An Information Systems Design Theory for an Expert System for Training

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ABSTRACT

The authors developed and evaluated an expert system-based training system using Information Systems Design Theory (ISDT). First, an Expert System for Training (EST) was designed and implemented, and then a version of EST without expertise features, called IST, was also created. In order to evaluate which training system (if any) delivers better training, a three-group quasi-experiment was used. Each group was trained to use Statistical Process Control (SPC). One group was trained using the EST; outcomes for this group were significantly the highest among the three. A second group was trained using the IST; outcomes were not as high as the first group but significantly higher compared with the control group. The control group was trained with traditional means. Results show that the ISDT led to a useful purposely-developed application for enhancing the training of workers who have limited education but need to know about a very specific and complex field where the availability of trainers is limited. The authors call for further research that uses this ISDT to build purposely-developed software to support training of complex tasks.

Keywords: Expert Systems, Information Systems Design Theory (ISDT), Information Systems Development, Statistical Process Control (SPC), Training

INTRODUCTION

This paper reports the development of an information systems design theory (ISDT) for an expert system to support worker training. It describes design research that produced a system to support the teaching of quality control concepts to workers who do not know these concepts. The motivation for this work came from small manufacturing companies in central Mexico that need to teach their employees statistical process control. They approached the
local university for assistance. As a first step, the first author of this paper devised standard training sessions without the aid of a training support system.

However, technology, including information technology (IT), has added new options to deliver training (Buch & Bartley, 2002). IT is used to build new tools and methods that share knowledge and learning (Kekäle, Pirolt, & Falter, 2002). For example, production managers can use such tools for training the workforce before the production actually occurs, and consequently, make savings and reduce the time used in training. Marold (2002) believes that “the learning model of the 21st century uses the computer as the conduit of teaching and learning” (p. 114). Kekäle et al. (2002) argue that IT continues to produce new ways to help people learn.

Expert systems (ES) provide the means to create tools that are used for helping people solve problems. ES use artificial intelligence (AI) and are defined as computerized advisory programs that attempt to imitate the reasoning process of experts (Turban, 1995; Turban, McLean, & Wetherbe, 2001). Training represents one of the areas with the most significant payoff in using AI (Herrod & Papas, 1989). ES help to focus the instructional development efforts on knowledge rather than procedures and to develop solutions to increasingly complex problems (Grabinger, Wilson, & Jonassen, 1990). An ES is one of the best tools to train people in quality systems (e.g., ISO 9000) (Chang, Tsang, & Yeung, 1993).

As a result, we decided to use design research to develop an information systems design theory (ISDT), including an ES instance, to support statistical process control (SPC) training. The next section of this paper describes the ISDT using the components suggested by Gregor and Jones (2007). Next, we explain the process we used to build the training systems (IST, EST), and the process we used to evaluate these systems. These sections are followed by a discussion and concluding remarks.

INFORMATION SYSTEMS DESIGN THEORY

Building on the work by Walls, Widmeyer, and El Sawy (1992, 2004), Gregor and Jones (2007, p. 329) note that their purpose “was to delineate the possible components of a design theory for IS, providing an ontological language for discussion of these theories.” They suggested eight components which we describe in the following subsections.

Purpose and Scope

When an organization has need for very domain-specific software, it is generally not available in the market. Thus, it can become necessary to develop new software that addresses these special needs. This software can be referred to as “purposely-developed”. A few years ago, a number of small manufacturing businesses in the State of Aquascalientes, Mexico identified a need to improve their workers’ ability to recognize defective products that they were manufacturing. With the help of the State employment agency and the Autonomous University of Aguascalientes, training in Statistical Process Control was offered. Although the training was successful, it was observed by the instructors that it should be possible to build an Expert System that could improve the quality of training because an ES could provide the trainees with advice as to the likelihood that a pattern of defective items was “out of limits”. We decided to create a purposely-developed ES that would be part of a class of information systems that could be used for similar training contexts.

Constructs

The constructs for this research are expert systems (ES), $\overline{X}$ -R charts, and training. ES provide the means to create tools that are used for helping people solve problems. ES use ar-
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