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Research Paper

The use of e-Portfolios to enhance and assess learning in higher education context towards ontology network-based portfolio management

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ABSTRACT

In educational contexts marked by high technological availability, it is necessary to ask ourselves about new pedagogical challenges of our time. Intellectual associations that are established daily with different types of digital technology have changed the social interactions, schemes of perception and representation of the world and, fundamentally, the way people learn and produce knowledge. A new training scenario that demands a redefinition of methods, organization and learning processes with assessment systems, the notion of classes and the traditional concept of teacher / learner role arises, thus, leading to the appearance and development of emerging educational practices. At present, with regard to the assessment procedures implemented in situations of learning mediated by technology (e-learning), the portfolios constitute a key tool since it enables customization of teaching and self-regulation of learning process. Its educational benefits are many and vary, although there are certain limitations in their use as regards its pedagogical validity as an assessment tool, its complex technological nature and interoperability. The approach of semantic technologies and ontological engineering applied to e-learning give concrete answers in this regard. This paper reflects on the inherent characteristics and types of use of e-portfolios (portfolios mediated by technologies) while communicate fundaments, objectives and methodology of a research proposal that has as main purpose the design of a framework based on an ontology network to support portfolio management to assess learning in e-learning environments, considering the domain of the portfolios, the domain of educational resources and areas of knowledge to be evaluated.

Keywords: E-portfolio, e-learning, ontology, semantic technologies, assessment.

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INTRODUCTION

The current communicative ecosystem marked by the ubiquitous presence of portable electronic devices connected to large telematic networks offers a new scenario for teaching and learning practices. It presents a series of challenges, both pedagogical didactic and technological, while visualizing great educational opportunities.

The progressive and sustained intellectual association with different technological tools modifies the perceptual and cognitive schemas of the new subjects of learning giving rise to the emergence of new educational needs. This fact raises the need to think again teaching practices in order to respond to the training demands of today's world. In this sense, the traditional teacher-student roles and pillars concepts such as classroom and class are resignified within the new emergent educational

paradigm.

Education tends to be immersive, ubiquitous, not circumscribed to a given time and space. In this way teaching and learning practices demand work with different materials and supports, they are developed in different spaces (physical and virtual) and are aimed at training / acquisition of new skills.

The new expanded classrooms (Osorio, 2009) promote the inclusion of e-portfolios, as a didactic tool that allows not only to evaluate the acquisition of knowledge, but also to record the academic trajectory of the students; demonstrating, among other things, marches and counter-marches in their learning processes, their interactions with peers and teachers, their capacity for collaborative work, their areas of interest, developments and productions and the particularities of their travels through the space of the discipline.

This trajectory, accessible to teachers and students drives the metacognitive capacity of the latter to become real protagonists of their learning process by giving them greater control in their progress, offering them an instance of self-regulation (Barragan et al., 2009; Klenoswski, 2005).

An e-portfolio can be understood as a collection of artifacts that includes different types of learning materials (text, image, audiovisual and software among others) although its definition is not only limited to this since it can also be thought of as a tool for administration and management of learning and creative work that allows socialization and enhances the exchange and reflection. This technology is one that favors the educational practices in non-traditional contexts offering the possibility of responding to an inherent need of the system (Lorenzo and Ittelson, 2005).

In this line, its implementation represents a technical challenge in multiple senses since it involves responding to problems such as: the use of formats on open standards, co-existence between different tools or applications and hosting on different educational platforms that imply operability restrictions.

E-PORTFOLIOS REVIEW

Definition, types and uses

An e-portfolio is an ordered and intentional collection of digital material, text, image, audiovisual and software, which gives evidence of thoughts, demonstrations, developments and the capabilities of the subject to which they belong and promotes evaluation by a selected audience.

The use of electronic portfolios in educational institutions and organizations has spread widely today and, helped by the advancement of technologies, has enabled its application in different areas generating various practices according to the purpose of its implementation. The types of e-portfolios are varied (Kimball, 2002), being the most used; those of the educational institutions are applied to the process of teaching and learning; in companies, to gather the professional background of their employees and in different citizen applications that aim to compile trajectories or make collective memory of historical facts (Barbera et al., 2006).

In all applications the portfolio is a technology whose purpose is the collection of evidence of an educational, professional or other path that, according to the format imposed by the institution that adopts it, promotes reflection on each of the practices. Thus, people who build a portfolio undergo self-evaluation of their work and the valuation of others, either by an educator in the case of educational trajectories, or by a superior in professionals (Barbera et al., 2006).

This work is aimed at establishing ontological educational e-portfolios as a particular set of universe of application of this technology and this cut responds to the need to define the specific category of application in the academic field.

Thus, the types of portfolios that we can find according to their application are: students, teachers and institutional portfolios. The first ones are aimed at demonstrating evidence that shows the level of progress in learning. These become a source of inputs for teachers in what concerns the evaluation process, which is not traditional and focuses in a theoretical constructivist methodological perspective where the accent is in the process. The institutional ones integrate the previous ones, at the same time that they establish a dialogue with the outside, that is to say, with the professional scope. All portfolios share six basic functions (Lorenzo and Ittelson, 2005):

1) Contain educational plans;
2) Document knowledge, skills and learning;
3) Systematize evidence of development with a program;
4) Promote the development of professional skills;
5) Allow obtaining of statistical data related to the academic performance;
6) Monitor and evaluate performance.

Student portfolios collaborate in the acquisition and / or development of thinking skills involved in the exercise of critical reflection, while contributing to the improvement of multimedia writing and communication skills. On the other hand, the evidence gathered gives students the opportunity to create a sample of productions that account for their knowledge and skills, thus, facilitating possible job searches.

Assessment, self-regulation and skills training

The implementation of e-portfolios responds to the need

for a comprehensive training of students with the aim of forming competences in learners that allow them to overcome the requirements of a social and work reality that demands, fundamentally, competences integrated in a new professional profile characterized by a permanent update (Barberá et al., 2009).

With regards to the use of e-portfolios within the evaluation system we can recognize a first moment in which its application was oriented to the exhibition of final productions, while in a second instance the focus is transferred to the follow-up tasks that accompany the learning processes, aiming at the progressive improvement of academic performance. Thus, the purpose is not only accreditive but fundamentally, pedagogical.

The evaluation in the e-portfolios focuses on the negotiation and the exchanges between teachers and students. Far from being vertical and definitive, a traditional evaluation, this is built on the sustained consensus in the different stages that make up the pedagogical act. In this way, the student acquires an active role in his own learning process, exposing himself to a double evaluation, both external and self-assessment.

Barbera et al. (2006: 57) repoprted that "from the perspective of the student, the development of an academic portfolio will allow him to learn to plan and self-manage based on teacher orientations, to be more autonomous in the learning process and to promote decision making during the educational activity; in short, it will allow and facilitate the regulation of its own learning process."

This evaluation that combines multiple perspectives enables the student (Rodriguez Illera et al., 2009):

1) Develop metacognitive skills that allow him to regulate his learning processes,
2) Acquire communicative skills and social skills that allow him to interact with others and establish consensus, and;
3) Project his work in the professional sphere.

It is clear from the aforementioned and in line with Barberá's assertion that "the presence of e-portfolio in the educational context, as far as current higher education is concerned, is a necessity rather than a novelty" (Barberá et al., 2009). In this sense, given that this didactic tool requires a combination and integration between educational purposes and applied technologies for its development and implementation, it is necessary to have a common language that includes the definitions, concepts and their interrelations, covering the field object of interest and restricting the possible interpretations of the terms.

Portfolio management tool based on semantic technologies

E-porfolios are increasingly being used in the field of high level educational institutions as a valuable tool for continuous learning not only for careers offered in distance learning but also for face-to-face careers.

In the last years, different e-portfolios systems were developed such that using different technologies offer the student the possibility of creating their own portfolios to personalize the evidences of their career advances. Due to the growing use of educational platforms, it is desirable that the systems allow the management of portfolios be integrated to the educational platforms offering different functionalities for their management and integrating a unified workspace.

Currently, tools to manage portfolios are developed on formats that do not reflect open standards and do not facilitate the import and export of the information contained. This makes it difficult to share the artifacts contained in an e-portfolio between different tools or applications and to share an e-portfolio between different educational platforms or LMS (Learning Management System) in the context of different educational institutions. It is usual within the teaching practices to have virtual classrooms enabled and to find implementations of LMS with different levels of complexity and different functionalities offered.

In this sense, to take advantage of the benefits of using e-portfolios, it is necessary to favor the integration of its components and especially those that allow determining the level of learning. As part of its components, which are called artifacts, are the work done, the evaluations and the corresponding results or achievements. These artifacts represent means to facilitate educational continuity between programs within an educational institution and conform evidence that can be shared and integrated among institutions and organizations throughout their academic and work performance. This requires specific technologies that provide a solution for interoperability.

In this context, Semantic Web technologies provide solutions for interoperability and the need to integrate heterogeneous and diverse information (Sheth, 1998). Semantic technologies can be exploited as a platform for the implementation of an e-learning system since it provides all the tools that this educational modality requires: conceptualizations of data based on ontologies of educational materials (Stojanovic et al., 2001), standardization of the components for information sharing and composition in educational courses with proactive delivery of teaching material through LMS (Chung et al., 2003).

Semantic interoperability

As a consequence of the need to integrate content and complex environments in web context, the definition of articulation mechanisms that establish a common conceptualization of the work domain becomes essential. Therefore, interoperability is presented as the

implementation of principles for the solution to the problems generated by global and interdisciplinary work, developed in multicultural and technologically enriched infrastructures. These problems could be summarized as the drawbacks of trying to share and reuse heterogeneous information resources. The heterogeneity is generated, among other things, by technological differences (Sheth, 1998), differences in hardware and software systems (for example, Operating System) or differences in communication systems. As for specific information issues, Sheth (1998) identifies different levels of heterogeneity, between which is found semantic heterogeneity considering aspects of the meaning of the contents.

Each level of heterogeneity requires the implementation of specific interoperability mechanisms to address the complexity derived from the interaction of autonomous information technologies. As a consequence, according to Miller (2000), it can be deduced that different levels of interoperability exist according to the type of heterogeneity that they solve. One of these levels presents solutions for the treatment of the meaning of information through the construction of semantically consistent individual resources. It is the goal of semantic interoperability to make autonomous information systems "understand" the proposed information generated by other means that reuse it. Each resource uses different terms to describe similar concepts or use identical terms to mean different concepts by introducing confusion and error in their use. Technological solutions for semantic interoperability range from controlled vocabularies, thesauri and ontologies to the use of metadata and standards.

As earlier discussed, interoperability is the condition by which heterogeneous information systems can exchange processes or data. Two interoperable information systems have the ability to work together for the purpose of performing a task. In this sense, interoperability is presented as a fundamental quality as it increases visibility, participation and access to information systems. The use of technological solutions for the interoperability of information does not require prior agreement between the institutions that manage the machines and the information systems for the exchange and reuse of components that leads to the specialization of the work.

Semantic technologies in learning

In order to achieve the objective of co-operation between universities or training institutions, taking advantage of the re-use of educational resources, it is necessary to first address the issue of interoperability in education, since it raises a work scenario where the sources of information are diverse and therefore, the data have different technologies, structures, formats and conceptualizations. This generation of distributed, autonomous, diverse and dynamic information (Ouksel et al., 1999), raises the need for technological solutions in line with this challenge. In heterogeneous environments arising from the exchange of information between educational institutions, interoperability is presented as the ability to achieve the objectives of reuse of educational materials independently generated by various mechanisms.

In this technological context, the possibility of having an LMS platform with semantic technologies can facilitate exchange and co-operation between universities, encourage the exchange of teachers and promote distance education. The easy portability of materials due to the use of ICT simplifies the process of exchanging content from the institution of origin to the target institution.

In this context of cooperation between educational institutions, it can be assumed that adequate solutions must be incorporated to achieve interoperability (Miller, 2000) to ensure that an institution's systems, procedures and culture are managed in a way that maximizes exchange and re-use of information. In this way, among the benefits that semantic technologies can represent for education, the benefits of integration are counted since the semantic technologies can collaborate with the creation of a uniform platform for the processing and organization of the business. E-learning activities can be integrated into these processes and this solution can be particularly valued by commercial companies (Antoniou et al., 2003). At the same time, flexible access to knowledge on the part of the student can be counted in the order determined by the student according to his interest and needs. The study materials can be obtained within a specific context of the problem determined by the student.

Ontologies

As part of the semantic technologies, ontology provides an explicit definition of the shared conceptualization of a certain domain (Gómez et al., 2004). Ontology can take a variety of forms, but it will be necessary to include a vocabulary of terms and some specifications of its meaning (Uschold, 2003). This includes definitions and an indication of how concepts are interrelated, which collectively imposes a structure on the domain and restricts the possible interpretation of the terms. Ontologies aim to capture consensus-based knowledge in a generic way, so that it can be reused and shared through software applications and by groups of people. This conception implies the possibility of reusing and sharing components. Ontologies are usually constructed co-operatively by different groups of people immersed in different cultural contexts.

In this sense, the progressive use of semantic technologies for the management of e-portfolios is evident (Lougheed et al., 2005; Taibi et al., 2013; Nguyen et al., 2014). Nevertheless, these proposals do not exploit the full semantic potential either because they only model or identify hierarchical relationships between their terms or

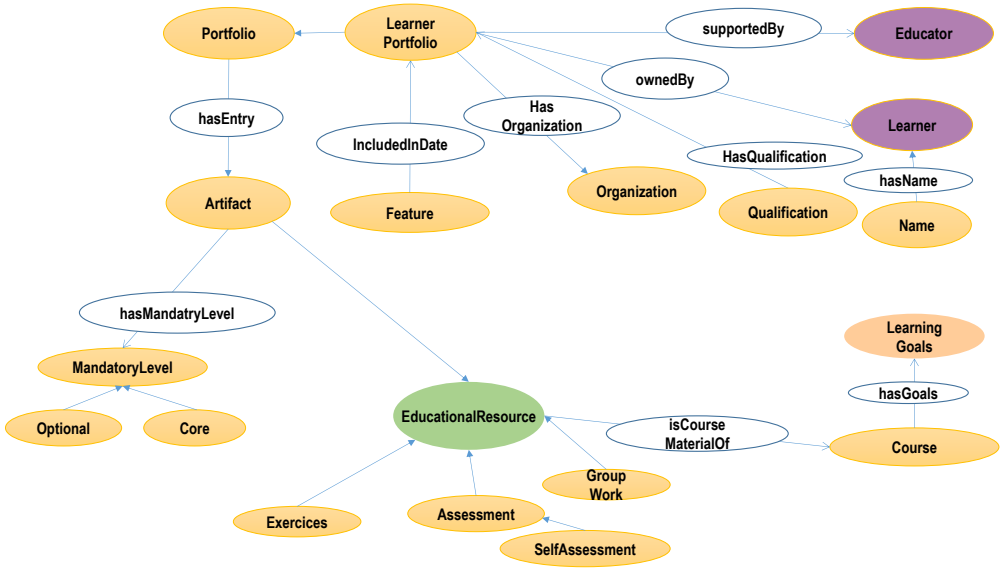

Figure 1: Portfolio ontology.

mainly take into account social aspects of collaborative work with respect to the use of portfolios.

Portfolio ontology

Within the development process of the Portfolio ontology, several activities were performed within the NeOn methodology framework (Suarez, 2012), since the portfolio ontology is part of an ontology network that models various domains involved in teaching in higher education (Romero et al., 2016).

An ontology network is a collection of interconnected individual ontologies related through a variety of meta-relations (Haase et al., 2007). In a network of ontologies the meta-relations that are defined between the ontologies that make up the network are expressed explicitly.

The benefit of working in an ontology network is represented by the modular organization of the domains involved in the development that facilitates the collaborative work. The languages and technologies proposed for the development of ontologies include different characteristics of vocabulary and component definition that lead to differences in the expressiveness and semantics that can be transmitted. In this paper, only the main terms involved in the use of portfolios for the purposes of studying evaluation are shown.

In the ontology model shown in Figure 1, the Portfolio can be seen as the main element. As a portfolio subtype the Learner Portfolio or student portfolio is modeled. This distinction is made since there are also teacher portfolios that reflect the teacher activities and his/her performance.

To represent the main components of the portfolio is the term Artifact, which models the different resources proposed by the teacher used by the student in their learning process. The Portfolio concept is related to the Artifact concept by the Entry relationship expressing the aforementioned situation. The Artifact concept is a subtype of the Educational Resource concept that expresses all the educational resources or learning objects available for teachers in order to teach their classes. Within the different educational resources, we have notes, books, videos and presentations that are materials associated with a course. There are special educational materials that will be part of a Portfolio such as assessments, practical work and group work (Assessment, Exercises and Group Work terms), which results will be included in each student's portfolio.

The instances of the term Learner Portfolio will be the portfolios of each student of a given course containing assessments, practical work and group work solved or in which student participated. This situation is expressed through the relationship owned between the concept of Learner Portfolio and the term Learner, whose instances are all students of the course. On the other hand, the Learner Portfolio is related to the Educator concept through the support by relationship expressing that a portofolio will be designed and structured by the teacher in charge of the course. In this way, the teacher will determine the assessments, practical work and group work that will be proposed to students; in some cases as a compulsory task and in other cases as an option. This is expressed through the term Mandatory level with the Optional and Core subtypes associated with the Artifact class.

As a special subtype of the assessments the teacher makes available to the students the self-assessment (Self assessment) that can be proposed to students such that they can prove their knowledge or progress in the face of mandatory assessments aimed at qualification.

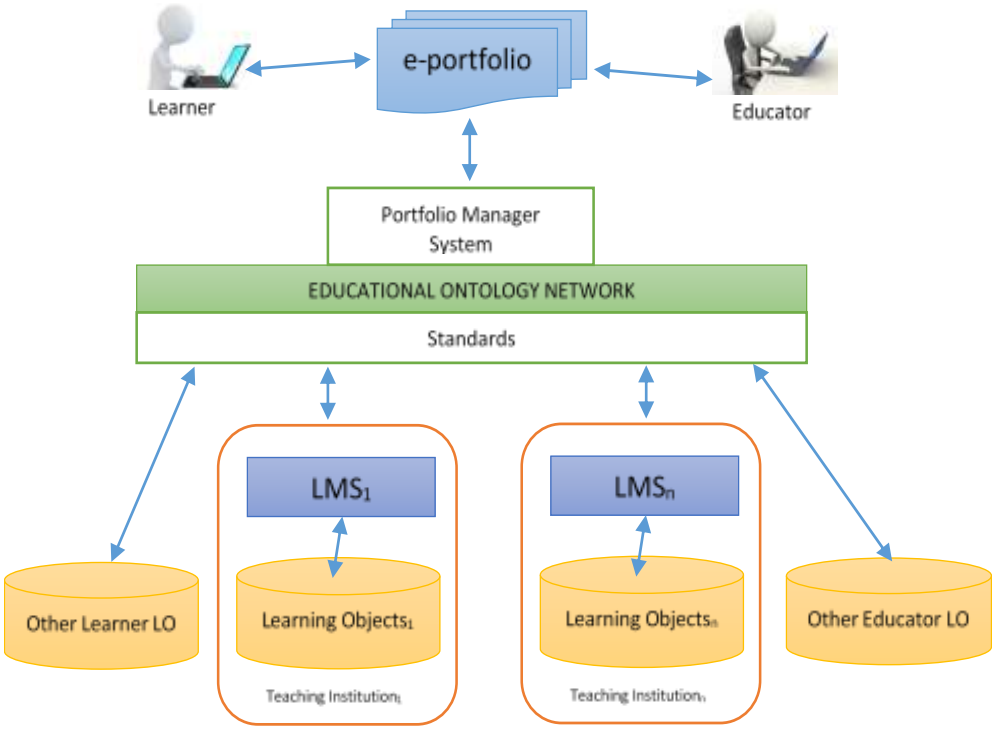

Figure 2: Framework for ontology network-based portfolio management.

Framework design

In order to take advantage of the potential of the LMS already in use in many institutions and the advantages exposed in relation to the use of e-portfolios for the evaluation instances, a framework is proposed.

The framework uses the ontology (part of the educational network ontologies) as an intermediate layer that hides the complexity and particularities of each LMS (Figure 2). This intermediate layer would serve as a common language that would homogenize the communication and use between different learning objects belonging to different LMS that both educators and students can use.

In this way, it is possible that both the educator and learner make use of learning objects that may have been stored in different LMS, or on their own repositories or institutional open access repositories in general. To do this, the processes of search, retrieval and storage of different learning objects will go through a translation process in the intermediate layer. This layer is supported by the ontology network that models the educational domain as a whole (and particularly the portfolios domain) and of the standards most used in the representation of metadata to describe learning objects.

The benefits of this type of scheme are numerous. The educator can concentrate his efforts in generating quality artifacts without worrying about the format or the destination of them since it can be reused transparently in any instance of portfolio that generates. On the student's side, the framework allows the fulfillment of tasks assigned in the portfolio with artifacts already available from other sources. On the other hand, the use of a common vocabulary and recognized standards contributes to ensure the correctness of the artifacts generated.

CONCLUSIONS AND RECOMMENDATIONS

This paper contextualizes the use of e-portfolios in higher education in order to facilitate the evaluation of students' progress in the learning process in a course. In this sense, different types of portfolios and a diversity of key elements that can be included in a portfolio are recognized as a demonstration of the aforementioned advance.

At the same time, it recognized the need for a software that allows the management of such portfolios. That is to say, it is necessary to have applications that allow the administration of the components of the portfolio by the teacher (including and proposing evaluations, practical works and group work among others) and their subsequent resolution by the students. These applications should enable the individualization of the portfolio and its subsequent qualification by the teacher. For this reason, it is desirable that these applications are integrated into LMS, currently in popular use, in order to provide a single, integrated interface for course dictation. For this, it is essential to become independent portfolios of the platforms in which the portfolios are to be used to allow their exchange and reuse.

In this sense, ontology that models the main components of a portfolio and highlights the relationships established between them is proposed. This ontology is part of an ontology network that models other components that are considered when expressing learning process in higher education.

As part of the work, a framework is also proposed that implements this network and serves as an intermediate layer or common language between the users of the portfolios (educators and learners) and the different LMS or learning objects that can be generated and used.

The progress of the work allows professors who are in charge of the planning of courses to obtain an evaluation based on the results of a portfolio that allows them to guide the learning activities and select educational resources according to the possibilities of each learner and, this way, favor personalization.

As a future work, the design and development of a software tool for e-portfolios management based on the ontology is proposed. This tool will be used to manage the artefacts of the portfolio and its subsequent integral evaluation in order to complete the pedagogical view of the teacher.

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