Framework for Cognitive Skill Acquisition and Spreadsheet Training

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It is well documented that electronic spreadsheet models utilized in many professions to enhance decision making frequently contain errors that have negative effects on the ultimate quality of decisions. Limited research has been published that systematically identifies potential reasons for the causes of these errors, and what procedures can be taken to minimize or eliminate them. Our research provides initial evidence concerning this problem area by investigating how several important cognitive skills are affected by formalized spreadsheet training. Results indicate that one cognitive skill, logical reasoning, significantly increases after a six-week training period. Importantly, the greater the increase in logical reasoning skill, the more effectively the subject developed competent spreadsheet models. These findings provide a meaningful step in more perceptibly understanding and defining important cognitive changes that occur in individuals as they undergo formalized spreadsheet development training. Further extensions of this research should more clearly refine our understanding of the cognitive changes that occur in spreadsheet developers and eventually cultivate the development of more efficient and effective training methods for spreadsheet model designers.

Keywords: Cognitive skills, logical reasoning, spreadsheet errors, spreadsheet training

INTRODUCTION

In a knowledge-based economy where end-user computing empowers the users to accomplish cognitively intensive tasks, cognitive skills play a critical role in how individuals perform their tasks. One of the first end-user computing tools to gain widespread popularity is the electronic spreadsheet. Effective electronic spreadsheet model development skills are considered vital for workers in a wide variety of occupations. Employers have identified competent spreadsheet skills as one of the most beneficial fundamental computer literacy skills a worker can possess following word processing skills (see Davis & Leitch, 1988; O’Leary, 1989; Coy & O’Grady, 1992; Heagy & Gallum, 1994; Davis, 1997; Albrecht & Sack, 2000). However, it has been well documented that spreadsheet models developed by end users contain suprisingly high error rates (e.g., Brown & Gould, 1987; Davis & Ilkin, 1987, Cragg & King, 1993; Janvrin & Morrison, 1996; Panko & Halverson, 1997; Panko &
Sprague, 1998). Spreadsheet errors can have a dramatic effect on the performance and decision process of end-users. Given the widespread use of spreadsheet models, it is critical to understand how spreadsheet training interacts with cognitive skills.

In this paper, we propose a framework that suggests spreadsheet training will influence four cognitive skills: namely logical reasoning, spatial visualization ability, mnemonic skill, and sequencing ability; and that these cognitive skills will influence the errors in spreadsheet models. We empirically test the framework to identify specific cognitive skills that influence errors in spreadsheet models developed by end-users.

We use a block experiment (Cook and Campbell, 1979) where one group is the treatment group who will not receive spreadsheet training and another group will receive six weeks of spreadsheet training. We perform a pre-test and post-test analysis of the measures of the four components of cognitive skills in our framework (i.e., logical reasoning, spatial visualization, mnemonic skill, and sequencing). The results of the study lead us to modify the framework because only one of the cognitive skills, namely logical reasoning, is found to possess the dominant effect while the other skills do not seem to have significant effects. Spreadsheet training enhances the logical reasoning ability of end-users, which subsequently results in these users developing more effective spreadsheets that have substantially fewer errors. Spreadsheet training enhances the logical reasoning ability of end-users and appears to do more for the end-users than to merely teach them how to use another software package; it improves their logical reasoning ability.

The findings of this research can be a step in the right direction for developing better training modules for spreadsheet users by understanding the cognitive abilities that reduce errors and improve task performance. Ultimately, this could help enhance the correctness and productivity of end-user developed spreadsheet models, as well as influence the accuracy and proficiency of their decision-making process.

Figure 1: A Framework for Cognitive Skills, Spreadsheet Training, and Errors
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