

# A LEARNING ENVIRONMENT WITH KNOWLEDGE REPRESENTATION AND SOCIAL INTERACTION

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## ABSTRACT

Web 2.0 technologies are bringing up a shift in learning environments where different approaches on how to represent content and promote collaborative spaces are emerging. This paper initially presents a general survey on emergent web based learning environments both technological and social-oriented and then describes our ongoing project for analysing collaborative learning tools and its later usage in real learning situations. The research focuses two topics: knowledge representation and social networks. The first includes the possibility to represent knowledge using a tree structure, which enable users to access, distribute, store and share learning material associated to a particular topic. The later reflects a social environment based on the connectivism theory which asserts learning in a network of connections formed from experience and interactions within a knowing community. Consequently users may interact with the learning material and make connections within a community who have the same topics of interest. The two fold approach should be implemented and later validated in a class of high school students. By combining learning material organized in topics, user personalization on each topic entrance and with the possibility of enabling users to interact among themselves through discussions, we hope to push forward the web usage with a collaborative learning environment, where students and teachers will actively interact in a social network of knowledge.

## KEYWORDS

Collaborative Learning, Web 2.0, Instructional Design

## 1. INTRODUCTION

The World Wide Web has initially changed the way people interacted with information. But nowadays web surfers also interact among themselves, giving personalized feedback to the web sites. In this paper we will address to the interactions of users in dynamic learning scenarios, which play a key role in knowledge construction.

Our research, by exploring pedagogical approaches behind learning environments, considers the social aspects, namely argumentation and visual knowledge representation techniques in collaborative environments as the right ingredients to come up to an active learning web solution (Silva and Restivo 2006). This could break the classroom walls and provide an additional learning space. Hence with a web solution, available everywhere and at anytime, students and teachers can work together between classes, as a class complement, or a blended learning system.

There are two streams on our ongoing research. The first is about the formal representation of knowledge and find an effective mechanism to store and organize different learning materials. It was initially referenced to ontologies architecture (Mizoguchi and Bourdeau 2000), but now we are using a simple approach- tree of topics (Schiltz, Truyen et al.). Ontologies might have an interesting usage in interoperability issues (Dieng-Kuntz, Gandon et al. 2005), but at moment we are only concerned in a well structured information system with a simple semantic approach (Pasin 2005). The other stream is collaborative environments (Clark 2000),

strengthened with social networks (Tony Hammond, Timo Hannay et al. 2005), which will reinforce knowledge acquisition because learner's interaction is very important for the learning acquisition process. We found in the literature a theory that supports this approach (Siemens 2005). (Downes 2006) refers it and mentions that the newly empowered learner will give more focus to learning systems based on conversation, interaction, on sharing, creation and participation. He regards learning not as a separate activity, but rather, as embedded in meaningful activities such as games or workflows. Also the new e-learning 2.0 systems go in this direction because comprises resources and services organized in order to offer learning opportunities in a network environment. Moreover the computer supported collaborative learning (CSCL), which supports learning activities, considers scripts usage for facilitating social and cognitive processes in collaborative learning environments (Dillenbourg 1999). This mechanism promotes learning scaffolds and increases the level of tutoring and orientation on learning activities. We consider that by shaping the way learners interact with each others we will provide an effective learning system in an adaptive learning process, increasing the student's participation and involvement levels. Furthermore in computer supported inquiry learning (CSIL), which involves students in an active engaged and constructive learning process, students by investigating a domain, actually learn about it and build inquiry skills (de Jong 1998). Several systems have been developed using this approach namely (CoLab), (Inquiry Island) and (Cool Modes).

In this progress report a survey about web based e-learning systems is presented next. After on chapter 3 our ongoing project with our premises and alternative collaborative learning tools are described, along with some expected technological and social-oriented problems.

## 2. WEB BASED LEARNING SYSTEMS

E-learning has the potential to become more personal, social and flexible with new web services, empowering students in a truly learning environment (Thomas K. and Velthouse B. 1990). And so for enabling computers to play a key role in collaboration environments, one's must combine computers with people. (Downes 2005) argues that personal descriptions, as found in social networks, and resource descriptions, as found in the semantic web, should be merged to form a single network, the semantic social network. Also (Marchiori 2006) claims there are in learning systems cost relations between technological and social aspects. Therefore, learning systems should have: *more interaction*, *more connection* between social space and data space with the semantic web usage, *go social* with social software where by spreading the load, multiplies the benefit, *go visual* creating interactive systems enticing the user like in (MMORPGS 2006) environments, maintain the *social cost low* by using poor semantics and reasoning, like a keywords approach, rather precise semantics and exact reasoning from semantic web. Some good examples can be found such us (Tagworld) for meeting people; (Flickr) for sharing photos, discover, bookmark, and promote news; (Technorati) for tracking blogs; (Wink) for making tutorials; or (Eurekster) system for vertical community web search.

Nowadays there are innumerable web tools and we present next a table where some available web tools are classified according to user's interaction. The first level only enables access to data and information. The second level considers the formulation of opinion based on others points of views, but the users are not stimulated to contribute with their opinion to the web site and a third level where user's contribution is possible to be added into the web.

Table 1. Tools analyses

Types of tools	Factual information	Formulate opinion	Contribute own opinion
Alerts	✓		
Wikis	✓		✓
Podcasts	✓	✓	
Blogs	✓	✓	
Chat Interview	✓	✓	
Discussion Boards	✓	✓	✓
Quick Poll	✓		✓
Survey	✓		✓
E-portfolios	✓	✓	

We give focus to the tools which combine access to factual information and users can contribute with their opinion and have greater control over their learning experience by managing resources and activities they participate in. Also they would personalize their own learning environment and interact with the web system to access content, assessment and other activities (JISC e-Learning Focus 2006). The middle level formulate opinion is considered to be very important for the user to reach critical thinking, but without contributing to the community by adding the personal opinions to the web site.

E-portfolios, tools used to construct one's identity within social networks and organizations, are value learning in forms of collection, archive, learned, reflected or presented assets. With (E-portfolios) learners build and maintain a digital repository of artefacts, which they can later use to demonstrate competence and reflect on their learning. Also discussion boards, which is directly related to our project, is a very dynamic and powerful tool worth use in the learning context. There are two interesting reference projects. The SEE-K project is a platform for collective laboratory from (Trivium Soft 2006), accessible via a navigator Internet and does not require a heavy technical investment. The (BitTrees) is another project where it was designed to be a flexible way to store and share information in a social way. The objects are stored in a hierarchical tree, with relationships and organizing all data in a personalized manner. All objects can be pieces of text, links to images on the web, links to websites and personalized discussions. One interesting thing is the ability to view the object in the form of a blog using a treeview and also link user's objects into an own tree.

### 3 ON GOING PROJECT

When students engage in learning community processes, they create, appropriate, share and construct knowledge within a specific group. Also with co-working, students can break some barriers and minimize the learning difficulties. As a result social network analysis is an additional element in understanding learning models in a digital era. (Kleiner 2002) explains not just how to recognize the collective cognitive capability of an organization, but how to cultivate and increase it.

From the student's point of view, motivation is a key issue and despite social phenomena being crucial, each student has his or her own learning rhythm. The freedom of choice and not being tied or to the curricula or teacher's perspective is very important. On the teachers' side, it is crucial to be able to synthesize all the learning content and having some feedback on the student's level of achievement. Both perspectives have led us to finding a solution for an e-learning network environment, where both actors interact together.

However learning environments, where students have no guidance, does not result in effective knowledge. In fact, pure discovery learning, without any guidance does not result in knowledge acquisition. Hence guidance in the form of scaffolds is a solution for these environments. As (McKenzie 1999) reported, a web system must provide a structure, supporting the students investigation and keeping them on the path while seeking "the truth" about whatever issue. Having this in mind we headed our research on two dimensions: *collaborative environments* and *technological development*.

For the first dimension, learning is seen with a socio-cultural perspective. The process of learning, which incorporates different forms of signs, symbols and tools in social activities, and intellectual development are undoubtedly related to social interactions. The learners constructs knowledge due to the interactions among them, as defined by the (Vygotsky 1978) Zone of Proximal Development. Furthermore the conectivism theory argues that through the disperse meaning, learner's must recognize the patterns, which appear to be beneath it. Therefore, meaning-making and forming connections between specialized communities are important activities (Siemens 2005). In other words, a learner can perform a task with teacher coaching and with peer collaboration that could not be achieved alone. (Brown 2002) research can reinforce this theory when he claims that the internet leverages the small efforts of many with the large efforts of few.

For the second dimension, technological issues arise and we are trying to relate emergent web concepts as mediation tools for knowledge construction and Ajax with Php techniques to develop our web system as a desktop application.

The idea is to, on a button up approach, provide a web learning system with structuring knowledge, visual representation and navigation, where students and teachers additionally interact online and get connected in an informal space. The learner is supposed to choose or add content, which allows short connections on the information. Interesting, though, is realising that people with similar interests and knowledge aggregate themselves in small networks. The chaos starts to give way to organization units.

We argue that people can use computers in collaborative learning environments, while constructing knowledge, but the underlying questions are how web systems might improve the computer's usability in learning processes? And how do students interact with the learning community to develop knowledge? Also we must consider how a web system that organizes structures and enables navigating through learning content, reinforces the collaborative learning?

Our hypothesis is based on the complementary of real class dynamics with web supported learning environments, where both systems merge, giving place to an integrated environment increasing the active participation of students in their studies. It would be possible for students and teachers to dynamically participate in the learning process, if we considered social interactions on the structuring and discussion process.

We are developing a web based solution with a layered architecture, where the knowledge tree (KT) is on the centre (figure 1). The teacher has the ability to construct it and populate it with content. The student can navigate through the KT and make a collection of subjects (different resources: doc, ppt, pdf, url, podcasts, quizzes, and others), enabling the teacher to become aware of this collection. A third layer is presented where both actors: teacher and students will interact in an argumentation visualization system: Forum. In this layer the users can discuss the subjects with other users.

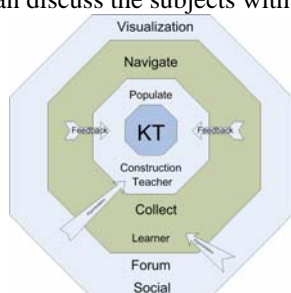


Figure 1. Layered Architecture



Figure 2. Tool components

The tool can have different usage levels, from individual assignments, to group class and it has four distinct components (topics, tags, discussions, assessment). *Topics* are started by the teacher and different resources are structured in the topic tree. The students can navigate through this KT, choose the more interesting resources, study them and even personalize his or her own topic tree with their own learning content. *Tags*, made of free keywords, are associated by students in different web resources, which will help to categorise all the learning resources, despite being topic related. *Discussions* processes with visual argumentation methods, where students actively learn how to support their claims and use the discourse scientific methodology, will add a social dimension on the learning acquisition process. *Assessments* made by the teacher, where he or she will be able to monitor the student's activities (collecting and discussion) and at the same time give support contributions (figure 2).

In a social perspective we can better enhance knowledge acquisition by enabling learners to interact together. And so the system should present to learners some information regarding who collected the objects. The web system should also have some intelligence because by giving suggestions to users which object should be interesting, is in fact contributing for the learner's success. The difference between system and peer suggestions is mainly because it's dynamic and doesn't depend on previous students choices. The differences between this system and the others are its effectiveness and social support for learning activities based on our learning theory approach.

#### 4. SYNTHESIS AND FUTURE WORK

The learning research associated with web technologies and the subsequent change in learning paradigm is an area of extreme importance for improving the levels of motivation and student empowerment.

By analysing several web based learning environments we tried to pinpoint the user's interests in a web learning system. Our project reflects these same aspects, but also the learning theory behind it.

This tool although very similar with some CSCL environments, has a different approach, because it is seen as a class complement, where the users actively improve their learning capabilities in an informal space. The system has two goals: organize, structure the learning content available mainly by the teacher and dynamically improve the students learning process on the proposed activities. To reach these two deliveries one can take advantage (1) of the teacher expertise, (2) learners interaction through social networks in web systems and (3) Web 2.0 technologies, namely semantic web and AJAX.

One of the major difficulties will be its effective validation, but the students can be inquired about its usefulness and the usage levels can be monitored. We will validate it using a high school class and make my proof of concept of the tools usage.

## REFERENCES

- ArBor & SenS. Retrieved September 2006, from <http://www.arbor-et-sens.org/arbres/seek.html>.
- BitTrees. Retrieved October 2006, from <http://www.bittrees.com/>.
- Brown, J. S. (2002). "Growing Up Digital: How the Web Changes Work, Education, and the Ways People Learn." Retrieved December 2006, from [http://www.usdla.org/html/journal/FEB02\\_Issue/article01.html](http://www.usdla.org/html/journal/FEB02_Issue/article01.html).
- Clark, J. (2000). Collaboration Tools in Online Learning Environments. *ALN Magazine* 4. CoLab. from <http://www.colab.sfu.ca/>.
- Cool Modes. Retrieved December 2006, from <http://www.collide.info/software/pscproject.2006-09-26.1109060707>.
- de Jong, T., & Van Joolingen, W.R. (1998). Scientific discovery learning with computer simulations of conceptual domains. *Review of Educational Research*. 68: 179-202.
- Dieng-Kuntz, R., F. Gandon, et al. (2005). "Ontologies for the Semantic Web and e-learning." *Workshop - SW-WL'05 - Second International Workshop on Semantic Web for Web-based Learning*.
- Dillenbourg, P. (1999). "What do you mean by 'collaborative learning'?" *Collaborative-learning: Cognitive and Computational Approaches*: 1-19.
- Downes, S. (2005). "Semantic networks and social networks." *The Learning Organization* 12 (5): 411-417.
- Downes, S. (2006). "Learning Networks and Connective Knowledge." Retrieved October 2006, from <http://www.downes.ca/cgi-bin/page.cgi?post=36031>.
- E-portfolios. Retrieved October 2006, from [www.ep2010.org](http://www.ep2010.org).
- Eurekster. Retrieved December 2006, from <http://www.eurekster.com/>.
- Flickr. Retrieved November 2006, from <http://www.flickr.com/>.
- Inquiry Island. Retrieved December 2006, from <http://thinkertools.soe.berkeley.edu/Pages/sciwise.html>.
- JISC e-Learning Focus. (2006). "<http://www.elearning.ac.uk/>." Retrieved October 2006.
- Kleiner, A. (2002). "Karen Stephenson's Quantum Theory of Trust." Retrieved December 2006, from <http://www.netform.com/html/s+b%20article.pdf>.
- Marchiori, M. (2006). <http://www.icl-conference.org/>.
- McKenzie, J. (1999). "Scaffolding for Success." *The Educational Technology Journal* 9 (4).
- Mizoguchi, R. and J. Bourdeau (2000). "Using Ontological Engineering to Overcome AI-ED Problems." *International Journal of Artificial Intelligence in Education* 11(2): 107-121.
- MMORPGS. (2006). "<http://www.mmorpg.com/index.cfm?bhcp=1>." Retrieved December 2006.
- Pasin, M. (2005). *Semantic Learning Narratives*  
An Investigation of the Usage of Semantic Web Technologies to Support Learning. O. University, KMI Knowledge Media Institute: 80.
- Schiltz, M., F. Truyen, et al. "Cutting the Trees of Knowledge: Social Software, Information Architecture, and Their Epistemic Consequences."
- Siemens, G. (2005). Connectivism: A Learning Theory for the Digital Age. *eLearn Magazine*.
- Silva, J. and F. Restivo (2006). *Combining Ontologies, Social Networks and Argumentation into a Dynamic Learning Portal [Scientific presentation]*. ICL 2006, Villach-Austria.
- Tagworld. Retrieved December 2006, from <http://tagworld.com/-/Main.aspx>.
- Technorati. Retrieved December 2006, from <http://www.technorati.com/>.
- Thomas K. and Velthouse B. (1990). "Cognitive Elements of Empowerment: an interpretive model of intrinsic task motivation." *Academy of Management Review* 15(4): 666-681.
- Tony Hammond, Timo Hannay, et al. (2005). "Social Bookmarking Tools (I) A General Review." *D-Lib Magazine*  
Retrieved October 2006, from <http://www.dlib.org/dlib/april05/hammond/04hammond.html>.
- Trivium Soft. (2006). Retrieved October 2006, from <http://www.triviumsoft.com/>.
- Vygotsky, L. S. (1978). "Mind and society: The development of higher mental processes." *Cambridge, MA: Harvard University Press*.
- Wink. Retrieved December 2006, from <http://wink.com/>.