Considering User Knowledge in the Evaluation of Training System Usability

Clint Bowers[1], Jan Cannon-Bowers[2], and Talib Hussain[3]

[1] Department of Psychology, University of Central Florida, Orlando, FL, USA 32816
[2] Institute for Simulation and Training, University of Central Florida, Orlando, FL, USA 32816
[3] BBN Technologies, Cambridge, MA, USA
{Clint Bowers,bowers}@mail.ucf.edu, talib@bbn.com

Abstract. A variety of software-based systems are being used as training media. There is not, however, an accepted approach to evaluating the usability of these systems. Traditional usability approaches can be employed with some effectiveness, but they may lack appropriate specificity for use in training. In this paper, we evaluate whether assessing, and remediating, gaps in learner knowledge might be an important addition to training system evaluation. The results suggest that remediating knowledge gaps might lead to more accurate usability conclusions.

Keywords: Learner-centered design, usability, training.

1 Introduction

As the utilization of electronic systems in training becomes more prevalent, it will be important to adopt usability evaluation approaches that yield an accurate portrayal of the system's potential as a training platform. However, according to Squire & Preece, [1], traditional usability evaluation approaches may not be sufficient to address the particular needs of the training community. These authors conclude that there has been a failure to integrate usability evaluation with the science of how people learn. Thus, usability evaluations may yield results that are misleading. Given this problem, some researchers have discussed the notion of "pedagogical usability analysis." This approach extends traditional usability analysis by considering not just the user's ability to interact meaningfully with the system, but the ability of the system to satisfy its intended educational goals [2].

In response to the challenges described above, it has been suggested that the traditional user-centered design approach be altered to "learner-centered design" [3, 4]. A central tenet of this approach is the emphasis on the ability of the system to help the learner get from their current state to their desired state. This design approach and its corollary evaluation approach consider a number of factors (see Ardito et al., 2006 for a review of these issues [5]). However, one feature that all approaches have in common is a need to make some assumptions about the learner's state of knowledge. These assumptions play a critical role not only in the development of training systems, but in the interpretation of usability evaluation data. For example, if a user is unable to

M. Kurosu (Ed.): Human Centered Design, HCII 2009, LNCS 5619, pp. 27–30, 2009.

perform a task for which they are presumed to have the requisite knowledge and ability, it would logically indicate a design flaw that might necessitate an expensive redesign. Given the importance of these data, it is important that their validity be established.

In many cases, user knowledge is determined by successful completion of educational experiences. For example, if a student has passed a particular course, it is typically presumed that they have a mastery of materials covered in that course. This approach is used frequently in the usability arena, but there is some reason to suspect that it may not be optimal. Learners frequently receive "passing grades" without acquiring targeted knowledge. Further, even knowledge that was successfully acquired is likely to have been forgotten if the usability testing is conducted well after the educational experience. Consequently, conclusions based on assumed competencies may be incorrect.

A variety of usability evaluation methods have been suggested for educational software [1, 6, 7] . In large part, these approaches all emphasize the manner in which the software presents information, but there is somewhat less emphasis on the existing knowledge of the learner. This is likely because these studies have focused on education of novices rather than the training of participants who are likely to have some, perhaps substantial, prior experience with the course material. In training applications, software designers are likely to make assumptions about the knowledge state of the learner. The accuracy of these assumptions, however, is likely to be an important factor in downstream usability and training effectiveness. Thus, we assert that assessment of learner state, or appropriate remedial activities, may be an important consideration in this type of usability analysis.

To further investigate this possibility, we conducted a study to determine whether faulty assumptions about user knowledge based on experience would influence the interpretation of usability data. The details of this study are detailed below.

2 Participants

A total of 60 recruits at a military recruiting command participated in the study. There were 56 males and 4 females in the sample. The average age of participants was 19.7 years. The users had a wide range of experience with computers, with the majority describing themselves as comfortable with computer applications. All users had completed their initial training and had passed a "capstone exercise" in which targeted skills had been successfully demonstrated within the preceding 6 weeks.

3 Instruments

Users were asked to play a newly developed computer-based simulation that emphasized the control of onboard flooding. The scenario required users to understand ship navigation, proper communication procedures, and repair procedures. All users completed a tutorial that taught the simulation controls. Users then completed a simulated damage control mission similar to their capstone experience. User performance was observed and rated by trained raters. Users also completed a customized version of the Questionnaire for User Interface Satisfaction (QUIS, Chin et al., 1988) and the System Usability Scale (Digital Equipment Corporation, 1986).

4 Method

Users were assigned to one of two groups. All groups received informed consent, the tutorial, the test mission, and the questionnaires. Half of the group was assigned to a "training condition," which quickly reviewed the concepts of ship navigation, a critical ability for the test mission. The training was a brief review (< 5 minutes) which included a text-and-graphics form that demonstrated navigation principles.

5 Results

Statistical analyses of demographic data indicated no significant differences between the training and control groups on any of the QUIS items. Further, independent samples t-tests indicated that there were no differences in the subjective evaluation of system usability. Interestingly, however, the data indicated that the training group made fewer errors on performance tasks involving navigation ($\underline{t} = 2.87$, $p < .05$). Further, users in the training group were significantly less likely to "fail" on these events (e.g., be unable to accomplish a desired task) ($X^2 = 5.09$, $p < .05$).

6 Discussion

The results of this study demonstrate that assumptions about user knowledge based on experience may lead to misleading usability conclusions. In the current case, the assumption of competency based on experience (i.e., successful completion of the capstone experience) would have lead us to conclude that the training system was flawed, and would have likely led to a re-design and the delays and costs associated with it. By providing brief, extremely inexpensive training, we were able to reveal that the critical errors were not likely due to a design flaw, but the lack of a critical competency in our users. We were able to correct this deficiency without changing the software at all.

Clearly, there is a need to provide accurate evaluations of training systems. These evaluations will increase in frequency and importance as we grow more reliant upon technology-based education. A critical element in these evaluations will be an understanding of the user's pre-existing knowledge, skills and abilities. These results of the present study suggest that there may be an advantage to evaluating this factor more carefully than is often done. A more thorough evaluation (and remediation when necessary) is likely to result in a more accurate and useful evaluation.

References

1. Squires, D., Preece, J.: Predicting quality in educational software: Evaluating for learning, usability and the synergy between them. Interacting with Computers, 467–483 (1999)
2. Silius, K., Tervakari, A.M., Pohjolainen, S.: A multidisciplinary tool for the evaluation of usability, pedagogicalusability, accessibility and informationalquality of Web-based courses. Proceedings of PEG2003–The 11th International PEGConference: Powerful ICT for Teaching and Learning (2003)

3. Quintana, C., Soloway, E., Norris, C.: Learner-Centered Design: Developing Software That Scaffolds Learning. In: Second IEEE International Conference on Advanced Learning Technologies (ICALT 2001) (2001)
4. Quintana, C., Krajcik, J., Soloway, E.: Exploring a structured definition for leaner-centered design. In: Proceedings of the ICLS 2000 (2000)
5. Ardito, C., Costabile, M.F., De Marsico, M., Lanzilotti, M., Levialdi, S., Plantamura, S., Roselli, T., Rossano, V., Tersigni, M.: Towards Guidelines for Usability of e-Learning Applications. User-Centered Interaction Paradigms for Universal Access in the Information Society (2004)
6. Dringus, L.: An iterative usability evaluation procedure for interactive online courses. J. Int. Instr. Dev. 7(4), 10–14 (1995)
7. Ravden, S.J., Johnson, G.I.: Evaluating usability of human-computer interface: a practical method. Wiley, Chichester (1989)