Open Learning: Advances in the eMadrid Excellence Network

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Abstract— **This Special Session is going to present some of the activities carried out by the Excellence Network on e-learning that is being funded in the Region of Madrid, called eMadrid. They are related to the application of open source principles in the educational context and in opening up the alternatives to the learner.**

Keywords: e-learning, technology-enhanced learning

I. INTRODUCTION

eMadrid is the Excellence Network about e-learning funded by the Regional Government of Madrid. Its members are the Universidad Carlos III de Madrid (UC3M), who acts as a coordinator, Universidad Autónoma de Madrid (UAM), Universidad Complutense de Madrid (UCM), Universidad Politécnica de Madrid (UPM), Universidad Rey Juan Carlos (URJC) and Universidad Nacional de Educación a Distancia (UNED), together with a large number of associated companies and educational institutions. The aim of the network is to provide leadership and perform advanced research in the area of e-learning, including technology transfer to companies.

II. OPENNESS IN TECHNOLOGY-ENHANCED LEARNING

Although much progress has been made in recent years in the field of e-learning, important challenges lie ahead for this technology to maximize its impact. Many topics are studied within the eMadrid network. In this Special Session, a sampler of relevant issues will be tackled. They are related to the application of open source principles in the educational context and in opening up the alternatives to the learner:

1) Open source principles have in the first place been applied to the development of software, where they have been very successful. In fact, Moodle is an open source learning management system that used all over the world. Its openness allows extending it by providing innovative additional functionality. The first paper in this session will report on how Moodle can be extended to support problem-based learning: *Enhancing Moodle to Support Problem Based Learning* (UCM).

2) The open source principles have been taken from software development to the authoring of content. Open Educational Resources are presently a very strong movement that is increasing the amount of freely available educational material exponentially. With a steady increase in the number of Open Educational Resources available worldwide, now the question arises of how to discover and recover these resources in a viable way. Recent advances in web technology, such as social web and linked data technologies, can help here. This is the objective of the second paper: *Open Educational Resources Search based on Social-Semantic Architecture Engine Search* (UPM).

3) Furthermore, open source principles can be also applied to education organization. The third paper in this session will present experiences like having "free learners", outside of any type of formal educational context, or setting up P2P online communities devoted to learning in open study groups: *New Trends from Libre Software that May Change Education* (URJC).

4) Technology-enhanced learning is not just interacting with learning objects. Physical labs are another useful resource in education. They are normally confined to the physical location they are bound to. It would be nice to be able to open up this access from remote locations in the same effective way as learning objects are accessed through a Learning Management System, taking advantage of the services they provide, such as authentication, group building, etc. The fourth paper will

present solutions for opening up remote labs: *Remote Labs as Learning Services in the Educational Arena* (UNED).

5) Mobile devices provide access to educational content and services anytime and at any place, at school, at work, or in the open. Independently of that, 3D virtual worlds or metaverses can provide rich in-world learning experiences in synthetic worlds or in mirror worlds (worlds that are models of the real world). Now taking these two technologies together, we can ask how the combination of mobile devices and mirror worlds can offer a more complete learning experience that provides the advantages of both approaches. The elaboration of these ideas of opening up the choices for the learner is presented in the last paper of the session: *Towards Parallel Educational Worlds* (UC3M).

In the following sections, we further detail these five contributions.

III. Enhancing Moodle to Support PBL

Learning Management Systems (LMSs) are following the path of modern Internet applications, as the social and communication habits of learners and teachers change. Social networks, Multi-User Virtual Environments (MUVEs), online games and software collaborative tools such as *Google Apps* have opened the door to new possibilities in collaborative learning.

But it is not just a matter of the possibilities that recent advances in technology enable. Educational paradigms are also changing, as learning is not just about acquiring technical knowledge anymore. Work is increasingly becoming a team-integrated activity, and less of an activity that one can carry out alone.

As society demands professionals with complex skills, learning has to cope with the new needs. Therefore the educational system must ensure students acquire abilities like working in teams, organization of team-work, dealing with conflicts, communication of ideas and concepts, and leadership.

This leads to a change in traditional class dynamics where collaborative learning paradigms are becoming more and more prominent both in face to face and in online learning. Among these paradigms Problem Based Learning (PBL) has been in the educational arena for many years [1] with proven results in terms of developing situated learning and soft skills [2].

Modern LMSs offer a wide range of possibilities that enable the integration of PBL and other collaborative paradigms in class dynamics. Class or group forums, chat-rooms, *wikis*, databases or glossaries are a few examples of the tools that the teacher may use to support collaborative pedagogical approaches in most popular LMSs (e.g. *Moodle*, *Sakai*, *Blackboard*, etc.).

Nevertheless, since common LMSs have not been designed to support PBL explicitly, it is useful to have some additional functionality for managing a PBL approach. Some examples of these functionalities are: automatic group formation, group evaluation and assessment of the methodology in terms of soft skills acquisition.

Nucleo is a blended learning approach that combines game dynamics with a PBL underlying strategy and with adaptation to student's learning styles [3][4]. It is conceived to change students' attitude to a more active role and to help them to acquire soft skills. It uses *Moodle*, a popular LMS, extended through plug-ins that facilitates managing the specific work-flow involved in our modified PBL approach. Both the learning strategy and the *Moodle* plug-ins are being tested in several courses at the *Complutense University of Madrid* (UCM).

IV. Finding OERs with Social-Semantic Search

Social and Semantic Web are two complementary approaches and each must draw from the other's strengths [5]. In this regard, the ontology metadata provides the benefit of enabling a semantic search engine to find accurate results and to apply reasoning procedures on the metadata [8]. With respect to the social dimension, social annotations remove the high entry barrier, because web users can annotate web resources easily and freely; it directly reflects the dynamics of the vocabularies of the users and thus evolves with the users [9]. This cooperative approach is called social-semantic web and lets 'creating, managing and sharing information through combining the technologies and approaches from Web 2.0 and the Semantic Web' [6].

This work is essentially an applied version to OER search based on the Social-Semantic Search Architecture of [7] proposed by the authors in the OER's domain. By means of metadata enrichment and logic inference, OER consumers will get more precise results from general search engines. And at the moment of determining the relationship between the open resources, social annotations, RDF graphs and expert's recommendations, the system itself will be in charge of recommending action paths for information seekers.

An existing ontology from a previous work [10] has been used for representing the semantic metadata of OER, which has been designed to support the OER search based on Semantic-Social Web technologies.

Two open academic content providers were selected: OpenCourseWare from MIT, and the university where the work is being carried out, OCW-UTPL. The Search prototype has been applied to find OER related with computers and engineering. The search engine not only gives back the information that the user is looking for but also gives back explanations (related tags, related OER, social annotations, RDF graphs and so), which makes the search results much more understandable. The search results are ranked according to their closeness to the specified user keywords. The search engine takes two factors into consideration when ranking. One is the social recommendation between OERs based on each keyword and its semantic matches. The other is the number of keywords the search results satisfy.

The semantic search is answering questions reasonably well where data are available. In particular, the searcher was able to answer a good proportion of the questions despite its simplicity.

Currently, authors are working to implement other supporting components, such as the implementation of: a

public query API using the Web REST service that allows developers to integrate the search services into other applications.

When having semantically described resources and offering the results of a search in RDF format, the authors think it will contribute to create a *Web of Data* –LinkedData– for Open Educational Resources. In this way, different human and software agents will be able to communicate among them. They will also be able of enriching and consuming that information with different purposes. The search prototype of OER demonstrated that it is possible to take advantage from the infrastructure to organize and integrate the metadata of resources. These metadata are in repositories or existent files, e.g. the feeds RSS offered in different Web sites.

V. New Trends from Libre Software that May Change Education

The libre software [1] phenomenon has already heavily influenced educational environments with the presence of technology and philosophical aspects such as content sharing and collaboration.

This work has tried to emphasize a second wave of influence from the libre software world that has so far not reached widely traditional educational settings. We have departed from the point of view that participating in a libre software project is basically a continuous learning process, where not only technology is to be considered but also other factors, such as group work and communication.

It should be noted that the main reason for the participation of developers in libre software projects, according to what they have answered in several surveys, is learning [11]. Obtaining information has, in general, become a minor problem with the current technological conditions, giving the widespread of Internet and an ample number of institutions and initiatives offering high-quality materials freely available.

But the process from information to knowledge is still a barrier that has to be circumvented by learners. Libre software projects face this when integrating new contributors. Although the source code is available, and much of the process can be easily retrieved (mailing lists, bug reports, etc.), the knowledge that newcomers have to acquire requires practice, support and feedback.

The knowledge acquired while participating in projects is not only technical one, such as programming, debugging, or documentation; other knowledge of legal (think of licenses, patents, etc.), organizational (such as teamwork, assessment of other's code, among others), and even personal (as accepting criticism from others or expressing their own opinions) nature have been noted by developers as very important [12].

Some large libre software projects offer some solutions to help mainly developers joining the project. In our work, we present first several learning initiatives from libre software projects, specifically:

- MySQL University
- GNOME-love
- Learning Ubuntu
- Debian New Maintainer Process

and then, initiatives to move this type of experience to a purely educational environment will be depicted. These include initiatives centered on community learning, informal learning, and flexible mentoring and learning outside the scope of institutions. As an example, following experiences will be described:

- Google Summer of Code
- openSE
- Peer-2-Peer University

Finally, the characteristics of these initiatives will be identified and briefly discussed as in the opinion of the authors we will see and experiment in the next years with many of these characteristics in order to obtain new learning methods.

VI. Remote Labs as Learning Services

Nowadays there are a great number of institutions and universities [13][14][15] developing their own architectures for web and remote labs. Some of the most relevant initiatives are Visir [16][17], WebLab [18][19], LILA [20] or the iLab project [21].

All these initiatives use different architectures to build and use remote labs. There are even attempts to define architectures to connect different laboratories from different institutions, as the case of ISA [21] from MIT. But these attempts do not take into account the learning advantages provided by the standard features in Learning Management Systems (LMS), as chat, forums, work groups, etc. When such features are wanted, they must be programmed into the web lab or remote lab software.

To solve this problem, a new architecture has been designed [22] to communicate an LMS with web and remote labs. This architecture provides web and remote labs with LMS services, allowing a teacher to include a web or remote lab into an LMS course.

A module for Moodle and other for .LRN are now available that provide including information about:

- the description of the remote lab,
- how to communicate the lab with the LMS, and
- how to include the lab into a course.

The communication has now been implemented by using Web services. The implementation of Service Oriented Architecture (SOA), using Web Services Description Language (WSDL), the Discovery and Integration service (UDDI) and the Simple Object Access Protocol (SOAP) put in place the infrastructure necessary, usually called the Enterprise Service BUS (ESB), to use services in a productive system. By using ESB, the LMS uses the data transformation service to establish

1 We use the term libre software to refer both to free software and open source software.

a communication with a system, independently of the particular communication mechanism used by the system.

This is a solid first step to connect LMS with iLabs and remote labs, for obtaining shared labs, reusing of services and merging these two solutions.

The next step is to use this middleware to build specific web services for Moodle or .LRN, as for example a scheduling service. We are also working on the implementation of a single sign-on authentication mechanism to access different remote labs through the same LMS. Other future work must be done to create a standard, like WSDL or UDDI, to describe web labs, and to search for web labs and binding with labs providers.

VII. Towards Parallel Educational Worlds

Mobiles devices, such as smartphones and tablets, have transformed themselves from simple calling devices that use the cellular phone network for voice communication or primitive digital agendas with local synchronization to powerful devices that connect through a number of different networks and technologies (3G, WiFi, Bluetooth, NFC, etc.) and incorporate many different sensors and cameras, becoming in this way ubiquitous personal assistants with extraordinary functionality. They have become a portable window from the real to the digital world, allowing us to get online information, but also to superpose location-dependent digital content to the real one, thanks to Augmented Reality techniques.

On the other hand, we are successively replicating more and more aspects from the real to the digital world. The World Wide Web put hyperlinked *documents* online. The Web 2.0 put several aspects of *persons* and their relationships online. 3D virtual worlds go a step further by the ability to mirror complete *geographies* and letting users appear in the scene in form of *avatars*. The partial information available in social networks or in user-aware programs experiment a quantum leap with the corporeality of avatars in metaverses. 3D mirror worlds [23] can even have a window to the real world. This can be provided with a panel showing real-time information coming from a camera.

So mobile devices provide a window to the digital world and dually with metaverses the real world can be replicated digitally with scenes and avatars and also windows to the real world. We have interlinked and communicating parallel worlds. Now the question is how can these technological advances influence and facilitate education. Mobile devices in the hands of teachers and learners provide them with a very powerful tool for teaching and learning. A metaverse is potentially a much richer environment than a Learning Management System. An LMS is just document- and communication-oriented. A metaverse allows a much richer interaction. The potentiality of mobile devices and metaverses acting together should unleash an even greater potential.

In the paper, we will first revise the state of the art of the technologies that allow linking both kinds of worlds. We will see a vast range of technologies, ranging from URLs and QR codes to holographic images. Next, we will investigate the concept of a Learning Object under these new possibilities. Learning Objects refer typically to digital files in LMSs, but get a new meaning under the light of the new scenarios. Then, we will concentrate on assessment, as a very relevant activity in the learning process, because it can serve both the evaluate learning (summative assessment) and to help learning (formative assessment). What new possibilities arise with the new scenarios? Finally, we will devote our attention to the choreography of learning activities and see that also here the future is promising.

Parallel educational worlds: The digital projection of the real world becomes increasingly clear and distinct. The challenging question is what new opportunities will arise from this fact for education.

VIII. Conclusion

Many topics are studied with the eMadrid Excellence Network in relation to Technology-Enhanced Learning. For a complete summary, please see the web site [24]. In the papers corresponding to this special session, we have concentrated on a few developments that are somehow related to the notion of "openness", which have a number of important implications in several aspects of Technology-Enhanced Learning.

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