A Semantic Metacognitive Learning Environment

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Abstract

In the last years, knowledge technologies have been exploited for self-regulation functionalities inside e-learning systems. The definition of integrated system suitably scaffolding learners to improve their experience is still lacking though. In this work, we propose an innovative Web-based educational environment that sustains metacognitive self-regulated learning processes upon Semantic Web and Social Web methods and technologies.

Introduction and Motivations

Learning processes, especially when linked to conceptually-rich domains (Azevedo 2009) (Lin 2001), require strategic environments, where learning experiences are the result of a design phase that looks at a metacognitive perspective (Tsai 2009) as a vehicle able to stimulate reflexive processes on knowledge and self-knowledge.

Metacognitive knowledge, the highest level of knowledge as presented in didactical taxonomies, refers to the ability and opportunity for learners to understand, control, direct and manipulate their knowledge and their learning process (Azevedo et al. 2009). Metacognition is achieved through Self-Regulated Learning (SRL), considered a cross-competency whose acquisition aids self-directed management of individuals’ learning processes (Zimmerman 2000) and allows to learn to learn (van den Boom et al. 2004).

The self-regulation competency is a key element to be considered in designing learning environments (Lee 2004) and as a prerequisite, method and objective of information systems seen as compounds of socio-cognitive artifacts (Shih et al. 2005).

SRL includes three major phases, namely self-instructioning, self-controlling and self-reinforcement (Greene and Azevedo 2007) (Witherspoon, Azevedo, and D’Mello 2008). These phases foresee several specific processes (Azevedo 2009) that must be supported by a metacognitive-driven solution (Kemp, Kemp, and Todd 2009):

- In the Self-instructioning phase we identify Self-planning and Self-evaluation processes. During Self-planning activities, students pursue course outcomes through activities they design themselves (Zimmerman 2000). Moreover, Self-evaluation process enables students to view their fruition state and the evidence of their cognitive status (Sperling et al. 2004) with respect to the attainment of their educational objectives (Zimmerman 2000).

- In the Self-controlling phase we identify Goal setting and Self-control processes. Goal setting refers to the possibility students have to autonomously express their objectives and control the specification of their needs (Zimmerman 2000). Furthermore, the Self-control process refers to the assessment the students themselves carry out during their goal setting activities (Crippen et al. 2009).

- In the Self-reinforcement phase we identify Help-seeking and Self-reflection practice processes. The Help-seeking appears when the student identifies and seeks further human resources in order to obtain assistance on specific learning tasks (Dabbagh and Kitsantas 2004). Self-reflection practice is a process, based upon social comparison (Dettori and Persico 2008), where students reflect on their learning process and react by modifying the way they face their learning activities (Dabbagh and Kitsantas 2004).

Although several scientific works confirm that e-learning environments necessarily have to pay attention to the self-regulated learning processes (Steffens 2008), modern e-learning systems are still characterized by a weak relationship between self-regulated learning processes and technological-driven functionalities.

This work proposes a Web-based metacognitive environment (composed of three main components illustrated in sections 2, 3 and 4), for the definition and execution of self-regulated learning activities, that leverages on Semantic Web and Social Web technologies and methods. In section 5 we provide conclusions and future works proposals.

Personalized e-Learning Experiences

The first component provides a set of tools enabling the definition (for instructors) and the execution (for learners) of personalized e-learning experiences helping learners execute self-regulated learning activities and, as side effect, enhance their self-regulated learning abilities (Zimmerman 2000).
Learners perceive it as a direct participation in learning experience personalization process (self-planning) being consistent with self-regulated learning main principles. They can constantly observe their cognitive status evolving and the results of their assessment activities (self-evaluation).

Objective-driven Learning

This component allows learners to declare in simple natural language their Learning Needs in order to receive a personalized e-learning experience matching to their needs.

So, a Learning Need (LN) is a sentence like I would like to learn Java Programming. In our approach, a LN can be processed by performing a matching with a set of Learning Objectives.

A Learning Objective is defined as: 
(Title, C_{1}, C_{2}, ..., C_{n}). Title is a text representing the Learning Objective in a natural language, C_{i} is a piece of knowledge required by the objective, representing a reference to a subject of an e-learning ontology.

The matching operation consists in executing the Sentence Similarity Algorithm (it is defined exploiting and contextualizing to the e-learning the algorithm presented in [14]) between the text representing the expressed LN and the texts of all the Learning Objectives (LO_{i}) stored into the repository.

The result of the algorithm execution is a list of all sentence similarity measures S_{i} = S(LN, LO_{i}). Only the objectives LO_{i}, such that S_{i} is bigger than a given threshold, can be presented to the learner who can select one (or more) of them and request the delivery of a personalized e-learning experience (with respect to modalities indicated in the above sections) in order to meet his/her needs.

The definition of a personalized e-learning experience starts from one or more Learning Objectives and can adapt Learning Path and Presentation using information stored inside the learner profile. Learners have also the possibility to compose more Learning Objectives for the specific Learning Need.

The provided composition could become a new Learning Objective in the repository.

In the case that no Learning Objective in the repository satisfies the expressed LN there are two alternative ways to process it.

The first way (Fig.2) foresees that the simple natural language sentence corresponding to the expressed LN is matched on the subjects of the available e-learning ontologies. Once a set of subjects are identified on the ontologies, the involved learner can select one or more of them as set of Target Concepts (TC) to start the definition and the execution of a new personalized e-learning experience. The ontology navigation and the selection of TC sets are activated only if the involved learner owns some specific and basic self-regulated skills (Dabbagh and Kitsantas 2004) (Teng and Benson 2006). If not (Fig.3), the LN is broadcasted to the community (e.g. using the Educational Micro-Blogging defined below) of instructors able to support the learner by providing new Learning Objectives matching with the considered LN.
This component allows the learner to define their learning needs and direct their learning experience (goal setting), to explore the conceptual space developing a larger locus of control (KINSHUK et al. 2000) and to determine when individual goals have been adequately addressed (self-control).

**Educational Social Network**

The third component proposed is the Educational Social Network where social activities and objects become educational.

The most important aspect in our Educational Social Network model is represented by the Educational Social Profiles (ESP).

An ESP is a structured description of several characteristics (e.g. skills, knowledge, attitudes, learning preferences, expertise, and so on) that identify people (learners, instructors, etc.) from the educational point of view.

An ESP allows individuals to be discovered by people who would benefit from an association with them.

The Educational Profile Pages (EPP) are exploited in order to publish ESPs on the Web.

An important feature of EPPs is provided by the Educational Micro-Blogging (EMB). Typically, Micro-Blogging tools (e.g. Twitter, Jaiku, Tumblr, etc.) enable users to share ideas, activity descriptions, etc. using a few characters and, as illustrated in (Dong et al. 2010), they are more and more used in educational contexts.

In our work we propose the Educational Micro-Blogging tool for sharing information generated by software modules enabling the formulation of learning needs and the execution of learning experiences. In particular, every time a learner executes a new learning activity, achieves a learning objective, expresses a learning need, achieves a considerable result, acquires new knowledge and skills, his/her EPP is updated via the EMB and his/her followers are notified with a new activity description.

EPPs also allow to follow other users in the Educational Social Network so to be notified for their new activities shared by the EMB.

Users can be automatically found basing on two main principles. The first one is the similarity principle, i.e. a learner follows users with the same learning needs. The second one is based on the assumption that a learner follows users/experts with knowledge, skills, expertise, etc. able to support him/her in his/her learning activities.

The proposed component upholds social presence dimension supporting the development of self-regulated learning. Educational Micro-blogging serves as a pedagogical advance organizer (Mcmanus 2000) for the learners’ community, as it anticipates and spreads needs, knowledge and learning paths. Furthermore, the component facilitates the expert finding and peer finding, it also supports help-seeking and self-reflection practice processes improving the students’ self-regulation over learning (Fitzgerald et al. 2007).
Conclusions and Future Works

This work proposes a metacognitive educational environment which extends an innovative e-Learning Platform (presenting personalization and other knowledge-based features), namely IWT, with a Social Network system contextualised for educational aims. The integration among the different components enables the development of the addressed metacognitive processes: self-planning, self-evaluation, goal setting, self-control, help-seeking and self-reflection practice.

In future works we will develop the proposed Web-based environment and will evaluate it in ARISTOTELE Project (co-funded by European Community in the context of FP7 framework programme for R&D 2007-2013) focusing on the Corporate context. The proposed approach is specially suitable for the Corporate Learning and Knowledge Management, where the necessity to fill the gap between organization learning pathways and real contingent employees’ learning needs is pressing.

References


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