Usability Issues in Content Based Multimedia Computer Based Trainings
Emphasizing on Content Based Multimedia Computer Based Trainings Developed by Allama Iqbal Open University (AIOU).

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ABSTRACT

In distance education, students and teachers are at different places and interact with each other with the help of different technologies. Broadcast television, two-way video conferencing, asynchronous learning mode, virtual learning environment (VLE) and content based multimedia computer based trainings (CB-MCBTs) are some of the technologies used to provide distance education. Content Based Multimedia Computer Based Trainings (CB-MCBT) is a computerized learning environment.

The acceptance of computerized learning environment is based on its usability. And usability in any computerized learning environment is supportive to learners and it increases their learning experiences of learners.

Authors of this research have evaluated usability of CB-MCBTs, specifically CB-MCBTs designed by AIOU. Usability evaluation has been performed to find out usability issues in CB-MCBTs, and figured out requirements of learners regarding CB-MCBTs. To figure out usability issues in CB-MCBTs authors have used inquiry technique with focus group and questionnaire.

Authors have proposed usability criteria to evaluate usability of CB-MCBTs. Each element of proposed criteria is based on principle of user interface design, and three main usability aspects: effectiveness, efficiency, and satisfaction.

Development of CB-MCBTs in AIOU is nice and unique effort in the field of computer based trainings. However if these CB-MCBTs are designed to support distance education, then AIOU should focus on the availability of CB-MCBTs to the students, feedbacks within CB-MCBT and feedback from university to students and completeness of these CB-MCBTs regarding features and facilities required by the students.

This research also gives recommendation to AIOU for improvements in CB-MCBTs. These recommendations are helpful to fix usability issues in CB-MCBTs and to make these CB-MCBTs according to the requirements of learners.

Keywords: Usability, Computerized Learning Environment, Usability issues in computerized learning environment, Computer Based Trainings. Content Based Multimedia Computer Based Trainings.

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CHAPTER 1: INTRODUCTION AND BACKGROUND

Chapter 1 provides brief introduction and background of this research. Authors of this research have fleshed out usability and its three main aspects effectiveness, efficiency, and satisfaction in section 1.1. Introduction of AIOU and distance education are described in section 1.2. Section 1.3 elaborates educational computing and its history. Section 1.4 and 1.5 presents computer based learning and computerized learning environment. Content Based Multimedia Computer Based Trainings is explained in section 1.6. The last section 1.7 describes Multimedia Courseware Design Center AIOU and elaborates each component of CB-MCBTs developed by AIOU.

Content based multimedia computer based trainings are used to provide educational trainings to increase the learning experience of leaner's; CB-MCBTs is a computerized learning environment and usability in computerized learning environment is very important because it affect the whole user satisfaction and ability to learn the system. Usability in computerized learning environment is also helpful for learners to increases their subjective learning. If the environment is useful then user will fully concentrate on educational learning instead of learn how to operate the system.

1.1 Usability

Usability is a significant issue in human computer interaction, and its aspects commonly refer to the quality of user interface (Semugabi et al., 2007). According to ISO 9241-14, the definition of usability is: *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* (ISO/IEC, 9241-14, 1998). Usability helps the users to achieve their goals during their work, and it does not only focus on user interface of product.

Goal: *intended outcome* (Jokela et al., 2003)
Task: *activities required to achieve a goal* (Jokela et al., 2003)

According to Jakob Nielsen usability has five attributes: learnability, efficiency, memorability, errors, and satisfaction (Nielsen, 1993).
Here we would like to define efficiency, effectiveness, satisfaction, learnability, memorability and errors
Efficiency: Once user learned the system, how fast he/she can accomplish task (Usability basic, www.usability.gov). It is the relation between completeness and accuracy with which user achieve specific goal (Jokela et al., 2003). Resources used to achieve goal is also efficiency e.g. time. Therefore primary metric of efficiency is time spent to complete any task (Frøkjær et al., 2000).

Effectiveness: It is about how well goal is achieved? It is accuracy and completeness with which user attains certain goals by performing some tasks. Metrics of effectiveness are error rates and quality of solution. But the primary metric is quality of solution (Frøkjær et al., 2000).

Satisfaction: how much user likes to use the system (Usability basic, www.usability.gov)? It is user's positive attitude and comfort toward the system. Satisfaction's metric is attitude scale (Frøkjær et al., 2000).

Learnability: "Learnability is concerned with the cost to the user in reaching some competent level of performance with a task excluding the special difficulties associated with completing the task for the first time" (Jordan, P. W. 1998), e.g. if user can easily learn the method of performing the task in any application while using it first time, then the application is highly learnable for this particular task (Jordan, P. W. 1998). According to (Carol, M. 2001) "Learnability is that system should be easy to learn so that the user can rapidly start doing some work".

Memorability: Once user uses the system, how easily user memorizes the user interface of the system and how easily user can reuse the system after a break (Usability basic, www.usability.gov). One study (Carol, M. 2001) defines memorability as "system should be easy to remember, so that the casual user is able to return to the system after some time and not have to learn it over again".

Errors: How often user makes errors or mistakes while interacting with the user interface of the system, and how serious these mistakes and errors are.

1.2 Distance Education and Allama Iqbal Open University (AIOU)

Distance education is planned learning teaching process that normally occurs in a different place. Distance education requires special course designs and instructional techniques and universities communicate with students through various technologies (Moore et al., 1996). In distance education students and teachers are at different places, and communicate with each others with the help of different technologies. Most of the people use the term distance learning and distance education in the same context however distance learning only focuses on learners but distance education focuses on both learning and teaching processes (Moore et al., 1996). Some people think that distance education begins after arrival of internet but this is wrong perception, distance education has historical background that is clearly visible by the figure 1.1.
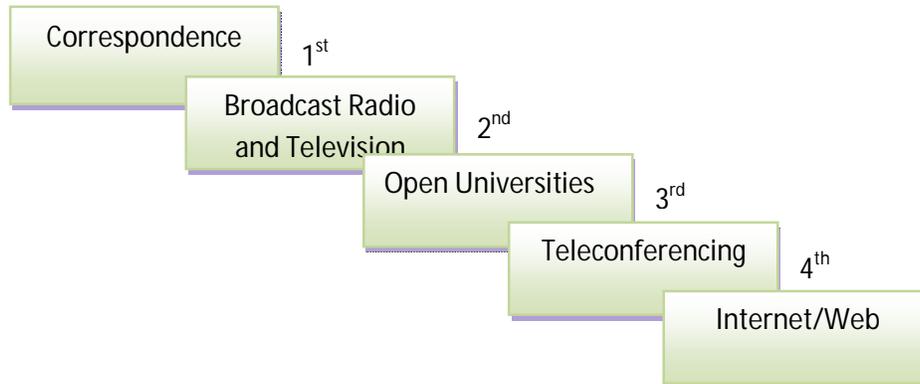
Figure 1.1 Generations of Distance Education (Moore et al., 1996)

Following are the most popular ways to provide distance education.

- **Broadcast Television**

  An instructor delivers lecture to the students over live video channel, Students watch programs and get education from distance. Drawback in this type of distance education is that teacher and students cannot interact with each other.

- **Two-way Video Conferencing**

  It is synchronous form of distance education. But teacher and students can interact with each other immediately and students can ask questions to the teacher. It is like teleconference or video conference on the network (Moore et al., 1996).

- **Asynchronous Learning Mode**

  In this type of distance education, instructor uses World Wide Web to provide distance education. It is asynchronous form of distance education. In this type of distance education students can continuously ask questions to the instructor (Moore et al., 1996).

- **Virtual learning Environment (VLE)**

  Universities are using virtual learning environments to provide distance education. In distance education students have to go to study centre but time constraints involved here therefore student must reach to specific location on time (Kumar et al., 1998).

  By using Virtual Learning Environment, there are no time condition or location constraints. VLE supports educator, administrator and students to interact with each other during learning teaching process (Benyon et al., 2005). Students can get admission through internet, enroll in the class, take part in exams, and communicate to their class fellows and teachers. VLE has complete features and facilities for students, teachers and administrators regarding distance education. VLE facilitate teachers for grade management, assignments management and course management etc (Kumar et al.,

1998). VLE also have the facility of notice board for up-to date course information, interaction platform through chat rooms, moderators and different access rights for student and teachers (The virtual learning environment, Wikipedia).

VLE contains following modules,

- Admission Module (Admission Status Monitoring Module)
- Course Registration Module
- Administrative Resource Module
- Communication System
    - Email Service
    - Online Chat Service
- Course System

Virtual universities and open universities can get benefits from web conferencing software's to support distance education.

Web Conferencing

Web conferencing is used for live meetings or presentations over Internet. Participants can use their own computers to meet to other participants with the help of internet (Web conferencing, Wikipedia. 2006). Common features of web conferencing software's are: Slide show presentations, Live or Streaming video, VOIP, Web tours, Meeting recording, Whiteboard, Text chat, Polls and surveys, Screen sharing/desktop sharing/application sharing (Web conferencing, Wikipedia. 2006).

Some famous web conferencing software's are fallowing,

- **GoToMeeting by Citrix**

GoToMeeting is a remote meeting and desktop sharing software and it helps the customers, colleagues and users to meet with each other over internet with their personal computers (GoToMeeting, Wikipedia. 2008). GoToMeeting is the easiest and cost effective way to participate in online meeting (Product Overview, GoToMeeting)**.** Moreover, GoToMeeting is considered as the easiest to use for online meeting within all other available web conferencing software's (Product Overview, GoToMeeting)**.**

- **Netviewer Software**

Netviewer Software provides web conference, admin, desktop sharing, plus remote maintenance capabilities. Market research says that Netviewer is leading European company among web conferencing products. Desktop sharing is the main feature of Netviewer Software. In desktop

sharing, a direct connection between two or more computer has been established over the internet. No installation is required for desktop sharing in Netviewer Software (Netviewer, Wikipedia).

- **WebEx**

WebEx provides online meetings, web conferencing and video conferencing. WebEx is considered as secure and reliable web conferencing software it is easy-to-use and firewall friendly.

According to (WebEx, Communique), its main features are fallowing,

- Host online meetings with 2 to 500 participants
- Give a power point presentation
- Share webcam video
- View and edit documents
- Share desktop and software applications

- **Adobe Acrobat Connect:**

Adobe Acrobat Connect is web conference software from a well known software development company Adobe. It is very helpful for small businesses to easily communicate with the clients and customers. It is easy approach to connect and personal meetings (Adobe Acrobat Connect. www.adobe.com).

Allama Iqbal Open University is providing distance education in Pakistan and Middle East countries since 1974. Allama Iqbal Open University (AIOU) is first Open University in Asia and it's a unique institution in Pakistan because of its philosophy, system, approach and over all structure. University has its campuses and regional centers spread all over the country and Middle East countries. AIOU has established complete television broadcasting department with the name of institute of educational technology and this department is performing a vital role to provide distance education to remote areas of Pakistan through radio and television media.

Traditionally AIOU sent books and assignments to admitted students and students communicate with university through mail services. Students receive books and assignments and send back solved assignments to the teacher within due dates. AIOU conduct the examinations by hiring the services of available institutions in remote areas. The whole communication between university and students is normally through mail system.

To support distance education with the help of latest technology, AIOU have designed its own computerized learning environment in the form of content based multimedia computer based training (CB-MCBT). Students use their personal computers to use these CB-MCBTs. Here we would like to

introduce educational computing and its history, computer based learning and computerized learning environment.

1.3 Educational Computing and History

Educational computing begins with some large government funded projects on main frame and mini computers. E.g. university of Illinois PLATO project started in 1960 and MITRE Corporation TICCIT project in 1980. Both projects were assigned to develop computer based instructions with integration of graphics and text (Stephen et al., 2000). In the beginning of educational computing researchers were focusing on availability of these computer based instructions to the learners instead to increase the actual improvements in subjective learning (Stephen et al., 2000). And researchers achieved availability with the help of computer networks. Computer has been used for learning purposes in many different ways. E.g. computer assisted instructions or computer based instructions (Koschmann et al., 1996). Educational computing is still young field, availability, technology, understanding, learning psychologies and technical backgrounds of users are obstacles in growth of educational computing. Many researchers have proved that using computer in education is more effective than using books, teachers or traditional methods (Stephen et al., 2000).

1.4 Computer Based Learning (CBL)

Technology based learning is helpful to provided effective and efficient access of learning materials to the learners, therefore technology based learning is increasing with importance of e-learning (Kakasevski et al., 2008). Computer based learning used to provide highly motivated learning experience to the learner (Clarke, 2001). To increase learning experiences, computer based learning have been used increasingly. The term computer based learning is widely used and attempting to replace traditional classroom environments. CBL is very important resource for teaching to a specific group of student with same educational and cultural background (Overfield et al., 2003). As there are many different fields of study and different kind of teaching approaches are used but usefulness of these approaches is dependent on nature of courseware. Therefore considering CBL for learning is very much dependent on nature of subject and educational and technical background of students. In computer based learning, learning took places in several ways e.g. student only, student teacher and community based learning (Cai et al., 2008). Computer based learning took places through computerized learning environment.

1.5 Computerized Learning Environments

In computer based learning learners and teachers interact with each other with the help of computerized learning environment (Cai et al., 2008). As a traditional learning system students and teacher present in a classroom and teacher delivers the lecture to students. In the figure 1.2 students, teacher and IT experts are connected with a learning environment. Student and teacher interact with each other through interactive learning environment, which is flexible to handle the communication between students and teacher. Presence of IT expert is to manage updates in the system.
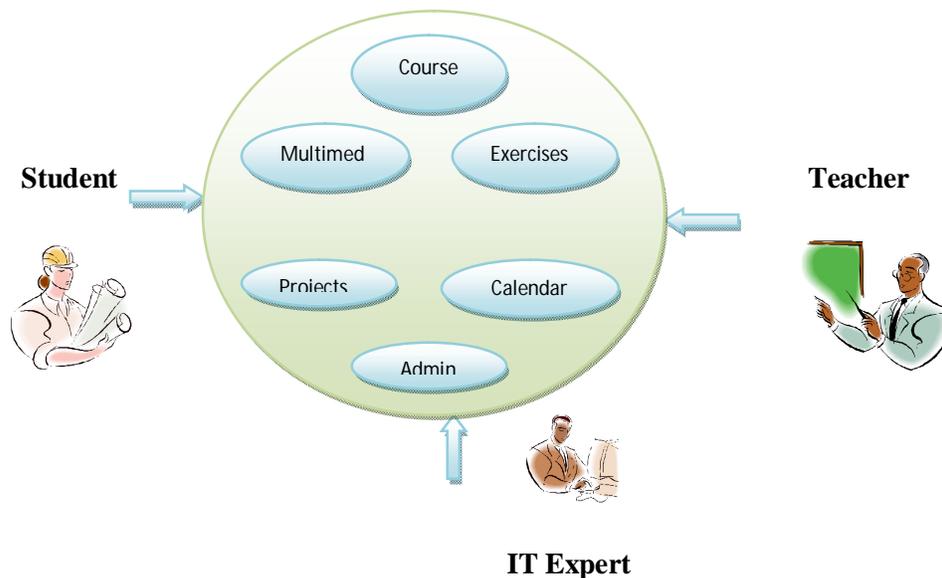
IT Expert
Figure 1.2 (CAI Et Al., 2008)

According to (Cai et al., 2008), course material, exercise, calendar, admin, projects and multimedia are the basic components of any computerized learning environments as shown in figure 1.2. Learning environment is very much dependent on learning interaction models. There are three types of interaction models, Learner-contents, learner-instructor and learner-learner. **Learner-content** is self directed learning. Students learn with course material without any feedback from teacher. **Learner-instructor:** learner and instructor interact with each other with the help of computerized learning environment. Third is **Learner-learner** which is engagement between students (Kearsley, 2000).

AIOU have designed content based multimedia computer based trainings as computerized learning environment based on computer based training (CBT). Here we would like to explain training and education.

Training: Trainings do not need theoretical obsessions. And objective of any training is to increase learner skills (Sapieha, 2007).

Education: Education comes under necessitate process, but education normally does not provided by any organization and it is a self directed activity (Sapieha, 2007). One study (Harrison, 1998) stated that education is what people do to increase their knowledge.

Here we would like explain computer based trainings,

Computer Based Trainings: Computer based training in general is a combination of audio, video, graphics, text, series of frames and screen display. Glossary of terms, bank of questions different choices of routes, help, and verity of media are the basic elements of computer based trainings (Clarke, 2001). Today computer based trainings are used to provide trainings and education to learners. Companies are using computer based trainings to train their employees. As traditional trainings are expensive therefore computer based trainings are alternate of traditional trainings. Once a company has developed any computer based training for their employees to train them for any specific task, it can be used any time. Educational institutes are using these computer based trainings for educational purposes and to support distance education.

Normally there are two kinds of computer based trainings,

1. Simulations based multimedia computer based trainings
2. Content based multimedia computer based trainings

Simulation based computer based trainings are useful for technical trainings. Developments of these computer based trainings are expensive, and interaction in simulation based trainings is at very high level. Simulation based CBT is an exact copy of real learning environment. Simulation based CBTs are normally used to train aircraft pilots for their initial trainings, medical surgical trainings etc.

1.6 Content Based Multimedia Computer Based Trainings (CB-MCBT)

Most of the time content based multimedia CBTs are used for educational purposes. We would like to introduce multimedia. Multimedia as it is obvious by its name: multimedia is combination of more than one media e.g. text, graphics, audio, and video (Grimes et al., 1991). Today multimedia techniques are very much useful in computer based trainings to increase interactivity and learning experience of learners. Content based multimedia computer based trainings are combination of multimedia contents and educational contents.

Multimedia electronic courseware design center is responsible for development of these CB-MCBTs in AIOU.

1.7 Multimedia Electronic Courseware Design Center AIOU

Multimedia Electronic Courseware Design Centre is a department of AIOU sponsored by higher education commission Pakistan. The purpose of this design centre is to develop content based multimedia computer based trainings for Bachelor of Science (BS) in computer science students to improve quality of distance education. The purpose of this design centre is to provide distance education with the help of CB-MCBTs. These CB-MCBTs are very much helpful for students of AIOU and today BS level students are using these CB-MCBTs. CB-MCBTs are available for students in CD form. Students receive this CB-MCBT from AIOU by post. Students use their personal computer to utilize these computer based trainings. Student doesn't need to install any new software to run this CB-MCBT; they just need to insert CD into the computer and CB-MCBT runs automatically.

CB-MCBT designed by AIOU has following components,

1.7.1 User Interface of CB-MCBT

Figure 1.3 shows the main user interface of CB-MCBT developed AIOU.
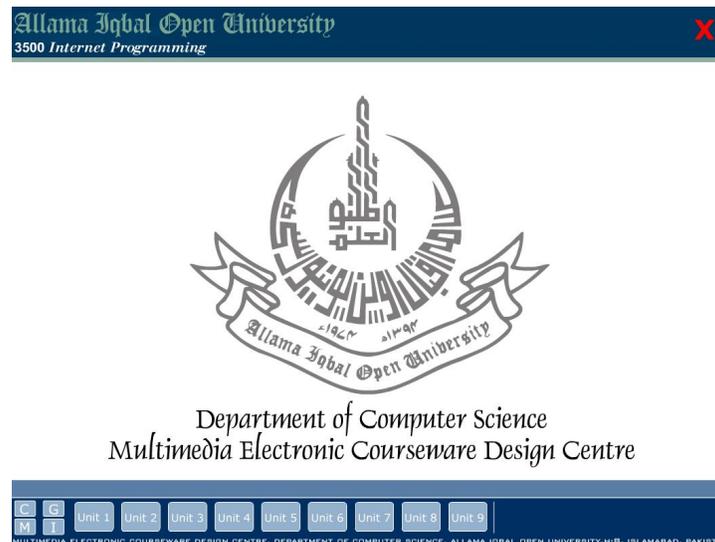
Figure 1.3

Interface contains logo of AIOU, series of buttons and title of CB-MCBT. This particular CB-MCBT is developed for internet programming course with course code 3500 and has 9 units of study.

1.7.2 Buttons

Every course divided into 9 parts, these parts are called units of study. Series of buttons as shown in figure 1.4from **unit 1** to **Unit 9** represents the entire course.

Figure 1.4

E.g. if student click on button, the multimedia slides containing learning material related to unit 1 will start automatically.

Figure 1.5

Figure 1.5 has four buttons,

Button with label C: Course outline

Button with label G: Glossary

Button with label M: Message to students from voice chancellor and dean faculty of

        Sciences

Button with label I: Animated Introduction of Allama Iqbal Open University

Figure 1.6

Figure 1.6 contains the sub menu. Sub menu contain buttons, if student click on button with title **OVERVIEW OF INTERNET,** multimedia movie contain lecture about **overview of internet** will start.

1.7.3 Educational slides and Animations available in CB-MCBT

Educational slides e.g. PowerPoint slides etc are used by teachers to deliver lectures to students. These slides contain educational contents, graphics and audio/video. Therefore by adopting the same concept AIOU have used educational slides designed in macromedia flash and these educational slides contain audio/videos, animations and graphics. Figure 1.7 present educational slides available in CB-MCBT and slide contains educational contents in text, animated graphics, and audio/video form. If we see the top left corner of figure 1.7 there is video of lecturer, who is delivering lecture and left side of slide contain textual contents and right side of slides contains animated graphics.
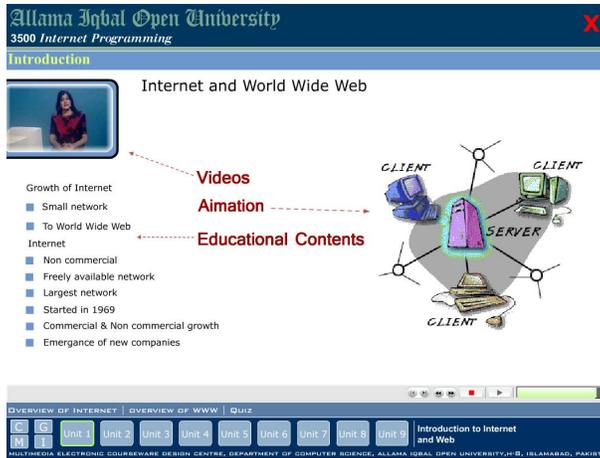
Figure 1.7

Human learn fast by visually representation of things. Therefore every lecture in CB-MCBT has animations and graphics which are helpful to create more understanding about the topic. AIOU have used animations in the educational slides and these animations fallows lecture deliver by the lecturer in the video. Figure 1.7 present an educational slide available in CB-MCBT. Left side of the slide contains textual contents and right side of slides contains animated graphics. These animations are according to topic of the lecture. E.g. in figure 1.7 it is a lecture about "internet and world wide web" therefore the graphical animations presented in the right side of figure 1.7 is about computer network and how it works. AIOU has used 2 dimensional animations, 2 dimensional animations are based on X coordinate and Y coordinates. Figure 1.8 shows the X and Y coordinate.
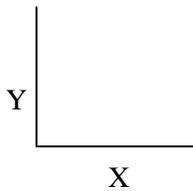
Figure 1.8

If we design a cube in 2D graphics it will look like figure 1.9.
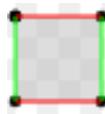
Figure 1.9

Figure 1.10 represent 3Dimentioanl graphics and it is based on X, Y, Z coordinates.
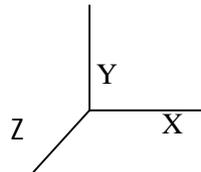
Figure 1.10

And if we design a cube in 3D graphics it will look like figure 1.11. AIOU uses 2D graphics and animations in CB-MCBTs. whereas use of 3D animations can provide more understanding about the topic to the student.
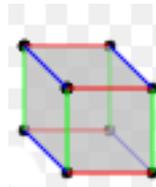
Figure 1.11

1.7.4 Navigations

Navigation is basic element for designing computer based learning materials and it has a great influence on interactivity in CBL (Clarke, 2001). In the context of CB-MCBT navigation is freedom of user move through the system, e.g. user move from one slide to another within the system or from one feature to another. To create better navigation in CB-MCBTs AIOU has designed its own movie player with buttons to control navigation with in CB-MCBT, figure 1.12 represent movie player available in CB-MCBT.

Figure 1.12

With the help of this movie player students can move back slide, forward slide, can scroll the educational lecture forward and backward and can stop and play lecture any time they want.

1.7.5 Self Assessments

Student can assess their knowledge about the course with the help of quiz type test available in CB-MCBTs.
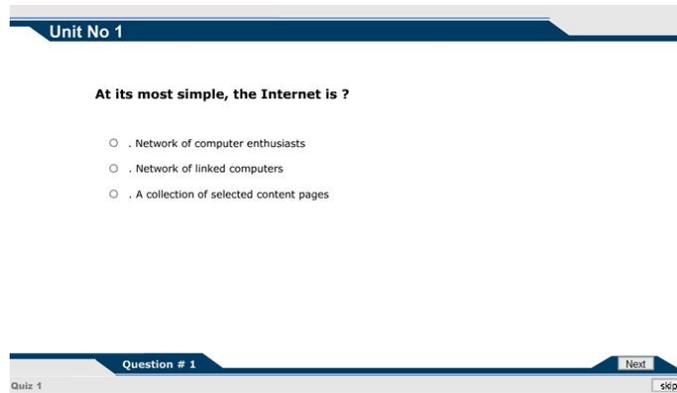
Figure 1.13

Figure 1.13 shows the type of quiz available in CB-MCBT, questions with multiple answers are used for self assessments.
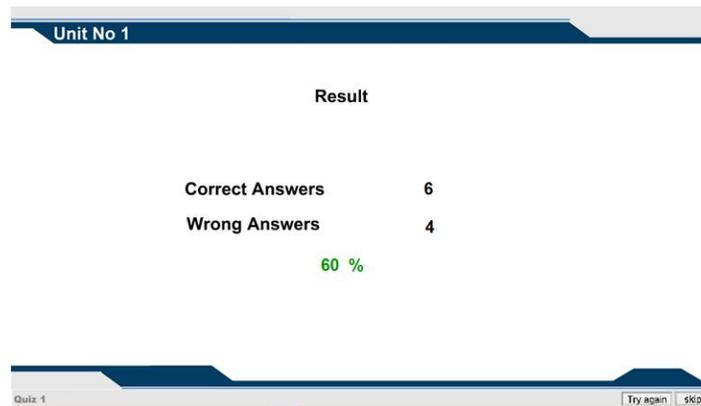
Figure 1.14

When student fill all the questions in quiz, CB-MCBT provides the results. Figure 1.14 shows result screen.

1.7.6 Reference Materials

CB-MCBT contains reference material which acts as an extra educational support for learners. E.g. CB-MCBT has educational lectures with audio, video, animations and graphics. But along with those educational lectures CB-MCBT provides extra literature about the topic in the form of text, and this literature provides more understanding about the topics to the learners. If students are not satisfied with the educational stuff available in educational lectures then they can go to reference material file which contains literature about the subject in text form and they can read the text.

1.7.7 Glossary

Glossary of words related to the subject is also available in CB-MCBT. Electronic glossary is shown in the figure 1.15. Student can search the any word or term related to subject and can sees the detail meanings.
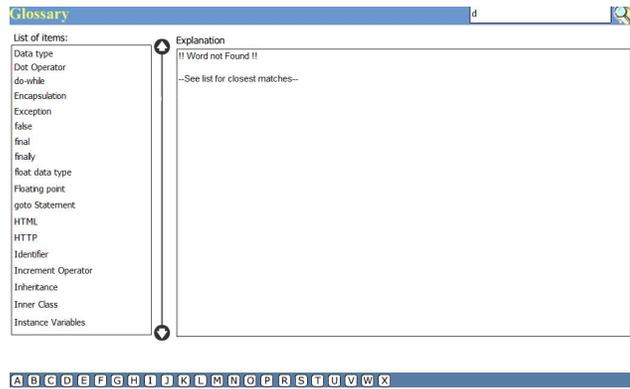
Figure 1.15

CHAPTER 2: PROBLEM DEFINITION

This chapter starts with problem definition and leads to research questions.

Allama Iqbal Open University has designed CB-MCBTs as a computerized learning environment to support distance education in Pakistan. AIOU has established multimedia electronic courseware design center and starts developing these CB-MCBTs. Students use these CB-MCBTs on their personal computers without interaction with university. CB-MCBT contains user interface with navigations, multimedia and educational contents. Interface of CB-MCBT contain buttons, menus, animations and different routes to access the available information. AIOU have designed these CB-MCBTs for those students who are unable to attend regular classes and CB-MCBT act as an extra educational support for students of AIOU.

CB-MCBT is a computerized learning environment and usability of any computerized learning environment does not only depend on its usable interface, it is also dependent on achieving the educational goals. And student's primary and basic goal is to get education from distance. Therefore if the interface of CB-MCBT will be usable then user will concentrate more on educational learning, and it is also very important that educational stuff in CB-MCBT is satisfying the learner needs and requirement. This research covers usability issues in CB-MCBTs and the requirements of students regarding distance education provided by AIOU through CB-MCBTs.

Research focuses on usability issues in CB-MCBTs particularly on effectiveness, efficiency and satisfaction. With the passage of time technology coming into the remote areas of Pakistan, therefore requirements of students are changing regarding distance education and students want more features and facilities in CB-MCBTs provided by AIOU. Therefore this research has figured out the student's requirements regarding CB-MCBTs. After analyzing student needs and requirements regarding CB-MCBTs, research provides suggestions to AIOU for improvements in CB-MCBTs so that student can achieve educational goals with effectiveness, efficiency and satisfaction.

2.1 Research Questions

1. What are usability issues in CB-MCBTs?
2. What are the requirements of BS level students regarding distance education provided by AIOU through CB-MCBT?
3. What are the suggestions to make these CB-MCBTs more effective, efficient and satisfying to the learners?

CHAPTER 3: THEORETICAL WORK

In this chapter, Section 3.1 describes usability and user interface design principles. Usability in computerized learning environment discussed in section 3.2. Usability issues in CB-MCBTs are discussed in section 3.3.

3.1 Usability and User Interface Design Principle

In the year of 1990 usability was considered as most cost effective tool to verify efficiency, effectiveness, and satisfaction (Nielsen, 1993). But Usability domain is still comparatively new field in research and knowledge (Hartson et al., 2003). Usability evaluation is very sensitive issue and if usability evaluation conducted wrong then it will affect the whole product and can crash potential ideas on early stages (Greenberg et al., 2008). There should be any particular criteria to evaluate effectiveness, efficiency and satisfaction of any product; however there are no precise criteria to determine effectiveness, efficiency and satisfaction (Ramli et al., 2008).

CB-MCBT designed by AIOU have a complete graphical user interface, and efficiency, effectiveness, and satisfaction aspects of usability also depends on interface of system. User interacts with the system through its interface and for better interface there are different user interface designs principles defined by different researchers. But the basic interface design principles are defined by Larry Constantine and Lucy Lockwood.

3.1.1 User Interface Design Principle

- Structure emphasizes on "grouping all relevant elements of the system" (Apsel et al., 2008). E.g. in Gmail Ajax enabled page, all elements are well structured e.g. folder/labels, chatting contacts, emails are grouped on their own separate windows. All these windows are collapsible and expandable, but organized in a nice way. Structure makes interface as easy to use and faster to accomplish the task.
- Simplicity focuses on UI to keep it as simple as possible. This principle follows the rule KISS (Keep it Simple, Stupid). This emphasizes to keep mostly used and common features visible and other unimportant features should be available on user's demand (Apsel et al., 2008). Sometimes developer place lot of options and features on main page of the system because developer wants to provide much more facilities and the entire feature on the main page so that user could use it whenever he/she wants. But it is not the right way to facilitate user on the main page. User naturally like simplicity, therefore it is important to keep the system as much simple as possible.

- Consistency improves UI by emphasizing that there must be uniformity in appearance, placement and behaviour throughout the interface. On study (Apsel et al., 2008) examined that user builds a model while uses an application and expects to be same throughout the interface. It could bother and dissatisfy users if there is inconsistency in the system (Apsel et al., 2008). E.g. in Gmail, to maintain consistency, sign out link is as top right of the page like close button in Microsoft products, or if user receive an email with attachment then there is a graphical sign of attachment and that sign should maintain consistency as people are familiar with that attachment sign and already learned it from real world.

- The visibility design principle states that all features and contents must be clearly visible. Important data should be placed at centre of interface and other not much important contents should not being as prominent as important one (Apsel et al., 2008).

- When user interact with the interface and performs some actions interface of system should provide him/her feedbacks (Apsel et al., 2008). E.g. in Gmail, when user moves mouse pointer on different buttons or links, system gives response in the form of colour changing. When somebody sent an instant message in chat messenger, it gives feedback in the form of beep or blinking text.

- Tolerance principle stresses on tolerance of faults or mistakes done by the user's interaction with the interface. If user mistakenly or unintentionally do something wrong, the interface should provide a facility to user to undo that action in a systematic way, this is called, tolerance design principle (Apsel et al., 2008).

It is important to evaluate usability of educational system from two prospective (Diaz etal., 2002).

1. User interface
2. Educational usefulness

It is important to consider following points for usability evaluation of user interface of any educational system: esthetic, consistency, self evidence, naturalness of metaphor, and predictability. For assessment of educational usefulness of any educational system following points are important: richness, completeness, motivation, hypertext structure, autonomy, competence, and flexibility (Diaz etal., 2002).

We would like to describe all the points shortly.

Aesthetic: is about user interface of application e.g. multimedia contents are organized well, understandable, and make sense is called aesthetic. This arrangement of contents in user interface of

applications is dependent on cultural and educational background of users. **Consistency:** is representing those elements that are conceptually similar in design. E.g. design of menus, buttons and contents related to each other should be easily understandable by the user. If information is consistent in educational system, user concentrates more on learning or teaching goals, rather than to learn the system. **Self evidence:** how easily user can find the purpose of information presented on interface. **Naturalness of metaphors:** extra support of literature e.g. electronic books, stories or other relevant materials should be used to increase the knowledge of learners, although this information should be concise and relate to topic otherwise user concentration can be mislead. **Predictability:** After interaction with any system user predicts the outcomes. When user interact with the system and perform any action it is important that how results or consequences of actions can be represented. **Richness:** it's about the information and functionality or features available in the system. **Completeness:** system is fulfilling the user's needs is called completeness of system. For an educational system completeness relates to support provided by the system regarding learning teaching activities. **Hypertext Structure:** Organizing the hypertext in educational system in a way that similar links or buttons should be group together and make sense. **Autonomy:** is freedom of interaction and navigation within the system. **Competency:** is the ability to navigate through the system and attaining specific goals. **Flexibility:** is about easiness of using and maintaining the system (Diaz etal., 2002).

3.2 Usability in Computerized Learning Environment

The acceptance of computerized learning environment based on its usability and utilization. Utilization of environment is the extent to which environment fulfill learner requirements, and satisfy their needs (Fetaji et al., 2007). According (Fetaji et al., 2007) people leave if the website is difficult to use, If website is unable to provide important information on first page, and if user get lost while using the web and unable to get required information. Therefore designers of computerized learning environment should focus on the requirements of learners. Designers can't analyze learning environment from usability prospective. Usability provides procedure through which on the spot user activities and problems are analyzed by different experiments and find outs runtime usability issues.

Usability in computerized learning environment is very important because it affects the whole user satisfaction and ability to learn the system. If the environment is useful then user will concentrate fully on educational contents instead to learn how to operate the system. Useable learning environment minimizes the errors, which is helpful for increasing effectiveness and it makes learning environment more efficient (Fetaji et al., 2007). Some benefits of usable learning environment are following, if user will perform task efficiently then it will lead to effective educational learning activity. If actions of users are effective while

operating with the learning environment then it will lead to successful educational learning. If users are satisfied with the learning environment then it will lead to better educational learning and user will enjoy while interacting with the learning environment (Fetaji et al., 2007).

Authors of this research have selected some elements which are helpful to figure out usability issues in CB-MCBTs. These elements are described below.

Memorability: is how easy to memorize and reuse the system (Fetaji et al., 2007). Learning environment is a path through which learner achieve their mandatory goal that is subjective learning. In distance education, user alone uses the learning environment from any remote location and if the interface of system is easy to remember it helps the user to concentrate on educational learning. And if user is efficient in operating the system it will increase the satisfaction in a sense that learner will enjoy the system and will not be frustrated and concentrate on subjective learning.

Completeness: system is fulfilling user's needs and requirements. In the context of CB-MCBT it is necessary to consider completeness of system and CB-MCBT should fulfill the student need and requirements. Does CB-MCBT provide complete interaction mechanisms to reach educational goal? And does the educational contents available in CB-MCBT satisfying learners and providing complete educational knowledge? And CB-MCBT have usable user interface? These questions are important issues to consider while developing CB-MCBTs.

Navigation: In the context of computerized learning environment, freedom of users to move through the system is called navigation e.g. user goes from one slide to another slide or from one page of information to another page of information within the system. It is very important for the computerized learning environment to provide complete navigation and different routes to reach the information. CB-MCBT designed by AIOU has nice navigation and provides series of buttons and menus to navigate through the system. For this particular research our goal is to verify that whether users are satisfied with the navigations and they have freedom to navigate through CB-MCBT.

Satisfaction: Satisfaction is the "users' comfort with the system and positive attitudes towards the system" (Frøkjær et al., 2000). User satisfaction and their positive attitude towards the system depend on educational and cultural background of users and domain of application. For example, kindergarten students normally have interest in colourful animated things. Therefore learning stuff for kindergarten's students comprises of colored books with images and fascinating objects. Such learning ways are used to increase their likeness, preferences and their attitude towards the system and which is helpful to increase the educational learning. But the case is different for graduate level students. And graduate level students

like the system where they get enough subjective knowledge. They like little appealing interface but they mainly focus on subjective learning. The subjective learning stuff provided by the system should contain enough learning material and which should fulfill the user need and requirement. In short, satisfaction in learning environment refers that after using the system, learner should be satisfied regarding user interface and subjective learning provided by computerized learning environment.

Simplicity: The user interface should be simple and user should be able to perform common tasks easily (Constantine et al., 2009). Keeping mostly used and common features visible and other unimportant features should be available on demand, is helpful to increase simplicity in interface (Apsel et al., 2008). Learning environment should be simple to use so that learner feel comfortable while interacting with the system and concentrate more on educational learning.

Consistency: Improves user interface by focusing on uniformity in appearance of objects, placement and behaviour objects throughout the interface. Consistency does not only increase learnability of the software but also makes the system pleasant and likely to the users. As user already has learned and experienced most of things from their culture, daily life and by using different software. Therefore when user uses a system, they build a model in their mind. E.g. when we use a throttle of the tap, we learned from our experience that by turning it clock-wise pour hot water will come out and in anti-clock wise cold water will come out. Whenever user will use tap for hot water, he/she will unconsciously turned it clockwise direction for hot water. Similarly red colour is alert signal e.g. red light of traffic signal mean stop. Developers use this red colour to show busy status in chatting. If there is inconsistency in the system it bothers users and makes him/her uncomfortable about the system.

Feedback: When user interacts with the system and performs some action and system provides feedback to user according to the action he/she have performed is called feedback (Apsel et al., 2008). Feedback can be used for different purposes,

- To guide a user how to operate system
- To give acknowledgment about an action performed by the user
- Error handling and input validation

First type of feedback is used to help user to learn how to operate the system. For example, when user moves mouse over button and user gets feedback from system in the form of changing colour, change in fonts and text bubble containing short description. These kinds of feedbacks are helpful for learners to learn the system, but once he/she have learned the system, he/she will not pay attentions on these kinds of feedbacks e.g. when users starts learning how to ride the bicycle, bicycle two extra wheels with back

wheel are very helpful for him/her but after some time when he/she has learned how to ride the bicycle then he/she don't need extra wheel anymore.

Really Simple Syndication (RSS) is helpful for feedbacks in the context of CB-MCBTs, because with the help of RSS user is able to find out the updates available about CB-MCBTs. RSS usually used to get updates from different websites without visiting these web sites. It was initially used for news sites to fetch headlines of news. It can be used for both internet sites and on desktop applications (Lee et al., 2008).On desktop application it can be used for software update indications e.g. Updates available about chat messengers or updates in antivirus software's etc. So RSS can be used to update CB-MCBTs e.g. if university have updated some results or assignments on the server then RSS tells the user of CB-MCBTs that following updates are available regarding this CB-MCBT. RSS is spam free, quick and efficient way for updates (Lee et al., 2008).

Visibility: Most important features should be located centrally and clearly visible for users (Apsel et al., 2008). It's the nature of human beings that our eye catches all visible things at once. While visiting webpage our eyes focuses on most visible components, therefore the important information must be clearly visible than less important information. Therefore in computerized learning environment most important and frequently used items should be clearly visible to users. And system should be flexible that user can adjust the elements according to his/her own choices. E.g. in mobile phones software's users can set their own shortcut keys.

Educational Learning: Educational learning means learning materials provided by the system is according to learner needs and learners are satisfied with the educational contents available within the system. The volume of the educational material are normally contents (text), audios, videos and animations. And these elements are quite enough for a learner to get almost complete knowledge and understandings about the topic. The system should provide precise and understandable knowledge to the learner, so that learner can perceive topic completely and easily.

Availability: system should be available for learners through different sources e.g. on internet as website or in CD form etc. Online availability of the learning environment makes it rich in terms of educational learning. As CB-MCBTs by AIOU are designed and developed to support distance education. Therefore when distance education is through CB-MCBT, it's important to consider element of availability CB-MCBT so that learners can use this learning environment anytime they want.

3.3 Usability issues in CB-MCBTs

Here authors of this research have discussed effectiveness, efficiency and satisfaction in the context of CB-MCBTs designed and developed by AIOU.

Effectiveness: It is about how well the goal is achieved? Metrics of effectiveness are error rates and quality of solution (Frøkjær et al., 2000). There are three major aspects involve in effectiveness, 1) how well goal is achieved, 2) accuracy in achieving goal, 3) Error rates and quality of solution. If these three aspects achieved, then effectiveness of application is achieved.

In the context of CB-MCBT basic goal of learner is educational learning, if the system is designed according to the requirements of learners then learners can easily achieve their educational goals. And the educational material provided by CB-MCBT should be enough to satisfy the learner's needs. Therefore in context of CB-MCBT two elements are important for achieving effectiveness: 1) completeness and 2) effective educational learning. Completeness can be achieved by the useful interface of CB-MCBT and effective educational material provided by CB-MCBT. Mandatory goal of learner is subjective learning not to learn how to operate the system. To achieve the mandatory goal of subjective learning, learner defines some secondary goals. These secondary goals can be different tasks or actions to achieve mandatory goal. And these small goals and tasks can be the use of user interface CB-MCBTs and effective educational material within CB-MCBTs. Therefore if the interface of CB-MCBT will be useable then user can easily achieve the subjective goal and concentrate more on subjective learning. For assessment of CB-MCBT regarding effectiveness, it is important to consider the following points, usable user interface with complete features and facilities required by the learner, effective educational contents, communication between student-student and student- teacher, navigation, and availability of CB-MCBT to each student.

Efficiency: Once user has learned the system, how fast he/she can accomplish task (Usability basic, www.usability.gov). In context of CB-MCBTs, following elements are important to consider for evaluating efficiency of CB-MCBT, memorability, navigation, consistency, feedback, and aesthetic. Memorability is how easy to memorize the system and how easy user will reuse the system (Fetaji et al., 2007). If student will learn and remember the system fast then they will concentrate more on subjective learning. Memorability of interface is depending on consistency, simplicity and aesthetic of interface. Therefore interface of CB-MCBT should be consistent in design and simple to operate and all multimedia contents should be organized in way that make sense, then learner will be able to concentrate more on subjective learning.

In the context of CB-MCBT navigation is freedom of user move from one slide to another within the system and from one feature to another. CB-MCBT designed by AIOU has provided series of buttons and menus and these buttons and menus are very much helpful to provide nice navigation in CB-MCBT. Still some weaknesses are there in navigation in CB-MCBT, e.g. CB-MCBT designed by AIOU contains an electronic file consist on course contents. But these course contents are not link with the relevant lectures in CB-MCBT. It will increase the navigation in CB-MCBT if each of course content links with the relevant multimedia lecture. If interface of CB-MCBT is consistent in design then user will easily memorize and reuse the system. With the help of consistency, user feels comfortable while interacting with the system. Interface of CB-MCBT designed by AIOU is consistent in presenting the educational contents and animations but the design of buttons and menus has little contradiction with the consistency. Authors of this research have asked the students of AIOU in questionnaire whether they are satisfied with the design of buttons and menus used in CB-MCBT or not.

If system guides the user while interacting with it, then user will be able to perform the task fast and in efficient way. Feedback from learning environment helps the user to achieve mandatory goal of educational learning efficiently. There are three types of feedbacks, 1) system guides while user interaction e.g. buttons provide feedback, 2) when user perform any task and system response e.g. user sent an email and system reply, your email has been sent to xyz@yahoo.com, 3) error report e.g. user try to write numbers in a text box but text box don't allow numbers and text box is set for alphabets only. Therefore system should provide feedback that you can just enter alphabets in the text box. In the case of CB-MCBT, there are some weaknesses in feedback. Some buttons provide feedback others do not.

Figure 3.1

Figure 3.1 shows that if user role mouse over button label unit1 the feedback is far away from the unit1 button, which is wrong way to present feedback. Therefore we have considered to feedback as one of element to evaluate efficiency in the user interface of CB-MCBT designed by AIOU.

Aesthetic is about the interface, that whether the multimedia elements and educational contents organized in a way that make sense. But according to authors of this research, interface of CB-MCBT needs improvements E.g. Figure 3.2 represent the interface. The most visible area of interface is middle, left, or right.
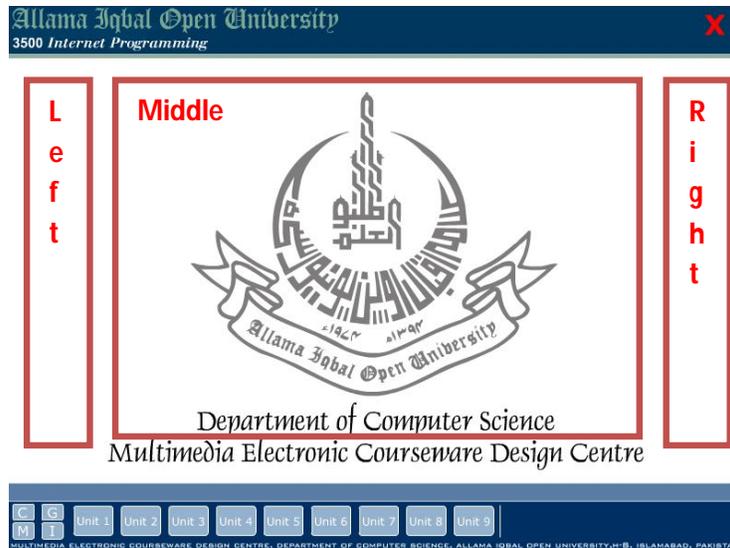
Figure 3.3

And user normally tries to find out information on the middle, left or right side of the interface. But all the menus available in CB-MCBTs are on the bottom of interface. Therefore esthetic of interface of CB-MCBT designed by AIOU needs improvements.

Satisfaction: satisfaction is how much user likes to use the system or it is user's positive attitude toward the system (Usability basic, www.usability.gov). In the context of CB-MCBT visibility, feedback, consistency, simplicity, and availability are important to consider regarding its satisfaction. Each element has its own importance. When educational and multimedia contents are visible then user will feel comfortable while interacting with the system. In CB-MCBT again we would like to consider figure 3.3 where the most visible area is middle, right or left, which is empty with no information, and buttons used in CB-MCBT are different in design therefore user can be confused while using the system. Therefore it's important to consider the visibility factor to create user satisfaction in CB-MCBTs. In CB-MCBT we founded that some important things are hidden and not visible clearly e.g. each unit have a file that contain reference material but if user wants to just read the reference material in CB-MCBT, he/she has to go to specific unit then he/she will find the button for reference material, however main page of CB-MCBT is almost empty and AIOU can provide some more impotents link on main page of CB-MCBT.

Designers or developers of learning environment can't judge the usability of computerized learning environment on their own (Fetaji et al., 2007). Therefore it is very important to involve users of learning environment for its usability evaluation. This research has used focus group and questionnaire to gather the student requirements regarding CB-MCBTs.

CHAPTER 4: METHODOLOGY

Research methodology is a systematic study of methods and a procedure through which researchers investigate related research disciplines (Writing up research methods and research design. 2008). In this chapter authors of this research have defined the methods and techniques used to figure out usability issues in content based multimedia CBTs developed by AIOU. In this chapter, 4.1 describe overview of this research, 4.2 discuss literature review, 4.3 describe survey and questionnaire, 4.4 defines focus group, and 4.5 describe the working experiences of authors of this research with AIOU.

4.1 Overview

Authors of this research have chosen qualitative research approach; the qualitative research "That describes how individuals understand the world and construct meaning out of their personal experience" (Dagez et al., 2008), qualitative research is related to study an object in their natural order (Wohlin, 2000). Usability evaluation contains three different evaluation methods, testing, inspection, and inquiry technique. Testing and inquiry involve user's participation, but inspection normally based on involvement of experts in specific system (MacManus, 2005). Authors of this research have chosen inquiry technique to figure out usability issues in content based multimedia computer based trainings designed by AIOU.

4.1.1 Usability Inquiry

This approach emphasizes on usability evaluators to figure out user's like, dislike about any system by observing and talking to them and questioning them verbally or in written form. Following methods are commonly used for usability enquiry (Folmer et al., 2002).

- Focus Groups
- Field Observations
- Questionnaire
- Interviews
- Proactive field study
- Logging actual use

In inquiry technique authors of this research have selected focus groups and questionnaire to figure out usability issues in CB-MCBTs.
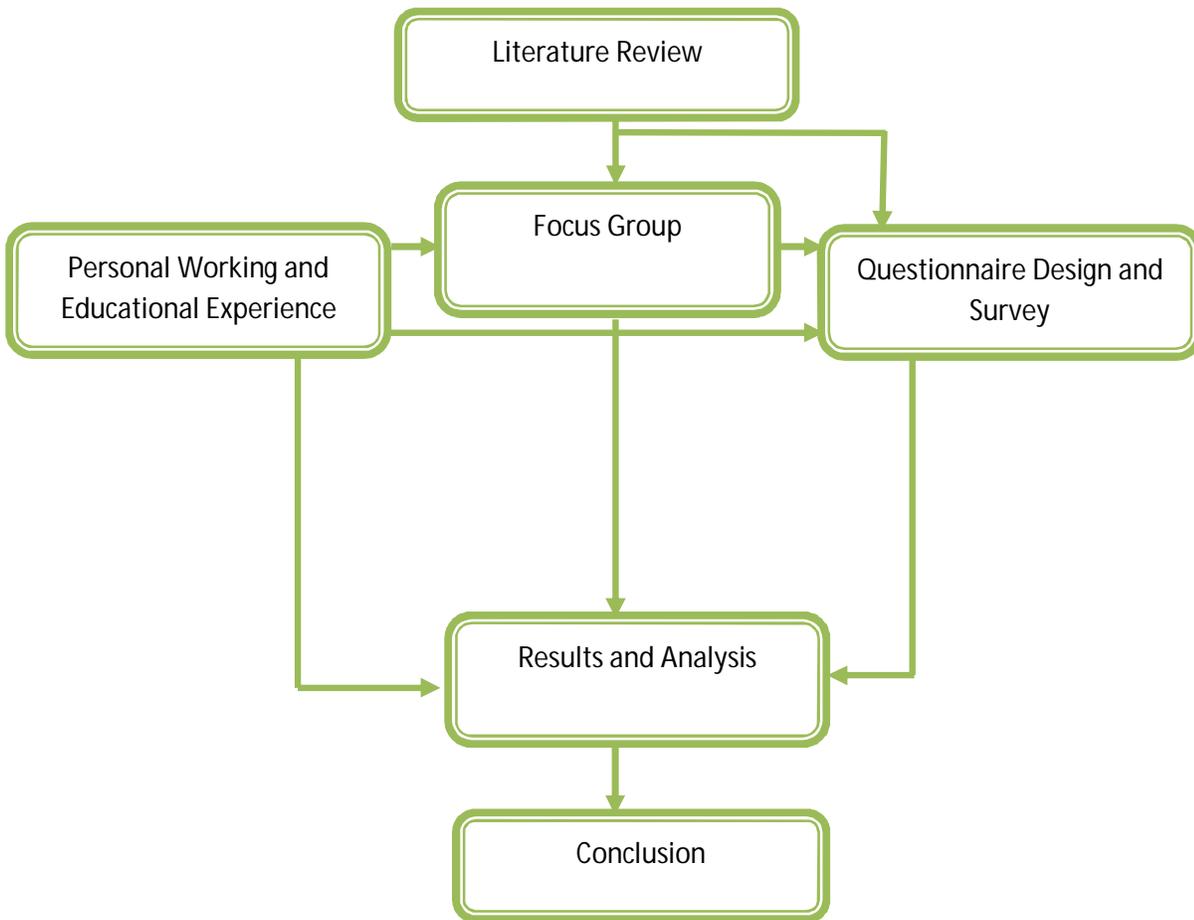
Figure 4.1 Research Methodology

4.2 Literature Review

Literature review is indispensable part of qualitative research and in this research literature review was done initial phase to get current state of research in usability, distance education, computer based learning and computer based trainings.

Authors of this research have defined some search queries to search the literature from ACM and IEEE Xplore. The keyword for searching literature were "usability", "Satisfaction", "efficiency effectiveness correlated", "user interface design principles", "computerized learning environment", "Virtual learning environment" "computer based trainings". The authors of this research have borrowed books from BTH library. And BTH Electronic Library Information Navigator (ELIN) has been used as a surfing tool to search literature for this research.

4.3 Survey and Questionnaire

The survey is non experimental and descriptive research method. Surveys are used when researcher wants to collect data that cannot be observe directly (Survey Methods). Surveys are used to gather attitude and opinion of users. But rather gathering opinion and data from all users, researcher choose sample of users and take decision on data collected from that sample. Data are usually collected through the use of questionnaires and interview. Surveys normally consist on tow type of questions open ended questions and close ended questions with multiple choices (Survey Methods).

Questionnaire is well known technique to collect demographical data from users (Preece et al., 2002). Questionnaires are used to get user thought about any system (Alshamari et al., 2008). Questionnaire is one of the effective ways to check usability, reliability, and interactivity in any system. Main three aspects of usability are efficiency, effectiveness and satisfaction. These three main aspects directly or indirectly depend on user need and requirements. And questionnaire is one of the best approaches to get users thoughts related efficiency, effectiveness and satisfaction about any system. Therefore in this research authors have used questionnaire to the gather the requirements of users regarding effectiveness, efficiency and satisfaction about CB-MCBT.

4.4 Focus Group

Focus group is an informal technique to conduct qualitative research, and helpful to access the requirements of user and their feelings about user interface of applications (Nielsen, 1997). Focus group is a preliminary technique to know user's attitude to the system. In Focus group, a group of people meet in a conference room with a moderator. The moderator leads the focus group discussion and tries to keeps the discussion within area of interest (Focus Group, 2008).

4.5 Working Experience of Authors of this research with AIOU

Both authors of this research have working and teaching experience in AIOU, one of the authors has been working in multimedia electronic courseware design center AIOU as IT Worker with responsibility of interface and multimedia designing of content based multimedia computer based trainings. And other author has teaching experience in AIOU and he has been teaching programming languages to the student of AIOU. Therefore both authors of this research have working experience with AIOU and they can critically analyze content based multimedia CBTs designed by AIOU on behalf of their own experiences.

CHAPTER 5: FOCUS GROUP

Chapter five consists of two parts; 5.1 describe focus group. And 5.2 presents authors personal analyses about CB-MCBT designed by AIOU.

5.1 Focus Group

In the phases of focus group authors have involved a group of students from AIOU; these students have used CB-MCBTs while studying in AIOU. According to (Lif, 1998) different users have different needs e.g. a machine can be user friendly to one user but not for all. Therefore it's important to consider the ages, genders, and educational and cultural background of users before involving them in usability evaluation. Authors of this research have arranged a focus group meeting and involved the users of CB-MCBTs and these users belongs to almost same ages and educational background, and three students have attended the meeting.

Name	Age	Sex	Education	Experience
Student 1	27	Male	Bachelor of Science in Computer Science	2 years as web designer
Student 2	26	Male	Bachelor of Science in Computer Science	N/A
Student 3	26	Male	Bachelor of Science in Computer Science	1.5 years teaching experience in high school.

Table 5.1

Table 5.1 shows the details about students those who have attended the focus group meeting.

Key points of focus group meeting were

- Interface of CB-MCBT
- Educational contents available in CB-MCBT
- Animations and graphics in CB-MCBT
- Student problems and suggestions regarding improvements in CB-MCBTs

Authors of this research have designed some questions for focus group meeting and tried their best that discussion should remain under CB-MCBT developed by AIOU.

Following questions were asked to the students during focus group meeting.

1. Does interface of CB-MCBT is understandable?
2. Menus and buttons used in CB-MCBTs are easy to understand?
3. It's easy to find information during lectures?
4. Learning material available in CB-MCBTs is enough to get sufficient knowledge about subject?
5. Are students satisfied with the animations and graphics used in CB-MCBT?
6. Navigation used in CB-MCBT is easy to understand?
7. What are student's suggestions for improvements in CB-MCBT?

5.1.1 Results and Discussion

According to focus group, development of these CB-MCBTs is very nice effort by Allama Iqbal Open University to provide distance education to the remote areas of Pakistan. But student faces some problems while using these CB-MCBTs and students need some more features in these CB-MCBTs. Students are satisfied with the combination of colors used for text, graphics and interface of CB-MCBT. But students said that they don't feel easy while using menus in CB-MCBT. to create more understanding about the topics AIOU uses 2 dimensional animations in educational slides, but students suggested that sometime 2 dimensional animations are not enough to get understanding about the topic and if AIOU use 3 dimensional animation in educational slides it will create more understanding about the topics. Students said the CB-MCBT is good to have a concept about the course, but CB-MCBT does not provide complete and in detail course material and literature about the subject. Available search facility in CB-MCBT is only in glossary of words. Student can search any word in glossary of words. CB-MCBT doesn't provide complete search facility to the students therefore student cannot search any text or educational contents available in CB-MCBT. CB-MCBT does not help them to interact with the teacher and other students. There is no communication module in CB-MCBT. Student complaints that interface of CB-MCBT should guide them while using it. But CB-MCBT doesn't guide them and there is no help feature available in CB-MCBT.

5.2 Authors Personal Analyses about CB-MCBT designed by AIOU.

As both authors of this research have working experiences in AIOU, and one of the authors of this research have been the BSCS student of AIOU and author have used these CB-MCBTs as student of AIOU. Both authors of this research have studied human computer interaction (HCI) from Blekinge

Institute of Technology, Sweden. During the course of human computer interaction authors have got in-depth knowledge about interface designing's and development procedure. Therefore, due to author's educational and working experience, authors of this research can evaluate the weakness in CB-MCBT developed by AIOU.

Authors of this research have figured out some issues in CB-MCBTs and described here. User interface of CB-MCBTs is simple and size of buttons is visible. But design of menus and buttons need improvements. Buttons of different designs are used in CB-MCBT which is violating the consistency principle in the user interface. CB-MCBT has nice navigation, and user have freedom to move within the CB-MCBT. And user can easily move from one slide to another and CB-MCBT provides different routes to reach the information. But if CB-MCBT contain a page with table of contents and each content link with related multimedia slide then it will increase navigation in the system. AIOU should design these CB-MCBT in a way that student will be able to update the educational contents of CB-MCBT through the internet. Self assessment available in CB-MCBT is a quiz type tests, but the final exam conducted by AIOU is 3 hours theoretical exam, and quiz type test is not sufficient for self assessment of students, therefore there should in detail assignments in CB-MCBT, which helps the students to prepare their self for final examination. Reference materials available in CB-MCBT should be in detail, CB-MCBT provides reference material about every topic, but available reference material is not sufficient to fulfill the student's requirements, there should be in detail subjective notes or electronic books so that students can get in detail subjective knowledge by these reference material. CB-MCBT should provide saving facility to students so that students can save their activities within CB-MCBTs, and whenever they starts learning again by CB-MCBT they will start their learning from where they had left.

CHAPTER 6: QUESTIONNAIRE DESIGN AND RESULTS

This chapter is about questionnaire design, its distribution and result. Section 6.1 contains questionnaire design and its distribution among the students. Section 6.2 contains questionnaire responses.

6.1 Questionnaire Design and Distribution

Authors of this research have designed questionnaire with the help of theoretical work, focus group and personal experience. Two major types of questions have been used in questionnaire; open ended and close ended questions. In open ended questions respondent is free to give suggestions and comments but in close ended questions respondent is restricted in multiple limited choices. Online questionnaire is easy to access therefore authors have designed web questionnaire and distributed to 22 students of AIOU through their email addresses. Appendix A represents the questionnaire designed to figure out usability issues in CB-MCBTs.

Table 6.1 represents the criteria to find out usability issues in CB-MCBTs.

Table 6.1 Criteria	Question numbers
Visibility	**1, 2, 3 and 4**
Completeness	**5, 6**
Memorability	**7**
Navigation	**8**
Consistency	**9**
Simplicity	**10**
Satisfaction	**12,13**
Availability	**14, 15**
Feedback	**16, 17**
Educational Learning	**19**
Aesthetic	**11**

Table 6.1 Questions Bond With Criteria

6.2 Questionnaire Response

Questionnaire responses have been collected within four days after questionnaire distribution. 19 out of 22 students had responded. Three students did not answer the questions. Graph 6.2 shows the results in visual forms.

38% students are agreeing with the visibility in CB-MCBT, 42% said neutral, 10% responded disagree with visibility in CB-MCBTs, 4% are strictly agreed with the visibility in CB-MCBTs.
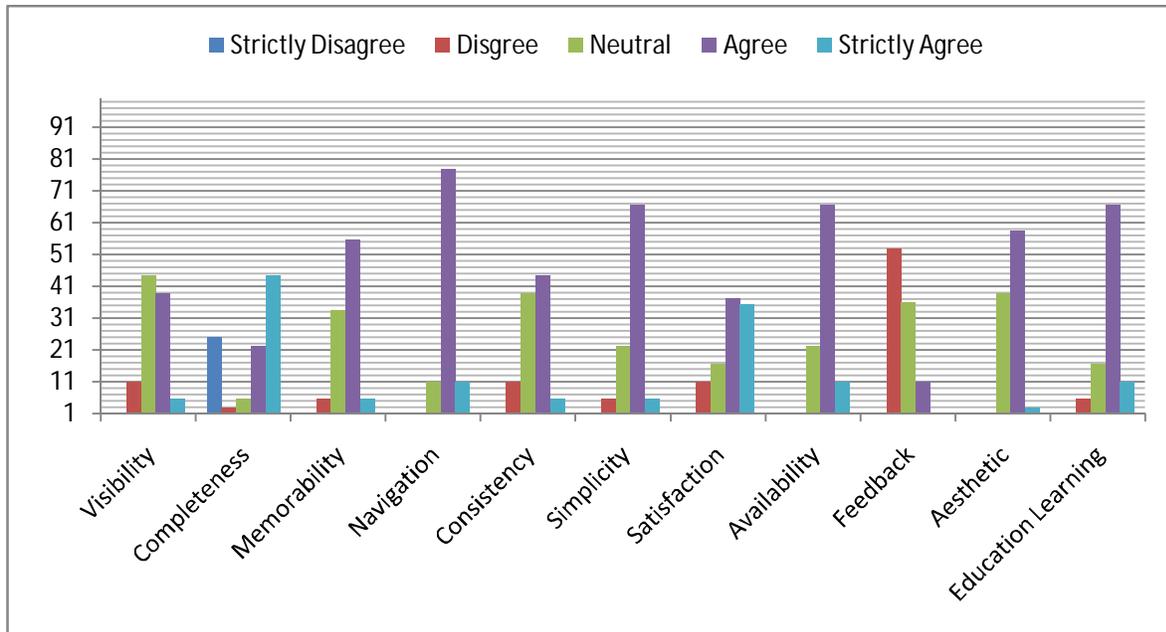
Graph 6.2

45% student responded that they are strictly agreed that system should have more feature and facilities. 22% agree to have more features within the system, 2% disagree and 22% are strictly disagreeing.

54% students are agreeing with the system memorability, 32% are neutral, 5% disagree with system memorability, 3% are strictly agreed with it.

78% students agree with the navigation available in system, 10% are strictly agreed and 10% are neutral.

43% students replied that system is consistent by selecting agreed option, 38% replied neutral, and 10% are disagreed on it and 4% are strictly disagreeing on it.

65% of students are agreeing with the simplicity of the system. 22% students are neutral to it. And 5% disagree with the system simplicity and 4% are strictly disagreeing with the simplicity provided by the system.

35% of students are agree with the satisfaction, 33% are strictly agree with it, 15% are neutral, and 10% are disagree with the satisfaction.

65% students are agreed for the online availability of the system, 22% said its neutral, and 11% are strictly agreed.

52% students are disagree that system is providing feedback and 33% are neutral and 10% are agree with the feedback provided by the system.

59% agree with the aesthetic of interface, 38% are neutral and 3% are strictly agreed with the aesthetic of user interface.

65% are agree with the educational learning provided by system, 16% said its neutral, 3% are disagree with it, and 10% are strictly agree with educational contents.

Question no 20 was open ended question and following are the responses of student.

Q no20: What do you suggest for improvements in CB-MCBT?

- Three students suggested they want online chatting facility within the system, so that they can discuss educational issues with other fellow students and teachers.
- Two students need a forum where students post their problems and get responses of other students.
- One student mentioned that there should be frequently asked questions in every unit.
- Five students are not satisfied with the menus and buttons used in the system.
- Two students mentioned that use of 3D animations will be more effective instead of 2D animations in educational slides.
- One student wants to save his activities within the system.
- Two students are not satisfied with the quality of graphic in CB-MCBT.
- Three students said that system provides sufficient support to get concept about topics, but system should provide some books in electronic forms to get in detail subjective knowledge.

CHAPTER 7: DISCUSSION

Visibility means all features and contents of user interface should be clearly visible. According to results obtained by questionnaire, educational contents and graphics available in CB-MCBT have low visibility and students want improvements in visibility of user interface of CB-MCBT. Menus and buttons used in CB-MCBT need improvements regarding the visibility. Different designs of menus and buttons are used in CB-MCBT as shown in figure 7.2, figure 7.3, and figure 7.4, and there is no consistency in design of menus and buttons in CB-MCBT, which is a cause of low visibility in CB-MCBT, but text, audio, videos and animations used in CB-MCBTs are clearly visible to students. Although quality of graphics used in CB-MCBTs need improvements e.g. figure 7.1 is a image used in CB-MCBT and text in the image is not clearly visible, which is decreasing the visibility of graphics and animations in CB-MCBTs.
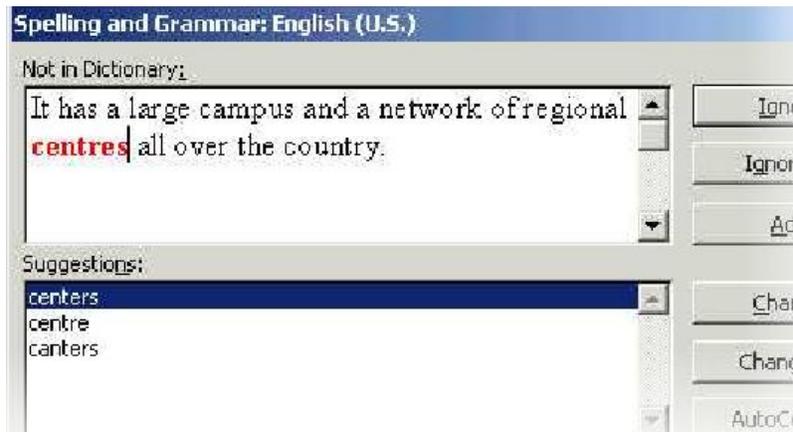
Figure 7.1

Within CB-MCBT some more features are required by the students and they have mentioned their requirements in open ended question. Following features are required by the student, saving data and activities within CB-MCBT, online multimedia conferencing for communication between student-teacher and student-student. Students wish to have a file containing frequently asked questions related to each topic in CB-MCBT, frequently ask questions are common questions asked by the users or learners about any topic during lecture, AIOU should provide a file containing frequently asked questions related to every unit of study in CB-MCBT, which is helpful for learners to solve their basic subjective learning problems instantly.

Student wants a discussion forum with in CB-MCBT, where they can discuss their educational issues with their fellow students. CB-MCBT should provide some books in electronic form so that students can

get in detail subjective knowledge. Students are satisfied with the availability of CB-MCBTs by post. But most of the students wish that CB-MCBT should be available online, so that they can download it on their personal computers and use it anytime they want. Web conferencing is helpful to support distance education, therefore Virtual universities and open universities are getting benefits from web conferencing software's e.g. Adobe Acrobat Connect, GoToMeeting by Citrix, Netviewer Software, and WebEx. AIOU can provide distance education in better way by using web conferencing software's parallel with these CB-MCBTs. AIOU should provide facility of Really Simple Syndication (RSS) for feedback regarding updates in CB-MCBTs. Use of RSS will be helpful for students of AIOU to receive updates in courses, results, assignments and news. According to authors of this research student should be able to search any topic within the CB-MCBT. Currently CB-MCBT is just providing search facility in glossary of words available in CB-MCBT. But students want to search any unit or sub topics within CB-MCBT. AIOU have used animations in educational slides to create more understanding about the topics. Students learn through CB-MCBT with multimedia slides containing lectures about different topics and each slide contain audio, video, animation, graphic, and text. Animations in slides are according to the topic of lectures. AIOU uses 2 Dimensional animations in CB-MCBT, but most of the time 3 dimensional animations are required for create more understanding about the topics. Questionnaire results of this research showed that memorability in the CB-MCBT is not sufficient. How easily users can remember the system once, he/she have used the system is called memorability.. Providing the help facility in CB-MCBT can increase the memorability. E.g. if student face some problem to use the interface of CB-MCBT then CB-MCBT should help the student and guide him/her during their interaction with the system. In the context of CB-MCBT navigation is the freedom of user move though the system e.g. users move from one slide to another and from one feature to another feature within CB –MCBT. Questionnaire results show that students are satisfied with the navigation of the system. But providing table of contents linked with the multimedia lectures available in CB-MCBT will increase the navigation within the system. Consistency is about the uniformity in appearance of objects in user interface. User already has learned and experienced from other interfaces and expects to find same feature on same locations when they use different software's (Apsel et al., 2008). Questionnaire results of this research shows that some improvement required in the interface of CB-MCBTs regarding consistency. According to (Galitz, O. W. 2002) ambiguous menus and icons is one of the 10 most common usability problems in user interface. Different designs of menus and buttons are used in the CB-MCBT. Use of different designs of menus and buttons are violating rule of consistency.

Figure 7.2 Main Menu

Figure 7.3 Sub Menu

Figure 7.2 and Figure 7.3 represent the menus used in CB-MCBT. Designs of both menus are different to each other therefore it is difficult for users to recognize the menus in CB-MCBT.

Figure 7.4 Buttons

Figure 7.4 represents the buttons used in CB-MCBT, and designs of buttons are different to each other, which is breaking the rule of consistency. It is important to use same design of menus, and buttons and it will be helpful for students to easily understand the interface of the system and concentrate more on educational learning. Questionnaire results show that available educational contents in CB-MCBTs are helpful to increase subjective knowledge. But still some improvements are required in the educational contents; according to focus group CB-MCBTs are enough to get concept about the subject but to study the subject in-detail and pass the exams with high grades students needs to get support from other literature and books. Therefore to increase the subject learning in CB-MCBT, it should provide some electronic books and literature related to the subject and these books and literature can be in portable document format (PDF).

CHAPTER 8: CONCLUSION

This chapter contains conclusion, recommendations and future work.

8.1 Conclusion

Usability evaluation doesn't have any specific criteria to figure out usability issues in any application. And effectiveness, efficiency and satisfactions in any application are dependent on the domain of applications. Effectiveness, efficiency, and satisfaction in any computerized learning environment is dependent on two major points, 1) Usable user interface of computerized learning environment, and 2) Quality of subjective learning material in computerized learning environment. AIOU is trying to implement latest technologies to provide distance education to the remote areas of Pakistan. To support distance education AIOU has developed CB-MCBTs as a computerized learning environment (CBL). Computerized learning environments are very much helpful to support distance education and communication and administration modules in CBL are helpful for learner's interaction with university. In CB-MCBTs, AIOU has focused on multimedia educational contents, navigation, glossary of words, and references material. But CB-MCBTs don't have communication and administration modules. Therefore usability of CB-MCBT in distance education provided by AIOU is not sufficient. When we talk about the university distance education supported by computerized learning environment students desire to have complete virtual learning environment with Admission Module (Admission Status Monitoring Module), Course Registration Module, Administrative Resource Module, Communication System, Course System.

Goal of this research has been to figure out the requirements of BS level students regarding the CB-MCBTs developed by Allama Iqbal Open University. To identify students requirements inquiry technique have been used in this research. It is concluded that CB-MCBTs developed by AIOU needs improvements regarding completeness in CB-MCBT related to features and facilities required by the student, availability of CB-MCBT to each and every student and feedback to the student (feedback from university to student and feedback within CB-MCBT). Students need some extra features related to completeness in CB-MCBTs e.g. Search within the system, electronic course books in PDF form, and use of 3dimentional animations within educational slides in CB-MCBTs, online availability of CB-MCBT to the student, so that students can download it on their personal computers and use it whenever they want. Student wants feedbacks within the system and feedbacks from administration of the course, these feedbacks can be about new assignments, results, news and updates in CB-MCBTs.

Critical suggestions by the students about CB-MCBTs show that students are taking so much interest in this computerized learning environment. Therefore by updating these CB-MCBTs according to the recommendation given by this research will make these CB-MCBTs more effective, efficient and satisfying to students.

8.2 Recommendations

Authors of this research give following recommendation to AIOU regarding improvements in CB-MCBTs.

- AIOU should adopt virtual learning environment because virtual learning environments contain different modules e.g. Admission Module, Course Registration Module, Administrative Resource Module, Communication System (Email Service and Online Chat Service) etc and these modules are helpful to provide distance education in better way.

- Providing CB-MCBT in the form of web over internet will enhance availability of CB-MCBT to the students. Moreover AIOU have to develop updateable CB-MCBTs e.g. teacher should be able to update assignments and results and educational contents in CB-MCBT. Students and teachers should be able communicate with each other with the help of online chat feature in CB-MCBT. And AIOU can use web conferencing software's parallel with these CB-MCBTs to deliver lectures to the students from distance. AIOU can use one of these web conferencing software's to support distance education: Adobe Acrobat Connect, GoToMeeting by Citrix, Netviewer Software, and WebEx

- Students should be able write notes within the CB-MCBT and CB-MCBT should provide a saving facility so that student can be able to saves their learning status and activities, so that whenever student starts learning again with CB-MCBT they can start from where they had left their learning.

- Design of buttons used in CB-MCBT are not consistent and causing the low visibility in the interface therefore it is recommended to AIOU that designs of buttons should be similar to each other and all buttons should provide proper feedback to leaner's so that learner can understand the purpose of buttons. Menus used in CB-MCBT by AIOU are also not similar in design and it causes inconsistency in the interface of CB-MCBTs. Therefore if menus will be similar to each other's it will make the interface more understandable.

- CB-MCBT designed by AIOU uses 2 dimension animations in educational slides to create better understanding about the topics. Development of these 2d animations in educational slides is a nice effort by AIOU and these animations are very helpful for subjective learning. But according to the results of questionnaire students will understand the topics in better way if CB-MCBT uses 3D animations in educational slides. Therefore it is recommended to AIOU to use 3 Dimensional animations in educational slides.

- Students are not satisfied with the literature available in reference material files in CB-MCBT. If AIOU provide some electronic books related to subject in CB-MCBT then it will be helpful for students to get more knowledge about subject or topic. And these books can be in portable document format (PDF).

- AIOU can provide distance education in better way if CB-MCBT contain following modules and components.
  - Registration of students (Assigning a unique user id and password to students to avail online facilities)
  - Registration of subjects
  - Multimedia Learning slides and Lectures
  - Communication between student-teacher and student-student.
  - Administration module
  - Updates and Alerts (AIOU can use Really Simple Syndication (RSS) for updates and alerts in CB-MCBT)

8.3 Future Work

This research is a contribution in the area of usability evaluation in computerized learning environment and particularly in a computerized learning environment designed by Allama Iqbal Open University. Effort of AIOU for designing these CB-MCBTs is appreciable. CB-MCBT designed by AIOU is a unique development in computer based trainings.

This product is very much helpful for distance learning. AIOU is eagerly implementing upcoming technologies to provide distance learning in better way. Implementing recommendations given by this research will improve usability in CB-MCBTs.

Future work of this research is to design a usable user interface for CB-MCBTs developed by AIOU. And this interface should contain the features recommended by this research. After

designing interface for CB-MCBT, designer of interface should perform a usability test to verify the usability of interface.

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Appendix A: Questionnaire

Table 6.1 Questionnaire					
Questions	**Scale**				
1. **I can find and recognize the educational contents.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
2. **I can easily find menus.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
3. **I can easily find buttons.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
4. **I can easily find animations/videos.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. **I am satisfied with features provided by the system.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
6. **I can save my learning status or activities.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7. **I can easily remember how to use the system.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
8. **I can easily move within the system.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. **Layout remains same throughout the system?**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
10. **System is easy to use and understand?**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
11. **Organization of information remains same throughout system.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
12. **It works according to my requirements.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
13. **I am satisfied with this system.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
14. **It should be available online.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
15. **System is available in CD form and available for every student.**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
16. **Buttons tell about it when you**	Strongly	Disagree	Neutral	Agree	Strongly

click or roll mouse over it.	Disagree				Agree
17. System tells when you perform an action.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
18. Educational contents are helpful to increase my knowledge.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
19. Do you want to suggest something about system?					