ABSTRACT

Right from its original conception in 1989, the Web has changed into an environment employed for the delivery of different types of applications. These applications range from small-scale information dissemination to large scale commercial, enterprise-planning and scheduling, collaborative-work applications [1]. Information and Communication Technology (ICT) has caused a revolution in the field of education moving it from the physical environment to a Virtual Learning Environment (VLE) and providing courses to increasingly diverse and distributed student population. This requires a shift from tutor-centric education to learner-centered education involving high level of interaction between the user and the computer. Web Based Learning (WBL) systems demand developing more realistic and interesting user interfaces to provide flexibility in learning style and to enhance the learning capability of the user. Therefore, the effectiveness and efficiency of a WBL system is indicative of its quality.

Any system does not serve its purpose unless its functionality is completely utilized by its intended users. For an effective use of the system, effective Human Computer Interaction (HCI) must be designed. HCI is the crucial component that influences the quality of usage and communication between the user and the virtual environment as well as in the learning environment [2]. Also, usability of the system is an issue. The development of such Web-based application implies following Web Engineering processes. This research focuses on the contribution of HCI towards usability in a WBL environment.

This thesis has made the following significant contributions:

1. A critical concern for researchers has been the measurement of HCI usability in online learning systems. To address HCI usability issues, this research explores user perception of WBL in a Blended Learning System (BLS) by classifying the usability into multiple categories. The qualitative input is converted into quantitative values and user acceptance is ranked by order. Understanding the
level of HCI acceptance by users provides insight to designers and developers of WBL system.

2. With the emergence of interactive software system and their widespread use over the last decades, the needs of potential users have increasingly become crucial to design. The detection of usability errors in the early phases of WBL system development helps to minimize the usability defects and rework effort later on. The main work of this thesis is that HCI plays a crucial role in the WBL system and early detection and rectification of HCI defects can improve the efficiency of WBL application development.

3. Further, this thesis discusses evaluation of the rework effort and cost incurred for resolving usability errors through a mathematical model, making its adoption feasible for developers. We gather data pertaining to the rework effort from organization developing WBL projects. We provide a model for estimating rework effort during development of WBL system and simulate the same using MATLAB. We extend this study to provide a \textit{costimate} \footnote{Costimate = Cost + Estimate} model, to estimate the total cost of developing a WBL system and the Return on Investment (ROI).

4. For the successful implementation of online learning throughout India, a tripartite G2B2B model involving Businesses, Academia and Government is suggested.

5. As a social obligation, we perform an empirical study to explore the energy utilization in e-Learning. Increased internet usage increases the energy utilization at the data centers, equipment resources, transmission network, etc. Pertaining to this issue, we analyze the ‘green-ness’ of online learning system via comparison of energy consumption by users of WBL system with the energy consumption by data centers and traditional learning system. This comparison facilitated the recommendation towards accelerating global Green-IT efforts. The analysis of energy utilization by WBL system refutes the assumption that online learning is not environment friendly.
Studying HCI usability of WBL system from the user perspective is a novel contribution to the Web Application testing field. The strategies presented in this dissertation have the potential to:

1. Provide insight into user the preferences in a WBL system

2. Increase the availability of WBL application country wide

3. Increase the ROI for WBL applications providers

4. Increase the efficiency of WBL application development due to rectification of errors, thereby improving their reliability

5. Provide an environment friendly cost effective mode of learning

The successful dissemination of any WBL program is based on the costing and viability. The research focuses on the WBL system holistically in terms of its acceptability, cost estimation for development, ROI and implementation through case study and models. The socio-technical outcome of this research has been an empirical assessment of energy utilization in WBL and recommendations towards Green-IT.

Peer-reviewed papers that contain outcomes of our research form the main components of this thesis.