Usability Problem Solving: Designing Good Interactive Software

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Abstract

Software development is the creation of software systems for human users. This development is guided by systematic methods and techniques capable of achieving valued usable systems or pointless non-productive systems. Usability engineering offers a promising new approach to the design of software systems that enable the human user to produce faster, better work. A human-centered, task-oriented methodology achieves good usability for the system being created. The problem solving involved in obtaining this usable system can be taught with a problem-based learning approach. The incorporation of usability evaluation laboratories in the current methodology of software development is a key ingredient. This paper gives an exposition and analysis of the student problem solving involved in the user-centered, task-oriented methodology of producing good interactive software systems and presents the information with a method for the student projects.

Introduction

In the quest for quality, software developers are focusing on the improvement of the ingredient that impacts the user of a software system the most, the interface. The interface will be significantly improved when a design method called user-centered design is used in the development of the software product. The user-centered design methodology includes the evaluation of the interface by typical users during multiple milestones of the lifecycle. A powerful resource in this endeavor of interface development is the usability evaluation laboratory. Typically, a true user in the lab with a one-way observation mirror performs several functions and tasks on the software system. The usability evaluation team observes and records what happens when the user attempts to use the system. Video cameras, computer programs, and interviews capture all relevant information for later analysis. But the lab is essentially a data collection tool that will not enhance the evaluated software unless there is a method for significant change to the usability defects uncovered. Historically the last decade of testing labs still produced systems with glaring usability defects [Constantine 1999]. Southern Polytechnic State University (SPSU) has implemented a Usability Research Lab (ULAB) to support the student design of usable systems in the School of Computing and Software Engineering. A teaching methodology that incorporates the ULAB in the curriculum is used to enhance the new software system's quality and user satisfaction.

However, many pitfalls and breakdowns lie on the path to learning this good interaction design. Students need to assimilate the breadth of knowledge that goes into designing real systems and all the characteristic elements of human factors. The requirement analysis of a design project starts with the identification of the users and their related species. The lexical interactive perfect dialogue desired between the human user and system is based on the user’s cognition model. Students request a magical precise formula out of a guidebook – a list of principles that prescribe the correct design. However, interaction design is a problem solving activity that thrives on experience, wisdom, and extensibility, not in having the correct guidebook. The design principles learned in human factors and user centered design does not always prescribe a unique absolutely correct solution to the

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current project. The essence of design solving is a balancing of the making tradeoffs in accomplishments. The correctness of building a prototype of the system needs to encompass what matters, what makes sense and what the user can do [Rosson, 2002]. Every student problem solving decision in their pursuit of the correct usable software design must reflect a set of assumptions regarding the requirements of the user of the software. During all the stages of development the student's decisions regarding priorities and alternative must be presented to the user in a usability evaluation to obtain feedback that will be incorporated in the next cycle of design.

**Problem Solving in Design**

The main purpose for the ULAB is to provide the capability to ask users to evaluate the usability of systems, especially the usability of the interface. Usability is one of the main principles contained in a new design methodology for software systems called user-centered design. User-centered design is a systematic approach for devising software closely fitted to the genuine needs of users. It provides a scheme for quickly understanding users in relation to systems, their working intentions in carry out tasks, and the support they need from the system to perform those tasks [Preece 94]. The ULAB, as a curricular resource, enables our graduates to be ready to apply their knowledge to industry usability evaluations by promoting usability as an integral part of the software's pursuit of quality. A usability evaluation project is done in the ULAB in the user centered course and software development courses.

**The ULAB**

**The Design**

Usability evaluation is an empirical study with true users of the proposed system to provide feedback in the software development during an iterative development life cycle. It has come to be recognized as an integral part of quality assurance and its effect on quality can be readily measured. The field of software development has reflected increasing interest in usability testing, which is generally performed on new software and hardware in the development stages. The concept of usability evaluation is to enable the validation of all requirements, to make it as useful as possible, and thus enhance product quality and customer satisfaction of the potential product [Mayhew 99].

**The Method**

Usability evaluation is performed by typical users in a lab with a one-way observation mirror that allows the software engineering team, the developers of the software and other interested parties to observe what happens when the user attempts to use the product. Video cameras capture the keystrokes and body language of the users for later analysis. Computer programs are used to record all activities as well. The users are interviewed before and after the test for initial representation and final impressions. During the evaluations the users are asked to think aloud to share their thinking processes, with their verbal protocols and behavior recorded as data to be review by the student developers.

**The Facility**

The facility built for the Usability Research Lab at SPSU consists of three adjacent rooms, (1) User Area, (2) Control Room, and (3) Observation Room. The user area resembles a standard workroom with typical computer equipment, printer, and telephone on a desk. The room is furnished to resemble an office setting and increases the user's identification with similar environment of their work. The user area also contains the three video cameras in three of the corners of the room, audio recording equipment and a large one-way mirror. Page 5 contains two images of the user area and the control room.
The control room is equipped with a specially built work space that includes monitors for each of the camera feeds, one monitor for the software screen feed, and one monitor for the composite image which will be recorded onto the video tape of the evaluation session. The evaluation team logs the interaction events displayed by the user with specific software in a computer in the control room. This event data is used to make the final analysis of the evaluation and backs up the recommendation. The team documents the interactions, features, functions, and/or objects of the user interface that violate established principles of usability. The violations are likely to lead the user to errors, confusion, or failure to complete a task with the system.

The last room in the series of rooms is the Observation Room, which is adjacent to the control room. This observation room has a large window to the control room, which permits all the interested parties to observe the entire evaluation session. The room also has a large TV screen showing the composite image that is being recorded from the control. The capacity to directly observe evaluation sessions by interested parties is an important feature. This feature was incorporated in our ULAB with this additional room adjacent to the control room that can look at the evaluation session without disrupting the usability team in logging the events. This room, which is buffered from the user area, enables the interested parties to be able to discuss what is happening without comments, laughter, etc. reaching the user.

**The Usability Evaluation Project**

**Gather Information**

The usability student team begins a Usability Evaluation Project by gathering information about the prototype software to be evaluated. This prototype software is in one of the iterative cycles of design by the software engineering class. The main three deliverables (goals) in the gathering information step are (1) the task analysis, (2) the user analysis, and (3) the conceptual modeling of the interaction. The task analysis is the study and determination of the characteristics present with regards to the users of the software system. The important cognitive characteristics of the users are previous knowledge needed, decision strategy, cognition loading, etc. The modeling of the interaction is a clear diagram of input needed from the user to complete the task. Interviews with the student designers of the prototype software are conducted to obtain descriptions of the software, the purpose, current development stage, roles of the development team, etc.

The active participation of both student designers and student usability evaluators in the team is critical to the success of the evaluation. The conversations between these groups provide supportive confirmation of the progress in the design of the new software, and specific feedback to guide for changes to the next iteration of software’s design. Research evidence shows how usability evaluations speeds up many software projects and also produces dramatic cost savings [Shneiderman 98].

**The Plan and Preparation**

The student team’s plan to obtain usable interactive software is specified with the determination of the individual tasks for the evaluation. The following is an example of what the final agenda can include:

- Refining of the goals and concerns for the evaluation
- Establishing the parts of the evaluation
- Creating the final user profile
- Developing a screening questionnaire
- Inventory of the user tasks in system
- Creating multiple task scenarios with storyboards of the screens
- Determining the quantitative and qualitative measures
- Develop the usability baseline criteria
- Identify the events for logging
• Assigning team roles for the evaluation
• Establishing the method for the data analysis

The team members have different roles for the evaluation. These roles include a briefer/debriefer, a computer logger, a video editor, and the camera personnel. They complete independent tasks including refining of materials developed in the planning meeting, development of evaluation materials, recruitment of participants, etc. Once these independent tasks are completed a walk-through of the entire planned evaluation with all team members practicing their roles is completed. This rehearsal usually uncovers required editing of the materials prepared by the team in the previous steps.

**The Evaluation**

The evaluation is usually conducted in multiple days with one pilot evaluation session and four additional sessions. Five to six recruited users come for these sessions. Usability requirements are represented as performance measures which the team logs as events [Bailey 96]. These events are usability metrics decided in the previous steps. A formula for the acceptance or the redesigning of each aspect of the software is the baseline criteria, which was determined before this step by the Team. During the last portion of the evaluation, the team prepares the study findings and recommendations.

**Conclusions**

**Usability Problem Solving**

The experience of watching users attempt to use the software, noting their performance and subjective reactions compared to the expected scenarios reveals the complexity of the heterogeneous interactions by users. The problem solving involved to state the problem areas and recommend possible solutions is the magic. The team contains current and future software developers that will understand and adhere to the concept of user-centered, task-oriented software systems. The benefit of the team evaluation experience enables a wisdom regarding the choices for interface design. This wisdom is extended into all the future system development. This paper has presented an exposition, analysis, and methodology of the student problem solving involved in the user-centered, task-oriented software development strategy.

**References**


ASEE Southeast Section Conference

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Barbara Bernal Thomas is a full professor in the School of Computing and Software Engineering at Southern Polytechnic State University (SPSU) for the last sixteen years. The areas of Software Engineering, User-Centered Design and Computer Graphics & Multimedia are the focus endeavors. She is a co-founder of the SPSU Usability Research Lab and is directly involved in corporate-sponsor ULAB projects. She has given numerous papers, tutorials and presentations locally and internationally on User-Centered Design, Usability and Software Engineering topics. Barbara is involved with computer educational support for local businesses in the Atlanta area. She does specialized software development and evaluation as a consultant.