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CONCEPTUALIZING INTELLIGENT AGENTS  
FOR TEACHING AND LEARNING

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**Abstract** This paper elaborates on the role of Intelligent Agents in teaching and learning, more especially within course management software or an e-Learning environment. Intelligent Agents, as they are proposed in this paper, appear as a series of independent software modules operating within a web-based teaching and learning environment, such as course management software or an e-Learning Portal. The agents perform specific tasks on the behalf of students, instructors, and other members of the educational community, including parents and alumni. This paper has identified three groups of Intelligent Agents for teaching and learning applications:

- “**Digital Classmate**” as a series of Intelligent Agents assisting students and performing tasks related to learning.
- “**Digital TA**” (or Digital Teaching Assistant) as a series of intelligent agents assisting teachers and performing tasks related to instruction and course management, and
- “**Digital Secretary**” as a series of intelligent agents assisting all members of an educational community in performing various administrative assistance tasks.

All three Intelligent Agents groups proposed in this paper are conceptualized as a web-based multimedia agent (character) communicating with their human clients using one or more communication channels, including: text, speech, voice recognition, and animated facial graphics. Each Agent could include a series of independent or mobile Agents assisting an educational group.

## **1. What is an Intelligent Agent?**

An Intelligent Agent is a set of independent software tools that are linked with other applications and database software running within a computer environment. The primary function of an Intelligent Agent is to help a user (client) to better employ and interact with a computer application. It is assumed that artificial intelligence (AI) is involved and certain degree of autonomous problem solving ability is presented in agent-based

technology systems. Nicholas Negroponte (1995) talks about agents as perfect helpers. For example, a “digital-sister-in-law” that you ask for movie suggestions. Since she knows you and your movie preferences and has extensive knowledge on new movies and reviews, she can intelligently advise you about what movie to see; an intelligent agent who is expert on both movies and you. The Microsoft “Clipit,” for example, provides some basic intelligent agent functionality for Microsoft Office Suite users. The Clipit monitors the user’s actions during the use of the word processor and provides visual and audio feedback as the user makes progress or begins to make a mistake. Intelligent Agents can also play a major role in education.

Amy Baylor (1999) defines three major educational potentials for Intelligent Agents as cognitive tools: 1) managing information overload; 2) serving as a pedagogical expert; and 3) creating programming environments for the learner. This paper is interested in the conceptual development of Intelligent Agents in teaching and learning applications.

## **2. The New Electronic Teaching and Learning Environment**

Over the last few years, universities and colleges have demonstrated substantial progress toward the use of World Wide Web for distance learning applications. Many schools have re-purposed some of their course offerings for distance learning delivery, where students and instructors are no longer required to meet in a same place at the same time. Some other schools are using course management software to complement traditional classroom instruction (Indiana University, 1998).

While the distance learning concept provides more convenient virtual access to learners around the world, it also introduces some limitations and shortcomings, mainly from communication, collaboration, pedagogy, and course administration perspectives. The course instructor, for instance, can no longer enjoy the powerful face-to-face communication channels available in a traditional classroom environment. The virtual teacher will have difficulty assessing student progress in learning as well as their participation in classroom collaboration. Using Intelligent Agents in a distance learning environment can diminish some of these limitations. For instance, once a course

instructor logs into his/her course environment, a teaching assistant Agent could provide the instructor with information such as the names and pictures of students who have overdue assignments, have not collaborated in classrooms message boards, or have not taken an on-line quiz. All of these students could even be ranked and categorized according to the instructor's preferences. The Agent can also be configured to automatically send personal email to those who have done better than average or worse than expected.

Today there are a number of different brands of course management software in use. Some institutions are using a homegrown software environment (Jafari, 1999) or utilizing commercial products (BlackBoard, 1999 and WebCT 1999). Although these environments offer easy-to-use web authoring tools, but all are offering passive and static sets of services. As a result, some instructors are spending more time teaching a distance learning course than teaching the very same course in the classroom setting. This problem is mostly due to the time-consuming maintenance requirement of distance learning courses. For instance, the instructor is expected to regularly check students' log files or grade books to verify that they have all taken a required online quiz or participated in an online collaboration exercise. Intelligent Agents used within a course-management environment can perform some of these tasks, releasing the instructor's time for manual monitoring of the course activities.

### **3. Needs for Development of Intelligent Agents to Assist Teaching and Learning.**

In order to further improve the course management environment, one can assume using a series of Intelligent Agents that are performing a series of teaching and learning tasks on the behaviors of a teacher and a learner. This paper defines three groups of Intelligent Agents for use within a course management or e-Learning portal environment. Each set of agents is conceptualized to perform certain tasks as it relates to learning, teaching, and administrative assistant needs. They are called, Digital Classmate, Digital TA (Teaching Assistant) and Digital Secretary, respectively. The Agents communicate with their

human clients using a combinations of text, graphics, speech, facial expression, and voice recognition. .

#### **4. Digital Classmate Intelligent Agents**

The Intelligent Agents acting as a Digital Classmate assist the learners (students) in various learning objectives. Such Agents can be configured by the learner, instructor, course administrator, course content, and the environmental default setting. The Digital Classmate Intelligent Agents proposed in this paper would appear as a tool or a plug-in in the web-based course management system.

#### **5. Digital TA Intelligent Agents**

The intelligent agents acting as a Digital TA (Digital Teaching Assistant) assist the teacher (instructor or other members of teaching group) in various teaching functions as configured by the instructor, course administrator, course content, and the environmental default setting. In a distance learning setting, for instance, the instructor is physically isolated from the students, not necessarily knowing if and when students worked on a due assignment, for how long, or types of collaboration used, and is incapable of dynamic assessment of a student's works. The teacher is mostly unaware of the student's progress until an exam is taken, or until the student submits an assignment or drops out of the course. In terms of student retention, it is important to constantly and dynamically be aware of a student's participation in a course, and to assist a discouraged student before s/he drops out. Additionally, the Digital TA can assist a course instructor with various course operation and maintenance aspects. This includes automatic student notification for past due assignments, class attendance, and various monitoring and housekeeping tasks.

#### **6. Digital Secretary Intelligent Agents**

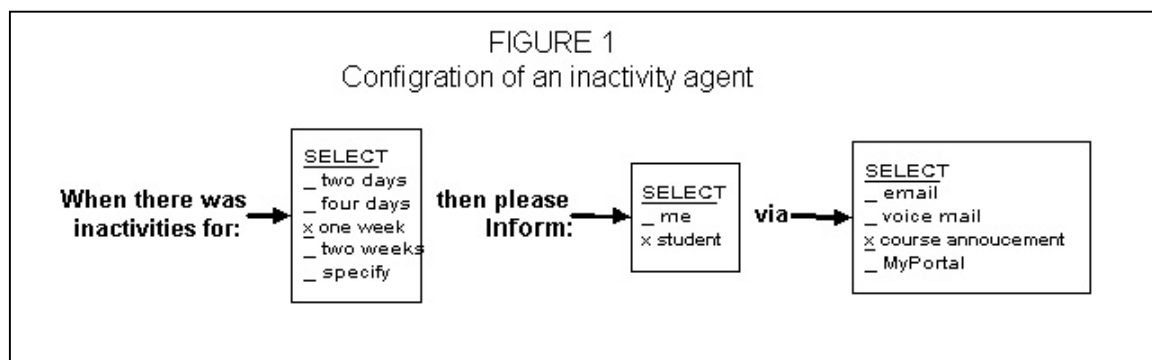
The intelligent agents acting as a Digital Secretary assist students, instructors, and staff in various administrative assistant needs, as configured by the user and environmental

default setting. Scheduling a meeting, finding colleague with similar research interests available over weekends, or finding the best math students who might serve as mentors, are examples of tasks undertaken by a Digital Secretary. A Digital Secretary is conceptualized to serve the students, faculty, and staff of an educational institution.

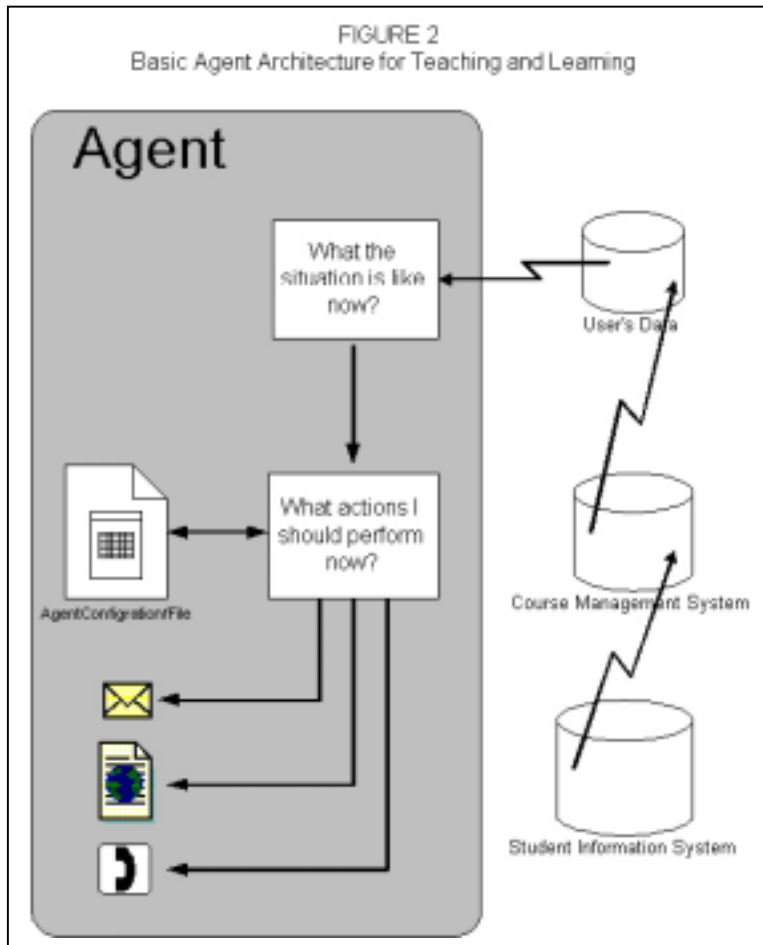
## 7. How do Agents Act in Teaching and Learning Situations?

The teaching and learning agents operate within a profile-based course management enterprise system. Each member (student, teacher, etc.) has access to a series of personal Intelligent Agents. Each agent can be configured or programmed by the owner of the profile. For instance, a teacher can program his agent to send e-mail notification to students with a lower than C grade who **ADDITIONALLY** did not participate in the classroom message forum collaboration activities.

The agent can also be programmed to sequentially monitor certain incidences, compare with preset thresholds set by an owner, and perform certain tasks on behalf of an owner. The Agents could be located in the “MyProfile” or “MyPortal” section of a course-management or portal environment respectively. The Agents could be profile or course specific agents(i.e., an agent that monitors certain activities in a specific course or monitors all the courses that a student is taking or an instructor is teaching. Figure 1



illustrates configuration example of an “inactivity” agent monitoring students activities in an online course. Figure 2 illustrates basic agent architecture for teaching and learning.



## 8. Scenarios and Conceptual Stories in an Agent Based Teaching and Learning Environment

This paper is intended to define and conceptualize applications of Intelligent Agents in teaching and learning situations. One common method of defining new applications is by presenting realistic scenarios and conceptual stories. The following section presents two conceptual scenarios in

order to illustrate the applications of Intelligent Agents in teaching and learning situations.

**Digital Classmate Scenario 1.1.** Bonnie Williams, a graduate student at IUPUI is interested in participating in a chat or message board discussion regarding the recent shooting at Columbine High School in Littleton, Colorado. She is writing a paper for her Social Psychology class and would like to know student's opinions and positions regarding this incident. She clicks on the Digital Classmate icon and enters information such as keyword search, scope of search, chat vs. message board, etc. The Digital Classmate (as a mobile agent) will monitor all the public chat and message board activities and interrupt the student when it observes any

discussion regarding this matter. “Knock knock,.... Excuse me Bonnie, there seems to be a lot of discussion about the Littleton shooting in the Crime And Society course taught by Professor David Mills. Would you like me to take you to their chat room?”

Scenario 1.2. The Digital classmate advises and directs the learner into the appropriate page or screen to complete a due assignment, incomplete lessons, or read important announcements. “Hi Bonnie, long time no see, you haven’t logged on for three days and you have several important notes to read with three assignments due tomorrow morning,” Digital Classmate says after the student logs on to the course. It appears as a graphical display with animated motion, voice synthesis and voice recognition software.

Scenario 1.3. User interface dynamically adjusts and navigation sets according to the learner’s past navigation practices.

**Digital TA Scenario 2.1** Monday morning Professor Amy Baylor at Florida State University arrives at her office around 10 AM. She is teaching two courses that meet twice a week and are complemented by a course management environment. Professor Baylor switches on her computer, logs into her course management environment, clicks on the Digital TA icon and begins organizing papers on her desk. A Digital TA named Angie appears on her desktop as an animated character on the top left corner of the computer screen. “Good morning Professor Baylor, here are the activities of your E214 and E723 courses. Over the past weekend there were moderate activities on your E214 website.” Professor Baylor, while browsing through her campus mail, looks up at the computer monitor on the other side of her desk. An XY graphic shows the students’ activities with date and time over the last three days in the middle of the computer screen. “Angie next,” Professor Baylor says to see the next activity report. “There are three students with overdue assignments!” Angie notes, “Would you like me to send them a email notice?” Professor Baylor, reading the campus



paper, looks up and recognizes the pictures of the three students on the computer screen. She asks the Digital TA to send the e-mail messages.

**Digital TA Scenario 2.2** Professor Baylor is giving an online quiz to her E214 class. On Tuesday morning after she logs on to her course portal she receives an alert warning from the cheat buster Intelligent Agent. “Excuse me Professor Baylor, I am noticing many similar quiz answers on Ron Montena’s and Sue Cassidy’s tests.” The Agent continues, “There is 92% similarity between right and wrong answers in their last quiz, and both have taken the quiz at the same time from two adjacent computer workstations in the University Library.” The Cheat Buster Intelligent Agent then displays a three-dimensional graphic on the screen highlighting similar answers. It also provides statistical analysis of the past six quizzes, highlighting similar answers. Professor Baylor sends e-mail messages to Ron and Sue asking for explanations.

**9. Conclusions** The current commercial course management software offers static and time-consuming operational environments. There is a need for the development of agent-based course management software where a series of Intelligent Agents offer an automated and dynamic operational system. Some new companies (CyberLearning Labs, 1995) began to deliver agent-based course management software but the majority of market is still focusing on the development of static course management systems.

The Teaching and Learning Intelligent Agents can be divided into three categories as they are defined in this paper. These include the Digital Teaching Assistant, Digital Classmates, and Digital Secretary.

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