

The Roles of Repository of Digital Learning Objects in building a Knowledge-Based Society

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Abstract

Learning is a must to do in every individual knowledge acquisition process. A knowledge-based society has learning implication on its members since they have to have the required knowledge to shape their life. They need to have a searchable or easy to find, accessible, reliable and dependable learning resources to gain knowledge that they need.

There are two aims of this proposed paper. The first one is to elaborate the role of a digital repository of learning object in a knowledge-based society. The second one is to share ideas of a just started PAN-IDRC-supported collaborative research and development to develop a repository of digital learning objects by Asian distance education institutions.

This paper will begin by clarifying the meaning of knowledge-based society in terms of behavior and attitude of members of a knowledge-based society. Based on this clarification, the paper will then derive some implications and needs that has to be fulfilled for knowledge-based society to happen. Further, the paper will elaborate the use of information and communication technology (ICT) in e-learning and the latest trend in e-learning development, in the form of digital learning objects and their repository.

To address the second aim, this paper will elaborate relevant standards to develop digital learning objects and their metadata and build the repository such as Instructional Management System (IMS), Shareable Content Object Reference Model (SCORM) and CanCore, the methods that develops, and the plan to promote them and evaluation on both the learning objects and repository in terms accessibility, acceptance, and usability. Participating institutions, their roles, as well as stages and activities of the research and development activities will also be presented in the paper.

Keywords: knowledge-based society, digital learning object, learning object metadata, learning object repository, IMS, SCORM, CanCore.

The purposes of this paper are to elaborate roles of digital learning object repository in building a knowledge-based society and to share a research and development undertaking to build such a repository for distance learning in Asia.

Role of Learning Object Repository in building knowledge-based society

To address the first purposes, this paper will start by making clarification what is meant by knowledge-based society.

The following are several excerpts found in the literature concerning knowledge-based society:

In a knowledge-based society “knowledge and information are viewed as global public goods, and they are tools to enrich the learning environment, support everyday experience, and augment instructional resources”

http://www.sciforum.hu/knowledge_based_society.html

“A knowledge-based society is an innovative and life-long learning society, which possesses a community of scholars, researchers, engineers, technicians, research networks, and firms engaged in research and in production of high-technology goods and service provision”

http://www.sciforum.hu/index.php?image=update&content=up_knowledge_based_society

A society/economy endowed with the ability and capacity to generate and capture new knowledge and to access, absorb, share and use efficiently information, knowledge, data, communications and best practices.

<http://www.undp.org/info21/present/tokyo/tsld009.htm>

There are several aspects that can be learned from the three excerpts above. The first one is that there must be knowledge production or creation in a knowledge-based society. The second one is that the generated knowledge is to be shared within the society and finally the society need to be equipped so that they will be able to access the knowledge and use it effectively in their daily life to improving their life.

Universities, research institutes and research units of industry whether it is good or services are agents that play the roles knowledge production. As knowledge doubled every ... years, the amount of knowledge is just too much to learn all. There is a need to make the sharing of

knowledge effective and efficient meaning that members of society can easily find the kind of knowledge that they need so that they can utilize it to improve their life.

There are several issues need to be solved in making effective and efficient sharing of knowledge within a society. First of all, there is something to do with the knowledge it self. As it always the case, acquisition of knowledge is usually done through learning. Consequently, to be effective knowledge needs to be presented in learning units. Given the speed and the capacity of knowledge production, the number of learning units is expected to be a large one. This finally requires learning units to be organized in such a way so that society members can easily locate the one they need. Just like a library that has a library catalog, there should be something like catalog for learning unit. The catalog should help learning unit seekers. Entries to such a catalog include, among others, subject, learning objectives, target audience, years of creation, pre-requisites (if any), author(s), and location where learning units are stored.

The advancement of information and communication paved the way for organizing the learning units and to solve the second issue in providing a means for society to access the well organized learning units. The Internet as one of many results in the advancement of information and communication technology has become the world multimedia network. Though the quality of the communication network very much depends on the available infrastructure in certain location, in most parts of the world Internet has been and will continue to be a reliable, fast, and dependable means of multimedia communication network. One of the powers of Internet is that it breaks the barrier of time and space on conducting communication, meaning that communicants do not have to be available neither in the same place nor the same time. It doesn't matter if one communicant is sleeping a thousand miles away when the communicant at the other end sends a multimedia message. The receiver will be able to pick up the message as soon as he wakes up.

Many applications have been developed, up and running on the Internet such as e-mail, file transfer, website presentation, e-learning, e-commerce. The one that is most relevant to the discussion on this paper is the e-learning or online learning. In e-learning teachers and students are able to communicate either real time/synchronous or delayed / asynchronous. Teachers can leave learning units on the course website/ web-pages and students can access it where they time and energy to do it.

The latest development trend on e-learning is development of relatively small learning units or what is usually called as learning objects that are stored in digital repositories with their kind of catalog entries or what it usually known as metadata of learning objects. In addition to what has been discussed earlier, the metadata of learning objects may include the specification of hardware and software to utilize the learning object, the level of the learning objects is it for elementary, secondary, or tertiary education? The purpose of development of the metadata is to increase the reusability, accessibility, and interoperability of the learning objects. In the

repository, there must be a mechanism to select only high quality learning objects so that its users can rely on the repository to get good quality of learning object or in other words the repository and its learning objects are dependable.

As discussed earlier that knowledge grows rapidly and the capacity of knowledge production is overwhelmingly big and that one best be to get members of society learn the newly created knowledge by engaging the in learning activities, the idea of repository of digital learning objects comes to play. The newly created knowledge by universities, schools, research institutions, and other knowledge producing bodies is presented to the society in the form of learning objects and tagged with accurate metadata . These learning objects and metadata are stored in repositories that are accessible through computer networks, such as the Internet. MERLOT (www.merlot.com) , and Co-operative Learning Object Exchange OR CLOE (cloe.on.ca) are examples of digital learning object repositories.

There are several standards of metadata for learning objects repositories namely the Instructional Management System of IMS-Global Consortium, the Shareable Content Object Reference Model (ADL-SCORM) and CanCore among others. The IMS standard is basically the standard which other standards refer to. The following is the summary of IMS metadata standard.

1. General
 - a. Identifier
 - b. Title
 - c. Catalog Entry
 - 1) Catalog
 - 2) Entry
 - d. Language
 - e. Description
 - f. Keywords
 - g. Coverage
 - h. Structure
 - i. Aggregation level
2. Lifecycle
 - a. Status
 - b. Contribute
 - 1) Role
 - 2) Entity
 - 3) Date
- 3) Metametadata
 - a. Identifier
 - b. Catalog Entry
 - 1) Catalog
 - 2) Entry
 - c. Contribute
 - 1) Role
 - 2) Entity
 - 3) Date
 - d. Metadata scheme
 - e. Language
4. Technical
 - a. Format
 - b. Size
 - c. Location
 - d. Requirement
 - 1) Type

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- 2) Name
 - 3) Minimum version
 - 4) Maximum version
 - 5) Installation remarks
 - 6) Other platform requirement
 - 7) Duration
- 5. Educational
 - a. Interactivity type
 - b. Learning resource type
 - c. Interactivity level
 - d. Semantic density
 - e. Intended end-user role
 - f. Context
 - g. Typical age range
 - h. Difficulty
 - i. Typical learning time
 - j. Description
 - k. Language
 - 6. Right
 - a. Cost
 - b. Copy rights and other restrictions
 - c. Description
 - d. Language
- 7. Relation
 - a. Kind
 - b. Resource
 - 1) Identifier
 - 2) Description
 - c. Catalog Entry
 - 1) Catalog
 - 2) Entry
 - 8. Annotation
 - a. Person
 - b. Date
 - c. Description
 - 9. Classification
 - a. Purpose
 - b. Taxonomy path
 - 1) Source
 - 2) Taxonomy
 - a) identity
 - b) entry
 - c) taxonomy
 - c. description
 - d. keywords

Next to IMS is the SCORM which is a standard developed by the Advanced Distributed Learning of Department of Defense USA. The metadata of the SCORM depicted in the picture below that is taken from Manifest Maker of Dreamweaver that is capable of producing SCORM 1.2 compliant learning object manifest that include metadata in it.

The screenshot shows a software window titled "Manifest Maker for ADL SCORM 1.2". At the top, there are three radio buttons: "Metadata" (selected), "SCOs", and "Resources". Below this, there are several input fields and dropdown menus. The "Manifest ID" field contains "TrackedCalculator-MANIFEST". The "Version" field contains "1.0". The "Title" field contains "TrackedCalculator". The "Description" field contains "This is a calculator application that is treated as a learning object". The "Keywords" field contains "calculator". The "Catalog Name", "Catalog Entry", and "Lifecycle Version" fields are empty. The "Lifecycle Status" dropdown is set to "Draft". The "Educational Resource" dropdown is set to "Simulation". The "Cost" dropdown is set to "no". The "Copyright" dropdown is set to "no". The "Rights Description" field contains "public". The "Classification Purpose" dropdown is set to "Prerequisite". The "Copy XSD Files" checkbox is checked.

SCORM Metadata

Other standards such as CanCore that is used in Canadian Education System, share many aspects of the IMS metadata. It drops several fields of metadata but add some others to suit its own needs.

Up to this point, it can be concluded if knowledge of the past, present, and future can be presented in the form of learning objects and tagged with metadata comply to one of the standards discussed earlier, and then made the in repositories of learning objects and made accessible through Internet will pave they way for sharing the knowledge to the society. Still some work need to be done to install the infrastructure and train the society how to access the knowledge in the repository and in using the learned knowledge to improve their living either in small scale-individual level or up to a national level. Having finished discussing the role of

repositories of digital learning objects it is time now to move on to share information on the research and development effort on developing a digital repository of reusable learning object for distance learning in Asia.

A Digital Repository Of Reusable Learning Object For Distance Learning In Asia

This research and development activities to develop a digital repository of reusable learning object for distance learning in Asia is one of the nine R & D activities of Pan Asia Networking Distance Learning Technology that is funded by International Research Center of Canada and is organized by PAN-Asia Networking Singapore.

The underlying rationale for the development of the repository is as follow. Many education institutions have developed and applied some kind of ICT-supported learning system. Within their efforts, those institutions have also been developing learning content deliverable through the Internet. The problem faced by many institutions with regard to content development is usually related to the high cost required for it. In the mean time, due to the lack of collaborative networking, a lot of similar if not redundant content is being developed everyday. This has decreased the capacity of the institutions to catch up with the necessary scope of content to be developed. In other words, there is a lack of institutional interchange of Learning Objects Materials (LOMs) among education institutions in Asia.

In relation to this, institutions are also faced with the problem of multidisciplinary curriculum development in a compatible and interchangeable way. One way towards solving this problem is to collaboratively harmonizing efforts for standards-based exchanges of educational resources. These efforts towards harmonization also address the needs of institutions to make themselves more cost effective in content development.

The project aims to address this problem through enhanced sustainable collaboration between Asian partners' Education institutions. The approach is to create an integrated platform for the open exchange of LOMs, to develop examples of LOMs for selected curricula, and to try-out the usability of the LOMs by individual course institutions/developers. The tangible results include a repository of LOMs based on this framework, as well as the flexible and maintainable environment for growth of interchangeable LOMs.

Research and Development Methodology

Research and Development Activities is started by a literature review on learning objects, repository and on metadata of learning objects. Based on the finding of this literature study operational definition of learning objects was formulated, functions of the repository have been decided, and metadata structure of learning objects has also been finalized. Based on these definitions and formulations, 120 learning objects in Mathematics, Statistics, Chemistry, Physics,

and Biology will be developed. To reach broader audience in increase their reusability the learning objects will be made available in four languages: Indonesian, Thai, English and Khmer. The development of the learning objects and their metadata as well as the repository will take approximately a year. Once finished they will be tested. Professors in the subjects identified above will be informed about the availability of the learning objects and information how to use them and they will be persuaded to use learning objects in their teaching. At the end they will be asked to respond to a research and evaluation instrument regarding the reusability, accessibility, and interoperability of the learning objects as well as the usefulness of metadata and the repository. Data collected by this instrument will then be analyzed to assess whether the the objective of developing the learning object repository has been achieved or not. The following are several results of the initial activities of the research and development.

The operational definition of learning objects is as follows. A Learning Object within this development is suggested to includes the following aspects:

1. It should be structured in a meaningful way and is tied to an educational objective
2. It should be self-contained and can stand on its own so that it may be used independently (stand-alone) or in combination (aggregated) with other objects as required
3. It should be available on-demand across different learning systems
4. It should be tagged with descriptive metadata, allowing them to be easily found and used
5. It should be:
 - a. in digital format
 - b. the digital materials should contain still images, video clips, simulations, and/or sounds
 - c. each visualization should not exceed 3 minutes of viewing
6. Time to learn the learning object is about 30 minutes of studying

Therefore, the LOM is suggested to be made up of the following 6 essential phases to make it a coherent learning experience:

1. **Introduction** - Context and learning objective(s).
2. **Preparation** – Pre-requisite skills, knowledge or equipment and where necessary a pre-assessment.
3. **Study Materials** – Presentation of knowledge or skill with informal formative assessment.
4. **Self-Assessment** - Immediate formal formative feedback.
5. **Off-Line Task** – Application of the knowledge or skill within a real world and active setting.
6. **Activity track records** in Learning Management System:
 - a. When a learner starts and ends
 - b. What a learner does with the LO
 - c. Results of exercises, quizzes, and test in LO

The functions of the repository will include:

1. Storing Place (Repository of) by using intermediate buffer
 - a. Learning Object Metadata
 - b. Learning Object (learning object can be stored in this site or in other site, the repository only give the URL)
2. Facilities for:
 - a. Contributors to put learning object metadata and its learning object
 - b. Users/Clients:
 - 1) Searching Learning Object they need by using keywords and related words in metadata
 - 2) Accessing Learning Object
 - 3) Download Learning Object
3. Recording
 - a. Contributors
 - b. Users/Clients
 - c. Usages
4. Access Management
 - a. Contributors access profile
 - b. Registered users access profile
 - c. Guests access profile
5. Statistics
 - a. Accesses
 - b. Learning Objects by subjects
 - c. Downloads
6. Security Measures:
 - a. Backup facilities
 - b. Disaster Recovery Mechanism

The structure of the metadata for the repository follows to the IMS metadata structure with several minor changes.

There are five institutions participating in this research and development, namely Universitas Terbuka – Indonesia, Sukhothai Thammathiorat Open University – Thailand, Alama Iqbal Open University (AIOU) – Pakhstan, International Institute of Education (IIE)-Cambodia and Open University of Hong Kong (OUHK) – China, Universitas Terbuka is the leading institution in this activity. UT and STOU each will develop 60 learning objects. UT will develop learning object in Chemistry, Physics and Biology, whereas, STOU will develop learning objects in Mathematics and Statistics. Representative from AIOU and IIE acted as resource person in formulating

metadata structure and functions of the repository. In addition the representative from IIE will coordinate the translation of learning object from English into Khmer. The representative of OUHK will participate in the evaluation of the learning objects, metadata, and the repository.

The learning objects, metadata and repository is scheduled to be up and running for pilot test in April of 2006 and the final report is scheduled at April 2007. During the development, the website of the repository will be hosted by UT and ASEAN Foundation. However, later on the course, the website at UT will be stopped and the repository will only be available on the ASEAN Foundation website.

Conclusions

In this paper the role that repositories of learning objects can play in building a knowledge-based society and effort to develop a repository of reusable learning objects for distance learning in Asia have been discussed. Though at its start the repository focused to meet the need of knowledge or learning objects sharing between distance learning institutions in Asia, it does not mean that it is restricted in that focus. The possibility is widely open to invite other knowledge producing institutions outside educational institutions to cater the repository with the newly-created knowledge.

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