APPROACH OF IMPLEMENTATION OF AN INTELLIGENT ENTERPRISE STAFF ADAPTIVE E-LEARNING

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Abstract: This paper presents the principles of development of an intelligent e-curricula model for the employees of the future generations of manufacturing or service processing systems. To introduce an adaptive e-learning property for the employees of an intelligent future enterprise, the proposed e-curricula model is constructed. It is based both on using an adaptive multi – agent system and on applying the following unsupervised learning algorithms: the Q-learning, and a special type of artificial neural network, the Kohonen's Self-Organizing Maps.*Copyright @ 2006 IFAC*.

Keywords: Adaptive algorithms, agents, electronic learning, enterprise modelling, intelligent knowledge-based systems, neural networks.

1. INTRODUCTION

(Europe Direct, 2005) points out an initiative of the "Ambient Intelligence Technologies for the Product Lifecycle" cluster. The cluster believes that the strength of the European economy is increasingly based on relationships among many enterprises, which together form agile networks, able to react to market demands in shortest time. These networks (sometimes developed as a virtual enterprise for a specific product) are still competing successfully on a global scale with enterprises from distant countries, where labour costs are just a fraction of those in Europe. This success can be retained, only, if the networks establish and maintain smooth interactions, which cover the complete life cycle of the product. In such clusters, knowledge is considered as the crucial resource for each organization which needs to be managed carefully. To do that, an aapproach of implementation of artificial intelligence in the modern enterprise staff tutoring process can be based on adaptive e-learning. E-learning provides a competitive edge with improved faster time-to-market, better supply chain communication and a well-trained workforce. Gabelhouse (2002) estimates that the enterprise-learning market is projected to grow at the annual rate of 4 percent through 2007, and one-third of staff members will be involved in e-learning. According to Brusilovsky (2004), the technological landscape of modern e-learning is dominated by so-called learning management systems (LMS) such as Blackboard or WebCT. Adaptive Web-based Educational systems (AWBES)

can perform some functions even better than the state-of-the-art LMS. In this paper, adaptive approach of an e-learning is considered as interactive learning in which the learning content is available online and provides automatic feedback to the employee's dynamically changing learning activities. The activities carried out are related both to design and implement some agents and their living environment. The proposed agents will provide the learning staff with personal assistants that can help them to carry out the learning activities considering learning styles and learner's knowledge level. Both the learner's progress tracking and motivation during learning are also considered. In this paper, the staff e-learning development model is proposed by using adaptive multi-agent system. Two unsupervised learning algorithms are proposed to gain some adaptive features of an introduced Pedagogical tasks management agency: Q-learning (Sutton & Barto, 1998, Iglesias, A., et al, 2003) and Self-Organizing Maps (Kohonen, 1997, Lukauskas, V., 2005). Methods of implementation of these algorithms in the curricula of Information technologies in the University of Klaipeda (Baziukaite, et al., 2002, Bielskis, 2004) are also discussed in this paper.

An objective of this paper is to propose the model of both involvements of the staff of given enterprise and integration of an intelligent electronic learning component of the staff within a product and process life cycle to permanently improve performance of this enterprise. In section 2, the principles of integration of the staff e-learning component within a

product and process life cycle of an enterprise are described. Section 2.1 describes architecture of Learning Staff E-Curricula Development Model. Section 2.2 discusses Q-learning Approach to Develop the Pedagogical Tasks Management Agency, the *PTMA*. Section 2.3 examines methods of application of Self-Organizing Maps for Development of the *PTMA* in the model. Section 3 considers experimental results of implementation of an adaptive intelligent component into a virtual e-learning environment by using SOM neural networks. The last sections contain concluding remarks and acknowledgement.

2. ON THE DEVELOPMENT OF E-TUTORING TOOL

In section 2, the principles of integration of the staff e-learning component within a product and process life cycle of an enterprise are described.

2.1. Learning Staff E-Curricula Development Model

Fig.1 shows learning staff e-curricula architecture, which is under permanent development phase. Its main purpose is to help logged into the system learner to achieve his/her main goal – better and faster learning fundamentals of selected course. Such e-curricula should be adopted to the learner's personality, his/her learning stile and gained knowledge level. The curricula should allow learner choosing a course which would be the most suitable to his/her working environment within the enterprise. *E-course management Advisor ECMA* has to fulfill the following tasks: *A1* − to define the primary level of the learner's knowledge for the selected e-course module; *A2* − to find the optimal number of topics for the fastest learning process of the given course module; *A3* − to find the best sequence for relations by knowledge context between topics of choosing in testing process for the fastest learning of given module; *A4* − to define the influence of primary learner's knowledge level of the module content in solving the multiple − choice exercises; *A5* − to use an e-advisor which follows the steps in solving a multiple-choice exercise for the fastest learning of given module; *A6* − to use an e-advisor to follow the steps of executing multi − choice e-laboratory simulations for the fastest learning of given module; *A6* − to use an e-advisor to follow the steps of executing multiple − choice e-laboratory experiments for the fastest learning of given module.

Pedagogical tasks management agency PTMA permanently manages pedagogical tasks of a learner under the curricula. The *agency* helps dynamically to adopt *Student Model SM* in learning process of various course modules of the Learning staff e-curricula. This information is being stored and updated during e-learning activities into *Student database StD* and it is available both to the personally logged into the system student and to the administration. *StD* keeps information about all the learners enrolled into the learning staff curricula.

Student Model SM stores into *StD* the following adaptively changing information about a learning style of the logged into the system learner under his/her curricula:
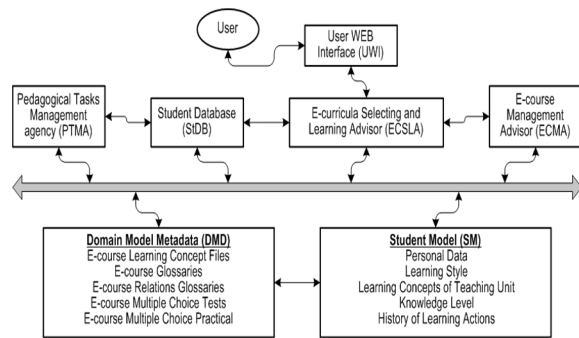

Fig.1. Learning staff e-curricula architecture

Personal data, learning style, teaching unit's learning concepts, teaching unit's knowledge level, history of learning actions. *Domain Model Metadata DMD* contains the following: the e-curricula course list and all e-courses learning contents files, e-course glossaries, e-course relations glossaries, e-course multiple-choice tests, e-course's multiple-choice practical. This metadata is the base knowledge for the learner to practically learn the content of the chosen by him/her courses in the curricula personally online and in the working place of his/her enterprise.

User Web Interface UWI allows to the learner under the given curricula to interactively take part in the distance education. *E-curricula selecting and Learning Advisor ECSLA* : offers to the logged into e-curricula learner e-supervising to decide what would be the best his/her choice of selecting the optimal learning modules or courses in this e-curricula available, involves the learner into interactive discussion to predict what might be preferences for a future his/her e-learning style. The questions for a given learner by *ECSLA* should be generated using knowledge gained by the *Pedagogical Tasks Management Agency PTMA* and *E-course Management Advisor ECMA* by correspondence with the *Student Model StM*.

The following characteristics of a given learner may be discovered: capabilities to learn from the static (text + image) materials, capabilities to solve small multiple-choice exercises, problems, and experiments, preferences of the learner to choose particular e-learning stile. The *ECSA* may help to choose courses by using his/her *Student Model StD* that was created during his/her introductory studies under the supervising of *ECSLA*.

2.2. Q-learning Approach to Develop the Pedagogical Tasks Management Agency PTMA

The purpose of the *Pedagogical Tasks Management Agency PTMA* is to permanently help for the learner on all his/her phases of the curricula: in developing of the individual learning strategies, in selected e-course studying process interactive supervising, and