Chapter 8
Pedagogical Agents and the Efficiency of Instructional Conditions in Educational Applications

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ABSTRACT
This chapter discusses how the use of pedagogical agents in educational applications may influence the relative efficiency of instructional conditions, a concept proposed by Paas & Merriënboer (1993), which combines the measures of mental effort and task performance to determine, for example, how efficient certain settings are regarding their potential to promote learning. The authors describe an experiment carried out with 179 students who were enrolled in a distance learning course about educational software. The results of the study demonstrated that the conversational agent contributed to the improvement of the efficiency of instructional conditions. Such results make a relevant contribution to interactive learning research as they demonstrate that the use of pedagogical agents may improve the efficiency of learning material. Furthermore, by simulating social interaction, these agents may expand the boundaries of educational applications, which have been often designed mainly for individualized learning.

DOI: 10.4018/978-1-4666-0137-6.ch008
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INTRODUCTION

Research on pedagogical agents has demonstrated that the introduction of animated life-like characters in educational applications may have a positive effect on students’ perception of their learning experience (Craig, Gholson, & Driscoll, 2002). By simulating social interaction, these agents try to improve student’s engagement and learning, whether the users are just kids or adults. However, the inclusion of a pedagogical agent in the user interface introduces additional graphical and audio elements which may interfere with the user’s mental workload. As a consequence, one could also consider the possibility that, instead of providing a richer learning experience, pedagogical agents could somehow hinder the learning process by providing excessive stimuli.

Therefore, it is important to evaluate pedagogical agents from the perspective of the impact they may have in students’ performance, as well as from the viewpoint of cognitive load theory which may reveal how learners are affected by the imagery and audio of pedagogical agents. Seeing agents as a media choice, one could argue that such choice is frequently related to cognitive and learning aspects, which can profit from an understanding of cognitive processes (Cobb, 1997).

This chapter presents an investigation on how the use of pedagogical agents in educational applications may influence the efficiency of instructional conditions. This concept combines the measures of mental effort and task performance in order to determine how efficient are certain settings regarding their ability to promote learning (Paas & Merriënboer, 1993). The chapter also discusses how the use of pedagogical agents may affect other variables, such as engagement and ease of use, which could have an influence on mental effort.

The chapter begins by presenting an overview of pedagogical agents and their role in interactive learning, focusing on results achieved so far in the area regarding their benefits and disadvantages. Then, we present the concept of efficiency of instructional conditions, demonstrating how mental effort and performance can be related to determine the effectiveness of learning material. In this context, we also discuss the importance of understanding the limitations of humans’ cognitive capacity in the design of such educational applications. We then describe an experiment carried out with 179 students who were enrolled in a distance learning course about educational software. The students were divided into two groups: an experimental group A (85 students) which had a pedagogical agent inserted in their virtual learning environment; a control group (95 students) which did not have the agent. Both groups worked with the virtual learning environment for five weeks. The results of the study regarding the influence of the agent in the experiment’s instructional conditions are presented, closing the chapter with a discussion about current and emerging trends in the area.

BACKGROUND

The use of virtual characters with different types of communication skills has spread in a wide range of applications, both in academic and commercial spheres (Pandzic, 2001). Within these applications, many examples can be found in the educational area. In Shaw & Johnson (1999), for instance, virtual teachers guide the students in online interactive activities. In other research, it has been demonstrated that students considered the subject studied significantly less difficult and the presentation more entertaining in the presence of a virtual character (André, Rist, & Muller, 2002). In the same experiment most of the students stated that the assistants helped them pay attention to the most important details in the pages. A significant portion of these investigation results are aligned with the ideas that teaching and learning are highly social activities. Based on this premise, Kim &
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