EXPLORING SOCIAL NETWORKING TECHNOLOGY AND MULTIPLE PEDAGOGICAL AGENTS: HOW, WHEN AND TO WHAT EXTENT THEY FACILITATE LEARNING IN E-LEARNING SYSTEMS

Melvin Ballera and
Aziza Ehmaid Omar
Sirte University
Libya

Abstract

The proliferation of e-learning using pedagogical agent in learning institutions has contributed a lot to the acquisition and applications of new skills. Pedagogical agents have proven their worth in multiple ways and in multiple domain of education. Likewise, social networking technology exponentially increases and in being used in tertiary level. This paper introduces multi-pedagogical agent system and the incorporation of social network services in the design and implementation of e-learning systems. Specifically it answers how, when and to what extent pedagogical agents and social networking services are used to aid learning.

Introduction

Early e-learning systems were developed following three stages; learners read theory, assessed knowledge through practices/exercises and answered a test. By adapting computer technology into education it: shows that student performance increases (Lave et al., 2001); deepened cognitive development (Sutton et al., 2003); and reduced time for the student to acquire skills and knowledge (Moreno et al., 2001). Along with the rapid development of Internet technologies, multimedia and research, e-learning has become interactive, dynamic and educationally oriented. Instructional designers and strategists introduced pedagogical agents into e-learning systems (Kramen et al., 2010; Osman et al., 2012).

Pedagogical agents are virtual characters that are used for instructional purposes (Veletsianos, 2010). They are frequently presented as digital teachers, coaches, tutors (Chou et al., 2003) or learning companions that exhibit an exclusive focus on the task and the content that is to be learned or taught. Agents are designed to help transmit knowledge or skill to a student by an interactive individualized process. Interactive agents usually focus on how to make a socially aware learning environment that interjects social remarks and comments (Gulz et al., 2011); but they must be carefully crafted in a way that they will not hurt or hinder the learning process but will motivate the learner (Veletsianos, 2012). Virtual Agent allows students to collaborate and share ideas to make the learning process interesting (Botsios et al., 2009). The inclusion of social networking technology and blogging

accomplish such task as ultimate area to support socialization. Several researchers show the importance of social interactions (Cloete et al., 2009., Brown, 2007) and conversation in social networking services such as Nazir et al., (2008) and Sanjaya et al., (2008).

This paper seeks to create learning experiences that incorporate a number of pedagogical agents working collaboratively including social networking technology and blogging to facilitate the learning process.

Review of Relevant Literature

This section discusses the relevant literature and includes discussion about pedagogical agent base system and current the use of social software in this context.

Pedagogical Agent-base E-learning

Much e-learning incorporates pedagogical agents - usually animated characters to make learning more attractive and effective (Johnson et al., 2000). These agents have animated personas that respond to user actions and have enough understanding of the learning context and subject matter that they are able to perform useful roles in learning scenarios. Shaw et al.,(2000) particularly focuses on the Agent for Distance Learning Environments (ADELE) that provides presentations, monitors and gives feedback, probes questions, and provides hints and explanation in scenario-based learning Pedagogical agents take other roles, for example, learning companions (Baylor et al., 2006), peer tutor (Uresti, 2004), collaborator and competitor (Chou et al., 2003). Such discussion focus on how pedagogical agents fulfill their educational duties. Moreover, pedagogical agents can now be used to support socialization as an essential part of the learning process. Social conversational agent have been implemented by Gulz et al., (2011) while Veletsianos (2007) studied the use of agents' social appearance or looks to increase students learning performance. Agents' appearances convey non-verbal messages to learners that influence perceptions and the ways learners interact with the agent (Rosenberg-Kima et al., 2008). It is now inevitable that socially oriented software agents play a vital rule to ultimately support socialization and interactions among learners.

Social Software

Social software is increasingly being used in education and training by blogging and social networking services (Atwell, 2007) . It lets people rendezvous, connect or collaborate using computer network. Blogging is short for web logging that contains website with several dated entries and arranged in reverse chronological order (Sanjaya, 2009). Instructors use blogs to post the e-learning materials for their students and embed multimedia content to describe the knowledge in more detail and use them to share the courses, research papers and workshops. Among the social technologies in the market, Facebook emerged as the most familiar and most used social networking site with its estimated one billion members today (Anson, 2012). It consists of personal profile, group, fan page, photo album, notes and other application. Facebook and blogs can work together by combining several applications to be connected to one another other. For example, Facebook

applications can be used to promote the contents in the blog and automatically display the blog contents to the wall. The students connected to the Facebook site of the e-learning providers can follow the latest contents automatically pushed from the e-learning blog. It is possible to implement this communication because the blog provides feeds to be read on the Facebook. The contents of the e-learning blog can be promoted by students to co-learner using a small script embedded in the blog. The script has a capability to post the title of the e-learning article and the link to e-learning article in student's Facebook wall if they are interested to share the contents. By incorporating social media, students will ultimately socialize, collaborate, share ideas while in the process of learning.

The goal of this paper is to discuss the architecture on how different pedagogical agents work collaboratively to fulfill their pedagogical duties and to integrate blog and social networking services into the e-learning system to support socialization during asynchronous learning process.

Methodology

The purpose of incorporating pedagogical agents and social networking technologies is to enhance the current e-learning system to support and promote collaboration and socialization among learners.

Pedagogical Agents' Responsibilities

The following are the five pedagogical agents used in the system detailing their responsibilities and roles in the architecture.

Preferences Agent.
The Preferences Agent supervises the user preferred style presentation such as font type and size, colors, and margins.. When a learner changes his preference style, the Agent creates a personalized style and updates the user interface. Usually the learner will be provided with questions at the beginning of the course to form his profile, such as general knowledge, special knowledge, personal data and psychometric tests. This Agent is continually running to know the student's preferences at any time. This way the user can perform the changes that he considers opportune. All changes from the Preference Agent will pass to the Tutor Agent for customizing learning delivery.

Exam Agent.
The Exam Agent takes charge of choosing appropriate questions during practice/exercise or graded exams to the student. Questionnaires are randomly selected from the database and arranged accordingly into predefined complexity. This questionnaire is stored in Exam DB. The exercises and Exam results will be forwarded to Tutor DB. If the result is below the minimum mark, reinforcement is needed.

Reinforcement Agent.
The Reinforcement Agent is a proactive agent that always attends to the needs of the Tutor and Exam Agents. During exams or exercises, the Exam Agent and

Reinforcement Agent work collaboratively by informing the latter of all the questions it chooses. The Reinforcement Agents prepare all the links related to theory pages that explain the concepts where errors or a wrong answer is detected. The Tutor Agent receives recommendation from Reinforcement Agent that the learner has been penalized by not allowing to proceed to the next topic if it perceives prior concepts have not been satisfactorily completed otherwise awards or points will be given. The Tutor Agent changes contents of the subject matter on the basis of information obtained from the Reinforcement Agent.

Social Agent.
The Social Agent is a supplementary agent that is activated by the Tutor Agent once the learner is working in an asynchronous environment.The instructor posts a related article in the blog and capture in the Facebook. Facebook users see it in the wall and it can be shared among the learners' group. Learners can collaborate and help one another in solving problems through chat, video call and, etc., using add-ins available from Facebook. Once online, learners will be able to communicate, query and asked other online learners for help in Facebook, thereby allowing online collaboration and socialization. The Social Agent records such names of learners that participated in the chats, number of hours spent, and resources shared by learners; the number of log-in and stored threaded messages are then passed to the Tutor Agent for profiling students.

Tutor Agent.
The Tutor Agent is the most powerful agent in the architecture since it uses all the information received from other agents. The knowledge or theories to be taught are stored and this provides the mechanism to efficiently present the subject matter to the students. It performs several tasks such as: providing learning guidelines for the students, storing data such as time constraints, schedules of exams, preferences, class records, and updates from different agents. Only the Tutor Agent in the form of an animation is actually seen by the learners while others are working in the background.

Multiple-Pedagogic Agent and Social Networking Services Architecture

How a multi-agent system can be developed in which agents cooperate with each other to collectively accomplish learning task is the key issue in building a multi-pedagogic agents and how to incorporate social networking services to support learners. The e-learning system breaks down the learning on the subject matter into theory, exercise and test questionnaires. Learners study the subject matter by reading theory first, then participating in exercises/practice and a weighted/graded final test. The subject matter is usually structured to facilitate learning.

Figure 1 shows five agents that have been incorporated into the system; Preferences Agent, Social Agent, Reinforcement Agent, Test Agent and the virtual instructor called Tutor Agent. Initially, the Preferences Agents will show default preferences and can be changed by the students whenever they want, even in the middle of the course. The changes will be reported to the Tutor Agent as the basis for customizing

the graphical user interface of the learners and then reading theory begins. The Tutor Agent serves as the controlling mechanism of all agents. During the theory phase, the agent will let the learners proceed with his/her reading but intervene if necessary with such actions as time lapses, needs reinforcement, explanations, activating simulations, executing executable files, linking topics and providing information and help in the form of suggestions like hints/motives that will activate the learner's thought so as to help its further development. Any moves from the learners in which the Tutor Agent perceives to be out of bounds will be dealt with accordingly. Some moves are opening multiple files and several windows, executing simulations several times and not following instructions, running multiple executable files and changing variables. The Tutor Agent maintains a record from all the agents such as the punishes and rewards recommended by the Reinforcement Agent, scores and other data from Test Agent, stored threaded messages from Social Agent and updates from the Preferences Agent. These collected data from agents will be used in building the student's profile. Only the Tutor Agent is directly seen by the learner while other agents are working in the background.

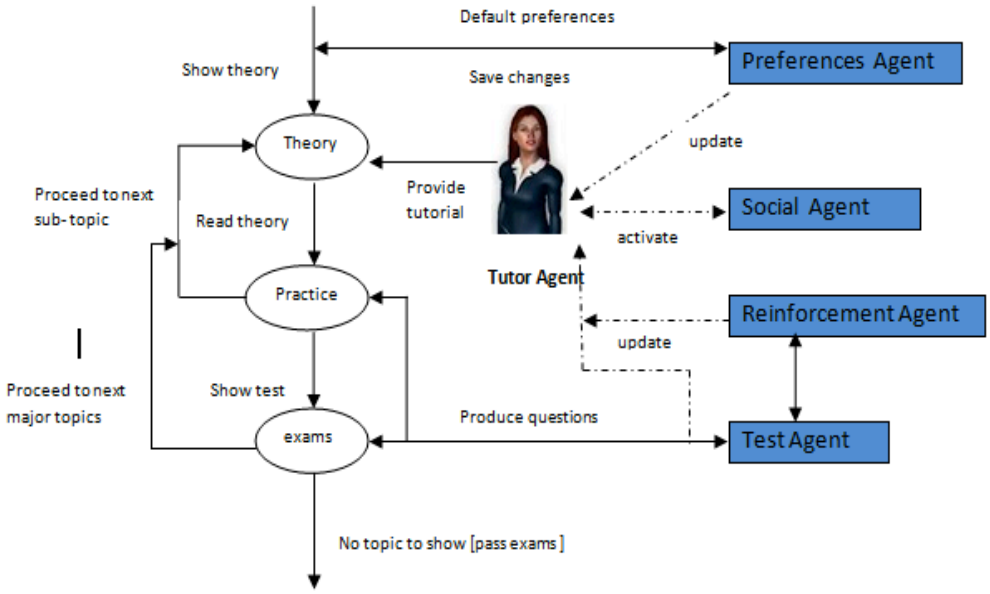

Figure 1. Multiple-Pedagogic Agent and Social Networking Services Architecture.

The Reinforcement Agent is directly collaborating with the Test Agent and Tutor Agent. The main function of the Reinforcement Agent is to recommend the topics based on its diagnoses from the practice module of learner to the Tutor Agent. This data will be used then by Tutor Agent in activating topics and explanations suitable for the learner. The incremental learning process is controlled by Reinforcement Agent in which, a learner can not jump to another topic, cannot takes practice and actual exams if the result is below minimum. The Test Agent on the other hand,

passes all the practice and exam results into the Tutor Agent database including how many practices committed and difficulty level to support building student's profile.. Practice and exam questionnaires are available whenever the Tutor Agent requests. The primary function of the Test Agent is to develop and design questionnaires according to time allocated index of the learner in each topic given.

The Test Agent divides the question according to their complexity as predefined by the e-learning administrator. In the practice module, the Test Agent develops questions for practice and mastery, and if minimum requirements have been met it will proceed to the next sub-topic as recommended by Reinforcement Agent to Tutor Agent. After mastery, the learner will take a one-time graded exam to allow learner to go to the next major topics of the module.

The Social Agent is controlled by the Tutor Agent to support blended learning and can be activated given any of the following conditions: (1) asynchronous environment – students want to continue learning and official time has lapses; (2) new articles related to a topic have been uploaded and published in the blog; and (3) the students need to solve problems collaboratively using Facebook. Each threaded message during discussion will be recorded as part of collaborative solving effort of the students. Threaded messages are the sequence of recorded exchange of communication to solve the problems. The threaded messages will then be submitted to the Tutor module for profiling the students.

Achieving Collaboration among Agents and Social Services

Figure 2 and **3** show steps followed by the learner when studying each topic:

1. The system will display default preferences. If a student wishes to change, it can create new preferences, can preview and save to Preference DB and update Tutor DB about the changes. Otherwise, students proceed to Step 2. During the study session, the student can change style of presentation of the subject matter by changing colors, margins, window size, etc.

2. Students read the theory for the current topic. Evidently, the Tutor Agent controls the flow of the learning materials. It gives reinforcement to the students based on the recommendation of the Reinforcement Agent and usually submits its diagnoses according to the practice/exercises results. Tutor Agent stores how many times the students have visited the theory page, consulted the Tutor, and performed practice exams and how many unanswered questions, correct and incorrect answers were given to exercises. For the practice questionnaires, the Tutor Agent may look for the number of times that each test question has presented and whether the test question was presented as reinforcement to an exercise or part of a test questionnaire. This is done by retrieving all the questions developed by the Test Agent during practice exams.

3. The student has to solve the proposed exercises. Usually practice exams or exercises are divided into two, Basic Exercise and the Difficult Exercises.

   3.1. After each subtopic or major topics, exercises are provided to check the mastery level of the students. The Test Agent randomly selected a set of questions in the Exam DB. If the student passes the minimum requirements, then he/she goes to Step 3.2. Otherwise a reinforcement is needed. The Reinforcement Agent immediately informs the Tutor Agent topics that need to be repeated or exercises to be re-taken. The Tutor Agent usually consults its records to determine the degree of reinforcement. If the result of the exercises is zero, the recommendation is to repeat the topic or consult the professor of the course.

   3.2 .Difficult Exercises focus on application problem solving skills. The Test Agent randomly selected questions from Exam DB and students need to pass the minimum to proceed to Step 2 or Step 4 otherwise another level of reinforcement will be implemented.

4. **Figure 2** - process 4 is a one-time graded exam that is part of a grading system. After exams, a new major topics will be presented and start at Step 2 .otherwise end of the module.

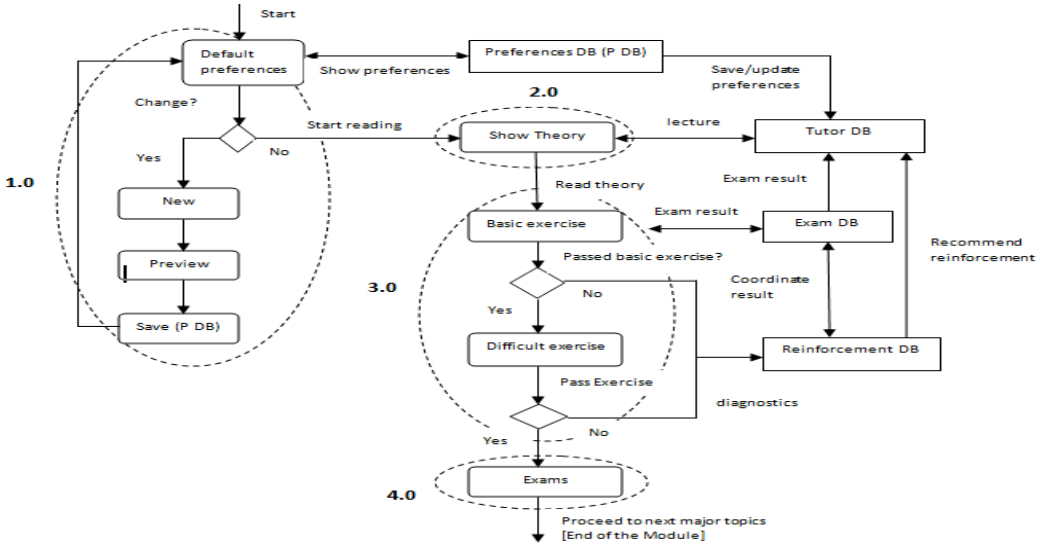

Figure 2. Flowchart diagram for Preferences, Tutor, Test and Reinforcement Agents.

During asynchronous learning, students can read theories only. Practice/exercises is deactivated to enforce learning process can take place among students if monitored by human instructor inside the e-learning laboratory. The integration of social networking services and blogging support collaboration among learners in solving problems.

5. **Figure 3 -** explains how to achieve collaboration between the Tutor Agent and the Social Agent. The professor enters into the GUI the article to be published to make the Tutor Agent aware that an article has been uploaded to the e-learning blog. When the student logs in outside the e-learning lab, the Tutor Agent informs the student that an article has been posted and needs to be solved collaboratively. Students will click the embedded social bookmarking button in the e-learning module signalling that the social networking has been activated. The Social Agent records learners participating in the chats, number of hours spent, stored the messages threading, resources shared by learners, number of log-in. This information will then be submitted by the Social Agent to Tutor Agent in profiling the students.

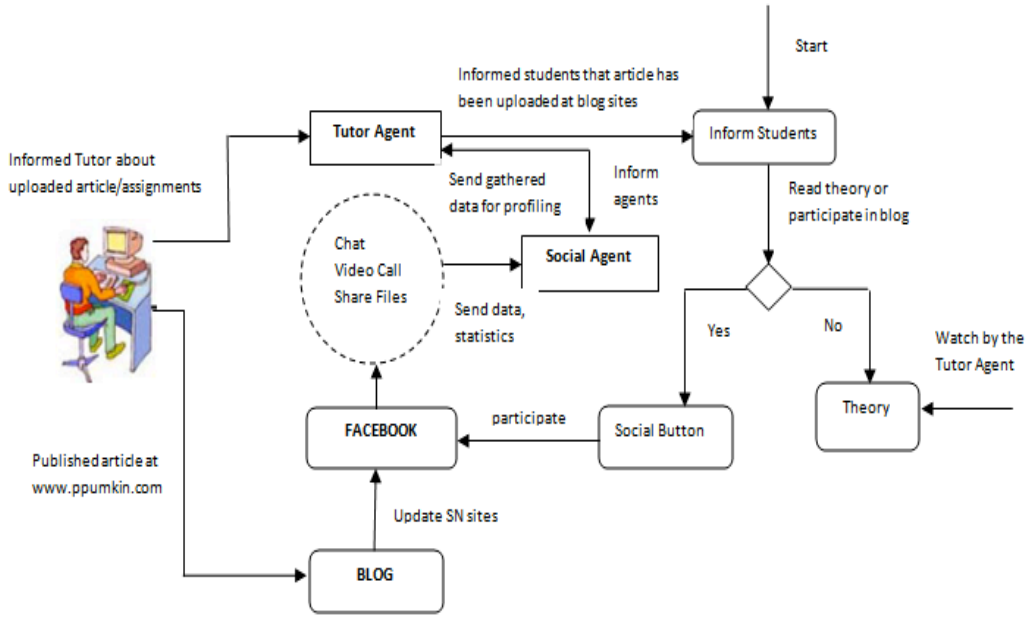

Figure 3. Tutor Agent and Social Agent collaboration.

Facebook users can view the contents using Really Simple Syndication (RIS) - a family of web feed formats used to publish frequently updated works - such as blog entries, news headlines, audio, and video - in a standardized format. It can be used for any applications that want to display the e-learning contents from the website. Another is installing NetworkedBlogs, a Facebook application that once installed and configured can read above URL. Facebook will display the e-learning contents from www.ppumkin.com automatically. The networks can read every latest e-learning articles on Facebook.

Conclusion

The architecture allows collaboration of among agents. The five pedagogical agents namely Preferences Agent, Social Agent, Tutor Agent, Test Agent and Reinforcement Agent work collaboratively to help learners achieve learning. The

primary concern and use of Tutor Agent is to gathers data from all the Agents to profile the students and control the flow. All gathered information will be used to aid the learning of the students. The used of Facebook and blogging technology by publishing related articles of e-learning and collaboratively solved problems by the students support socialization, collaboration among learners.

At hand, two research studies are currently originated from this paper: (1) experimental study and the implementation of the new architecture, and(2) extracting information among agents to intelligently profiling the learners to support personalization.

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