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An Overview of Repositories of Learning Objects

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Abstract: This work addresses the dispersion of learning resources on the Internet – many languages, all areas of knowledge, aims at different audiences, many "sizes" and varied quality; many are open to all. This paper presents the results of some searches on the Internet for Control Systems resources and suggests the implementation of a union catalog of metadata of contents from cooperating institutions. Union catalogs of theses and dissertations are mentioned as possible models.

Keywords: learning objects; shareable content objects; union catalogs; institutional repositories; metadata; metadata harvesting; reuse, share.

1. INTRODUCTION

Over five years ago, Pavani (2010) proposed the implementation of union catalogs of learning contents in Engineering to be populated with works from institutions in different parts of the world. A little earlier Ternier et al. (2008) proposed a query language to search repositories of learning objects for the sake of interoperability. About the same time, the Open Archives Inititative (OAI) presented OAI-ORE (2008), the Open Archives Initiativte Object Reuse and Exchange.

The three facts mentioned in the first paragraph are related to ICT – Information and Communication Technology support for education. A little before these facts, a new concept was created by UNESCO (2002): OER – Open Educational Resources. This concept is important because it stimulates cooperation among educators and content developers. ICT tools provide the infrastructure for the cooperation to happen.

OER is considered so important in Engineering Education that in November 2014 the IEEE Education Society published a special issue of the IEEE Transactions on Education devoted to this subject (IEEE, 2014).

One last point is worth mentioning – ACE 2016 (http://www.ace2016.sk/Scope) includes the following topics of interest for the symposium: (1) Teaching aids for control engineering; (2) Virtual and remote labs; (3) Open Educarional Resources; (4) E-learning and blended-learning in control engineering; and (5) Internet-based control systems materials. No doubt, all of them are deeply related to each other and to the three facts in the first paragraph..

This work addresses the availability and the easiness to find Learning Objects in Control Systems on respositories connected to the Internet. It also proposes the implementaion of union catalogs of learning contents in Control Systems to host the contributions from institutions and individuals all over the world. In order to state the scope of the work, some definitions are presented in subsection 1.1 and the objective of this paper in subsection 1.2.

1.1 Some Definitions

- Learning Objects (LO) and Shareable Content Objects (SCO)

Learning Object (LO) and Shareable Content Object (SCO) are two expressions related to the definition of educational resources in ICT supported learning.

LO is defined (IEEE, 2002) as: **"For this standard, a learning object is defined as any entity – digital or non-digital – that may be used for learning, education, or training."** LOs are "pieces" that can be used separately or that can be combined for teaching and learning. An important observation is that LOs are not necessarily digital. Thus, traditional laboratory equipment can considered LOs. This is nice in the context of Engineering Education – lab activities are an important requirement in engineering courses. In this paper, LOs are digital entities though.

"The Shareable Content Object Reference Model (SCORM) is a model that references and integrates a set of interrelated technical standards, specifications, and guidelines designed to meet high-level requirements for e-learning content and systems." (ADL, 2004). The SCORM defines: **"SCOs are the smallest logical unit of information you can deliver to your learners via an LMS."**.

The two definitions have differences and similarities.

- Differences: SCOs are to be delivered via LMSs and must be compliant to SCORM specifications so that they can be delivered by any SCORM compliant LMS. LOs can be non-digital, thus not to be exclusively delivered via LMSs.
- Similarities: The similarity is that SCOs and LOs have educational purposes and are units/entities.

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Two key concepts associated to learning resources are share and reuse. Associated to reuse, it is important to mention that Wiley (2000) introduced the terms reusable chuncks of instructional media, reusable instructional components, reusable digital resources, reusable learning objects. Besides Wiley, Alsubaie (2009) used the term Reusable Learning Objects (RLO). This is a set of terms that have much in common and, therefore, fuzzy boundaries.

- Institutional Repository (IR)

"A university-based institutional repository is a set of services that a university offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members. It is most essentially an organizational commitment to the stewardship of these digital materials, including long-term preservation where appropriate, as well as organization and access or distribution." This is the definition introduced by Lynch (2003) and covers all types of digital resources – learning contents included.

- Union Catalog

The online version of the Oxford Dictionaries (http://www.oxforddictionaries.com/us/definition/english/union-catalogue) defines Union Catalog(ue) as: **"A list of combined holdings of several libraries."** This concept has been used in digital libraries and institutional repositories. Three examples of union catalogs can be mentioned:

- BDTD – Biblioteca Digital de Teses e Dissertações (http://bdtd.ibict.br/) hosts over 271K metadata records of ETD – Electronic Theses and Dissertations of 101 Brazilian Institutions.
- NDLTD – Networked Digital Library of Theses and Dissertations Global ETD Search (http://search.ndltd.org/) hosts over 4.3 M metadata records of 158 institutions of higher education, consortia and other union catalogs.
- SHARE (http://www.share-research.org) hosts over 6 M metadata records of assorted scholarly contents – ETDs, articles, books, research data, LOs, etc.

The first two are specific for full-text online theses and dissertations and the third is for all types of scholarly resources. Though they offer different types of contents they have points in common:

- Their databases store only metadata sets – all contents are on the repositories of the original institutions.
- They are compliant with ISO 15836.2009 standard of digital contents description.
- Metadata are transferred from the original repositories to the union catalogs in an automated way based on OAI-PMH – Open Archives Initiative Protocol for Metadata Harvesting (2001).

At the same time, they have a significant difference – since the first two are specific for ETDs, their metadata sets have additional elements along with the ISO core in order to satisfy the needs of a more accurate description. Addition of elements is an international practice. Another example is the LOM set that contains the ISO core plus many other specific to LOs.

1.2 This Work

This work has the objective of examining the existence of LOs on the Internet. It tries to identify IRs, union repositories and different types of websites, and the ones that host resources in Control Systems. It mentions the types of contents, open access (versus with some restriction), description (to allow ease of finding), persistency (versus broken links), granularity (to allow redeployement, rearrangement, repurpose, and reuse) and the resource language.

Section 2 presents the results of some searches. Section 3 resubmits the suggestion presented by Pavani (2010) of creating a union catalog of LOs, this time focused on a narrower audience – those involved in Education in Control Systems. The suggestion is resubmiited due to the enhancement in the culture of sharing digital contents. Section 4 comments on the results.

2. AN OVERVIEW OF REPOSITORIES OF LOs AND THE AVAILABIBLITY OF LOs IN CONTROL SYSTEMS

The audience interested in LOs is divided in two large groups: (1) faculty; and (2) students. Some smaller groups may be involved: (1) librarians; (2) IR administrators; and (3) software developers. The first two groups are players in one of the main objectives of higher education – teaching and learning. The other groups support the activities of the first two.

Two words express very important concepts in dealing with LOs – share and reuse, presented in section 1. To get to the point of sharing and reusing, it is necessary that LOs (as any other resource) be found. This means that they must be searchable and retrievable; search and retrieve are two keywords too. Once a LO is found and retrieved two other concerns arise. The first is the size of the LO in terms of its educational content. This is associated with its granularity and indicates how "flexible" a LO is to be reused. The second is the language of the LO.

This section is devoted to presenting some results of searches performed on the Internet to find LOs in Control Systems. The results will be commented in terms of: searchability, retrievability, granularity and language. Subsection 2.1 describes the searches that were performed and subsection 2.2 comments the results.

2.1 Searches and Results

The searches were of different natures: (1) known repositories of LOs; (2) links found in articles or other known links; and (3) one search engine. Only higher education resources were examined; collections that did not include contents for this level were not examined. All searches were