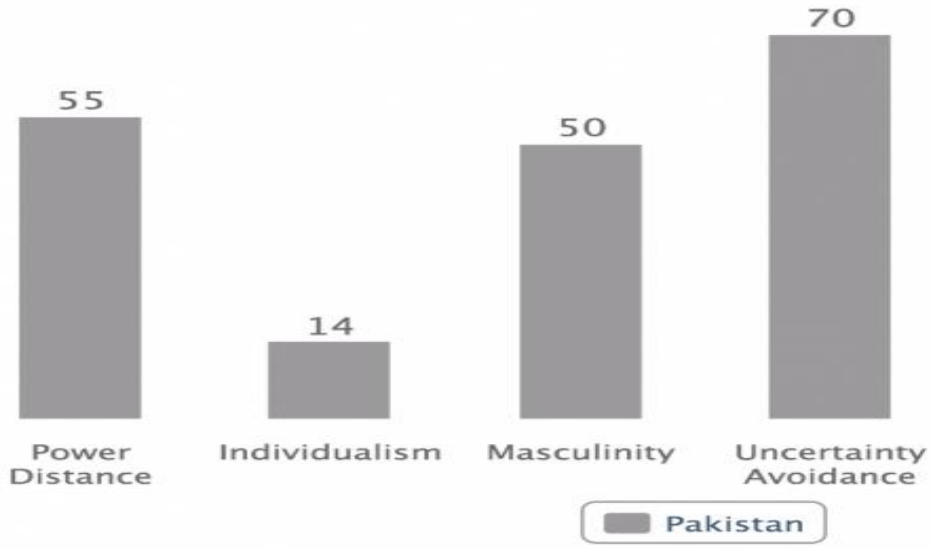


Figure 10: Pakistan Hofstede's Cultural Dimensions [31]

Based on the above table, it can be observed that the rate for power distance and masculinity is quite average in Pakistan [31] that drives in the favour of interactive e-learning approach while the uncertainty avoidance is adequately high. The high uncertainty avoidance and low individualism in the society of Pakistan represents the resistance against the adaptively of e-leaning systems which can be controlled by using right approaches in the system design that have been explained in the next section.

4.3 Usability of e-learning platform in context of User Experience

The primary objective to commence the system usability of e-learning platform is to address the user challenges relates to design constraints, site navigation, system effectiveness, error prevention etc. Ideally, greater user experience (UE) will constitutes unleash higher enrolment potential and improve the overall learning experience for women effectively and efficiently. Likewise, in order to thoroughly comprehend the usability challenges of existing e-learning platform I endeavour to design an inclusion and exclusion criteria which facilitates the selection of no. of Universities / Institute which includes Virtual University (VU), Comsats Institute of Information Technology and

Allama Iqbal Open University (AIOU). In order to conduct the survey results analysis essential USE questionnaire will be distributed in the above universities and institute to identify and recognize the overall student perception, learning platform challenges and opportunities towards comprehensive digital learning experience. Hence, overall 150 questionnaires were dispersed which aim to secure significant student's responses respectively.

The sample size for the first selected digital learning platform "Virtual University Learning Management System" was 50 but the total numbers of respondents were 41 so the overall participation record at Virtual University was 86% respectively. Correspondingly, identical USE questionnaire with 50 sampling size was perceived for Comsats Institute of Information Technology to examine "VComsats" online learning system and the comprehensive response was 74% favourably. Similarly, sample questionnaires were provided to the active students of "Allama Iqbal Open University" and 66% students managed to register their answers. Overall, the total response rate among all three universities was recorded at 74% respectively.

5 Results

In this section, I would thoroughly analyse the results acquired from the USE questionnaire and interviews and examine distinct usability factors that are essential in order to estimate the prevailing learning management system that are deployed in Pakistan.

5.1 Results from Questionnaire

Visibility of System Status and Content

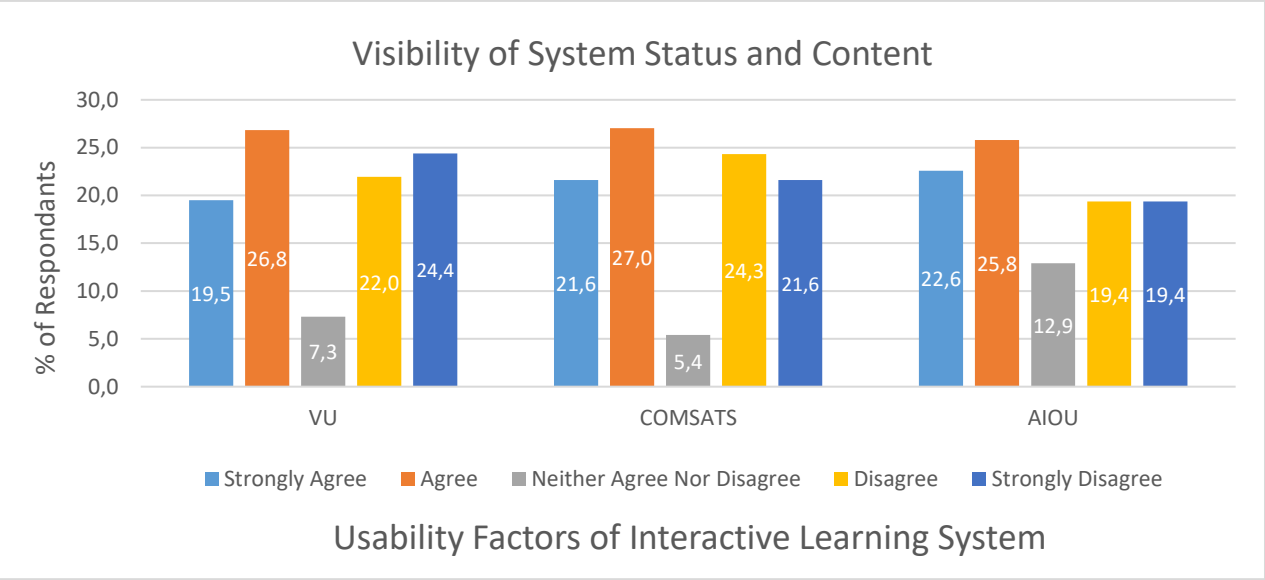


Figure 11: Visibility of System Status and Content

In the above figure, the analysis of results of questionnaire data of various online learning management universities of Pakistan can be analysed in the context of system visibility and relevant content. From the above graph, it can be concluded that almost half of the respondents enrolled in these three universities are not impressed with current system visibility and system status factor. On the other hand, 46% of the students seem to be satisfied with the visibility and content of the system with virtual university learning management system while almost 48% of the students either strongly agree or agree with the constraints of system and visibility and content of COMSATS and AIOU distance learning platform.

Site Navigation, Organisation and Structure

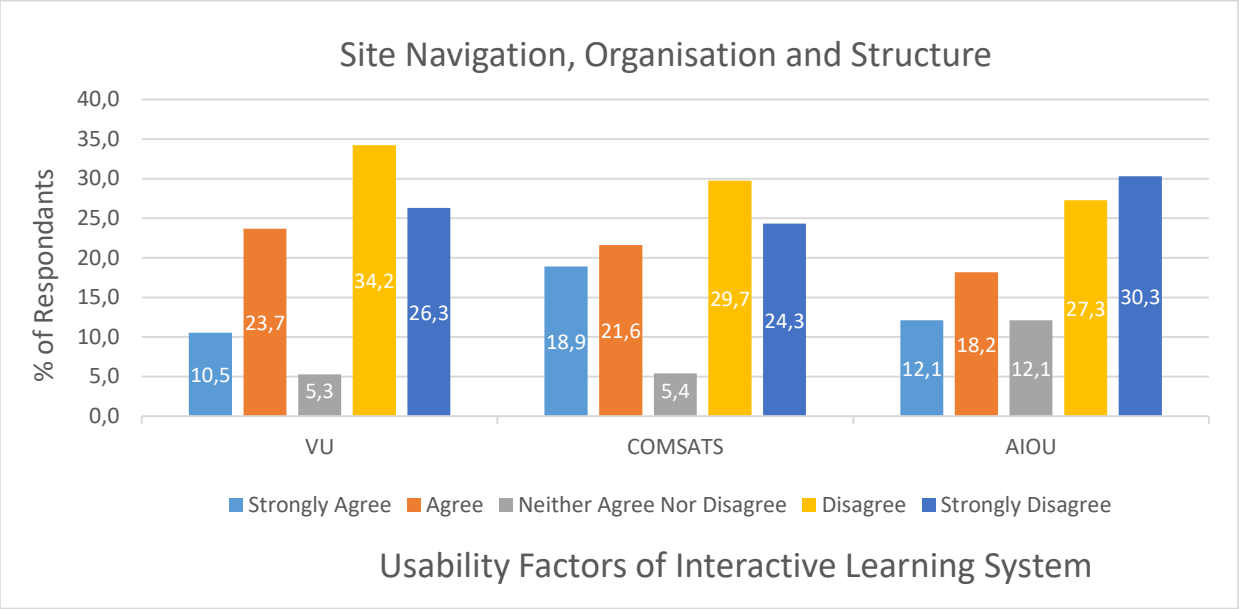


Figure 12: Site Navigation, Organisation and Structure

From the above graph, it can be analysed that the satisfaction rate for the site navigation and structure is quite low for all of three selected systems. For virtual university learning management system, only 10.5% of the respondents were strongly agreed with the constraints of site navigation and web structure while 24% agreed that they are content with this factor. Apparently, only 19% of the respondents using COMSATS online learning management system are highly satisfied with the system structure and navigation while 22% of the respondents are also agreed that the system is structured and well navigated. This show that the satisfaction rate for this factor of site navigation, layout and structure for the COMSATS online learning management is only 41%. Almost 30% of the respondents of AIOU also either agree or strongly agree with the asked questions relevant to site navigation and structure. This shows that the site navigation and structure of online learning management system is not highly appreciate able for the users using online learning management systems in Pakistan.

To sum up, more than 50% of the respondents clearly stated their disagreement with the navigation structure, presence of navigation buttons and proper web layout for all of the three systems. The ratio for disagreement and highly disagreement for Virtual Learning Management System, COMSATS and AIOU is 60%, 54% and 58% respectively.

Learnability and Accessibility

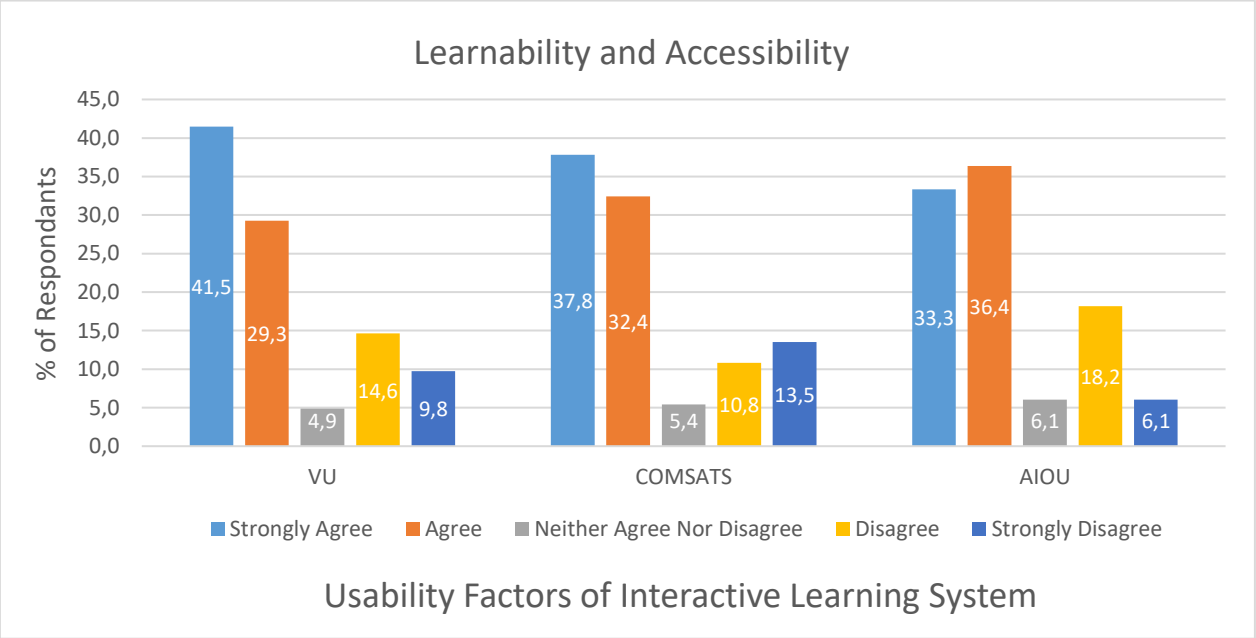


Figure 13: Learnability and Accessibility

In the above figure, the data analysis for the learnability and accessibility factor can be analysed easily. The data clearly shows an impression that all three systems are well performing in this area and providing easiness to their users to learn and access the system.

For the virtual university, COMSATS and AIOU almost 70% of the respondents either strongly agreed or agreed that they find the system to learn and remember with quite ease and do not find any hurdles while remembering or learning the system, while only 23%, 25% and 24% of the respondents either strongly disagreed or disagreed with this constraint of Virtual university, COMSATS and AIOU respectively.

The learnability factor and level of easiness to use the system is quite high for all the system and this shows this factor doesn't require any further improvement.

Consistency and Relevance

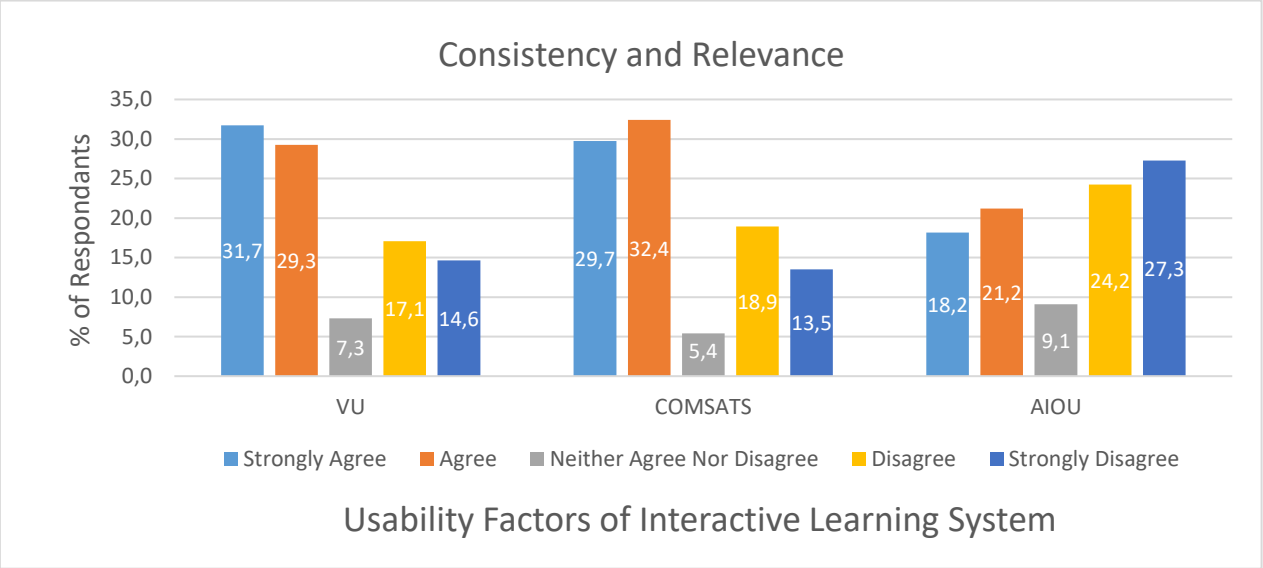


Figure 14: Consistency and Relevance

The factor of consistency and relevance is more towards the use of similar terminologies in the whole system and proper content provided to the students for study. It can be seen from the above graph, that 60% of the students in virtual university are quite satisfied with the study content relevancy and system consistency, while 32% of the students are not pleased with this constraint at all. For COMSATS online learning management, it can be concluded that almost 62% of the respondents either strongly agreed or agreed with the questions related to terminologies consistency and content relevancy, while 32% of the respondents either disagreed or strongly disagreed with this point. On the contrary with the above two mentioned systems, 39% of the respondents of AIOU online learning system claimed that they are not so pleased with the system consistency and content provided to them, while more than 51% of the students either disagreed or strongly disagreed with the factors associated with consistency and relevancy.

To conclude, the usability rate associated with consistency and relevancy factor is quite average in VU and COMSATS and too low in AIOU.

Efficiency and Flexibility

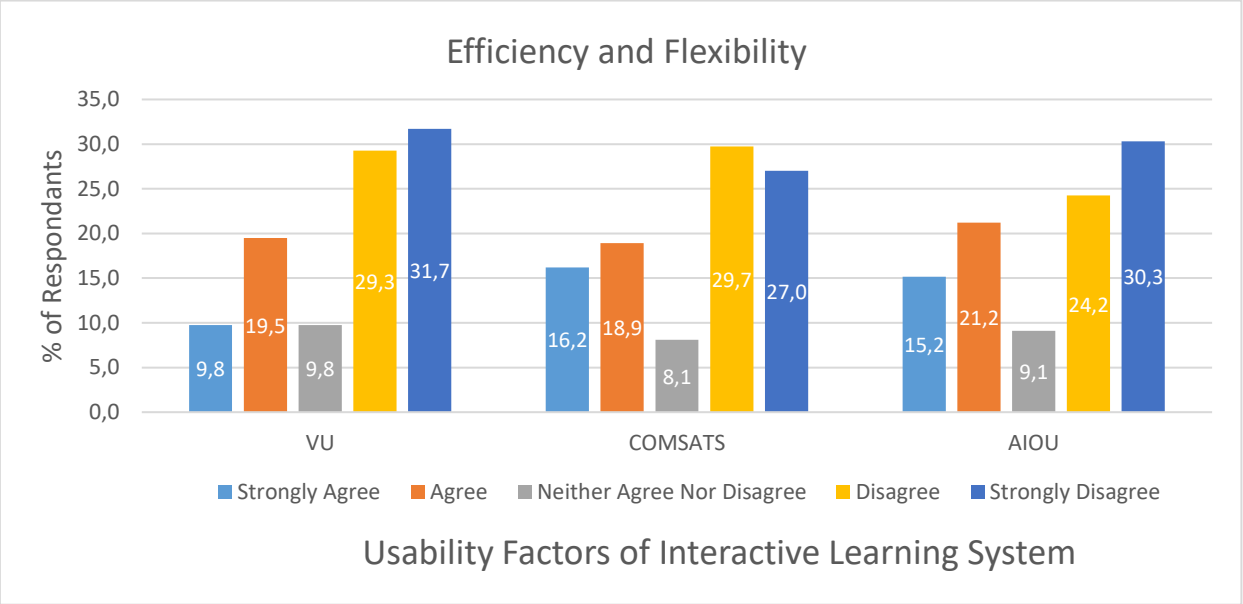


Figure 15: Efficiency and Flexibility

In the above graph, the efficiency and flexibility can be analysed of the selected systems. The flexibility is more related to customization and adjustments of settings while efficiency is more related to response time and least difficulties while using the system. All the systems are not able to provide enough flexibility to users and efficiency of the system. For the virtual university, it can be viewed that only 30% of the users may claim that system is flexible and efficient enough, while more than 60% of the users are agreed with this factor. Similarly, 35% of the respondents of COMSATS university are agreed with system flexibility and efficiency while 57% of the respondents disagreed or strongly disagreed in this regard. In the last, 26% of the respondents of AIOU are agreed with flexibility and efficiency factors while more than 54% of the respondents either disagreed or strongly disagreed.

The above analysis showed that the users must be provided some flexibility in terms of user settings and must apply the concept of fewer steps to perform a specific task. In this way, not only the response time will be increased but also the satisfaction rate will be improved for the users.

Effectiveness and Satisfaction

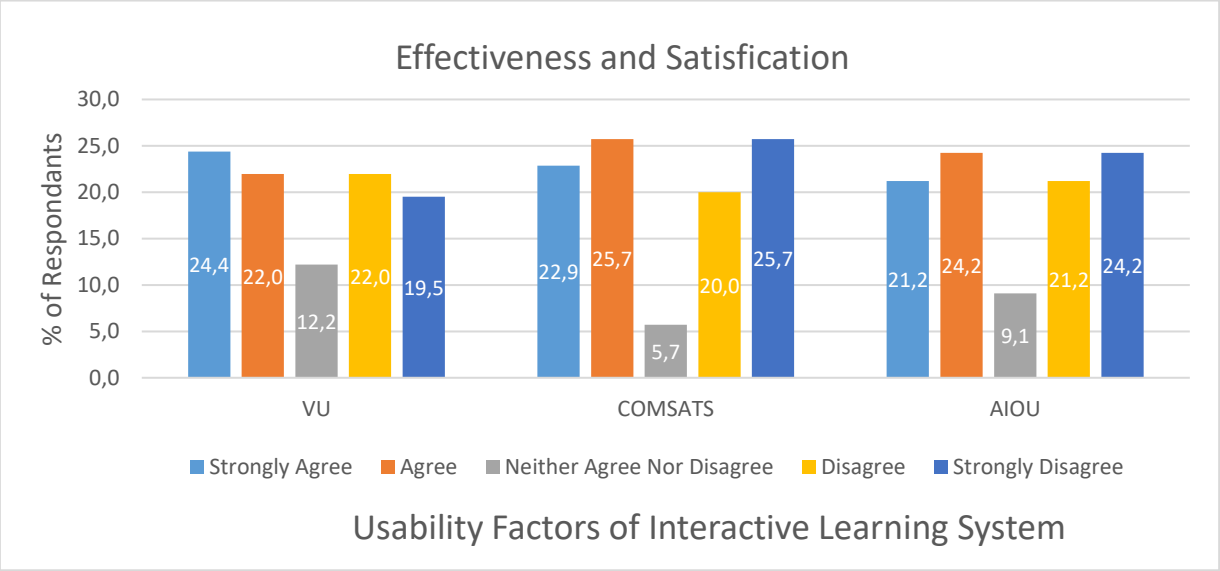


Figure 16: Effectiveness and Satisfaction

The above graph is related to system effectiveness and overall satisfaction rate of the system. It can be analysed from the above figure that the satisfaction rate is average in this contrast only for the virtual university. 56% of the respondents of virtual university claimed that the system is effective and productive while 42% of the respondents do not agree with the statement. 49% of the respondents of COMSATS university are also pleased with the activities and features of the system but on the other hand 46% of the respondents do not agree with the statement. In the last, 45% are satisfied with the AIOU distance learning system but more than 45% of the students do not have the same opinion and mentioned disagreement with the statement.

To sum up, there is a large room for the improvement for effectiveness and satisfaction rate for all these systems.

Error Prevention and Recovery

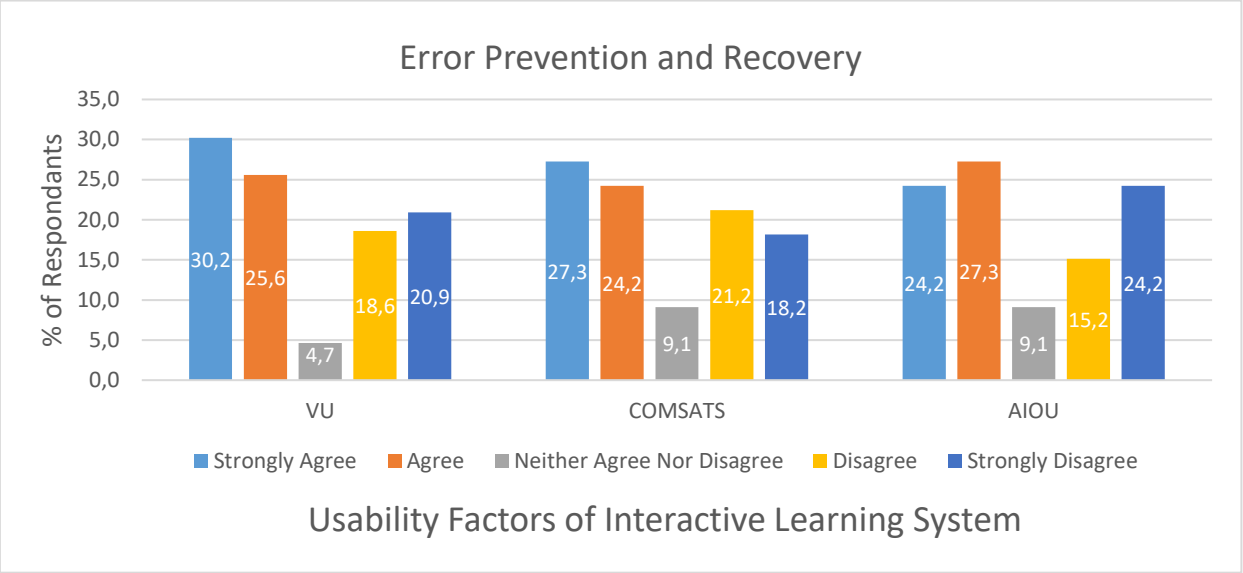


Figure 17: Error Prevention and Recovery

In the above graph, the user's response to the error prevention and recovery factor can be analysed. Most of the users for the selected systems come to an agreement with the use of error messages and proper prevention from serious errors. For example, 56% of the users of virtual university agreed that the systems help not to perform any serious error and displays appropriate error messages if applicable while 32% of the students did not agree with the statement. Likewise, 52% of the students of COMSATS and AIOU learning management system either agreed or strongly agreed with the error prevention and recovery statements while 40% of the students of COMSATS and AIOU were in the state of disagreement with such statements associated with the factor of prevention of errors and recovery.

Help and Support

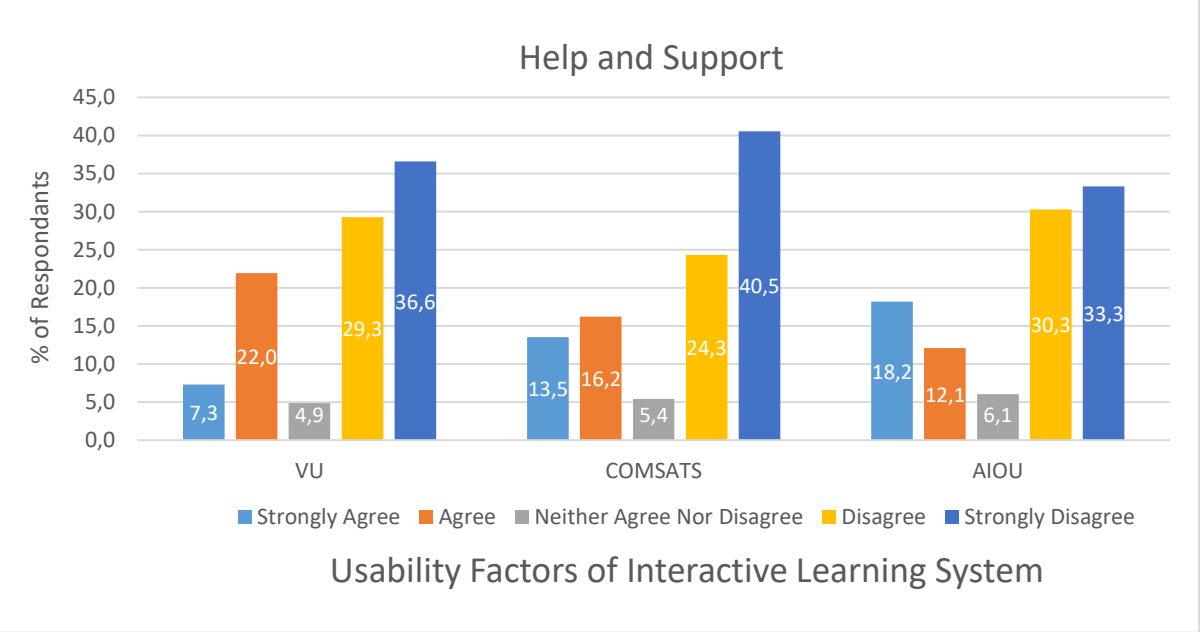


Figure 18: Help and Support

In the last graph of this section, it can be easily concluded that there is minimal use of help and support feature in most of the universities. Less than 30% of the enrolled students of virtual university and COMSATS distance learning program agreed about the help and support feature and user manual to learn the system while less than 65% of both universities find it difficult to identify appropriate information and resources when the system becomes dysfunctional. In the last, the rate of satisfaction with this feature is lowest in the respondents of AIOU as only 20% of the students either agreed or strongly agreed with the help function statements and 67% of the students either disagreed or strongly disagreed.

The help feature in these systems can only be seen on the home page and assist only to recover user credentials.

5.2 Results from Interviews

Primarily, data analytic considered as a significant segment in any research studies. Therefore, in this section, the data gathered from distinct aspirants in the form of discussion and interviews will be undertaken and conduct thematic analysis respectively.

Thematic Analysis

Thematic analysis is the procedure of recognizing themes or patterns in a qualitative data. According to Braun & Clarke (2006), proposed that it is the renowned qualitative technique that should be learned as 'it provides core skills that will be useful for conducting many other kinds of analyses' [36].

Apparently, thematic analysis is quiet candid and comprehensive in nature which offers valuable convenience and therefore distinct researchers carrying out a qualitative data analysis rigorously. It also facilitates the researcher to elect theoretical framework with greater flexibility and entails thorough and composite analysis of research data favourably.

Analysis through RQDA

In this study, qualitative data analysis will be performed through open-source software which is commonly known as RQDA. The aspirant's interview findings were transliterated in this research and later analysed using RQDA tool in order to execute thematic analysis. Furthermore, variable questions were asked during interviews and those were composite in nature, therefore dialogues are supplementary characterised as categories and distinct codes were defined as keywords which substantially facilitate and offers indispensable support to examine those interviews in order to achieve comprehensive thematic analysis.

Themes for Qualitative Data Analysis

Themes
Visibility and Site Navigation of e-learning Platform Structure
Application Learnability and Relevance of Content Management System
Effectiveness and Efficiency of digitally govern e-learning system
Barriers and Error prevention competency of interactive learning system

Table 3: Creating Themes for Qualitative Data Analysis

The following section represents the thematic analysis outcomes and provides details on them. The conclusions are associated with the themes and the categories that are illustrated in the table above. The acquisition of distinct themes was acquired from the codes of transliterated research in order to form rational interpretations of the study accordance to the volunteer's opinions.

Visibility and Site Navigation of e-learning Platform Structure

It is highly essential that visibility and site navigation of an e-learning application should be well design because it has a greater influence on users' routine interaction with the system for instance LMS structure, application menu, system layout, browser navigation etc. According to the interviewee, "Cloud learning management systems (CLMS) visibility is pleasant which includes terminologies related to specific tasks are appropriate. Secondly, application platform user interface and language representation such as symbols, buttons suffice the learner's expectation fairly". In addition to that, there are other significant choices which help to enhance the user experience that includes content and information are organised in an appropriate manner, dialect and terminologies are easy to follow.

Application Learnability and Relevance of Content Management System

Primarily, learnability refers to the accessibility of the platform and how convenient to learn the application and its processes. One of the interviewees said that "It is very straightforward to learn how to use the system and reasonably easy to remember its usage". Similarly, it also encounters the domain flexibility which subsequently associates

with the content management system. In order to examine CMS performance there are certain findings achieved through thematic analysis which includes content library, personalized learning, cognitive load and another aspirant emphasis on “tremendous flexibility for learners like one can easily access content anywhere and anytime.”

Effectiveness and Efficiency of digitally govern e-learning system

The accomplishment of digital learning platform is substantially depending on the overall operative efficiency of the system. It is observed via thematic analysis that effectiveness of digital learning system would be highly dependent on quick delivery of lessons, work-life balance, favourably achieving the learning objectives, IT system support, asynchronous learning etc. According to the interviewee, “Online learning accommodates everyone’s needs which facilitate asynchronous learning and quick delivery of lessons”. Likewise, efficiency could be measure through system layout, application response time, agile learning etc.

Therefore, it is estimated that adequate balance is highly essential between the application effectiveness in relation to its value proposition offerings.

Barriers and Error prevention competency of interactive learning system

In general, technical, financial and cultural limitations are often experienced and cause low implementation of interactive learning. However, it is examined that, following barriers would potentially hinder the digital learning implementation for women in Pakistan which includes highly dependent on third party services such as electricity and internet, bring your own device (BYOD), family customs (Culture), system technical issues etc. According to Allama Iqbal Open University student suggest that “e-learning is highly dependent on third party services such as internet, technology infrastructure, and browser compatibility problems”

Likewise, there is ample improvement opportunity that relates to error prevention such as offering robust help & support, periodic system maintenance, enhance system response rate and lastly error assistance respectively.

6 Discussion and Recommendations

6.1 Discussion

In this section, I would carry out the discussion in accordance to the research questions and extensively explain the overall user experience of distinct existing learning management system, design choices for the prospective LMS and effective implementation of an e-learning system.

Q1 - What is the overall user experience regarding the usability of distinct Learning Management Systems in Pakistan?

The primary determination of usability evaluation is to improve the user experience (UE) of interactive learning platform. Additionally, enhancing user experience will engage distinct concerns towards learner's diversity and incorporate system challenges such as heuristics which serves as a procedure in designing and examine HCI based digital platforms that largely address the needs such as platform consistency, feedback acquisition, site navigation, visibility, error prevention respectively [21][22]. According to survey data analysis, several aspirants were strongly agreed about the inconsistency of visibility and site navigation and empirically shared their perspective about platform ineffectiveness which subsequently effect the overall learnability and cause fragile user experiences respectively.

In terms of user experience, most of the interviewees have mixed opinions and proposed valuable improvements to emphasize on design choices. For example, one interviewee stated that '*the application programming interface (API) is nice and appealing, but I personally believe that visibility could be more emphasized by adding some interesting menu buttons, fonts, quotes and slogans.'* Similarly, another interviewee also specified that '*Usually, I found system is easy to follow and highlight the essential jobs that are significant for the students such as class timetable, homework, results etc. The computer-based training system of AIOU has menus on both sides of the page and various drop-down choices under each title on the main menu which is difficult for the users to locate the information and cause confusion. Similarly, application platform is not mobile friendly because images are not fully adjustable, menu options are also small and hard to find.*' As per comments by different end users, it can be perceived only minor changes

are required in the menu buttons, fonts and images for the attractive look and feel of the system.

In addition to that, most of the interviewees complained about the site navigation and layout of the system which was also reflected in the survey outcomes. One of the interviewees commented about the site navigation that. *'navigation is a nightmare because it's quite inconsistent for various reasons such as LMS searches functionality'* Another user also gave the same opinion by stating that '*it was difficult for me to recognize my current web page and view proper layout.'* Similarly, another interviewee commented that '*navigation via browser like previous (back) and next is occasionally not responsive in the system. The overall LMS structure is well organised despite some negligible inaccuracies.'* Hence, it has been observed that site navigation has an essential importance in terms of user experience and requires subsequent improvements that will encompass the user expectations and facilitate the overall system design.

Furthermore, few students discussed about the system capacity to handle the number of users. As stated, *"system response rate and capacity to host distinct no. of students on significant occasions would be burdensome for the application server which constitutes severe delays and cause inappropriate experience*" reported by interviewee.

Q2 - What should be the best design choices and usability considerations for the potential interactive digital learning system?

According to the interviews and survey results, there are numerous factors which has greater impact towards design choices and usability parameters. Majority of students proposed that overall system visibility and site navigation needs to be improved as it creates hindrances to follow the information sequence and cause ambiguity to locate relevant data. Most of the interviewees proposed definite suggestions about the system layout. For example, one of the interviewees proposed that '*In my opinion, the system should highlight the current page and there should be some navigational aid in the form of breadcrumb to recognize the detailed layout of the system.'* Likewise, another interviewee stated that *'There should be proper navigational aid and consistency in the system layout.'*

Similarly, system response rate was also mentioned by the aspirants which cause significant inaccuracies while interacting with the system. One of the interviewees suggested that *'system response rate should be improving, develop backend server capacity would be highly desirable in order to accommodate utmost traffic and avoid*

delays on crucial instances such as submission of course work at the deadline, online examinations and other classroom related participations.'

Moreover, while working on the design elements associated with Pakistan's cultural dimensions, it has been observed that slogans, images and other visual representations that illustrates state inspirations such as national quotes or images of vibrant leaders may also be useful in the enhancement of user experience. One of the interviewees particularly stated that *'because images are not fully adjustable, menu options are also small and hard to find.'* This means the size should be appropriate and understandable for the users. Another interviewee while commenting on visibility of the system suggested that 'visibility could be more emphasized by adding some interesting menu buttons, fonts, quotes and slogans.' Similarly, another user while discussing about font and image size commented that 'would require significant systematic changes in terms of mobile friendliness because smart gadgets are highly adaptable in the digital arena. Also, there is a scope in application menu design which require enhancement and could have been operate in a decent manner.'

Few of the comments about help and support feature also showed that it is one of the most desired functionalities for the users. One of the interviewees stated that *'enhance overall system Help and Support feature to avoid any unstructured technical malfunctioning.'* Moreover, as analysed the culture dimensions by Hofstede, the uncertainty avoidance factor is quite high in Pakistan, this shows the need of detailed descriptions, proper error and recovery messages, help and support section. In addition to that, feedback is also an essential feature discussed by interviewees. One of the users commented that 'certainly tough to seek timely feedback on learning sequels in case you missed the necessary checklist.'

Q3 - How to effectivelty implement an e-learning system for women in Pakistan?

In this study, discrete cultural norms, technical obstacles associated with platform and usability design constraints were addressed which constitutes ineffective implementation of e-learning system for women in Pakistan. Subsequently, after discovering the major challenges of prevailing e-learning systems with the help of interview and survey data analysis, it would be highly foreseeable to propose effective approaches which empower effective implementation of interactive learning which includes adaption of culturally oriented e-learning system that would be highly appropriate considering the standing circumstances. According to one interviewee illustrated that, *"I belong to a conventional family, where higher education for women considered as a unfavourable decision".*

Apparently, incorporation of cultural dimensions will improve the learning ability substantially and precisely facilitate the development of e-learning system with minimal usability constraints. As discussed previously in the literature review, culture is a distinct element and plays a lively role while interacting with the people.

Similarly, majority of the interactive learning platforms concluded to be ineffective in order to achieve its purpose due to insufficient usability considerations while developing a platform. Similarly, application developers and UI/UX designers often ignore the importance of usability effectiveness in the development phase which leads to drastic user experiences and subsequently impact the overall product effectiveness in a broader perspective. In this study, distinct cultural dimensions were discussed extensively which relates to end user experiences and preferences and propose guidelines for the developers that facilitate the user proficiency choices and ultimately support towards effective implementation of e-learning system. Furthermore, it also argued on significant factors that lessening the implementation of asynchronous learning that correlates to human computer interaction (HCI) which incorporates system usability, user experience (UE) viewpoint and usability assessment in the context of digital learning for women in Pakistan.

Moreover, effective implementation of an e-learning system is crucial and requires firm understanding of end users' mindset, perceptions, behaviors and expectations that are associated with distance learning [8]. To understand the influencing factors in e-learning, the cultural dimensions of Pakistan associated with the design elements have been discovered and proposed as recommendations.

6.2 Recommendations

In this section, the best design choices associated with cultural web design elements and the usability recommendations based on USE questionnaire have been discussed.

Cultural Web Design Elements

The recommendations in this section have been proposed for Pakistan after characteristics analysis of different societies and their preferred design choices based on cultural dimensions index table.

As the individualism factor is low in Pakistan and the targeted end users will be women, the e-learning platform must include ways for student-teacher interaction such as blog/forum, comments section under each lecture and flexibility for teachers to answer students' questions and provide feedback to motivate students. This motivation factor is crucial for the individuals in Pakistan to maintain their interest. Furthermore, there must be help and support feature for the students so the technical issues could be resolved so the appropriate and consistent guidance can be provided [10].

The power distance for the Pakistan is average and this shows that the page layout for the e-learning website can be formal, semi – formal or informal. However, as this system will be designed for the specific domain of education then it would be recommended to use formal layout for educational websites. In addition to that, this platform is only designated for the women of Pakistan, then it would be considered to use fewer masculine traits and higher power distance to emphasize on women empowerment. The systems with higher power distance represent their national culture and slogans which prefer to use visual images of their great leaders and historical elements. Moreover, the use of colours that represent both soft and vivid shades will be preferred because the society has high masculinity characteristic, but the target group is non masculine. It would be preferred to use visuals and slogans to represent women empowerment.

The uncertainty avoidance factor is adequately high in Pakistan so the system should be kept very clear and simple to use. This means that there should not be alternatives for users' choices and the given instructions must be simple and understandable. The content and messages in the system should be relevant and to the point. The primary principles govern the rules for navigation and interaction must be rigid and non-flexible. Furthermore, the system must include breadcrumb navigation, search engine and site map

so it would be convenient for the end users to understand and learn the system in less time. In terms of functionalities, there should be validation for each data input for the system so the risk can be avoided, and feedback can be given for each error. The error messages must be generated if some data field is missing or entered wrongly. The system should be able to provide practical, technical and functional knowledge to the women of Pakistan [10].

It has also been analysed that societies from south-east Asian region prefer to communicate and study in English rather than their own language. English is used as formal language and all the messages, documentation and notifications are delivered in English literature. As per culture, the language for the system will be English but there will be option to translate as females from rural areas may face some problem to understand technical terminologies and vocabulary.

Usability Recommendation based on USE Questionnaire and Interviews

In this section, the recommendation will be provided based on results analysis of USE questionnaire.

It seems that almost half of the students using e-learning platforms in Pakistan are not satisfied with the visibility and system status and this characteristic needs some improvement to enhance the usability of the system. It can be suggested that the irrelevant and not commonly used materials under different sections should be eliminated from the system. In addition to that, the terminologies and vocabulary used for digital learning should be kept clear and simple so it would be easier to understand for the students.

Apparently, most of the students in Pakistan using digital learning platforms are not pleased with the navigation and structure of the systems. This can be easily improved with the use of breadcrumbs, sitemap and visibility of the current page in the system.

From the results, it can be easily perceived that majority of the students are satisfied with the learnability characteristics of the system. All the mentioned systems have formal layout which is clear and simple to understand and that leads to high rate of learnability of the system. This area doesn’t require any further improved and should maintain ease of use.

The satisfaction rate for the consistency and relevancy of learning materials and content is quite average and this can be improved by providing interesting, relevant and latest

course materials to the students. The irrelevant and unused materials should be eliminated from the system.

Most of the students claimed that the e-learning system being used in Pakistan are not flexible and they have to perform number of tasks to reach desired result. To improve this factor, the systems must be enhanced, and only limited number of actions should be required to perform a certain task. For example, it should not be complex for students to add or remove a course for their current semester and it should be needed to access number of web pages to use this functionality. Furthermore, the students also complained about the response time for few functionalities. This should be eliminated in order to improve efficiency and reliability of system. Overall, the satisfaction rate is quite average for the systems and this can be improved by providing ability to interact for both students and faculty.

In terms of error prevention, the system can be improved by mentioning required and important data fields in the system. Additionally, there should be proper feedback provided to students in case of any wrong input and appropriate task. The instructions and feedback should be clear and easy to understand. The validation techniques can help to improve the usability and satisfaction rate for the systems.

In the last, most of the students were not content about the help and support feature of the system. There is no proper documentation, training or manual provided to the users in order to learn the system. There should be some induction and training sessions for the learning of system and documentation uploaded for the future use. In addition to that, technical support chat feature for the students may help the students in efficient way.

6.3 Future Work and Roadmap

In this section, implementation roadmap is being discussed as a guideline to the future learning management platform designers and developers towards the development of effective LMS targeting women colleges and universities in Pakistan who are planning to digitalize education and facilitate women education via e-learning.

Requirements and Target Audience Analysis

Firstly, it is highly essential to analyze both functional and non-functional requirements for the prospective learning management system while considering the targeted audience.

Similarly, most of the non-functional requirements such as content relevance, consistency, performance, learnability, flexibility etc. are closely related to usability factor of learning management system.

In this case, the targeted audience of digital learning platform is young female learners of Pakistan so the learning management system should be built according to their preferences. For this purpose, Hofstede's cultural dimensions and interview results were considered in order to estimate the essential requirements of target audience.

Women empowerment should be encouraged through influential female leaders, traditional symbols and in the form of design logos. Similarly, the page layout could be formal, semi-formal or informal but recommended to use formal layout for educational services. In addition to that, there should be use of sitemaps, search engine and breadcrumbs to avoid uncertainty. The course content and structure of the lectures should be concise and easy to understand in order to facilitate learners' expectations. Likewise, there shouldn't be greater number of menu choices for a single functionality or feature that may leads to confusion and distract aspirants. There should be guided instructions for learning activities. The earthy tones color shades should be chosen such as blue, green, purple and dark colors such as black and grey should be avoided. The site navigation structure should be simple with regulated choices. There should be proper error messages and indications to avoid mistakes. Adequate system training and timely support incorporate with learners needs. Possibility to contact peers for assistance and teamwork would be supportive.

Creating the User Persona

In order to develop a successful learning management system, it is highly essential to understand and create a user persona. In most cases, user persona, client persona or buyer persona is related to a fictional character that was created to illustrate a distinct type of user that might have considerable interest to use a platform in a desirable approach.

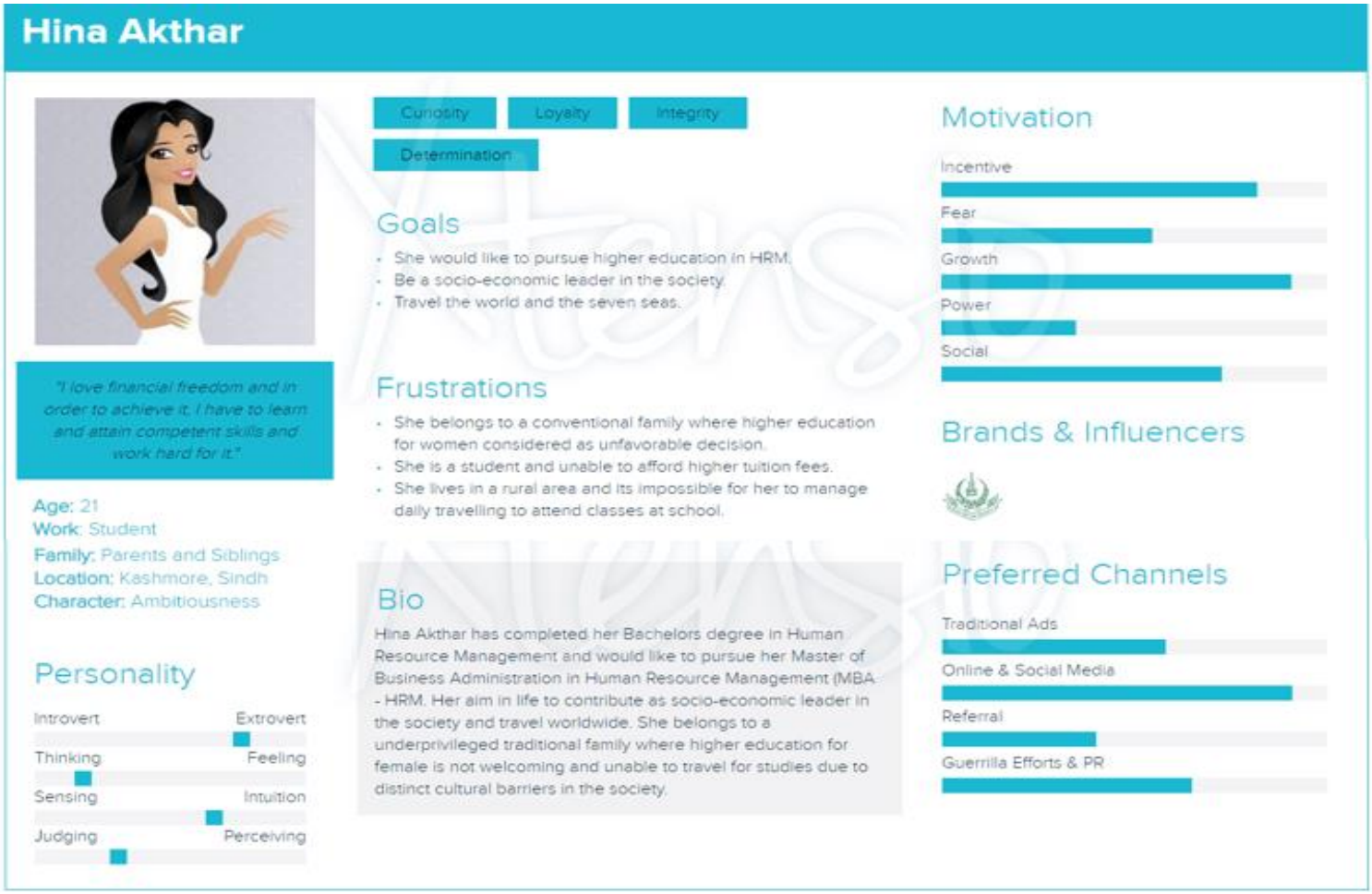


Figure 19: Learner (User) Persona

The above figure illustrated a user persona of one of our interviewees that she discussed about her personal user experience at Allama Iqbal Open University (AIOU). The client persona helps to estimate about user's bio, goals and obstacles in life. Furthermore, it also furnishes crucial information about personality traits, preferred channels to approach the user, motivation factors etc.

Design Choices

In this section, I will discuss about the key components that are essential in order to design the learning management platform. There are distinct designing tools available such as InVision, Adobe XD etc which facilitates faster, reliable and efficient product creation.

The chief objective of designing is to illustrate the idea and understanding the user preferences and incorporate those requirements in order to launch a successful product. Due to distinct advancements in the ICT arena, product development considered as an essential milestone and requires immense contribution related to design choices. In this study, I endeavor to captured best design choices that represents user experience based on interviews findings and serve as a carrier to enhance usability of prospecting learning management system for instance, the visibility of application programming interface (API) should be vibrant. Similarly, site navigational layout and structure has be consistent in order to locate content conveniently. Consequently, LMS should be mobile friendly such as images, text, menu buttons should be readable and adjustable. The graphic control for instance breadcrumb trail should be incorporated within the programs, documents and website for effective use of LMS. LMS should support distinct local languages in order to translate the content and facilitate students. Duplication of information, content, and parallel menus should be removed on as it may lead to confusion and compromise aspirant user experience. The designers must gather comprehensive information about the users such as cultural background, choice of language and other design related preferences in order to develop a user centric learning platform.

Implementation

The developers and designers should follow the above recommended design guidelines to build an effective user interface and enhance usability and accessibility. Furthermore, there should be more collaborative tools and features to get students' data such as tracking system for tutors to track students' attendance or performance. These features in the e-learning system could sustain the quality and may help to achieve learning outcomes more effectively. In addition to that, there should be functionalities that could help students to ask questions about the assignments, lectures and projects from the instructors. Also, the e-learning system should also promote teamwork by providing features like group discussion within the students to work on group assignments. In addition to that, the SCORM compliant feature should be implemented to enhance the interoperability of the

system. In the last, the feature to translate the content in the local language could be an additional benefit for the students to understand the terms efficiently.

It was observed from the survey and interview analysis that there are certain shortcomings found in the prevailing learning management systems in terms of functionalities that can make the digital learning platforms less productive and inefficient. Therefore, application developers are required to carry out work in the following areas in order to enhance the usability of the learning management system:

- Visibility of System Status and Content
- Site Navigation, Organisation and Structure
- Learnability and Accessibility
- Consistency and Relevance
- Efficiency and Flexibility
- Effectiveness and Satisfaction
- Error Prevention and Recovery
- Application Help and Support

Training

There should be proper training session for distinct stakeholders such as students, instructors and administrator to learn the system appropriately. This could be a video tutorial designed accordingly to different user role so it would be convenient to learn new functions with ease and less time.

Testing and Feedback

The functional and usability testing of both new and improved learning management system is significantly important and can play a vital role to assess the quality of the system. The feedback from the learners, instructors and administration bodies in the institutes can be used for the future improvements and enhancement of LMS. In addition to that, the feedback feature also helps to facilitate the relationship between teachers and students by asking students' feedback about the lecture contents and instructional methods and empower student's retention via e-learning.

7 Conclusion

In the end, to conclude it can be stated that the research objective was to address the overall user experience for the prevailing leading learning management system and to identify the best design choices to enhance usability for the prospective digital learning system.

In the first phase, the critical problems and significant causes have been recognized which substantially hinder and destabilize user experience of interactive learning. Similarly, the potential barriers that influence female education which includes travel and mobility constraints, gender discrimination, early marriage, lack of family support and opposition towards higher studies enrolment respectively have been extensively discussed. Likewise, accordance to the cultural proportions and discussed Pakistan's cultural index table based on Hofstede's dimension which includes high and low power distance, individualism, masculinity and uncertainty avoidance characteristics. Additionally, cultural web design elements to foresee considerable learning platform has also been argued.

In the second phase, the prevailing e-learning systems in Pakistan in order to examine the usability and design assessment was explicitly explored. Likewise, to determine the optimal learning platforms, the inclusion and exclusion criteria methodology to facilitate intense research objectives has been designed. As a result, the three leading interactive learning platforms were identified that offer higher education through distance learning in Pakistan. Furthermore, Dr Lund Arnold research questionnaire was deployed to acquire data from the end users for the assessment of usability and design parameters and estimate the outcomes of present e-learning platforms that facilitate women education in Pakistan.

In the third phase, the usability and design parameters of interactive learning system have been thoroughly investigated that are widely considered to examine the overall e-learning platform which includes Visibility of System Status and Content, Site Navigation, Organization and Structure, Learnability and Accessibility, Consistency and Relevance, Efficiency and Flexibility, Effectiveness and Satisfaction, Error Prevention and Recovery, Help and Support respectively. Furthermore, the comparative analysis of usability factors for selected universities and institute on Likert scaling system in order to estimate the optimal design preferences for prospecting platform was also carried out. Lastly, in order to validate the comprehensive findings, the female students were

approached who are currently enrolled and pursue higher education from universities and Institutes referred previously to conduct face to face dialogue and their valuable experiences were observed in order to conduct thematic analysis using RQDA.

In the last phase, the implementation roadmap for prospecting LMS was proposed considering the finding of USE Questionnaire and interviews. In addition to that, the importance of requirements and targeting audience analysis, designing the prototyping and create learner's persona, system development techniques for developers, training, testing and feedback analysis have also been thoroughly discussed in order to effectively implement future LMS to facilitate women education respectively.

References

1. Ambreen, Mamonah & Mohyuddin, Dr. Anwaar. (2014). Cultural Barriers to Girls' Education. EUROPEAN ACADEMIC RESEARCH. II. 8823-8841.

2. Bates, A. W. (1995). Technology, Open Learning and Distance Education. London: Routeledge.

3. Chukwuere, Joshua & Mavetera, Nehemiah & Mnkandla, Ernest. (2015). A Conceptual Culture-Oriented e-Learning System Development Framework (e-LSDF): A Case of Higher Education Institutions in South Africa. 2015 6th International Conference on E-business, Management and Economics. 6. 10.18178/ijtef.2015.6.5.479.
4. Chukwuere, Joshua. (2018). The application of a culture-oriented e-learning system framework for developers : an approach for developing countries. Journal of Gender, Information and Development in Africa. 7. 9-37. 10.31920/2050-4284/2018/v7n2a1
5. Daniel, A. & Oludele, A. & Baguma, Rehema & Weide, Theo. (2000). Cultural Issues and Their Relevance in Designing Usable Websites.
6. Dawson, C. (2005). Projects in Computing & Information Systems: A Students Guide, Addison-Wesley, ISBN: 0-3212-6355-5, (pp. 10-13).

7. Derbyshire, V. (2018) Literacy Rate in Pakistan 2018, UNESCO | INNNEWS.PK. Retrieved 1 December 2019, from https://innnews.pk/literacy-rate-in-pakistan-2018/

8. Erişti, S. (2009). CULTURAL FACTORS in WEB DESIGN. Available at: http://www.jatit.org/volumes/research-papers/Vol9No2/5Vol9No2.pdf

9. Feldstein, M. (2002). What is “usable”e-learning? ACM eLearn Magazine, 9.

10. Ferreira, Dan. (2016). Bridging the Cultural Gap of Online Learning: Implications and Strategies. Language Research Bulletin. 31.

11. Ihamäki, H., & Vilpola, I. (2004). Usability of a Virtual Learning Environment Concerning Safety at Work. Electronic Journal on e-Learning, 2(1), 103-112.

Retrieved at 12 February 2020 from http://www.ejel.org/volume-2/vol2-issue1/issue1-art18-ihamaki-vilpoloa.pdf.

12. IEEE. (1990). Standard Glossary of Software Engineering Terminology," in IEEE Std 610.12-1990 , vol., no., pp.1-84.

13. ISO. (1997). ISO 9241-11: Ergonomic requirements for office work with visual display terminals (VDTs). Part 11 guidelines for specifying and measuring usability. Geneva: International Standards Organisation. Also available from the British Standards Institute, London.

14. ISO. (1998). ISO 9241-11: Ergonomic requirements for office work with visual display terminals (VDTs)-Part 11: Guidance on Usability.

15. ISO/IEC (2000). ISO/IEC 9126-1: Software Product Evaluation–Quality Characteristics and Guidelines for the User.

16. Jones, P., Packham, G., Miller, C., Davies, I., & Jones, A. (2003). e-Retention: An Initial Evaluation of Student Withdrawals within a Virtual Learning Environment. In R. Williams (Ed.), Proceedings of the 2nd European Confrence on eLearning (pp. 239-248). Reading: Academic Conferences International.

17. Kent, T. (2003). Supporting staff using WebCT at the University of Birmingham in the UK. Electronic Journal of e-Learning, 1(1), 1-10.

18. Lund, Arnold. (2001). Measuring Usability with the USE Questionnaire. Usability and User Experience Newsletter of the STC Usability SIG. 8.

19. Mehmood, Sumara & Chong, Li & Hussain, Mehmood. (2018). Females Higher Education in Pakistan: An Analysis of Socio-Economic and Cultural Challenges. Advances in Social Sciences Research Journal. 5. 10.14738/assrj.56.4658.

20. Melis, E. et al., Weber, M., (2003) Lessons for (Pedagogic) Usability of eLearning Systems, Saarbruecken, Germany, Retrieved 22 January 2020 from http://www-ags.dfki.uni-sb.de/~melis/Pub/elearn03Usability.pdf

21. Nielsen, J. (1993) Usability Engineering, Cambridge, Academic Press.

22. Nielsen, J. (1994) "Heuristic Evaluation". In Jakob Nielsen and Robert L. Mack, editors, "Usability Inspection Methods". John Wiley and Sons, Inc

23. Preece, J., Rogers, Y., & Sharp, H. (2002). Interaction design: Beyond human-computer interaction. John Wiley & Sons, Inc.

24. “Shall I Feed My Daughter, or Educate Her?” | Barriers to Girls’ Education in Pakistan. (2018). Retrieved 2 December 2019, from https://www.hrw.org/report/2018/11/12/shall-i-feed-my-daughter-or-educate-her/barriers-girls-education-pakistan

25. SIG–CHI. Notes from E-learning Special Interest Group (SIG) - Discussion at CHI (2001). Retrieved 21 February 2020, from http://www.elearnmag.org/

26. Smulders, D. Designing for Learners, Designing for Users. ACM eLearn Magazine (2002). Retrieved 23 February 2020, from http://www.elearnmag.org/

27. Squires, D. (1999). Usability and Educational Software Design: Special Issue of Interacting with Computers. Interacting with Computers, 11(5), 463–466. doi:10.1016/S0953-5438(98)00062-9

28. The Social and Economic Effects of Adult Literacy in Africa - eLearning Africa News Portal. (2018). Retrieved 3 February 2020, from https://ela-newsportal.com/the-social-and-economic-effects-of-adult-literacy-in-africa/

29. Top 3 Universities Offering Distance Learning in Pakistan. (2020). Retrieved 3 April 2020, from https://www.zameen.com/blog/universities-offering-distance-learning-pakistan.html

30. Zaharias, P. (2006). A usability evaluation method for e-learning. CHI '06 Extended Abstracts On Human Factors In Computing Systems - CHI EA '06. doi: 10.1145/1125451.1125738

31. Zahid, W. (2014). Want to know about Pakistani culture? Try this 6-D Model. Retrieved 25 March 2020, from https://walizahid.com/2014/04/want-to-know-about-pakistani-culture-try-this-6-d-model/

32. Aparicio, Manuela & Bação, Fernando & Oliveira, Tiago. (2016). An e-Learning Theoretical Framework. Journal of Educational Technology Systems. 19. 292-307.

33. Is Your Organization Ready for "Education as a Service?" - GlobalEnglish. (2020). Retrieved 31 March 2020, from https://globalenglish.com/education-as-a-service/?fbclid=IwAR3GNlh475ErGpc71Xl9dK6o2QYOIqlk7Kl2UU2BMo0_ANAh5MWbDm8gBac

34. Chang, Vanessa & Uden, Lorna. (2008). Governance for E-learning ecosystem. 340 - 345. 10.1109/DEST.2008.4635164.

35. The Role of Governance in Learning Transformation. (2013). Retrieved 31 March 2020, from https://leolearning.com/blog/learning-strategy/governance-learning-transformation/

36. Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3, 77-101.

37. Pappel, I.; Pappel, I. (2012). Using e-learning methods in (e-)implementation of e-governance software at local governments. Case study in Estonian way. Advances in Digital Library Development: International Conference on Digital Libraries and Knowledge Organization ICDK 2011, Gurgaon, India, 14-16.02.2011. _EditorsAbbr Antony Jose. Delhi: Macmillan Publishers Ltd, 413−419.

38. Lachner, F., Nguyen, M., & Butz, A. (2018). Culturally sensitive user interface design. Proceedings Of The Second African Conference For Human Computer Interaction On Thriving Communities - Africhi '18. doi: 10.1145/3283458.3283459 Available at: https://www.medien.ifi.lmu.de/pubdb/publications/pub/lachner2018africhi/lachner2018africhi.pdf

39. Vitols, G., & Vitols-Hirata, Y. (2018). Impact of Culture Dimensions Model on Cross-Cultural Website Development. Proceedings Of The 20Th International Conference On Enterprise Information Systems. doi: 10.5220/0006781005400546 Available at: https://www.scitepress.org/Papers/2018/67810/67810.pdf

40. Ferreira, Dan. (2016). Bridging the Cultural Gap of Online Learning: Implications and Strategies. Language Research Bulletin. 31. Available at : https://www.academia.edu/31918381/Bridging_the_Cultural_Gap_of_Online_Learning_Implications_and_Strategies

41. Amjad Khan, A., 2014. *Opinion Divided Over Benefits Of Women'S Universities*. [online] University World News. Available at: https://www.universityworldnews.com/post.php?story=20140219104834967.

42. Pangestu, H., & Karsen, M. (2016). Evaluation of usability in online learning. 2016 International Conference On Information Management And Technology (Icimtech). https://doi.org/10.1109/icimtech.2016.7930342

43. Assessing the Relative Importance of an E-learning system's Usability Design Characteristics Based on Students' Preferences. (2019), 8(3). https://doi.org/10.12973/eu-jer.8.3.839

44. Gunesekera, A.I., Bao, Y. and Kibelloh, M. (2019), "The role of usability on e-learning user interactions and satisfaction: a literature review", Journal of Systems and Information Technology, Vol. 21 No. 3, pp. 368-394. https://doi.org/10.1108/JSIT-02-2019-0024

Appendix 1 – Questionnaire

Usability Questionnaire for e-Learning / Digital Learning Platform

Name of Institute/University: _____ Age: _____

Registered as: Student □ / Faculty □ **Gender:** Male □ / Female □

For each of the following statements, rate each item between 1-5 with 1 being "strongly disagree" and 5 being "strongly agree".

	Visibility of system status & contents	**1**	**2**	**3**	**4**	**5**
1	The interface of registered e-learning website is pleasant and attractive.	□	□	□	□	□
2	The system is easy to understand and highlights the tasks that you think of most important.	□	□	□	□	□
3	Font (size, style and colour) are easy to read on-screen.	□	□	□	□	□
4	Contents of system are organized in proper manner.	□	□	□	□	□
5	Language usage in system like terms, phrases and symbols are easy to understand.	□	□	□	□	□
6	Terminologies related to task are appropriate.	□	□	□	□	□
	Site Navigation, organization and structure	**1**	**2**	**3**	**4**	**5**
7	The e-learning platform has a simple navigational structure and related information is placed together.	□	□	□	□	□
8	System layout remains same when you navigate from one page to other.	□	□	□	□	□
9	Every page has the required navigation buttons or hyperlinks (links), like as previous (back) next and home.	□	□	□	□	□

10	Navigation through browser like previous (back) and next is supportive by the system.	□	□	□	□	□
Consistency & Relevance of site content		**1**	**2**	**3**	**4**	**5**
11	The same words, concepts, situation, symbols or actions refer to the same thing.	□	□	□	□	□
12	The e-learning system follows common platform standards.	□	□	□	□	□
13	The course contents are attractive, relevant, appropriate and clear to students.	□	□	□	□	□
14	System is free from irrelevant material (which is not used by students).	□	□	□	□	□
Error Prevention, recovery from errors & feedbacks		**1**	**2**	**3**	**4**	**5**
15	The system helps user not to make serious errors.	□	□	□	□	□
16	Systems displays appropriate messages in case of any error.	□	□	□	□	□
17	Displayed error message defines problem and immediately provide instructions for recovery.	□	□	□	□	□
18	System provides proper academic feedback about student activities like project or assignment deadlines.	□	□	□	□	□
Learnability (Ease of Learn) & Accessibility		**1**	**2**	**3**	**4**	**5**
19	It is easy to learn how to use the system.	□	□	□	□	□
20	It is easy to remember how to use it.	□	□	□	□	□
21	It is easy to become skilful to control the system.	□	□	□	□	□
22	You explored new features by using trials and learning from errors.	□	□	□	□	□

23	You never observe any technical problems (hyperlink errors, programming errors etc.) while using the system.	□	□	□	□	□
24	The response rate of system is good, and system is reliable.	□	□	□	□	□
Flexibility and efficiency of use		**1**	**2**	**3**	**4**	**5**
25	The system is flexible or customizable and users can adjust settings.	□	□	□	□	□
26	The system requires fewer steps to accomplish desired tasks.	□	□	□	□	□
27	Using the system is effortless and can be used without written instructions.	□	□	□	□	□
28	Both new learners and expert users can use it without difficulty	□	□	□	□	□
Help and Support		**1**	**2**	**3**	**4**	**5**
29	The site has a help facility and other documentation support student's needs.	□	□	□	□	□
30	Information is easy to search, appropriate and support to accomplish tasks.	□	□	□	□	□
Effectiveness and Satisfaction		**1**	**2**	**3**	**4**	**5**
31	The e-learning system helps me to become more effective and productive	□	□	□	□	□
32	The system gives me control over my learning activities and save my time.	□	□	□	□	□
33	Activities and features available in system encourage student-teacher and student-student interaction.	□	□	□	□	□

34	I am satisfied with the system and it is fun to use.	□	□	□	□	□
35	I work the way I want it to work.	□	□	□	□	□
36	What are your suggestions for the improvement of system?					
37	To which extent system supports your overall learning? What problems you face on daily basis that effects your overall learning while using this system?					

Appendix 2 – Interview Questions

Q1: Please introduce yourself and which program are you studying at Virtual University?

Q2: Why you preferred e-learning instead of traditional classroom-based training (CBT) at school?

Q3: What is your impression about the interactive learning system?

Q4: What problems do you faced during the interaction with the system?

Q5: How system constraints will affect your overall learning while using digital platform?

Q6: To what extent system supports you to attain learning activities or objectives?

Q7: What are the advantages and disadvantages of distance learning?

Q8: How do you see the overall visibility of the system?

Q9: What is your opinion about site navigation and platform structure?

Q10: Do you find the digital learning content management system (CMS) is relevant and consistent?

Q11: How do you define the system flexibility and efficiency in the context of digital learning?

Q12: How do you explain overall system learnability and accessibility of resources?

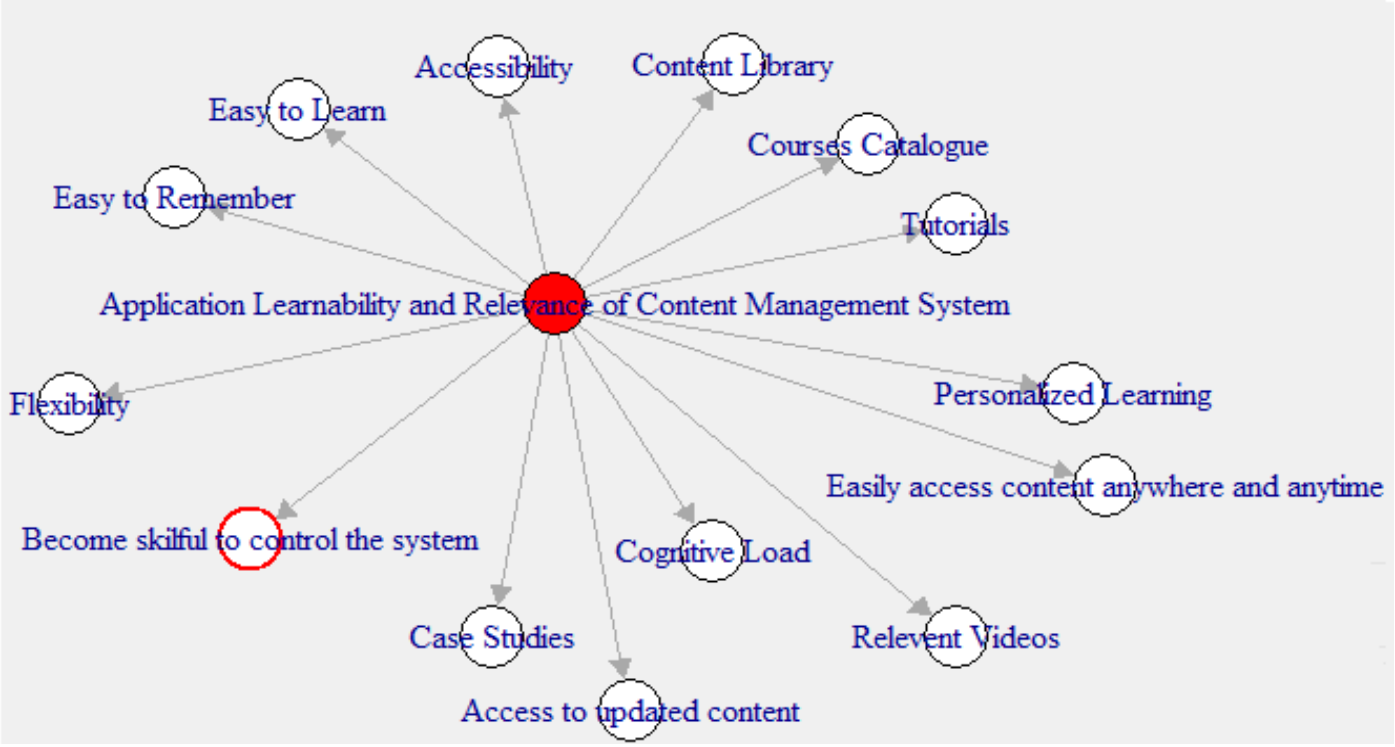
Q13: Please share your experience about the system effectiveness and satisfaction level?

Q14: Do you think interactive learning system is capable of error prevention and recovery?

Q15: What are your suggestions towards the improvements of system?

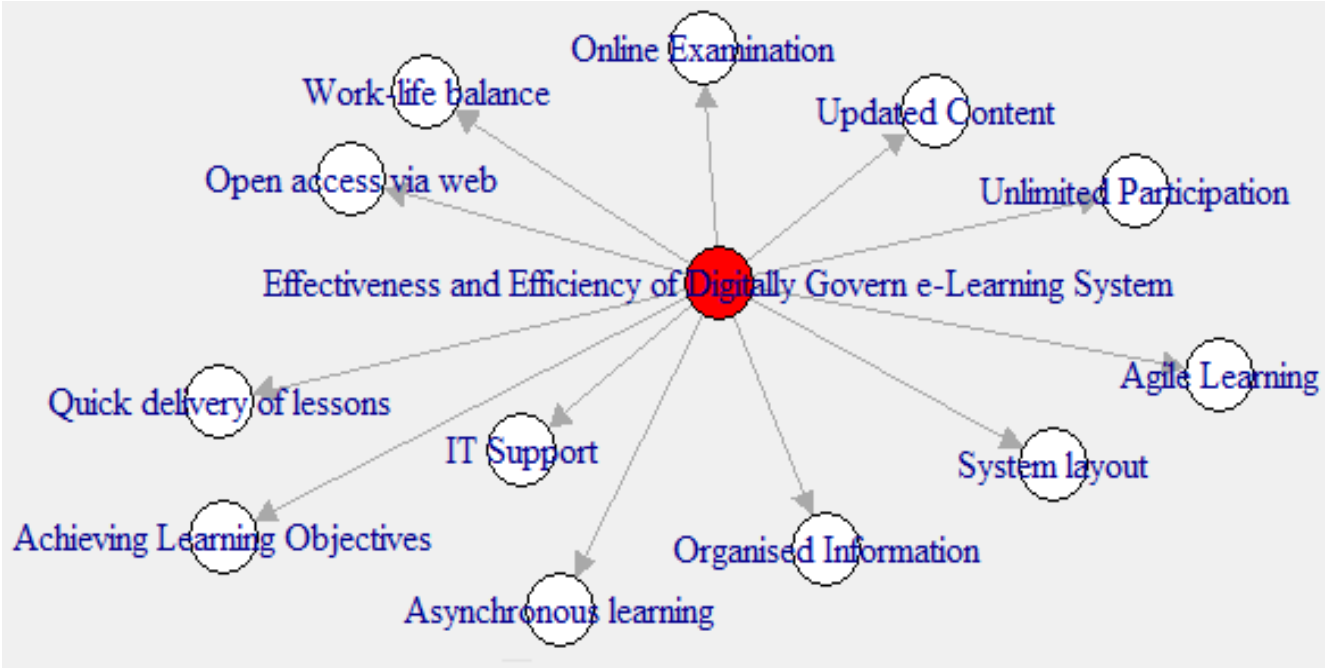
Appendix 3 – Thematic Analysis

Category 1: Application Learnability and Relevance of Content Management System



Category 2: Visibility and Site Navigation of e-learning Platform Structure

Category 3: Effectiveness and Efficiency of Digitally Govern e-Learning System



Category 4: Barriers and Error Prevention Competence of Interactive Learning System