

# Personalization in an interactive learning environment through a virtual character

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Received 21 February 2007; received in revised form 29 May 2007; accepted 31 May 2007

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## Abstract

Traditional hypermedia applications present the same content and provide identical navigational support to all users. Adaptive Hypermedia Systems (AHS) make it possible to construct personalized presentations to each user, according to preferences and needs identified. We present in this paper an alternative approach to educational AHS where a virtual character personalizes the interaction with the user through the use of a particular recommender system. The character has natural language communication abilities; it can learn students' profiles and use this knowledge to recommend appropriate contents and activities. Through its interaction with the user, the character is able to collect and organize information about students in order to identify appropriate suggestions of contents. The recommender system employs a knowledge representation scheme that is easy to understand and to modify, enabling teachers/tutors to explore the types of recommendations being made and to appreciate why they are made. An experiment with computer science students was carried out in order to validate the approach proposed. The results of the experiment showed that the presentation of personalized links through a virtual character had a positive impact in the users' perception of the system as a learning tool. The combination of the virtual character with a recommender system proved to be a good alternative for the delivery of personalized contents without making constant changes in the main user interface. This approach provides mechanisms to guide users through paths of study followed by students with similar profiles, without violating the human–computer interaction principle of perceived stability.

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*Keywords:* Virtual characters; Recommender systems; User modelling; Adaptive hypermedia

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## 1. Introduction

The main principle of intelligent user interfaces is to enhance the flexibility, usability, and power of human–computer interaction for all users (Maybury, 2001). In order to do that, some of the problems addressed are: handling of information overflow; providing help for complex programs; taking over tasks from the user,

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creating personalized systems (Ehlert, 2003). The work presented in this paper proposes answers for this last problem, i.e. taking into account differences between users and providing personalized methods of interaction. This is related to research in Adaptive Hypermedia Systems (AHS) where personalized presentations are constructed according to data collected through the interaction with users. Such systems have been built in many application areas, as in information systems, help systems and information retrieval systems, but the primary application of AHS has been in education (De Bra, 2000). Three functions are performed by an AHS (De Bra, Brusilovsky, & Houben, 1999): (1) While a user is browsing through a document, all interaction with the system is monitored. Based on the data collected, the system maintains a model of the user's knowledge about each domain concept; (2) The presentation of the document may be modified so as to make suggestions to the user about where to go next. Links can be added, changed, removed, sorted or annotated; (3) The AHS may conditionally show, hide, highlight or dim fragments of a page, ensuring that its contents include the appropriate information, at a suitable level of difficulty or detail.

Although the research on AHS has yielded promising results over the years, adaptive interfaces have received much criticism as adaptation and automatic assistance often contradict the principles of direct-manipulation and perceived stability (Tsandilas & Schraefel, 2004): How can the onscreen environment behave in a predictable and understandable way when changes are constantly made to the interface?

An answer to this problem is to shift from adaptive hypermedia to personalized virtual characters (André & Rist, 2002), i.e. anthropomorphic computerized beings whose main goal is to give the user assistance in operating a computer system and performing a given task. By using such characters as a communication channel, we may personalize the dialogues with the user and provide tailored assistance to each individual, without necessarily having to make major changes in the system interface. Nevertheless, virtual characters represent a big challenge to the research of adaptive hypermedia systems, adding complexity to the adaptation process and requiring the rethinking of the design of such interfaces.

At present, 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 and Johnson (1999), for instance, virtual teachers guide the students in online interactive activities. The interaction with animated and static virtual characters can also affect students' learning (Craig, Gholson, & Driscoll, 2002). 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, 1999). In the same experiment most of the students stated that the assistants helped them pay attention to the most important details in the pages.

In this paper, we present an educational system which personalizes the interaction with the user through the delivery of content recommendations by a virtual character. The character communicates with users in natural language and recommends appropriate contents and activities to them, according to their interests and needs. A profile management system is used to collect and organize student information and discover behavioral patterns in the data collected. A natural language mechanism endows the virtual character with communication abilities. Finally, a recommender system complements the character's architecture, being employed to use the patterns identified to make recommendations of contents and activities.

The paper describes the use of the virtual character in an interactive educational environment, emphasizing its recommendation mechanism. Results obtained from an experiment with 53 computer science students enabled us to verify the effectiveness of our approach in identifying and presenting personalized links to the users. The results of the experiment are presented here, as well as conclusions and directions for future work.

## 2. Delivering recommendations through a virtual character

Most of the research in the area of recommender systems is related to finding optimal algorithms for the retrieval of personalized information (Breese, Heckerman, & Kadie, 1998; Geyer-Schulz & Hahsler, 2002; Sarwar, Karypis, Konstan, & Riedl, 2000). However, the simple use of a recommender system introduces human-computer interaction issues, as the composition of a personalized page involves the modification of its structure and the presentation of different contents to different users. Recommendations may be blended together with other items, or they may occupy a specific area of a page to emphasize the personalized selection

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