AN INTELLIGENT ASSISTANT TO SUPPORT STUDENTS AND TO PREVENT THEM FROM DROPOUT

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Abstract: The research and development of an educational agent are commonly focused on the pedagogical aspect; the main objective is to automate the teaching activity, to replace the teacher in virtual learning environment. Our goal is different: it is to create a non pedagogical intelligent assistant that follows students during their learning to prevent dropout. This assistant can be compared to a coach, a motivator, or a mentor that motivates, encourages, and helps students to overcome their difficulties.

1 INTRODUCTION

Nowadays the use of Information Technology (IT) is essential in education. The development of IT in learning is one of the most important preoccupations for the future.

Our aim is to use Artificial Intelligent mechanisms as machine learning, fuzzy logic, and intelligent agents to build a personalized and autonomous virtual assistant that helps students during their learning experience. Currently the intelligent agent technology is broadly used in e-learning with a pedagogical purpose; it helps students to learn and intends to replace teachers. The aim of our approach is not to build another virtual teacher; the services of our assistant will be focused on the non pedagogical aspects of learning such as the management of motivation, stress, school orientation and task organisation. The actions of our assistant will be oriented at complementing the teacher's work.

In this article we present our concept of an assistant supporting student learning in three sections. The first section will explain the concept of educational agents, in proposing a taxonomy of educational agents. In the second section we will study the different types for student support: tutor, coach, and mentor. And the last section will focus on the architecture of our intelligent assistant.

2 A TAXONOMY OF EDUCATIONAL AGENTS

2.1 Characteristics of Educational Agent

The analysis of the taxonomy of educational agent indicates the positioning and the functionalities of our assistant. Educational agents can be considered as "Software agents" (Franklin&Graesser, 1996) and more precisely "User agents". This kind of agent is based on the concept of delegation and indirect management tasks (Sanchez, 1997); agents offer to end-users a new approach to interact with computer systems.

The Sanchez's taxonomy (Sanchez, 1997) can be extended in adding a new type of agent. The Intelligent Personal Assistant (IPA) is a sub-type of User Agents. We consider that an IPA differs from Information Agents, Task Agents or Synthetic Agents because it is more personalized and its relationships with its user are closer and durable. It can be considered as virtual companion.

The role of an IPA is to reduce the complexity and the rigidity of human-machine interactions, and to anticipate the needs of the user with some personalization capacities (Briot&Demazeau, 2001). The Foundation for Intelligent Physical Agents

(FIPA) states that *a personal assistant is like a secretary, it accomplishes routine support tasks to allow the user to concentrate on the real job, it is unobtrusive but ready when needed, rich in knowledge about user and work* (FIPA, 2000). The personal assistant will work in collaboration with the user in the same environment; the most important part of a personal assistant is the management of the user profile (Maes, 1994).

IPA can have the appearance of a simple software interface with button, textfield, list, radiobutton… Or it can be personalized with a human representation, a multimodal user interface as an Embodied Conversation Agent (ECA) that can carry a conversation with the user through the common communication modalities like speech, gestures, body stance, and facial movements.

The virtual companion, IPA represented through an ECA can be refined in various kinds depending on its purposes. It can be used for educational assistance, professional helps for complex task or entertainment. Educational agent is a specific kind of Embodied Conversation Agent (ECA) with a representation in 2D or 3D and a natural language communication capacity.

In our approach, an educational agent is a software agent, user agent, Embodied Conversation Agent and Personal Intelligent Assistant (see Fig. 1).
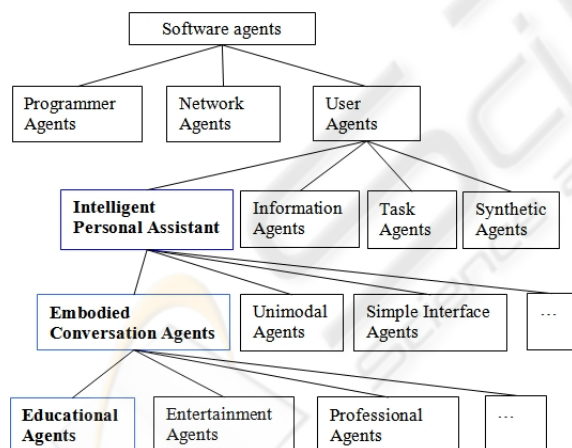

Figure 1: An extended software agents' taxonomy.

From the extended taxonomy (see Fig. 1), we can determine the common and essential capabilities of educational agents as it inherits the properties and capabilities of Intelligent Personal Assistant and Embodied Conversation Agents.

Capacities of Intelligent Personal Assistant (Maes, 2003), (Sanchez, 1997):

- To assist a user to perform task so it can hide the complexity
- To have a certain degree of reasoning and autonomy; user can delegate some tasks to the agent.
- To manage the user model and the domain model
- To learn the user's interests, goals and preferences from the interaction of the user with the IT system or with the intelligent assistant. This capacity is the most important and it is essential for personalization.

Capacities of Embodied Conversation Agent (Cassel et al., 2000):

- To recognize and respond to verbal and nonverbal input
- To generate verbal and nonverbal output
- To deal with conversational functions such as turn taking, feedback and repair mechanisms
- To give signals that indicate the state of the conversation and contribute new propositions to the discourse

The design of an educational agent has to include at least all of the previous capacities. In the next part we will explore the capacities of different kinds of educational agents.

2.2 Different Types of Educational Agents

In the education field, the use of intelligent agents can increase the attention of the student and make the learning more attractive. An Intelligent Personal Assistant should be a key success factor for online learning tools. Experiments conducted in California's university (Baylor, 2003) showed that the use of pedagogical agents motivate students and facilitate the learning. Usually, the educational agents have a pedagogical goal, their presence is supposed to replace the teacher in an e-learning environment.

(Chou et al., 2003) highlight two types of educational agents and place them into two categories:

- pedagogical agents involved in learning activities, they simulate a teacher. ITS (Intelligent Tutoring System) is an example of this type of agent.
- personal assistants providing help and information that pertains to learning activities, like collecting content to perform an activity or reminding tasks.

The exploration of the taxonomy of educational agents permits to define, identify and explain the general role of our assistant. We can see that there is a lack in the development of non pedagogical agents; a lot of the educational agents on the e-education market are principally designed to improve the transfer of knowledge without an intervention of human teacher.

The taxonomy of educational agents determined by Chou et al. (2003) only focuses on pedagogical agents, and how to improve the content learning transfer. But in the learning activities or processes there are other aspects. For example, motivation is essential in cognitive learning processes (Barnier, 2003) (Pintrich, 2000). Students need to be motivated and encouraged when they are in a failure situation. The non-pedagogical aspects of learning can include:

- the management of stress,
- the management of emotion : fear, anxiety, reduce the attention and cognitive abilities,
- a time management, task planning, scheduler,
- a vocational orientation,
- the identification of strengths and weaknesses,
- a development of self-confidence,
- a development of responsibility,
- a development of autonomous.

We can add four types (see Fig. 2) of student's agents to the description of pedagogical agents from (Baylor, 2003) and (Ali, 2002):

- the digital tutor
- the digital secretary
- the motivator agent
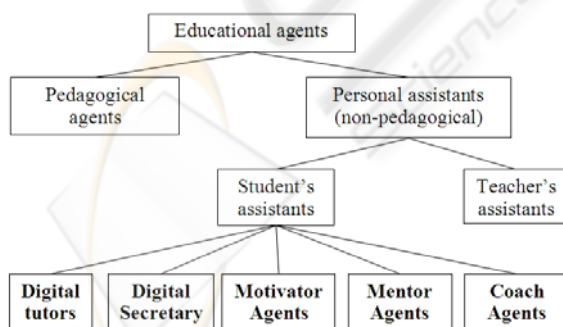- the mentor agent

Figure 2: Different types of student's assistant in educational agents' (Chou and al., 2003) taxonomy refined.

Mentor agents and motivator agents can also be considered as pedagogical agents but here we will only retain the non-pedagogical aspects of these agents.

Our assistant is a personal assistant and is in the sub-type student's assistant. In the next chapter, we will explore the concept of a tutor, a coach and a mentor and precise the role of our non pedagogical assistant.

3 DIFFERENTS TYPES OF STUDENT'S SUPPORT

With the massification of education, school dropout is one of the most important challenges for the education system. The best solution to help students to prevent dropout is the personalization of the learning to fit the student's abilities. A personalized support relation will allow improving their results.

3.1 Dropout: The Main Issue in 21st Century's Education System

In OCDE (Organisation for Economic Co-Operation and Development) countries, between 5% and 40% of students drop out of school and 30% of adults have only primary or lower secondary school (Field et al., 2007).

The consequences of failures at school are multiple:

- It generates stress, anxiety, and decrease self-confidence for students. These can have serious consequences for the teenagers like depression, behavioural disorders (runaway, flight, fight …).
- It increases the costs of education system; the financial costs of educational failure are high.

The causes of dropout can be differentiated into three categories of factors (Roiné, 2007):

- Individual factors: tardiness, suspension, absenteeism, lack of motivation, low social network, poor or trouble relationship with adults, disciplinary infractions, low self-esteem, substance abuse
- Familial factors: family organization, parental responsibility, socioeconomics status, poor education of parents
- School factors: relationship between teacher and student, equity in education, negative school climate.

Our assistant will focus on individual factor to help students. In the next section, we present

different types of support or help to prevent school failure. The different kinds of help can be classified by the relation with the learning content (Shea, 2004), the master just transmits a learning content while the mentor transmits the life experience and assists in the decision making.

3.2 Tutor

The concept of tutor is mainly encountered in e-learning environments; his mission is to maintain the motivation of learners. The tutor is the link between the e-learning system and the learner. His three main competencies are (Denis, 2003):

- pedagogical and relational: evaluates student works, analyse the progression, help and guide students
- technical: gives advise for technical problems
- disciplinary: gives academic subjects instructions and resources

3.3 Student Coaching

The role of a coach is to help student to identify and exploit his potentials. The study of French's school coaching shows that the helps are focused on vocational orientation on management of motivation, stress and self confident.

3.4 Mentor

It's the most personalized and closed relationship in learning. This type of relationship is commonly used in enterprise for the career path and the turnover management. A mentor is model, a motivator and advisor for students (Houde, 2004).

3.5 The Supporting Services

The analysis of non-pedagogical agents and supporting methods has permitted to identify four types of services for our non pedagogical assistant: student coaching, vocational guidance, virtual secretary and technical help (see Table 1).

The student coaching, vocational guidance modules are designed in using psychology concepts, affective computing and cognitive learning.

The technical part can be considered as an Intelligent Help System (Winkels, 1992) which assists the user with a current problem and to teach the user about the information system.

Table 1: Our four types of services.

Services	Functions
Student coaching	Diagnoses difficulties Motivates when student has bad results Gives a concrete meaning to the learning Increases the self confidence Reduces stress and anxiety
Vocational guidance	Gives a feedback on the potential of the student Identifies the potential vocation appropriate to the student's strengths and weaknesses
Virtual Secretary	Reduces cognitive overload Reminds tasks Organizes and plans work Manages files and contents
Technical help	Helps to use new tools Guides in the Virtual Learning Environment

4 THE ARCHITECTURE OF OUR ASSISTANT

In the previous sections we have identified the issues and the roles of an intelligent assistant to support students and to help them to overcome difficulties during learning.

4.1 Architecture of Our Assistant

The architecture of our assistant has four main modules. It can be considered as an instantiation of the ITS's architecture (Wenger, 1997) without the dimension of pedagogical expertise (see Fig. 3).

1) User Profile. This module manages all the information about the user, his environment and the Information Technology platform (virtual learning environment, e-learning tool). Technologies of semantic information representation can be used as ontology and the norm OWL to design user's data representation.

2) Embodied Conversation Agent. This module is the human-computer interface; the interaction with the user is in natural language.

3) Reasoning. This is the core of our assistant; fuzzy-logic based inference mechanisms are used, and machine learning tools are added to detect when a student encounters difficulties. The early identification of the failure is the key success factor

of our system. The reasoning module contains the student's diagnosis and the non pedagogical helps modelling.

4) Interoperability Technology. This is an interface that manages the exchange of information with a Virtual Learning Environment or e-learning portal and the integration of our assistant. This is the IT interoperability layer of our system.
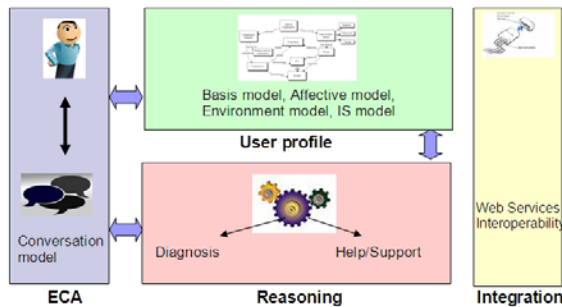

Figure 3: Architecture of our intelligent supporting assistant.

4.1.1 User Profile Module

The goal of the user's profile is to store student's characteristics. The management of user description is essential to an adaptive and personalized system.

Its objectives are:

1) To construct a model of student characteristics
2) To capture and maintain the coherence and consistency of the student profile
3) To give the pertinent indications to the HMI (Human Machine Interaction) and Reasoning modules.

The tracking of interaction with the Embodied Conversation Agent, and the use of the keyboard and mouse will allow the construction of the student profile. The user model is composed of four sub modules. The Basis, Environment, and Domain models are based on the works of (Brusilovsky, 2001), and (Kobsa, 2001).

▪ The **Basis model** maintains personal information as interests, preferences; cognitive profile, learning style and schooling's data: identification, personal data, interest, preferences learning results.
▪ The **Affective model** manages the student's emotion through the tracking of keyboard and mouse interactions. It will detect the stress, the sadness (depression) and the anger. This model is based on the theory of affective modelling by (Picard, 1997).

▪ The **Environment model** keeps information about the student's work context: type of device, place, and time.
▪ The **Information System (IS) model** handles the information about the technical environment in which the assistant is integrated, for example a Virtual Learning Environment. And the information about the student's learning, for example the school's organisation.

4.1.2 Embodied Conversational Agent Module

The interaction between student and assistant is carried out by an animated agent. First the communication will be in text mode like chatting on instant messenger and later we can add speech capacity.

The assistant can have the appearance of a talking head or a full-body character (see Fig. 4) and is considered as a multimodal system.

Figure 4: Different types of animated agent: full-body character and talking head agents.

Its objectives are:

1) To manage the dialog model to communicate with the student, it may include the facial or body corporal expression,
2) To interact with the user profile to learn new knowledge about student.

4.1.3 Reasoning Module

This module has two objectives, the first one is the detection of the weaknesses and the difficulties of the student and the second is to offer an appropriate help. On ITS the student's diagnosis aims to detect a specific lack of knowledge, in our case the global difficulties on school subjects are diagnosed.

The detection of the student's difficulties is based on the values of grades from learning evaluations, tardiness, suspension, absenteeism

(excused or unexcused, frequency), disciplinary infraction, teacher's remark. The evaluation of theses values individually and jointly will determine the degree of failure and activate the helping pattern.

5 CONCLUSIONS

In this paper we have studied the functionalities of a non pedagogical intelligent assistant to support students during their school learning though the taxonomy of educational agents and different types of the student support. This assistant can be considered as a coach or a companion that gives psychological helps and advices when student encounters difficulties. Our aim is to reduce the dropout through the use of Artificial Intelligent methods.

The limitations of our system reside in:

- The monitoring of the current student's state: school performance, physiological and psychological state. The performance level of our system depends on the quality of the analysis of these states.
- The construction of expert knowledge to support student.
- The relation between the assistant and the student: relevant and acceptance of advices from the intelligent assistant.

To solve these difficulties we need to combine Artificial Intelligence techniques with psychology, cognitive and learning theories.

Until now we have conceived the architecture and lead some experimental development of each module separately:

- The conversation module is build with a pattern-design model based on xml,
- The diagnosis of dropout is based on fuzzy rule,
- The user's profile is designed with web semantic standard; OWL is used to maintain user's characteristics.

Our next step is to make these modules work together to build a prototype of our non pedagogical agent, test and validate it in real-world applications.

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