Chapter 6
Building a Social Conversational Pedagogical Agent: Design Challenges and Methodological approaches

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ABSTRACT
This chapter discusses design challenges encountered when developing a conversational pedagogical agent. By tracing the historical roots of pedagogical agents in Intelligent Tutoring Systems (ITS), we discern central developments in creating an agent that is both knowledgeable and fosters a social relationship with the learner. Main challenges faced when attempting to develop a pedagogical agent of this kind relate to: i) learners’ expectations on the agent’s knowledge and social profile, ii) dealing with learners’ engagement in off-task conversation and iii) managing potential abuse of the agent. We discuss these challenges and possible ways to address them, with reference to an ongoing Research & Development project, and with a focus on the design of a pedagogical agent’s visual embodiment and its conversational capabilities.

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1. INTRODUCTION

1.1 Conversational Pedagogical Agents

In this chapter a “pedagogical agent” refers to a computer-generated character employed in an educational setting in order to fulfill pedagogical purposes. Such agents (or characters) can serve numerous pedagogical roles (Chou, Chan, & Lin, 2003; Baylor & Kim, 2005; Haake & Gulz, 2009). For instance, they have been presented and studied as instructors, coaches, tutors, and learning companions.

The concept of an “agent” denotes an entity with some degree of “intelligence” and capacity for autonomous action. Agents, or intelligent agents as used within the computer science discipline, refer to a computer programs that can “act” on their own (i.e. autonomously). When referring to “pedagogical agents” in today’s educational contexts, it is also assumed that the agent has a corresponding visual representation. Conversational pedagogical agents refer to a subgroup of pedagogical agents, namely those that can engage in a conversation with a learner, through dialogue, and, often through elaborate body language movements including gestures, facial expressions, etc.

In this chapter, we focus on conversation via natural language, and limit our treatment to text-based interaction (typed conversation via the keyboard). Thus, we do not discuss the challenges and potentials surrounding speech recognition and production. We also exclude complex non-verbal interaction (often explored in Embodied Conversational Agents research (e.g., Cassell, Sullivan, Prevost, & Churchill, 2000; Ruttkay & Pelachaud, 2004), where the agent’s body is used for demonstrating, showing, pointing, and for giving feedback via gestural and emotional expressions. We discuss animated pedagogical agents where the visual animations are less complex, mainly aimed at making the agent appear more life-like and appealing.

1.2 Chapter Outline

We begin our discussion by tracing the historical roots of pedagogical agents in the Intelligent Tutoring Systems (ITS) paradigm, and discussing two central lines of development that have transformed agents from the nonsocial and impersonal characters of the past to the tangible, social and personal pedagogical agents of today: i) development of their visualization and embodiment and ii) development of their conversational capacities. These developments, we argue, carry with them important potential, as well as challenges, for research and development within the field.

In section 3, we present an ongoing Research & Development (R&D) project within the pedagogical agent domain – a web-based game focusing on mathematics learning for children – which serves to illustrate and contextualize our discussion.

In Section 4, we present the guiding framework that we use for designing and researching the project: the Enhancing Agent-Learner Interaction framework (EnALI) (Veletsianos, Miller, & Doering, 2009).

In section 5, we discuss central challenges that we hold as being common in pedagogical agent design and development endeavors:

1. how to deal with students’ (often heightened) expectations regarding pedagogical agents’ knowledge and social competencies (including the problem of setting proper constraints),
2. how to deal with students’ varying degree of engagement in social interaction with the pedagogical agent, and
3. how to deal with the risk of verbal abuse known to arise when students interact with conversationally-capable pedagogical agents.

We illustrate these challenges and possible ways to address them, with reference to our ongoing project and with reference to the EnALI framework. The list of challenges above is of