Chapter 15

The Role of Pedagogical Agents on Learning: Issues and Trends

ABSTRACT

Research on the effectiveness of Advanced Learning Technologies (ALTs) on ubiquitous learning has suggested that students are often poor at self-regulating their learning (Azevedo, Taub, & Mudrick, 2015), and as a consequence, researchers have implemented Pedagogical Agents (PAs) to help foster students’ use of Cognitive, Affective, Metacognitive, and Motivational (CAMM) Self-Regulated Learning (SRL) processes (e.g., Azevedo et al., 2013; D’Mello & Graesser, 2012). Several analyses have been conducted that investigated the impact and effectiveness of PAs on learning with ALTs (Schroeder & Adesope, 2014; Veletsianos & Russell, 2014). These results indicated that the effectiveness of PAs in ALTs is dependent on many factors, such as the content being studied, the population of students, and the features of the PAs themselves. Thus, it is important to consider all these details when designing and measuring the effectiveness of PAs in ALTs. Therefore, the goal of this chapter is to provide a synthesis of research on PAs, including an overview of these issues that need to be addressed.

INTRODUCTION

The assessment of students’ ubiquitous learning is an important research topic, since we can use these data to gain insight into the context, behavior, and preferences of students during learning (Azevedo & Aleven, 2013). Based on these investigations, we have determined that students often require assistance when learning complex topics (e.g., Azevedo, Moos, Johnson, & Chauncey, 2010), and thus, researchers have been developing virtual and hypermedia learning environments to help foster students’ learning of various topics (Azevedo et al., 2012b).

DOI: 10.4018/978-1-5225-0125-1.ch015
Additionally, researchers have investigated the effectiveness of these learning environments, and research on these hypermedia learning environments, such as advanced learning technologies (ALTs), revealed that although these environments can be effective for learning (Azevedo et al., 2015; Lester, Mott, Robinson, & Rowe, 2013), they often require students to self-regulate their own learning, which compels them to plan, monitor, and strategize the steps and actions they need to take in order to learn the most effectively and efficiently (Azevedo et al., 2013; Winne & Hadwin, 1998, 2008).

Although self-regulated learning (SRL) can be an effective learning technique, research has found that students have a difficult time doing so (Azevedo, 2014a), and thus they do not optimize their learning with ALTs. To address this issue, psychologists, computer scientists, educational psychologists, and other cognitive science researchers have begun to incorporate pedagogical agents (PAs) into these learning environments, so they can help foster and facilitate the use of cognitive (e.g., taking notes) and metacognitive (e.g., evaluating the relevancy of the content to the current subgoal) SRL strategies to ensure that students are engaging in the most effective learning. These agents have been designed using different theoretical perspectives, such as self-regulated learning (e.g., Azevedo et al., 2013), the model of affect dynamics (e.g., D’Mello & Graesser, 2010), or teachable agents (e.g., Biswas, Jeong, Kinnebrew, Sulcer, & Roscoe, 2010), which has led to many different types of agents, such as pedagogical agents (Baylor & Ryu, 2003), conversational agents (Grasser, Li, & Forsyth, 2014), intelligent virtual humans (Gratch, in press), etc., who can all assist students as they learn with ALTs.

Due to the advances in developing PAs, researchers are paying closer attention to the effectiveness of the specific details of the agents themselves. For example, researchers have reported on the conceptual issues related to designing PAs (Veletsianos & Russell, 2014) and have noted that we must consider issues related to agent design when developing agents in different learning environments. Furthermore, researchers have created frameworks, such as the pedagogical agents—conditions of use model (Heidig & Clarebout, 2011), which has been used to evaluate the effectiveness of PAs, addressing the range of findings from the literature. In addition, several meta-analyses have been conducted that examined the context in which learning occurred as well as the effectiveness of PAs within those contexts (Schroeder & Adesope, 2014; Schroeder et al., 2013).

Based on these research findings, it is evident that agents with particular characteristics can be effective for learning based on the context (Schroeder & Adesope, 2014; Schroeder et al., 2013), the population of students (Heidig & Clarebout, 2011) or the type of agent itself (Veletsianos & Russell, 2014). Thus, it is crucial that we continue to investigate the impact of PAs in different environments to ensure that the most effective PAs are being implemented in each type of learning environment, with different types of ALTs.

Contemporary research in psychology, education, computer science, artificial intelligence, and affective computing has demonstrated a clear need for the integration of agents (i.e., PAs, intelligent virtual humans, human tutors, etc.) to help foster students’ use of effective SRL processes by externally regulating the students’ use of cognitive and metacognitive learning strategies (Järvelä & Hadwin, 2013). However, a series of issues remains that must be considered when developing an agent to foster effective learning.

When designing a PA, one must consider the specific role and function of the agent. It is necessary to first determine the kinds of scaffolding and feedback that the researcher wants the agent to provide in order to then establish what the scaffolds and feedback will provide for the students. In addition, the researcher must consider and decide on the appropriate theoretical framework with which to develop the agent. This will guide the researcher into selecting further details of how the agent will provide the