Creation of Lithuanian Digital Library of Educational Resources and Services: the Hypothesis, Contemporary Practice, and Future Objectives

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Abstract. Currently national digital library of educational resources and services (DLE) for primary and secondary education is under implementation in Lithuania. The article aims to analyse the hypothesis for creation of pedagogically and organizationally flexible, cost effective DLE, its contemporary practice and future objectives. The article presents the framework for such system's architecture design aimed to implement this approach based on the main DLE's components' reusability and learning customisation possibilities for its users. The original learning objects' evaluation instrument based on suggested DLE model is presented.

1 The Notions of DLE and its Main Components

DLEs are considered to be the *aggregates of "knowledge repositories, and services, organized as complex information systems"*. DLE must not be seen as merely a digitized collection of information objects plus related management tools, but as an environment bringing together collections, services, and people to support the full cycle of creation, dissemination, discussion, collaboration, use, new authoring, and preservation of data, information, and knowledge [3]. The notion 'knowledge' is used in this DLE definition as the synonym of 'digital learning resources' (LRs). Further the notion 'digital learning resources' is used as an 'umbrella' notion for different kinds of digital learning content such as 'learning objects', 'units of learning', etc.

The following LO notion is considered here as the most suitable for basic component for creation of pedagogically and organizationally flexible, cost effective DLE: *"LO is any digital resource that can be reused to support learning"* [16]. A LR truly becomes a LO when it is associated with self-describing information – metadata. Metadata is used to implement LO repositories, to search for LOs in the repository, to share LOs, to import LOs into or export them from Virtual Learning Environments (VLEs), to combine them with other LOs [5]. Key notion here is 'reusability'. LO reusability is considered: (1) as is; (2) by de and re composition (lego model); (3) adapted to fit a specific context; (4) as an example; (5) by modification; (6) by localization.

Learning assets (LAs) are considered here as smaller pedagogically decontextualised parts (pieces) LOs can be combined of [5].

LO repositories are considered here as *properly constituted systems (i.e. organised LOs collections) consisting of LOs, their metadata and tools / services to manage them.*

Unit of Learning (UoL) itself and all its components are considered here as *embedded LOs, including learning objectives, prerequisites, learners' or trainers' roles, activity assignment, information objects, communication objects, tools and questionnaire objects* [12].

The term *VLE is* considered here as *"a single piece of software, accessed via standard Web browser, which provides an integrated online learning environment"* [15]. VLEs usually include the following functions: (1) controlled access; (2) student tracking; (3) LRs; (4) communications; (5) links; (6) customisation [15].

2 The Hypothesis

The main goal here is evaluation of possibility to create in principle pedagogically and organizationally flexible cost effective DLE model providing learning customisation possibilities for its users.

The main hypothesis here is the idea that *ultimate increase of the main DLE components'* (i.e. approved LOs) *reusability* could ensure these DLE characteristics, and it is possible to ensure stable interoperable working of such system's components within DLE and the whole system on European level. The presented approach for DLE model is based on this hypothesis, i.e. on the idea that such system should be based mainly on 'ultimately reusable' LOs, their repositories and appropriate services such as VLEs.

Ultimate reusability of LOs should be ensured by their partition to two main separate parts (i.e. approved LAs and UoLs) which should work independently and should have clear different functions. LAs are considered not to be directly interconnected with particular pedagogical processes / scenarios / activities / designs, and therefore it should be possible to reuse the same LAs to implement different learning designs. UoLs are conversely considered to be LOs containing learning designs reusable for different subjects and different LOs / LAs.

This hypothesis needs the investigation of reusability and interoperability of these two separate parts of DLE within the system and DLE as a whole.

The feasibility study of creation of DLE most effective from socio-economic perspective has proven the reliability of the hypothesis that pedagogical and organizational flexibility and cost-effectiveness of DLE model should be ensured by providing ultimate reusability of LOs by their partition to two main separate parts (LAs and UoLs) which should work independently and should have clear different functions. This feasibility study has shown that this kind of "reusable" DLE design could be the best possible e-learning solution from technologic, educational, organizational and socio-economic points of view. The detailed evidence of this statement is out of scope of the article, but shortly the main components' reusability indeed ensures system's pedagogical and organizational flexibility as well as the better financial and economic efficiency indicators such as less investment into LRs for one probable user, major financial benefit, less time to buy off, etc. In could be achieved because: (1) major reusability of main DLEs components is achieved; (2) more users can benefit from such system; (3) content and learning design creators have the possibility not to reinvent the wheel but use and improve already created LRs; (4) better conditions are created for various content / design creators to improve the quality of existing LRs by their permanent (collaborative) modification.

3 Lithuanian DLE: History and Contemporary Practice

Currently Lithuanian DLE for primary and secondary education is de-facto under development mainly using scientific and technologic resources funded by European Commission while implementing several international projects: (1) FP6 IST CALIBRATE (Calibrating eLearning in Schools) project [2]; (2) eLearning P2V (Peer to Peer Networking for Valorisation) project; (3) eContentplus EdReNe (Educational Repositories Network) project.

The main components of Lithuanian DLE at the moment are LR repositories and LO metadata (LOM) repository as well as related services such as VLEs and LeMill learning toolbox.

Content: Learning Resource Repositories. At the moment there are several LR repositories in Lithuania established and developed on the Centre's for IT in Education (ITC) Web server. They provide several keywords-based non-standardized search possibilities for users. All LRs in these repositories were approved by independent IT and subjects experts. They are: (1) the central repository of 'valid', 'recommended', and 'experimental' computer teaching aids, (2) the repository of all 'valid' and 'recommended' educational web sites available for all Lithuanian schools, (3) the repository of methodical material on the use of ICT in education prepared mainly by teachers, (4) the repository of lesson plans and ideas designed with Microsoft Power Point template 'Virtual Classroom Tour' [7].

Content: Learning Object Metadata Repository. Several important developments were carried out by ITC while implementing CALIBRATE project: (1) EUN LO metadata (LOM) application profile (AP) 2.0 was localised by Institute of Mathematics and Informatics (IMI); (2) metadata for more than 1000 approved Lithuanian LRs were created in conformity with this AP by specially trained LOs indexers; (3) LOM repository based on MySQL database management system as well as PHP software package (internet programs handling environment) and Java technology was created. ITC Apache web server and Linux operating system were used for LOM repository; (4) user-friendly interface to aggregate LOs metadata into LOM repository was created; (5) all these LOs' metadata were created and filled into LOM repository; (6) all approved distance learning courses were disaggregated to LOs level and introduced as SCORM 2004 packages to reuse them in different VLEs; (7) LOM repository was connected to European learning resource exchange (LRE) system via Simple Query Interface technology and Brokerage system.

Currently ITC has prepared ToR for enrichment of LOM repository with additional services. Additional services for its open / informational part are: (1) LO searching and finding by subject (area) and key word; (2) extended search by desirable elements; (3) search by metadata creation period; (4) brief and extended (XML) metadata production for the users; (5) users' comments; (6) statistics of LO downloads and repository users; (7) LO ranking possibility; (8) automatic production of new LO metadata during the desirable period; (9) user's guide. Additional services for closed / administrative part are: (1) metadata import in XML format; (2) fixation of LRE AP version used; (3) portrait of LRE AP versions' comparison; (4) classifiers' management by desirable elements; (5) metadata elements creation using classifiers; (6) management of users' comments; (7) extended LO search; (8) legal mark if LO could be exported to LRE; (9) administrator's guide.

Services: Virtual Learning Environments. Scientific research on evaluation of the most popular open source VLEs was performed in Lithuania in 2005 by IMI. Several scientific methods and frameworks (such as [1] and [13]) were used as basic tools for this research. It have shown that the best open source VLEs are not less quality on module level than the best proprietary products while being more attractive for educational institutions from financial point of view. Therefore it was proposed Lithuanian educational institutions to comprehensively implement open source VLEs.

It was also investigated that VLEs are not neutral in their impact on pedagogical methods and scenarios [6]. We could divide VLEs to more 'content centred' and more 'learner centred' systems. The more VLEs are 'learner centred', the more they fit the aims of schools development as e-learning communities [9].

As the result, Moodle VLE was evaluated the best VLE suitable to use on the module level, therefore it was proposed as the most suitable VLE for wide implementation in Lithuanian comprehensive and vocational schools, as well as for teacher in-service training system. Its fundamental advantages in comparison with the other open source systems are: (1) clear social constructivist philosophy and design; (2) modular, extensible architecture; (3) wide and lively developer and user community [6].

In summer 2006 Moodle version 1.6.3 was fully localized by IMI and at the moment is downloadable from ITC server for installation in schools. VLEs most suitable for usage on module level were chosen for comprehensive implementation in Lithuania, therefore de facto decentralized way of VLEs implementation was chosen in Lithuania to strengthen schools as e-learning communities.

Services: LeMill Learning Toolbox. LeMill learning toolbox is under development in CALIBRATE to provide teachers the possibility of collaborative learning and creation of LOM compliant LOs. Its interface will be fully localized till March 2008, ant training is already provided to target group of Lithuanian CALIBRATE teachers.

4 Lithuanian DLE: Model and System Requirements

The newest Strategy for the Introduction of ICT into Lithuanian General and Vocational Education for 2008-2012 is aimed at creation of 'digital learning content' and 'teaching material' in 'compliance with international digital learning content resources standards'.

The main scientific and technologic decisions to provide the ultimate reusability and interoperability of Lithuanian DLE content and services could be full implementation of: (1) LO metadata interoperability standards such as EUN LRE Metadata AP v3.0 of the IEEE LOM standard and specifications such as IMS Common Cartridge (IMS CP AP integrating IMS QTI and LOM) and Learning Design (LD) [6]; (2) repository of LD compliant Units of Learning (UoLs) and tools (e.g. RELOAD, LAMS v.2.0.3 together with Moodle v.1.8, EduSource, etc.) to create and reuse UoLs; (3) LOM repository containing LOs' and UoLs' metadata created in conformity with the newest LRE AP and thesaurus; (4) LOs digital right management (DRM) system; (5) CALIBRATE project's Topic – Goal – Learning Activities (TGA) ontology-based curriculum mapping in main subjects to search for LOs in the repositories and VLEs.

The framework of DLE architecture design based on the introduced hypothesis and European experience in the field is the following:

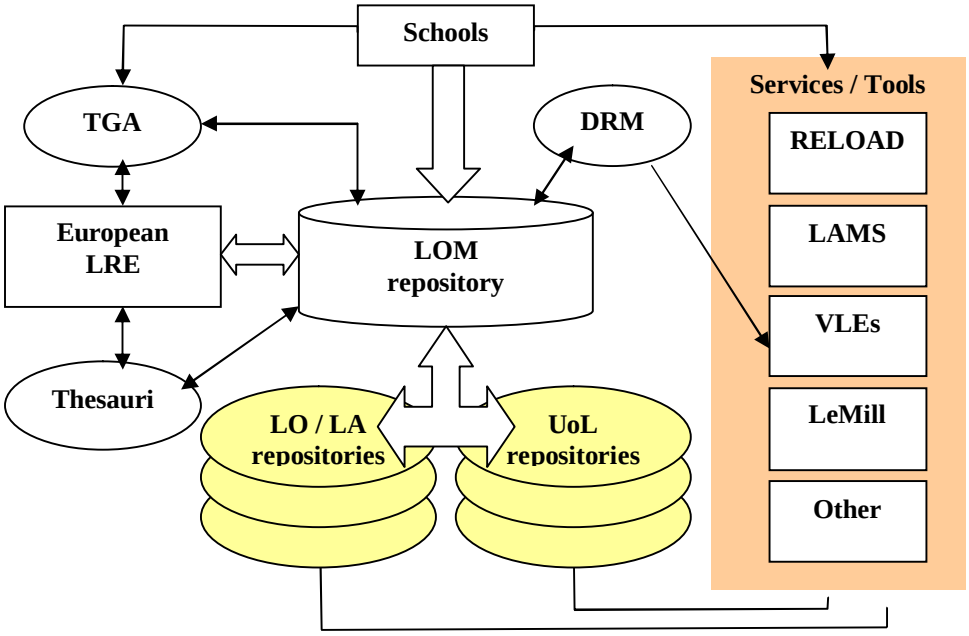

Fig. 1. Proposed framework of DLE architecture design

5 Reusability of Learning Content

The need for reusability of LO / LA has at least three elements:

1. *Interoperability*: it is interoperable and can be used in different platforms.
2. *Flexibility in terms of pedagogic situations*: it can fit into a variety of pedagogic situations.
3. *Modifiability to suit a particular teacher's or student's needs*: it can be made more appropriate to a pedagogic situation by modifying it to suit a particular teacher's or student's needs [11].

LOs Interoperability: Suggestions to LRE AP. Examination of LRE AP v3.0 has shown that it is fully suitable for interoperable working of so-called 'content' LOs and less suitable for UoLs. The 'content' LOs could be LAs and other ultimate reusable pedagogically decontextualised LOs with more complex structure and aggregation level. Approved LAs are considered here the main 'content' components of suggested DLE model.

This examination has also shown that it would be purposeful to prepare Lithuanian LOM AP by revision LRE AP v3.0 to fit the proposed DLE model requirements in order to provide more quick and convenient LAs search possibilities by the means of changing (advancing) the status of LRE AP elements listed below.

In the terms of LRE AP v3.0 ‘multiple reusable pedagogically decontextualised LAs’ are: (1) mainly ‘atomic’ (indivisible) LOs according to Element 1.7 General. Structure; (2) LOs with granularity level 1 (‘the smallest level of aggregation, e.g., raw media data or fragments’) according to Element 1.8 General.Aggregation Level; (3) ‘learning asset’ (‘audio’, ‘data’, ‘image’, ‘model’, ‘text’ and ‘video’) according to Element 5.2 Educational.Learning Resource Type; (4) LOs having vocabulary values ‘very easy’ and ‘easy’ according to Element 5.8 Educational.Difficulty; (5) LOs having vocabulary values ‘ispartof’, ‘isformatof’, ‘isreferencedby’, ‘isbasisfor’, ‘isrequiredby’, ‘ispreviewof’, ‘istranslationof’ and ‘hasmetadata’ according to Element 7.1 Relation.Kind.

Recommendations following these conclusions are to change the status of LRE Metadata AP elements mentioned above and consider them as: (1) mandatory elements: 1.7 and 5.2; (2) recommended elements: 1.8, 5.8 and 7.1.

In the terms of LRE AP v3.0 other more complex LOs / LRs are: (1) collection, networked, hierarchical and linear LOs according to structure; (2) LOs with 2, 3 and 4 granularity level according to aggregation level; (3) LOs other than ‘learning asset’ according to educational type; (4) LOs having educational difficulty value higher than ‘easy’; (5) LOs having more complex kinds of relations with other LOs.

These more complex LOs / LRs could be later on combined of LAs in various ways by searching for suitable LAs in various repositories and VLEs and combining them together for different pedagogical processes / scenarios / activities / designs. Creation of such LOs could be suitable for end users in educational institutions, for different projects, etc.

6 Learning Objects / Learning Assets Evaluation Instrument

In order to select and approve LOs / LAs suitable for proposed DLE model, the original LOs / LAs evaluation instrument based on the above mentioned framework of DLE architecture design is proposed.

In conformity with this instrument LOs / LAs evaluation criteria are: (1) Reusability: (a) interoperability (metadata, compliance with the main standards, can LO be used in different platforms / VLEs?); (b) decontextualisation level (LO granularity level, can LO be reused a number of times in different learning contexts?); (c) accessibility (is LO designed for all?); (d) appropriateness for different cultural and learning systems (LO internationalization level, is LO suitable for localization?); (2) Quality of content: (a) content accuracy; (b) compliance with national curricula; (c) clear and professional presentation (spelling / grammar, are appropriate academic references provided, etc.); (d) interactivity; (3) Design and usability: (a) aesthetics; (b) ease to use (i.e., navigation, user control, etc.); (c) user-friendly interface; (4) Economic efficiency (taking into account the number of probable users in conformity with LO reusability level).

Each selected criterion is proposed to be given an importance rating to be used when evaluating LOs / LAs. Major criteria have to be broken down into sub-criteria with each sub-criterion also having an importance rating. The importance rating range is 0–4, with 0 being the lowest and 4 being of the highest importance. Each sub–criterion has then to be rated using a range of 0–4, these ratings defined as: 0 – failed or feature does not exist; 1 – Has poor support and / or it can be done but with significant effort; 2 – fair support but needs modification to reach the desired level of support; 3 – good support and needs a minimal amount of effort; 4 – excellent support and meets the criteria out of the box, minimal effort [14]. It is proposed to weight each LOs / LAs evaluation criteria equally and to use this simple and clear criteria rating system for evaluation of all main components of DLE: LOs, their repositories and VLEs.

In conformity with proposed DLE model it would be purposeful not to incorporate pedagogically contextualised aspects (that is, everything dealing with LOs usage pedagogical methods / models / activities / scenarios) into LAs evaluation instrument, but to analyze these pedagogical criteria while evaluating separate LD-compliant UoLs [10].

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