Tools and Services
for Open Access to Education and Learning

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Abstract

During the last years, the term Open Educational Resources (OERs) has been emerged and several OER initiatives around the world have been developed, which aim to create and share digital educational resources that are openly licensed and available online for everyone to use. According to the various existing definitions, the OER term is subject to different interpretations such as open educational content, open courseware and open source software. This means that OERs are not limited only to open educational content and they can be of different granularity and different formats. Nevertheless, existing OER initiatives do not treat their OERs differently based upon their granularity levels and consequently they adopt a flat model for supporting the main stages of a typical e-Learning chain, namely, creation, publication, discovery, acquisition, access, use, re-use and delivery of OERs. The main drawback of this approach is that OERs are treated in a non-modular manner without considering the different levels of granularity and the different tools and services needed to handle the particularities of each granularity level. This leads to a limited organic relation of current OER initiatives to the current developments in Learning Technologies, which eventually confines their potential to accessing a repository of educational resources. In this paper, we propose a hierarchical framework for open access to education and learning that considers different hierarchical elements for supporting the main stages of a typical e-Learning chain and we present a set of tools that support this framework.

Keywords— Open Access, Open Educational Resources, Authoring Tools, Delivery Tools

1. Problem Definition

Over the past years, the term Open Educational Resources (OERs) has been emerged, aiming to promote open access to digital educational resources that are available online for everyone at a global level (Caswell et al., 2008). In response to this emerging trend several OER initiatives have been developed worldwide by large institutions such as MIT’s OpenCourseWare (OCW), Stanford’s iTunes and Rice University’s Connexions, or by communities (or consortiums) such as MERLOT and OER Commons (Ehlers, 2011).

The expected benefits of OERs for learners and teachers can be summarized as follows (Geser, 2007): (a) they are free to use and publicly available, (b) they can be used and/or reused in teaching and learning (usually with attribution to the creator), (c) they can be repurposed, that is, modified/adapted for different educational context of use, (d) they can improve teaching by building on other people’s work, and (e) their development is a global movement and as a result educational
communities across borders can be created around them.

As with many emerging terms, there is not a single and consistent definition for OERs. According to the various existing definitions, the OER term is subject to different interpretations such as open educational content, open courseware and open source software (Friesen, 2009). This means that OERs are not limited to open educational content and they can be of different granularity and different formats (Lane & McAndrew, 2010). Nevertheless, existing OER initiatives do not treat their OERs differently based upon their granularity levels and consequently they adopt a flat model for supporting the main stages of a typical e-Learning chain, namely, creation, publication, discovery, acquisition, access, use, re-use and delivery of OERs. The main drawback of this approach is that OERs are treated in a non-modular manner without considering the different levels of granularity (namely, educational content, learning activities, educational courses, education and/or training programmes) and the different tools and services needed to handle the particularities of each granularity level. This leads to a limited organic relation of current OER initiatives to the current developments of Learning Technologies, which eventually confines their potential to accessing a repository of educational resources. In this paper, we propose a hierarchical open access framework that considers different hierarchical elements for supporting the main stages of a typical e-Learning chain and we present a set of tools that support this framework.

2. Background

2.1 Open Educational Resources and Learning Objects

The OER term was introduced by UNESCO (2002), which has defined OERs as the “technology-enabled, open provision of educational resources for consultation, use and adaptation by a community of users for non-commercial purposes”. According to Geser (2007) OERs have three core features: (a) they are available for open and free of charge access by educational institutions and end-users such as teachers and students, (b) they are licensed for re-use, free from restrictions to modify, combine and repurpose, as well as they are designed for easy re-use in open content standards and formats, and (c) with regard to software tools, their source code is open and licensed for re-use. On the other hand, Learning Objects (LOs) are a common format for developing and sharing educational content and they have been defined by Wiley (2002) as: “any type of digital resource that can be reused to support learning”. More specifically, LOs include: “video and audio lectures (podcasts), references and readings, workbooks and textbooks, multimedia animations, simulations, experiments and demonstrations, as well as teachers’ guides and lesson plans” (McGreal, 2008). Thus, one can claim that OERs are related to LOs assuming open access licensing (Friesen, 2009; Lane & McAndrew, 2010).

2.2 From Learning Object Repositories to Learning Design Repositories
Los and their associated metadata are typically organized, classified and stored in web-based repositories which are referred to as Learning Object Repositories (LORs). McGreal (2004) has defined LORs as systems that “enable users to locate, evaluate and manage learning objects through the use of “metadata,” namely, descriptors or tags that systematically describe many aspects of a given learning object, from its technical to its pedagogical characteristics”. Most of the LORs that have been developed worldwide adopt the IEEE LOM standard (IEEE LTSC, 2005) or an application profile of IEEE LOM (Smith et al. 2006) for describing their LOs aiming to facilitate search and retrieval of them among different LORs (McGreal, 2008).

Nevertheless, in most cases LORs include limited explicit information about their hosted LOs’ learning and educational context of use, that is the pedagogical approach adopted, the subject domain, the intended learning outcomes and the environment within which the LOs are used (Conole, 2007; Bailey et al., 2006). Moreover, it has been identified that teachers would benefit from: (a) having access to best teaching practices, (b) sharing their teaching practices with other teachers, and (c) reflecting on others teaching practices (Galley et al., 2010). This has the potential to provide learning and educational contextual knowledge to LOs available in LORs. For this purpose, there are international efforts for designing and developing web-based repositories of learning designs (LDs), assuming that a learning design can offer an explicit description of the pedagogical context of use where all key design parameters (namely, educational objectives, pedagogical model, participating roles and tools and services) are formally described (Sampson et al., 2011c; Paquette et al., 2008).

A Learning Design (LD) is defined as: “the description of the teaching-learning process, which follows a specific pedagogical model or practice that takes place in a unit of learning (e.g., a course, a learning activity or any other designed learning event) towards addressing specific learning objectives, for a specific target group in a specific context or subject domain” (Koper & Olivier, 2004). As it becomes evident from the aforementioned definition, a LD includes information that contributes towards the definition of learning and educational context of use for the LOs. Similar to LOs, Learning Designs (LDs) can be organized, classified and stored in web-based repositories which are referred to as Learning Design Repositories (LDRs). LDRs are built so as to support storage, discovery, retrieval, use, re-use and sharing of LDs and LD Templates among educational communities (Griffiths et al., 2005). A LD Template is a LD without specific educational content (Griffiths et al., 2005). One way that provides a standard notation language for the description of LDs and LD Templates is the IMS Learning Design (LD) Specification (IMS GLC, 2003) and many of the existing LDRs adopt this specification for describing their LDs and LD Templates aiming to facilitate inter-exchange of them among different LDRs.

3. A Hierarchical Open Access Framework for Education and Learning

In this section, we propose a hierarchical framework, which aims to support the main stages
of a typical e-Learning chain namely, creation, publication, discovery, acquisition, access, use, re-use and delivery of OERs (Sampson & Zervas, 2011a). Next, we present in details the elements and the participating stakeholders of the proposed hierarchical framework.

3.1 Hierarchical Elements

The proposed hierarchical framework identifies four (4) basic hierarchical elements (see Figure 1), which are presented below:

- **Educational Content:** This is the lowest level of the hierarchical open access framework and it includes: (a) Open Educational Resources (OERs) in the form of Learning Objects (LOs), and (b) educational metadata that are used to describe the different educational characteristics and attributes of a LO (Currier, 2008).

- **Learning Activities:** This is the second level of the hierarchical open access framework and for the purpose of our work, a Learning Activity (LA) is defined as: “the interaction of learner(s) with other(s) (peers and/or tutors) and with a learning environment (optionally involving educational content, tools and services), which emerges as a result of performing a task following a specific pedagogical strategy in order to achieve one or more learning objectives” (Beetham, 2007).

- **Educational Courses:** This is the third level of the hierarchical open access framework and it can be developed as a sequence of LAs following a specific pedagogical strategy (Alonso et al., 2005). Moreover, for the purpose of our work we consider that an educational course is delivered entirely online through desktop and/or mobile devices (Sampson & Zervas, 2012; Sampson & Zervas, 2011b).

- **Education and/or Training Programmes:** This is the highest level of the hierarchical open access framework and it can be developed as a synthesis of educational courses. An education and/or training programme typically includes the educational courses that constitute it, as well as the virtual classrooms that are used for supporting the delivery of the educational courses (Sampson & Kallonis, 2011; Sampson & Kallonis, 2012; Sampson & Zervas, 2012; Daniels, 2009).

3.2 Main Stakeholders

The main stakeholders (see Figure 1) that are identified within the proposed open access hierarchical framework are the following:

- **Educational Content Suppliers:** this is the entity responsible for designing and developing independent open educational resources in the form of LOs. The Educational Content Suppliers need to be able to characterize their newly developed LOs with educational metadata and offer them to existing Learning Object Repositories (LORs) for sharing and
re-use by instructional designers and/or teachers. The proposed open access framework provides them with the technological means for tagging their LOs with appropriate educational metadata.

- **Instructional Designers**: They define learning objectives and they design appropriate LAs and educational courses that can lead to the accomplishment of these objectives. They are responsible (a) for designing LAs by selecting: (i) appropriate LOs (previously developed by educational content suppliers and/or teachers), (ii) appropriate tools and services that support the LAs and (iii) appropriate roles that participate to the LAs following a specific pedagogical strategy and (b) for designing educational courses, following a specific pedagogical strategy, by sequencing appropriate LAs (previously developed by them or by other instructional designers and/or teachers). Both LAs and educational courses should be represented in a common machine understandable format for offering them through existing Learning Design Repositories (LDRs) for sharing and re-use by other instructional designers, teachers and/or e-Learning services providers. Thus, the proposed open access hierarchical framework provides Instructional Designers with the technological means for (a) searching and selecting LOs, and (b) designing and developing Learning Activities and Educational Courses.

- **E-Learning Services Providers**: this is the entity responsible for delivering education and/or training programmes as a synthesis of appropriate educational courses (previously designed by Instructional Designers and/or teachers). The proposed open access hierarchical framework provides them with the technological means to deliver Education and/or Training programmes, as well as individual Educational Courses to Learners.

- **Teachers**: Their role is threefold. More specifically, teachers can design and develop new LOs to support their learning activities, possibly describe them with educational metadata and offer them to a LOR for future use by other instructional designers and/or teachers. They can design and develop LAs by selecting: (i) appropriate LOs, (ii) appropriate tools and services that support the LAs and (iii) appropriate roles that participate to the LAs following a specific pedagogical strategy and educational courses by sequencing appropriate LAs following a specific pedagogical strategy and offer them to a LDR for future use by other instructional designers and/or teachers. Finally, they can participate to educational courses and education and/or training programmes, so as to support learners in the attainment of their learning objectives.

- **Learners**: These are the final users of the educational courses and the main participants in education and/or training programmes. Thus, the proposed hierarchical open access framework provides them with the technological means to participate in education and/
or training programmes, as well as to individual educational courses through desktop and/or mobile devices.

**Figure 1**: Hierarchical Elements and Main Stakeholders of the Open Access Hierarchical Framework

![Hierarchical Elements and Main Stakeholders of the Open Access Hierarchical Framework](image)

Figure 1 presents the identified hierarchical elements and stakeholders, as well as, their needs and interconnections within the proposed open access hierarchical framework.

### 4. Tools for Supporting the Proposed Hierarchical Open Access Framework

The proposed hierarchical framework for open access to education and learning is supported by a set of tools that aim to address the needs of the main stakeholders identified in Section 3.2. Next, we describe these tools in details.

#### 4.1 The ASK Learning Objects Metadata Authoring Toolkit 2.0 (ASK-LOM-AT 2.0)

ASK Learning Objects Metadata Authoring Toolkit 2.0 (ASK-LOM-AT 2.0) is an open source web-based tool that facilitates the educational content suppliers, the instructional designers and/or the teachers in authoring educational metadata for their LOs, LAs and educational courses, as well as, in organizing and offering them through existing LORs and LDRs. The tool provides educational content suppliers, instructional designers and teachers with an authoring environment for describing their LOs, LAs and educational courses with educational metadata conformant with IEEE Learning Objects Metadata Standard (IEEE LTSC, 2005). The main functionalities of ASK-LOM-AT 2.0...
include (Sampson et al., 2011a): (a) educational metadata authoring by using a step-by-step wizard (as presented in Figure 2) or by using a single web-form (as presented in Figure 3), (b) browse and preview existing metadata records that have been authored by other users of the tool, (c) browse and edit metadata records that a specific user has previously authored and stored in the tool metadata repository, (d) import and edit metadata records in XML format following the IEEE LOM standard, and (e) export metadata records in XML format following the IEEE LOM standard and import them to existing LORs.

4.2 The ASK Learning Objects Metadata Application Profiling Toolkit (ASK-LOM-AP)

ASK Learning Objects Metadata Application Profiling Toolkit (ASK-LOM-AP) is an open source web-based tool that facilitates educational content suppliers to develop and manage Application Profiles (APs) of the IEEE LOM standard. An Application Profile (AP) is a metadata scheme, which consists of metadata elements selected from one or more standard metadata schemes combined in a compound schema (Smith et al. 2006).
The main functionalities of the ASK-LOM-AP include (Sampson et al., 2012): (a) the development and management of new IEEE LOM APs by using a step-by-step wizard (as presented in Figure 4) conformant with guidelines from International Organizations such as IMS Global Learning Consortium and European Committee for Standardization (CEN/ISSS), (b) the export of the XML Schema of a developed IEEE LOM AP with all the modifications, in accordance with the base schema of the IEEE LOM Standard (as presented in Figure 5). The produced IEEE LOM APs can be imported to ASK-LOM-AT 2.0, which was described in section 4.1 and support authoring of educational metadata based on these IEEE LOM APs.

4.3 The ASK Learning Objects Social Tagging Toolkit 2.0 (ASK-LOST 2.0)

ASK Learning Objects Social Tagging Toolkit 2.0 (ASK-LOST 2.0) is an open source web-based tool that facilitates instructional designers and/or teachers to add tags to LOs, LAs and educational courses that are stored in LORs and LDRs exploiting social tagging. Social tagging refers to the process of adding keywords, also known as tags, to any type of digital resource by users (rather than resources’ authors) (Vossen & Hagemann, 2007). Social tagging has emerged in educational applications encouraging individuals to tag LOs, LAs and educational courses and openly share their tags with other users towards facilitating search and retrieval of already used and known LOs, LAs and educational courses by using meaningful terms (Dahl & Vossen, 2008).

The main functionalities of ASK–LOST 2.0 include (Sampson et al., 2011b): (a) guided tagging (as presented in Figure 6), where the user is presented with his/her tags previously used for characterizing other digital educational resources (referred to as Personal Tags), as well as, with tags that are most frequently used by other users regarding this specific LO, LA or educational course (referred to as Popular Tags), (b) auto-suggested tagging (as presented in Figure 6), where the user is presented with suggested tags that have been used by other users and are relevant with the tag that the user is typing, (c) creation of user’s personal collection, where he/she has the capability to save to his/her personal list, LOs, LAs or educational courses uploaded by other users and browse the tags that these users have used, (d) browsing via tag cloud, where the user can search and browse LOs, LAs or educational courses using an appropriately formatted tag cloud produced by the tags that all users of the tool have offered, and (e) social networking support (as presented in Figure 7), where the user can create watchlists, which include other users’ profiles, so as to be able to monitor (through RSS feeds) the tags that these users are using, as well as the LOs, LAs or educational courses that they are submitting to the repository of the tool.
4.4 The ASK Learning Design Toolkit (ASK-LDT)

ASK Learning Design Toolkit (ASK-LDT) is a stand-alone tool that enables instructional designers and/or teachers (a) to express their pedagogical strategies, in the form of LD templates, using a common machine understandable way, and (b) to design and develop educational courses using a reference set of pre-defined learning design templates. As a result, a set of learning templates, which are following different pedagogical strategies, can be designed to facilitate the development of educational courses that adopt these strategies. More specifically, the main functionalities of ASK-LDT include (Sampson et al., 2005): (a) development of new educational courses based on pre-defined LD templates using a graphical interface (as presented in Figure 8), (b) characterization of the learning activities of an Educational Course by using a common vocabulary of terms based on “Dialog Plus Learning Activities Taxonomy” (LADiE, 2006) (as presented in Figure 9), (c) assignment of LOs (html pages, images, videos etc.) to the LAs of an educational course or change the existing ones, and (d) save educational courses as Packages (zip format) conformant with IMS Learning Design Specification (IMS GLC, 2003), and share them through existing LDRs.
4.5 The ASK Mobile Learning Design Player (ASK-Mobile-LD-Player)

ASK Mobile Learning Design Player (ASK-Mobile-LD-Player) is a stand-alone tool suitable for smart phone devices with windows mobile or android operating system that facilitates e-Learning Services Providers to deliver educational courses that have been retrieved from an existing LDR and they are conformant with the IMS Learning Design Specification (IMS GLC, 2003). More specifically, the main functionalities of ASK-Mobile-LD-Player include (Sampson et al., 2007): (a) enrolment of multiple roles/actors (individual learners, groups of learners and teachers) (as presented in Figure 10), (b) navigation to the LAs of an educational courses using a graphical interface (as presented in Figure 11), and (c) rendering of HTML-based educational content and flash files (as presented in Figure 12).

4.6 The ASK 3D Virtual Classroom Simulation (ASK 3D VCS)

ASK 3D Virtual Classroom Simulation (ASK 3D VCS) is a customization of the widely used existing Course Management System, Moodle, supported by 3D Virtual Worlds (such as Second Life), namely, the SLOODLE (Livingstone, 2009). 3D Virtual Worlds (VW) provide realistic three-dimensional environments accessible through the web that can offer engaging, interactive and immersive experiences (Sampson & Kallonis, 2012). ASK 3D VCS aims to provide e-Learning Services Providers with a platform for delivering education and/or training programmes to their learners by exploiting the Second Life VW. More specifically, the ASK 3D VCS consists of four (4) different rooms, which are (Sampson & Kallonis, 2011): (a) Lectures’
Room (as presented in Figure 19), (b) Lab Room (as presented in Figure 20), (c) Library Room (as presented in Figure 21) and (d) the Assessment/Quiz Room (as presented in Figure 22). All these virtual rooms feature tools that can support learners to execute different types of LAs based on the educational design.

Figure 13: The Lectures Room

Figure 14: The Lab Room

Figure 15: The Assessment/Quiz Room

Figure 16: The Library Room

5. Conclusions and Future Work

Within the landscape of the emerging OER paradigm, it has been identified that existing initiatives do not pay special attention to the different granularity levels of OERs and as a result they adopt a flat model for supporting the main stages of a typical e-Learning chain, namely, creation, publication, discovery, acquisition, access, use, re-use and delivery of OERs. As a result, this leads to a limited organic relation of current OER initiatives to the current developments of Learning Technologies, which eventually confines their potential to accessing a repository of educational resources. In this paper, in order to deal with the different levels of granularity (namely, educational content, learning activities, educational courses, education and/or training programmes), and the different tools needed to handle the particularities of each granularity level, we proposed a hierarchical open access framework, so as to support the main stages of a typical e-Learning chain. In this framework, we identified the main stakeholders and we presented a set of tools, which empower them within the various stages of a typical e-Learning chain.
Future work regarding the framework reported in this paper include the development of widget-based clients of the tools that support the presented open access hierarchical framework following the W3C Widgets standard that allows web applications to be integrated with other web-applications, as well as to run on mobile devices like native apps (Cáceres, 2011).

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