Chapter 3
A General Knowledge Representation Model for the Acquisition of Skills and Concepts

Carlos Ramirez
Tec de Monterrey, Campus Querétaro, México

Benjamin Valdes
Tec de Monterrey, Campus Querétaro, México

ABSTRACT

A cognitive model for skills and concepts representation as well as a proposal for its computational implementation is presented in this paper. The model is intended to help bridge some of the natural problems that arise in current massive education models through the adaptation and personalization of learning environments. The model is capable of representing rich semantic knowledge, including both skills and concepts, while integrating them through a coherent network of role based associations. The associations build an ontology that integrates on itself different domain taxonomies to represent the knowledge acquired by a student keeping relevant context information. The model is based on a constructivist approach.

I. INTRODUCTION

The study of Cognitive Informatics (CI) (Wang, 2002a, 2007), focuses on information processing mechanisms and cognition; within this discipline, knowledge is a fundamental part for cognition.

DOI: 10.4018/978-1-4666-0264-9.ch003

In this work, a model for knowledge and skills representation, called Memory Map (MM), which has a precedent in the Episodic Memory Model of Ramirez and Cooley (1997), is presented; the model presents similarities with the Object Attribute Relation OAR model (Wang, 2006), both store the concepts acquired during a learning process in a structured and flexible way: however, our model proposes a more flexible alternative as to some of the components of the CI framework, but it keeps the same approach of personalization derived from a unique perception as established in the fundamental theories of CI (Wang, 2007).

The model for the representation of concepts and skills presented here was originally created having in mind the development of Virtual Learning Environment Technology able to advance the current educational practices of instruction. The problem with current educational practices is rooted in historical reasons: since the beginning of the industrialization age till now, many voices have risen against the process of massive education without significant success, e.g., (Kilpatric, 1925; Lave & Wenger, 1990; Piaget & Inhelder, 1958; Vygotsky, 1986). Most of today's modern educational systems have significant deficiencies that hinder the natural development of concepts and skills, giving as a result the development of poor quality knowledge, focused mainly on concept memorization, mainly due to the lack of personalization of the instructional practices. Evidence of this can be observed in average students that memorize concepts, but remain unable to perform efficiently in real life situations, because of poor development of the skills necessary to apply such concepts on different contexts. What is even worse, a large amount of memorized concepts will to be forgotten shortly unless deeply understood and frequently used. It is therefore important to enrich the educational process, taking advantage of modern technological tools, to facilitate the acquisition of concepts and the development of skills.

It must be understood that learning is an individual process; as such, an educational model oriented to standardization, i.e., teaching the same content with the same methods, and at the same rate to every student, is inadequate. An individual learning process denotes a unique way of perceiving reality or the concrete world, people learn differently because they perceive the world in different ways. Unique perception of the world by each individual is one of the cornerstones of modern thinking, which is stated in fields such as biology (Maturana, 1980), education (Harel, 1991), psychology (DeVries et al., 2002), cognitive sciences (Winograd & Flores, 1987) and cognitive informatics (Wang, 2007) among many others.

There is a latent necessity for technology that supports educational models that are not basically focused on the acquisition of concepts and memorization skills, but also on the development and frequent usage of generic skills, including those for long life learning. To successfully implement such educational model, at least the following components are required:

- A computational representation of the student's knowledge and skills, and an algorithm for the process of acquisition, which should be compatible with complex and evolving learning theories such as Constructivism (Piaget & Inhelder, 1958; Vygotsky, 1986; De-Vries, 2002), Constructionism (Harel, 1991) and Transformational Learning (Mezirow, 1981) among others. Useful elements for both representation and acquisition algorithms are found in the CI theoretical framework of Wang (2007), specifically in the OAR model and concept algebra.
- A virtual learning environment (Dillenbourg, 2002) with adaptive capabilities, such as presented in (Torres et al., 2009), where personalization of learning resources is the main concern. The learning environment ought to be based upon pervasive computing (Hanssman et al., 2003) where workbenches, which are currently being developed (Ramirez, 2010), and regular accessories: earrings, wristbands, caps, among others, are used as non-intrusive sensors to provide feedback on the users physical and emotional condition used to personalize the environment.

Related Content

Multifractal Singularity Spectrum for Cognitive Cyber Defence in Internet Time Series
Muhammad Salman Khan, Ken Ferensand Witold Kinsner (2015). *International Journal of Software Science and Computational Intelligence (pp. 17-45).*
www.irma-international.org/article/multifractal-singularity-spectrum-for-cognitive-cyber-defence-in-internet-time-series/155157

Data Mining Applications in the Electrical Industry
Rubén Jaramillo Vacio, Carlos Alberto Ochoa Ortiz Zezzattiand Armando Rios (2012). *Logistics Management and Optimization through Hybrid Artificial Intelligence Systems (pp. 380-402).*
www.irma-international.org/chapter/data-mining-applications-electrical-industry/64930

Multi-Sensor Motion Fusion Using Deep Neural Network Learning
Xinyao Sun, Anup Basuand Irene Cheng (2020). *Deep Learning and Neural Networks: Concepts, Methodologies, Tools, and Applications (pp. 568-586).*
www.irma-international.org/chapter/multi-sensor-motion-fusion-using-deep-neural-network-learning/237893

Text Classification: New Fuzzy Decision Tree Model
Ben Elfadhl Mohamed Ahmedand Ben Abdessalem Wahiba (2017). *Handbook of Research on Machine Learning Innovations and Trends (pp. 740-761).*
www.irma-international.org/chapter/text-classification/180971

A Formal Knowledge Representation System (FKRS) for the Intelligent Knowledge Base of a Cognitive Learning Engine
Yousheng Tian, Yingxu Wang, Marina L. Gavrilovaand Guenther Ruhe (2011). *International Journal of Software Science and Computational Intelligence (pp. 1-17).*
www.irma-international.org/article/formal-knowledge-representation-system-fkrs/64176