Learning to Use a Complex Information Technology

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Complex information technologies are cognitive artifacts that have the potential to transform the way we think and work. In recent years, cognitive research has made progress into understanding learning processes and skill acquisition in complex technology-based domains (Howes & Young, 1996). The promotion of skilled use of complex technologies is a multifaceted challenge, including the need for better and more consistent interfaces, effective training methods, and explanatory models of the learning processes. In this paper, we characterize the cognitive consequences of physicians learning to use computerized patient record systems (CPR). CPR systems are computer-based devices for inputting, representing, accessing, and managing patient care records. Despite their great potential, the implementation and integration of such computer-based technologies in medical practice has proven to be difficult (Kushniruk et al,, 1996). This work aims to understand the effects of technology and how it can support performance.

How do people acquire the necessary skills for competent use of a technology? Optimal use of a CPR system involves a) the development of accurate patient problem representations, b) fast and efficient performance, and c) relatively problem-free use. A number of cognitive methods have been developed to characterize users' performance and investigate the usability of different kinds of computer-based systems (Polson et al, 1992). Common to most methods are the characterization of a users' goals, actions, and inferences over extended temporal sequences. Users of these devices must acquire knowledge of how to map the tasks they wish to accomplish into sequences of actions enabled by the technology (Howes & Young, 1996). These mappings can range from relatively simple to rather complex, involving considerable domain-specific and artifact-specific knowledge. We are concerned with use of CPR systems for diagnostic reasoning tasks. Entering patient data engages the interdependent component processes of *information gathering*, *diagnostic reasoning*, and *problem representation*. Each of these processes can be decomposed into set of goal-action hierarchies and prerequisite component skills.

This paper discusses a framework for investigating learning and the acquisition of cognitive competencies. This is illustrated in the context of an in-depth case study of a novice user learning to use a CPR system Our research methods including cognitive task analysis, video recording and computer-supported analysis of the video data in the study of human-computer interaction, as well as methodologies employed in the field of medical cognition (Patel et al, 1989).

The results focus on qualitative indices of learning such as changes in reasoning patterns as a function of using the CPR system and quantitative changes in performance. For example, as the user gains experience, we observed a shift in strategies which the subject employs the system to direct data gathering and diagnostic reasoning processes. This shift in strategy appears to completely transform the nature of the diagnostic task and variably effects the accuracy of diagnosis.

We also developed a set of task-specific quantitative indices to evaluate changes in performance as a function of learning. This indices reflect accuracy in developing a problem representation, measures of efficiency, and types of user errors and problems encountered. The physician showed general improvement in developing a more accurate representation over time, showed variable gains in efficiency (e.g., latency of response), and experienced different kinds of errors (more conceptual ones and fewer pertaining to the interface) as a function of working with the CPR system.

The process of complex skill acquisition necessitate particular kinds of cognitive transitions result in greater facility of use and accuracy of representation. The use of such cognitive artifacts may interact with component processes such as diagnostic reasoning and information gathering with significant and surprising consequences We need to understand these changes to harness the potential of emerging technologies. It is also important to begin to define some benchmarks of competency in using such systems. These kind of cognitive assessment can contribute to the iterative design process.

References

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