Knowledge Management and e-Learning – An Agent-Based Approach

Teodora Bakardjieva, Galya Gercheva

Abstract—In this paper an open agent-based modular framework for personalized and adaptive curriculum generation in e-learning environment is proposed. Agent-based approaches offer several potential advantages over alternative approaches. Agent-based systems exhibit high levels of flexibility and robustness in dynamic or unpredictable environments by virtue of their intrinsic autonomy. The presented framework enables integration of different types of expert agents, various kinds of learning objects and user modeling techniques. It creates possibilities for adaptive e-learning process. The KM e-learning system is in a process of implementation in Varna Free University and will be used for supporting the educational process at the University.

Keywords—agents, e-Learning, knowledge management, knowledge sharing, artificial intelligence

I. INTRODUCTION

IN each organization, knowledge must be organized according to its context, based on a corporate taxonomy. Knowledge can be distributed through portals as necessary by various applications such as e-learning, competence management, intellectual property management and customer relationship management [1].Knowledge management (KM) has to provide building culture of knowledge sharing, and open communications for supporting knowledge workers to satisfy their learning necessities [2]. Learning from other knowledge workers and sharing with them is an essential component of the knowledge creation processes [3].There is a view that KM is a business concept that can bring increased profitability for commercial organizations. However, the management of processes such as knowledge creation, capture, sharing and use are not exclusive to business and good KM practises could help to each organization. Given higher education's priority of developing knowledge assets, a culture that prioritises KM can be used to support university's organizational processes [4].As KM applies approaches to use knowledge to create value, KM can be appreciated as an access to experience that creates superior performance, encourage innovation and enhance customer value. KM initiatives can especially benefit the Higher Education System because accessing knowledge from available sources as fast as possible is a natural desire of the elite academia and students [5]. The main goal of Knowledge management (KM) is to help people acquire new knowledge, as well as package and deliver existing knowledge through teaching. As a KM environment encourages the flow of knowledge and exchange of ideas through feedbacks and collaborations, KM techniques

Prof. Dr. Teodora Bakardjieva is with the Varna Free University, Bulgaria; (e-mail: bakardjieva@vfu.bg).

and technologies would lead to better decision – making capabilities, improve academic and administration services, as well reducing costs [6], E-Learning is widely used by people because it offers flexibility in time and space and collaboration between students and tutors.

Knowledge management and e-Learning are two complementary fields. Nowadays, as stated by many researchers, the overlap between KM and e-Learning is widely recognized and smart companies are in a process of integrating them to better leverage resources and optimize activities [7]. E-Learning delivers processed knowledge – it takes expertise, puts it through a design process and presents the results in an open framework, while KM delivers raw materials or less processed knowledge. KM and e-Learning improve construction, preservation, integration, transfer and use of knowledge and competencies [8]. Whereas e-Learning has its foundations in pedagogy, psychology and didactics and emphasize the importance of structural (by preparing study resources) or personal guidance, KM refers to an organizational memory or organizational knowledge base into which the individual's knowledge is supposed to be made explicit and which is the basis for unguided knowledge transfer.

Knowledge management tools can support the development of open courses and open sources in e-Learning [9].

Nowadays, knowledge management has become an increasingly high profile approach to making education more effective, particularly for geographically dispersed learning environments. Knowledge management provides ways of reducing the constraints of existing operational management structures to improve innovation, responsiveness and creativity.

Although the benefits of KM for education have been acknowledged a lot of times, its complete investigation in educational field is still to be seen [10]. The knowledge must be delivered in a personalized way, according to user's preferences regarding content and presentation. Another issue is dealing with dispersed systems. Agent-oriented KM comes as a solution in such learning environments [11].

Agent-based approaches offer several potential advantages over alternative approaches. Agent-based systems exhibit high levels of flexibility and robustness in dynamic or unpredictable environments by virtue of their intrinsic autonomy. Agents facilitate knowledge sharing within a business since they require a common metadata model describing what and where the information is that they use. Agents allow learning capabilities to be incorporated in a natural way, enabling agent behaviour to change with time based on acquired experience. Agents can serve as personal assistants, maintaining the user's profile and preferences.

The building of the space for using distance education as one of the trends is the common goal of activities in the field of education and Bulgaria is not an excerption. The situation in Bulgaria in this field can be signed as dynamically improving. It is just electronic form of education which is able to ensure the expansion of distance learning and thereby also the availability of the education for wide groups of people.

Varna Free University (VFU) is among the first educational institutions in Bulgaria that decide to introduce e-Learning platform in order to support the educational model of the university. An e-Learning platform is the perfect medium to support the face-to face education and blended learning as a whole. The team of the Institute of Technology at VFU set up a project to create a support model for teachers when innovating their training process. The project started with a formulation made by the teachers of the hypotheses concerning the possible added value of an e-Learning platform.

This paper presents an agent-based e-Learning environment, where knowledge emerges as a result of the ongoing collaborative process. The relationship between students and teachers is non-hierarchical. All participants in the system are peers who collaborate in knowledge creation, integration and distribution. A user profile and knowledge base are maintained with the help of software agents. Other agents carry the responsibility for finding the best peer to answer to a question, and for managing knowledge resources.

II. AGENT-BASED FRAMEWORK FOR KM IN E-LEARNING ENVIRONMENT

In e-Learning environment every user has an access in a simple way across networks, to the communication tools and services, which are necessary to him in his activity. Such environments are possible because of the developments of agents systems where a resolution of a problem or sharing of tasks is the result of cooperative correlation between different agents [12].

In a learning environment there is a share of different kinds of resources:

- electronic documents, references, web links;
- books, articles, other educational artefacts;
- tacit knowledge, contained in people's minds and usually informally exchanged among participants. Technologies for extracting tacit knowledge should be designed in the confines of individuals' cognitive behaviour. In other words, extraction of soft knowledge should be considered in a dynamically real time environment where there is a continuous interaction among learners who harness user-friendly tools for learning [13].

These resources are distributed among people and it's difficult to find out at a certain time who has the right information, advice or solution. The context of these problems suggests that KM systems can be successfully implemented in learning environments. Inclusion of software agents with their specific characteristics make KM systems a powerful decision for education support [14].

Taking in account the above mentioned issues some concepts about the KM strategies applied in e-Learning environments are presented in the paper.

The main activities necessary to build a knowledge data base are [15]: creating knowledge, securing/combining knowledge and distributing/retrieving knowledge.

A. Creating Knowledge : Designers and users create one or more design solutions consistent with the user requirements. Whenever design participants gain a new understanding about user needs, they develop new design knowledge.

B. Securing/Combining Knowledge : Since learning systems design is multi-disciplinary, enhancing team collaboration is very important in the design process. It can be achieved when all participants share knowledge and freely integrate their knowledge into existing knowledge. All these require storing and indexing knowledge properly. Throughout a process of learning environment design, partially or completely specified new design knowledge should be evaluated by checking whether or not it is consistent and specifying how it should be integrated with knowledge already stored in a knowledge data base.

C. Distributing/Retrieving knowledge : Open, flexible and reactive communication channels are needed to distribute knowledge in collaborative learning system. The dynamic nature of such an environment requires content-based, context-based knowledge retrieving.
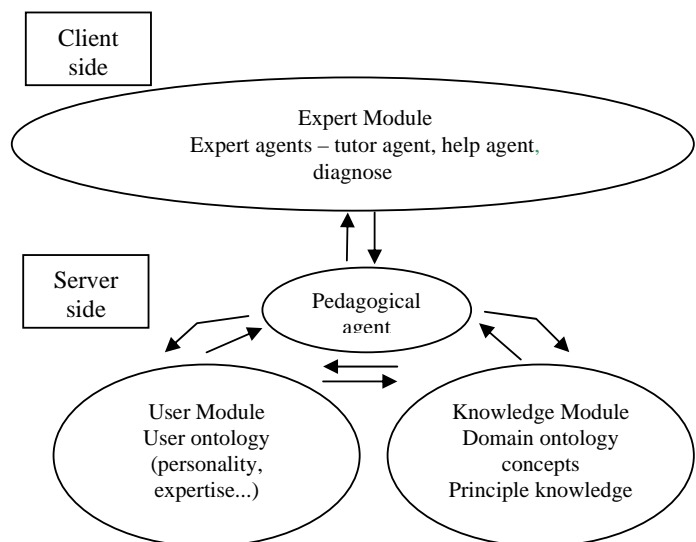

Fig. 1 Agent-based framework for KM in e-Learning environment

In the proposed approach, based on the user's characteristics, different types of agents, involve the student in learning processes according to the user's behaviour in the learning environment. The framework is combining three

interrelated components:

1. A domain ontology – a set of learning objects and knowledge elements, to be delivered to the user accessible by the agents;

2. A user ontology – covers level of knowledge sharing, domains of interests, learning goals, etc.

3. Expert agents, Coordinated by a Pedagogical Agent

The main task of the pedagogical agent is to access the user ontology in order to provide the appropriate instructional strategy, an adaptive curriculum adequate to the user's level of expertise, to the user's goals, etc.

Expert agents refer to ontology information maintained on the server side. Different types of agents could be integrated into the system as tutor, diagnose agents, etc. Different types of learning objects can be accessed by each expert agent.

The proposed framework creates possibilities for management of different knowledge domains and for integration of different types of learning objects – audio and video resources, hypertext, images, etc.

Knowledge sharing behaviour of the users is one of the main objectives related to the implementation of knowledge management strategies. The level of adoption of knowledge sharing practices can be captured through the knowledge sharing behaviour. Some authors describe users as undergoing a change process that moves them from their old practices to the adoption of knowledge management practices [16]

KM agents are implemented to improve the effectiveness of the proposed e-learning environment and to enhance knowledge flow in the model complementary: user profile agent, knowledge agent, manager agent and security agent.

The user profile agent keeps interest and qualification profile of the users. It can dynamically organize a person's agenda. The tasks of the knowledge agent include saving, retrieving and updating the knowledge from a data base. The knowledge agent crawls to the available information sources if necessary and personalizes the retrieved information according to the user's interest profile. The manager agent monitors the changes in the knowledge database and determines the most favoured alternative based on preferences. The security agent controls the import and export of all information and plays the role of a firewall guard.

XML representation is used to generate structured and dynamic HTML pages, based on CSS. We intend to reorganize the proposed model using Semantic Web Technology and ontology languages.

III. Conclusion

In this paper an open agent-based modular framework for personalized and adaptive curriculum generation in e-learning environment is proposed. The framework enables integration of different types of expert agents, various kinds of learning objects and user modelling techniques. It creates possibilities for adaptive e-learning process. The KM e-learning system is in a process of implementation in Varna Free University and will be used for supporting the educational process at the University.

The next step of this research is towards optimizing the support for real time collaboration and knowledge sharing process between the users and the real time intervention of different personal agents.

Future research direction is related to the design of new interfaces referring to guidance the user's attention.

It is high time for the academic fraternity of Bulgaria to realize that the only way to remain relevant to present and to the future is to keep engaged with students and there is no better way to do that than being e-connected. Educational institutions which plan to venture into e-Learning are suggested to first follow the education and communication strategy of organizational change where the stakeholders should be informed as to how the change will affect them.

REFERENCES

[1] Sinha S., M. Lindvall, I. Rus, 2004, Software Systems Support for Knowledge Management, Project Performance Corporation http://www.ppc.com/modules/knowledgecenter/knowledgemanagement.pdf

[2] Bennet A., D. Bennet, 2004, Organizational survival in the new world, Elsevier, Burlington

[3] Nonaka I., H. Takeuchi, 1995, Knowledge creating company, Oxford University Press NY

[4] Ragsdell, G., 2009, Managing Knowledge about Knowledge Mnagement: 'Practising What We Teach', ITALICS Volume 8 Issue 1 February 2009, pp. 21-26

[5] Kumar A., A. Kumar, 2005, IT based KM for Institutions of Higher Education – A Need, University News, New Delhi, Vol. 43, No. 30, July 25-31, pp. 4-9

[6] Abdullah, Doria, 2009, Knowledge Management in Higher Learning Institution, SPP 4052 Sociology and Professionalism in Education http://www.scribd.com/doc/22537231/Sociology-replacement-KM-in-Higher-Learning-Institution

[7] Morrison D., 2003, E-learning strategies, Wiley& Sons, Chichester

[8] Maier R., A. Schmidt, 2007, Characterizing Knowledge Maturing, 4th Conference Professional Knowledge Management (WM 07), Potsdam, Germany
http://publications.andreas.schmidt.name/Maier_Schmidt_KnowledgeMaturing_WM07.pdf

[9] Tu-Bao Ho, 2006, Knowledge management and e-Learning, APEC Symposium on Open Source and Open Course for E-Learning, Ha NOI, Viet Nam, 4-6 December 2006 http://www.apecneted.org/resources/files/06_hrdwg_sym1_010_Knowledge_management_Bao.pdf

[10] Guizzardi, R. (2003). 'Supporting Distributed Knowledge Sharing Environments', University of Twente, Enschede, The Netherlands, Retrieved July, 2010 from
http://wwwhome.cs.utwente.nl/~souza/phd.htm

[11] Dignum, V. (2004). 'An Overview of Agents in KM', Institute of Information and Computing Sciences, Utrecht University, technical report 2004, Retrieved June, 2010 from http://www.cs.uu.nl/~virginia/publications/publications.htm#y02

[12] Harbouche K., M. Djoudi, 2007. Agent-based Design for e-Learning Environment, Journal of Computer Science, June

[13] Asiamah, Frank N. (2009). Exploiting Tacit Knowledge through Knowledge Management Technologies, Learning Forum London Conference June (EIfEL) Retrieved July, 2010 fromhttp://bura.brunel.ac.uk/bitstream/2438/3613/4/EXploiting%20Tacit%20Knowledge%20-%20Frank%20Nyame-Asiamah.pdf
Blanzieri, E., Giorgini, F., Giunchiglia, C. and Zanoni C. (2004). 'Agent-Mediated Knowledge Management', International Symposium AMKM 2003, Stanford, CA, USA, Springer – Verlag, Germany, 2004, pp.245-261

[14] Baek, S., Liebowitz, J., Brasad S. and Granger M. (2000). 'An Intelligent Agent-Based Framework for Knowledge Management on The Web: An Exploratory Study of A Virtual Team in Designing A Multimedia System ', Retrieved July, 2008 from http://www.udlap.mx/~ayalasan/administracionDelConocimiento/baek.html

[15] Roda, C., Angehrn, A., Nabeth, T., Razmerita, L., (2002), "Using conversational agents to support the adoption of knowledge sharing practices", Interacting with Computers, special issue on Intelligence & Interaction in Community-based Systems