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LEARNING OBJECTS: FROM CONCEPTUALIZATION TO UTILIZATION

1. Introduction

Learning objects are the recent entrants in the e-learning community. A learning object consists of two parts: the content and the metadata. It is a small piece of instruction designed to be reused in multiple instructional contexts. IEEE's Learning Technology Standards Committee (2000) defines learning objects as „Any entity, digital or non-digital, that can be used, re-used or referenced during technology-supported learning. Examples of technology-supported learning applications include computer-based training systems, interactive learning environments, intelligent computer-aided instruction systems, distance learning systems, web-based learning systems and collaborative learning environments."

Wisconsin Online Resource Center's states that „Learning Objects are small, independent chunks of knowledge or interactions stored in a database – can be presented as components of instruction or as reference information." Its definition of LO expands to the following:

- Small, independent chunks of knowledge or interactions stored in a database – can be presented as units of instruction or information.
- Based on a clear instructional strategy – intended to cause learning through internal processing and/or action.
- Self-contained – each learning object can be taken independently.
- Interactive – each learning object requires that students view, listen, respond or interact with the content in some way.
- Reusable – a single learning object may be used in multiple contexts for multiple purposes.

- Able to be aggregated – learning objects can be grouped into larger collections of content, including traditional course structures.
- Tagged with metadata – every learning object has descriptive information allowing it to be easily found by a search.

Wiley (2000) defined LOs as „any digital resource that can be reused to support learning. This definition includes anything that can be delivered across the network on demand, be it large or small."

There are many benefits in using learning objects. For example, reduced costs, personalized learning, interoperability, and customization are benefits reported by Elearnspace (2003). Other benefits include increased value of content; improved content flexibility; improved updating, searching, and content management; and content customization (Longmire, 2000).

2. Purpose

The notion of reusable learning objects imposes the idea of order and structure of being systematic and methodical. It facilitates the quantitative evaluation of instructional activity and the ability to pinpoint unintended weakness in design and implementation. The purpose of this paper is to present the essentials of learning objects from conceptualization to utilization in seven phases. They are are:

- Phase I – Conceptualizing
- Phase II – Preparing
- Phase III – Creating
- Phase IV – Tagging
- Phase V – Storing
- Phase VI – Managing
- Phase VII – Evaluating

These seven phases specifically address the digital environment and its capabilities to design, develop, and deploy learning objects.

3. Phase I – Conceptualizing

As with any design and development project the most important work is done during the conceptualization phase. If it is done properly, it can save time and money in delivering the desired result. It is during conceptualization that the problem is analyzed. This encompasses the whole environment. To deliver the instructional objective, the whole environment is considered to achieve the objective. This includes the audience and their assumed and required skills to negotiate the instructional content. It includes the hardware, software, and network configurations to ensure no oversight in technically deploying the content. It then requires innovation to consider cost versus capability – to deliver the optimal result within the determined budget and time constraints. Different media types will be

considered and evaluated, based on the contribution any particular media type, or blend of media types, will have to promote the objectives and the ability to develop them given the time and money constraints.

The conceptualization during the maiden voyage of a project will be extensive. It is a crucial activity to confirm the validity of initial perceptions. Further projects within the same realm would likely be based on the work done during the initial conceptualization with a transfer of decisions and assumptions regarding the technical environment and the population and the scope of the instructional mission. Thus, it might seem that conceptualization is not a part of subsequent learning object development cycles, yet it would be anchored to the initial conceptualization session and remains relevant. With the facts on the ground determined during conceptualization, the considerations of the *preparing* phase become evident.

4. Phase II – Preparing

Learning objects can be deployed on many platforms. This notion of platform-independent reusability emphasizes the adherence to standard to enable reusability, interoperability, and accessibility.

Reusability

Reusability is the use of existing learning objects in various instructional contexts. Reusability of learning object means that it can be used over and over in multiple contexts. Reusability improves productivity, lessens the cost of production, and enhances the quality of instruction (Garzotto, Mainetti, & Paolini, 1996). To achieve reusability a learning object must be interoperable and accessible.

Interoperability

Interoperability is the ability of the learning object to function in various platforms. In other words, interoperability assures that learning objects not platform dependent. They can function in any delivery media regardless of the platform used.

Accessibility

Accessibility ensures that the learning object is accessible and read by the end user regardless of location, experience, or the type of platforms used. Both interoperability and accessibility contribute to increased usability. To attain interoperability and accessibility standards should be used.

Standards

Standards are necessary for interoperability and accessibility of learning objects. Standardization allows learning objects to be interoperable. As a result, standards assure reusability of learning objects. Listed below are several

organizations working on standardization. For more information about these standards visit the URL that follows the description.

- IEEE LO Metadata (LOM) Learning Technology Standards Committee (LTSC) P1484.
  „The IEEE Learning Technology Standards Committee (LTSC) is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices, and guides for learning technology. The LTSC coordinates formally and informally with other organizations that produce specifications and standards for similar purposes. Standards development is done in working groups via a combination of face--to-face meetings, teleconferences, and exchanges on discussion groups. The LTSC is governed by a Sponsor Executive Committee (SEC) consisting of working group chairs and elected officers." (http://ltsc.ieee.org/)
- Advanced Distributed Learning (ADL) Initiative Shareable Courseware Object Reference Model (SCORM)
  „The Sharable Content Object Reference Model (SCORM) aims to foster creation of reusable learning content as "instructional objects" within a common technical framework for computer and Web-based learning. SCORM describes that technical framework by providing a harmonized set of guidelines, specification and standards. Borrowing from work of other specification and standards bodies, ADL developed a model for creating and deploying e-Learning." (http://www.adlnet.org/)
- IMS (Instructional Management System) Global Learning Consortium
  „The mission of the IMS Global Learning Consortium is to support the adoption and use of learning technology worldwide." (http://www.imsproject.org/)
- PROMETEUS: PROmoting Multimedia access to Education and Training in EUropean Society
  „PROMETEUS is a European Partnership for a Common Approach to the Production of e-learning Technologies and Content." (http://www.prometeus.org/)
- The Dublin Core: Metadata for Electronic Resources
  Dublin Core: Metadata for Electronic Resources „is an open forum engaged in the development of interoperable online metadata standards that support a broad range of purposes and business models" (http://dublincore.org/)

5. Phase III – Creating

Content/Granularity

The content is a concept, theory, or view that has evident and understandable learning goals. To be considered valuable, the learning object content must have educational value. The content of a learning object is directly associated with granularity. Granularity refers to size and decomposability of the virtual learning

object. It also refers to the extent a virtual learning object is planned to be utilized as an element of a larger resource.

IEEE (2002) Learning Object Metadata (LOM) refers to granularity as an aggregation level that describes the functional granularity of a learning object. It offers the following scale for aggregation levels:

1. The smallest level of aggregation (raw media data or fragments).
2. A collection of level 1 learning objects (a lesson).
3. A collection of level 2 learning objects (a course).
4. The largest level of granularity (a set of courses leading to a certificate).

Granularity directly influences the learning object's reusability. Wiley (1999, p.2) asserts that reusability and granularity represent "the two most important properties of learning objects." Granularity means that objects as units can be aggregated in multiple ways. This means that an object can serve one purpose and in the meanwhile it can be aggregated with other objects.

Instructional Design/User Interface

When designing the content of the learning object attention must be given to instructional design theories and principles suitable for virtual learning objects used in e-learning settings. The transparency of the interface should be evident as content and method interact with the learner. Koohang & du Plessis (2004) suggested constructivism theory and principles as a suitable choice of e-learning designers. Specifically, Bannan-Ritland, Dabbagh, & Murphy (2000) assert that constructivism theory is well-suited for designing learning objects.

User interface is a significant element of design of the virtual learning objects. Koohang & du Plessis (2004, p. 43) state „All instruction occurs in some medium or an ensemble of media, ranging from mediation by air itself in direct face-to-face instruction, to instruction via the Internet with mediation by digital technologies. The moment the learner has to manipulate tools, equipment, or a system, usability is an essential issue. The usability properties are essential for e-learning instructional design process and subsequently instruction and learning to be conducted effectively." As a result, usability and user interface must be given attention in designing and creating learning objects.

Authoring tools

Authoring tools may be used to create the content of a virtual learning object. The authoring tools consist of multimedia software that are capable of producing text, still/animated/graphics images, audio, and video images. For example, Macromedia Flash ™ is a vector based animation program that can adapt to different display sizes and resolutions for fast download. It allows integration of video, text, audio, and raster graphics into learning objects. There are other software and editors that allow design and development of learning objects. An example of a learning design editor, a work in progress, can be found at http://www.reload.ac.uk/ldea.html.

6. Phase IV – Tagging

As mentioned earlier in this paper, a learning object consists of the content and metadata. Metadata is information about the content. Metadata is the tagging part of the learning object. Metadata tools are used to create metadata records. A metadata record is a set of elements that describe the content, including creation date, author, format, title, topic, etc. The metadata helps the discoverability, accessibility, and eventually the reusability of learning objects. The most prominent specification for metadata is the IEEE's specification of Learning Object's Metadata (LOM). The IEEE LOM defines nine categories for learning object metadata. They are as follows:

1. General – Describes the learning object as a whole.
2. Lifecycle – The history and current state of learning object.
3. Meta-Metadata – Metadata describing the metadata for learning object.
4. Technical – Technical requirements and characteristics of learning object.
5. Educational – Educational and pedagogic characteristics of learning object.
6. Rights – Intellectual property rights and conditions of use for learning object.
7. Relation – Relationship with other learning objects.
8. Annotation – Comments on the educational use of the learning object.
9. Classification – Learning object's relation to a particular classification system.

IEEE 's charted objective is the ongoing development and improvement of an XML binding for LOM (Standard for XML binding for Learning Object Metadata data model). A LOM editor is used to create a LOM records and then store the metadata records in the appropriate repository. Below are several LOM editors used to tag metadata:

- ALOHA: Java and XML-based tool for metadata tagging. http://aloha.netera.ca/
- DC-dot: Dublin Core Metadata Editor - A metadata editor created for Dublin Core metadata. It does, however; crosswalk the metadata into IMS. http://www.ukoln.ac.uk/metadata/dcdot/
- IMSE/VIMSE: A graphical editor written in Java. It is for editing IMS metadata XML files. http://imsevimse.sourceforge.net.
- LOM Editor: Designed for LOM information model. http://www.multibook.de/lom/

7. Phase V – Storing

Learning Object Repositories

LOs are sorted in a place known as LO repositories. There are two types of LO repositories. The first type contains the LOs and the LO metadata. This repository is used to locate and deliver LOs. The second type contains only the metadata. The

LOs in this type of repository are normally located at another place. This repository is used to only locate LOs.

According to Downes (2002) there are two major models of LO repositories: centralized and distributed. The centralized repository consists of the LOs metadata that is on a single server and the LOs are located elsewhere. The distributed repository, however; consists of the LO metadata in a number of connected servers. This model uses a peer-to-peer architecture that allows multiple servers to communicate with each other.

- Apple Learning Interchange (http://ali.apple.com/ali/resources.shtml)
- CAREO (http://careo.netera.ca)
- Distributed Learning Object Repository Network (DLORN) (http://www.downes.ca/cgi-bin/dlorn/dlorn.cgi)
- MERLOT (http://www.merlot.org/Home.po)
- Portal for Online Objects in Learning (POOL) (http://www.edusplash.net/)
- Wisconsin Online Resource Center (http://www.wisc-online.com/)

By means of a LO repository, the LOs can be accessed (accessibility). They can be reused (reusability) in various instructional contexts within and across disciplines. The instructor is also able to share (sharable) and exchange LOs with other instructors within and across disciplines.

8. Phase VI – Managing

Learning Content Management System (LCMS)

According to Downes (2002) a course is a larger chunk of instruction and to construct a course, a set of LOs are to be pulled together into a *package* where they are organized sequentially. This sequence identifies course-specific units, i.e., course outline or table of contents. A Learning Content Management System (LCMS) is used to construct packages. The author further adds that a typical LCMS normally contains four vital parts. They are: an authoring application, a repository, a delivery interface, and administration tools. A LCMS offers adaptability in such a way that the LOs can be personalized for each individual learner.

- Claroline (http://www.claroline.net/) - A collaborative learning environment that allows professors to create and administer courses via the Web.
- LRN Course Management (http://www.collaboraid.biz/products/dotlrn) – Supports courses in online communities.
- EduZope (http://www.eduzope.org/) – A Content Management System
- Moodle (http://moodle.org) – A course management system helping professors create Web sites for their course.

9. Phase VII – Evaluating

The computer's ability to report on activity within a learning event enables the evaluation of content and the associated activities an affordance that has be

exploited. It is imperative that instructional sessions are evaluated to determine how well it meets the objectives. It has to be emphasized that content is not a dormant entity and should not be defaulted to auto-pilot usage. With the content placed in a management framework, developers, administrators, and users will be able to address flaws in the design to edit weak content in the quest to meet the expected results. It is possible, for example, to determine content that is hardly ever accessed. With multiple choice questions, distractors that are never selected might be replaced with an option worth of consideration by users. Content and activities can be evaluated based on the time it takes to complete the activity. Activities taking too long can be analyzed and the issue remedied.

10. Conclusion

Digital learning objects have the potential to transform the design and delivery of instruction. The question is how institutions, especially higher education, could capitalize on the many benefits of learning objects. This includes saving time, money, and enhancing personalized learning, sharing, and reusing. This paper has presented the essentials of digital learning objects from conceptualization to utilization in seven phases – conceptualizing, preparing, creating, tagging, storing, managing, and evaluating. These essentials work together in order to create and utilize sound and valuable learning objects that possess educational values.

Many institutions of higher education are engaged in creating a new educational world in virtual space. In this virtual educational space, content can be developed and shared globally. The anticipated results and transformation provided by virtual development will offer sound learning objects that adhere to platform-independent standards that delivers the promise of reusability at different granular levels. There is, however; a need for social networking and international collaboration to materialize the long term objective of the reusability internal to an organization. There is also a need for a global collaboration among organizations with a similar mission.

It is also imperative that the impending key issue of open content development is raised and encouraged among the learning communities. In addition to the promotion of learning object development and usage according to the seven phases presented, the culture of collaboration will have to be nurtured in an open learning community/environment where learning objects could be used and reused by everyone.

The Internet already fulfills the dream of providing much information on extremely diverse topics. The next challenge is to continue expanding the concept of open access to information. Current and emerging open repositories must and will serve the global needs of education. Now is the time to establish the culture and processes to deliver this promise to the next generation.

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LEARNING OBJECTS OD KONCEPCJI DO PRAKTYKI

Streszczenie

Jedną z istotnych cech e-learningu jest idea tworzenia komponentów treści i ich wielokrotnego wykorzystania. Budowa materiału dla potrzeb kształcenia zdalnego może polegać m.in. na kompletowaniu treści z samodzielnych modułów, zwanych komponentami wiedzy. Idea ta zmierza do tworzenia obiektów wiedzy wielokrotnego użytku - *Reusable Learning Objects* (RLO). To idea, która ma zmienić obraz e-learningu.

Stosowanie obiektów wiedzy wielokrotnego użytku w wielu przypadkach przynosi wymierne korzyści. Odbiorcy umożliwia otrzymanie spersonalizowanej, dostosowanej do indywidualnych potrzeb treści szkolenia przy równoczesnym podziale wiedzy na niewielkie porcje tak, aby nauka przebiegała efektywnie. Natomiast osobom budującym kursy daje to możliwość wyboru treści zwykle z szerokiego wachlarza już przygotowanych obiektów oraz dopasowania programu dla potrzeb zróżnicowanej grupy odbiorców.