Cognitive requirements analysis to derive training models for controlling complex systems

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Abstract

Although simulators are widely used for training of process control tasks, simulator trainings are conducted with little consideration of research results on cognition, training design or effectiveness (Salas et al., 2006). Therefore, a hierarchical task analysis described through the sub-goal templates method, a cognitive reliability and error analysis method and a protocol analysis were applied to the Cabin Air Management System (CAMS), a process control simulation. Thirty-nine apprentices participated in a CAMS training and a test session a week later. System stabilisation and fault diagnosis as criteria as well as person-related variables such as general mental abilities, cognitive style, self-efficacy and personality traits were measured and think aloud protocols collected. Main results of the first study of the research project are presented. Each of the task analysis methods separately contributed to describe cognitive requirements. There were qualitative differences between good and poor performers, particularly with respect to decision errors, errors in sequencing and timing as well as explaining, forming rules and planning. Furthermore, person-related variables explained an additional proportion of variance. Based on these findings and the results of training research, methods of drill and practice, overlearning and error training are recommended.

Introduction

While simulator training is popular in varying work environments such as aviation or navigation as well as process control (e.g. nuclear power plants, oil refineries) the training method is applied with little consideration of research regarding training design, cognition or effectiveness (Salas et al., 2006). For this reason, Salas et al. encourage the integration of scientific findings on training with simulator application, design, and practice. With respect to training design, task analysis is an essential first step, yet Ryder and Redding (1993) consider it to be "the most crucial and resource-intensive phase in the development of any training program" (p. 77). Task analysis provides the information on which decisions about training design are based (Ryder & Redding, 1993). Furthermore, learning objectives and criteria can be derived through training needs analysis (Salas et al., 2006). There is mostly

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