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The effects of inspecting and constructing part-task-specific visualizations on team and individual learning

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A B S T R A C T

This study examined whether inspecting and constructing different part-task-specific visualizations differentially affects learning. To this end, a complex business-economics problem was structured into three phase-related part-tasks: (1) determining core concepts, (2) proposing multiple solutions, and (3) coming to a single solution. Each phase was foreseen with a part-task-specific representational tool facilitating visualization of the domain-content (i.e., a conceptual, causal and simulation tool respectively for the subsequent phases). Whereas all teams of learners ($N = 17$) were scripted to carry out the part-tasks in the predefined order, teams were instructed to (1) inspect expert visualizations ($n = 8$) or (2) construct their own domain-specific visualizations ($n = 9$). Results indicate that constructing visualizations, in comparison to inspecting them, evokes more meaningful discussion of the domain-content beneficially affecting team complex learning-task performance and individual learning gains (i.e., higher post-test score).

1. Introduction

The interest in complex learning is often regarded as education's response to the rapidly changing demands of society and work. Complex learning is necessary to carry out activities endemic to modern society, such as complex tasks or problems which (1) cannot be described in detail, (2) give no certainty about what the best solution is, and (3) require different perspectives on the problem and the problem-solving strategy for their solution (Jonassen, 2003; Spector, 2008). Learning to flexibly solve complex problems is, thus, an educational priority. To this end, schools incorporate educational approaches such as collaborative and/or individual problem-solving into their curricula (Hmelo-Silver, Duncan, & Chinn, 2007; Mergendoller, Maxwell, & Bellisimo, 2006). In problem-based learning approaches, learners are usually confronted with a case containing a problem for which a suitable solution must be found. To accomplish this, learners carry out a number of phase-related activities, namely (1) problem-orientation where the core concepts are determined and related to the problem, (2) problem-solution where multiple solutions to the problem are proposed, and (3) solution-evaluation where the suitability of the different solutions is determined and a definitive solution to the problem is chosen (Bigelow, 2004; Van Merriënboer & Kirschner, 2007).

When learners carry out such complex learning tasks without proper instructional support, they often experience difficulties leading to inefficient and ineffective learning (Kirschner, Sweller, & Clark, 2006; Reiser, 2004). In contrast to expert problem-solvers, learners (i.e., non-experts) experience considerable difficulties in solving complex problems. Non-experts rely primarily on superficial features such as using objects referred to in the problem instead of the underlying principles of the knowledge domain (Corbalan, Kester, & Van Merriënboer, 2009), and employ weak problem-solving strategies such as working with a means-ends strategy toward a solution (Dufresne, Gerace, Thibodeau-Hardiman, & Mestre, 1992). They lack a well-developed understanding of the knowledge domain and consequently have problems creating and combining meaningful problem representations. This hinders them in effectively and efficiently coping with their problem-solving task because the ease with which a problem can be solved often depends on the quality of the available problem

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