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INSTRUCTIONAL CONTENTS FOR CENTRALIZED LEARNING OBJECT

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***Abstract*—**Learning object is main unit of digital educational content. Learning objects are introduced in order to standardize and enable effective use of educational contents. They can be used and reused for a variety of learning purposes. Learning object metadata regulate what learning objects include and represent. Its type and structure is usually described by a metadata record. There are many standards that regulate metadata of learning objects, but these standards are not universal for all aspects of learning objects. Learning objects are stored and organized in a repository. Metadata facilitate searching of objects, but even with right metadata it can be hard to find appropriate learning object. This paper presents recommendation for solution of organizing learning objects in centralized repository in order to standardize and categorize learning objects.

***Keywords*—**learning objects, e-learning, learning content, digital learning content, learning object repository.

I. INTRODUCTION

IN the last few decades we have seen major changes, both in the teaching methods and in the methods of preparing and delivering learning materials based on digital technologies. Internet allows access to large amounts of information that embody knowledge. Using digital learning content completely transforms process of teaching and learning and result to the process called e-learning. The growth of e-learning is directly related to the increasing access to information which represents digital educational content.

In the field of education, learning object represents small instance of instructional components that can be used unlimited number of time in different context. A learning object is a reusable collection of information used as a modular building block for e-learning content. In practical terms, a learning object is a piece of digital learning content. Storage for learning objects which represent educational resource is called learning object repository. However, not everything can be qualified as learning object and educational resource. It is important to standardize and organize learning content as well as storage for that learning content.

In the first part of this paper we present learning objects potentialities and problems connected with standards for learning objects. Second part of paper focuses on preparation of learning objects and represent basic concept for centralized learning objects repository in order to standardize learning objects and its storage.

II. WHAT IS LEARNING OBJECT?

The problems related with learning objects begin with the definition of the term "learning object" itself. According to IEEE Learning Technology Standards Committee definition, the learning object is any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning [1]. This often cited definition implies that learning objects can include any type of information (multimedia content, instructional content, learning objectives, events, persons, organizations, etc), so it is difficult to define what is not learning object.

For developers it is difficult to create system design which has adequate interaction with learning objects while it is not know which learning objects will be used in that system. For developers of learning objects it is difficult to create objects while they don't know which learning objects will be used for which purpose.

Problem of this definition is that it fails to exclude what could not be "referenced during technology supported learning" [2, 3]. In order to clarify idea of learning object a definition must to be meaningful [3, 4].

Learning objects need to be labeled, described, investigated and understood in ways that make their advantages apparent to creators, teachers and learners. Meaning of learning objects need to be clear both to developers and to end users.

Definitions of learning objects are controlled by those who make them, but there is need for standardization of some parts that should to be unique for all definitions. Definition appropriated for this paper is that learning objects are digital entities of which learning content consist. Focus of this study is to define what learning objects contain and how to prepare, store and use components of learning objects. In order to define use of

learning objects it is important to define learning objects repository. While, much work has been done in this area, it is still an ongoing area of research and there are many problems connected with learning objects that need to be solved.

III. LEARNING OBJECTS STANDARDS

Many organizations actively developing standards and specifications for e-learning, (IMS Global E-Learning Consortium [5], the IEEE Learning Technologies Standards Committee [6], ISO Subcommittee on "Information Technology for Learning Education and Training" [7]) to produce a direct cost savings and allowing that e-learning systems could be used in a wider range of applications, and used more efficiently.

However these standards don't regulate learning content and systems for managing and delivering that content. Moreover, educational content and systems often are developed independently of one another, in a manner that makes it very difficult to support their interchange and scalability. E-learning standards are developed manly to ensure the interoperability, portability and reusability of learning content and of these systems [8].

Designers and developers of digital learning materials have variety of tools and frameworks for creating learning resources, but these tools range from very simple to more complex authoring environments. Learning systems and frameworks can be very useful for creating learning resources, but they often do not share a common mechanism for finding and using the resources. A number of organizations started developing standards for the learning technology in order to facilitate approach to the learning content (learning objects). Standards are needed to assure the interoperability of different instructional technologies, specifically different learning objects. Main goals of standards are to make learning objects to be modular, interoperable, sharable and discoverable. Sometimes, standards identify the pedagogical properties of learning objects, but they don't regulate them. Moreover, they are frequently described as "pedagogically neutral" or "pedagogically agnostic" [9][10]. Also, standards may be customized for a particular use.

IEEE (The Institute of Electrical and Electronics Engineers - IEEE) committee produces formal standards and includes a number of working groups that are involved in the process of defining these standards and each addressing a different aspect of the problem. 1996 IEEE developed and represents LTSC (Learning Technologies Standards Committee) working group that produce instructional technology standards for purpose of effective use of learning objects metadata.

LTSC has developed a draft standard "Learning Objects Metadata" (LOM - Learning Object Metadata Standard (IEEE LTSC 1484.12.1)) [1]. Standard describes the LOM data model and it is the first part of a multipart standard. LOM is introduced for describing learning resources. Other parts of the standard (IEEE 1484.12.3 and IEEE 1484.12.4) define how LOM should be represented in markup language or metadata data models [11][12].

IMS (Instructional Management System) consisting of many sub-committees and sub-projects. IMS GLC (Instructional Management System Global Learning Consortium) develops open interoperability standards that are the most widely used learning technology standards in the world, such as QTI [13] and Content Packaging Specification [14]. The European Union ARIADNE (Alliance of Remote Instructional Authoring and Distribution Networks for Europe) team has worked with IMS Metadata working group on the development of other standards within the LTSC domain [15].

The Aviation Industry Computer-Based Training Committee (AICC) is an international association of technology-based training professionals formed to develop guidelines for the aviation industry in the development, delivery and evaluation of computer based and related training technologies. AICC has focused on reuse and interoperability of e-learning and coordinates its efforts with other learning technology standards organizations like LTSA (IEEE) and ADL [1][16].

SCORM (Sharable Content Object Reference Model) is generated by Advanced Distributed Learning (ADL) initiative which incorporated the efforts of IMS, AICC, ARIADNE, and LTSC (IEEE) into a single reference model for learning design and delivery. SCORM represents collection of standards and specifications for the packaging and sequencing of educational material in the form of shareable, reusable content objects [17]. This standard can be used for building effectively reusable learning objects (SCORM learning objects). SCORM learning objects comprises a collection of assets, which represent pieces of educational content.

SCORM 2004 version introduced a set of rules that defines the order in which a learner may experience content objects. The SCORM Content Aggregation Model represents a pedagogically neutral means for developers of instruction for learning resources. The SCORM Content Model is made up of three components: Assets, Sharable Learning Objects and Content Aggregations, which support creation, discovering and aggregation simple assets into more complex learning content [18]. Generally, SCORM provides one of the best examples of the application and integration of the learning standards.

IV. LEARNING OBJECT METADATA

Learning object metadata regulate what learning object include and represent. Learning objects are tagged with metadata. Metadata facilitate process of object identification by search engines or used system. Learning object's type and structure is usually described by a metadata record. Metadata are used in order to facilitate learning objects localization, identification, storage and retrieval, the learning objects. Generally represent an external structure of information.

Components of learning objects are types of information that may be included in a learning object and its metadata. Some of the attributes of learning objects included by metadata are: type of object, author data, format, pedagogical requirement, technology requirements, terms and rights, etc.

LOM is internationally accredited technical standards recommended practices and guides for learning technology and learning objects. The LOM comprises a hierarchy of elements (metadata) needed for locating, managing and evaluating learning objects.

LOM defines which components of learning object can have a status of obligatory (must be present) or optional (maybe absent). The LOM standard proposes technical details including how data model work, requirements, application profiles, but don't include the pedagogical attributes. According to LOM standard, some of the types of information included in learning objects are: general descriptive data (subject area, descriptions, keywords...), instructional content (text, web pages, multimedia elements...), rights (cost, copyrights, restrictions on use...), relationships to other learning objects (courses) and other information [1].

There are more standards for learning objects description, one of them is The Dublin Core Metadata Initiative, which provides core metadata vocabularies in support of interoperable solutions for discovering and managing learning resources [19].

Metadata, except its usage for description of objects, are also used for their administration and structuring. However, it is not only metadata standards what is needed, also it is important to some aspects of learning objects to be standardized.

V. LEARNING OBJECT REPOSITORIES

Learning objects are stored and organized in a repository. Learning object repository usually represents resource of learning objects with search function. These resources can have a simple keyword search tool or more advanced searching features. Learning objects stored in repository should to be easily accessible and sharable. Repository also has to follow certain standards which ensure structurally searching and objects exchange between different repositories. End user will access to learning objects stored in repositories with adequate systems.

Repositories can store complete learning objects with content and its metadata, and there are repositories that contain only reference to learning objects and its physical location.

One of the best known general repositories is MERLOT [20]. MERLOT is a free and open online resource for sharing learning materials. MERLOT represent repository based on reference to learning objects, which include links to online materials with reviews and assignments. There are several other repositories with learning objects such as: Wisc-Online (Wisconsin Technical College System) [21], NCLOR (North Carolina Learning Object Repository) [22], Content Sharper Authoring Tool and Virtual Inorganic Pedagogical Electronic Resource [23].

Many of multimedia resources founded on Internet can qualify as learning objects, but not everything on the Internet is a learning object. When searching for learning objects it is important to revise factors as the intended audience as well as the content of potential learning objects.

VI. PREPARING LEARNING CONTENT FOR CENTRALIZED REPOSITORY

In order to standardize learning object storage it is need to define and categorize learning objects as well as its design. When learning objects are categorized and have design principles, it is easier to manipulate them.

Background system allows inserting each learning object ever created in one large database. Access to large resource of learning object on the same location, improves process of searching and using these objects.

Categorization and using centralized resource of learning objects brings order in system, allows ranking the learning objects and improve process of learning.

A. Learning object design

Even when learning objects are founded they can be in different forms, types or design. Without standard for design of learning objects they cannot be used on every platform or system for learning. In order to be compatible with as much as possible technologies learning objects need to have standardized design.

This paper represents a set of recommendations for the design of learning objects for delivery with any technology. Our recommendations for design of learning objects are based on using three types of learning objects: standalone, primary objects (parallel objects) and connector objects. Basic elements of learning objects design are learning object content, description and metadata.

Design principle presented by this concept is based on following recommendations:

- Standalone objects include only multimedia elements.
- Primary objects include standalone objects with text;
- Primary objects also can reference each others.
- Connector objects include only reference to primary and standalone objects.
- Every object should include short description about its content
- Metadata include all relevant information about objects, its authors and rights

B. Centralized repository of learning objects

In our approach we represent system with centralized base of learning objects which represent centralized repository of learning objects. This type of repository includes objects physical location and its content.

System will include three types of learning objects: standalone objects (1st level of learning objects), primary objects (2nd level of learning objects) and connector objects (3rd level of learning objects). Standalone objects include only multimedia elements without text. Primary objects include standalone objects as reference and additional text. Connector objects only include reference to standalone and primary objects. On this way system saves on its capacity. Figure 1 (below) shows concept of learning object repository based on three levels of learning objects which can be used by any type of applications or systems.

Learning objects can contain reference to other learning objects that are connected by subjects (regulated by metadata). If content of one learning object was used for creating other learning objects, then that learning object will be used as reference in other.

Major advantage of centralized repository is standardized and categorized learning objects. Other advantages are that these objects are completely sharable and reusable, and they can be used without any defined frameworks or templates. Problem of defining the learning object is facilitated by categorization according to function and level of learning object.

Principle of connecting stand alone and primary object in connector objects allow centralization and standardization of learning object. Advantages of this system also include use of parallel objects, historic data and reference score presented in our previously works [24, 25].

Importance of centralized resources of learning objects is based on need for standardization of learning objects and its storages.

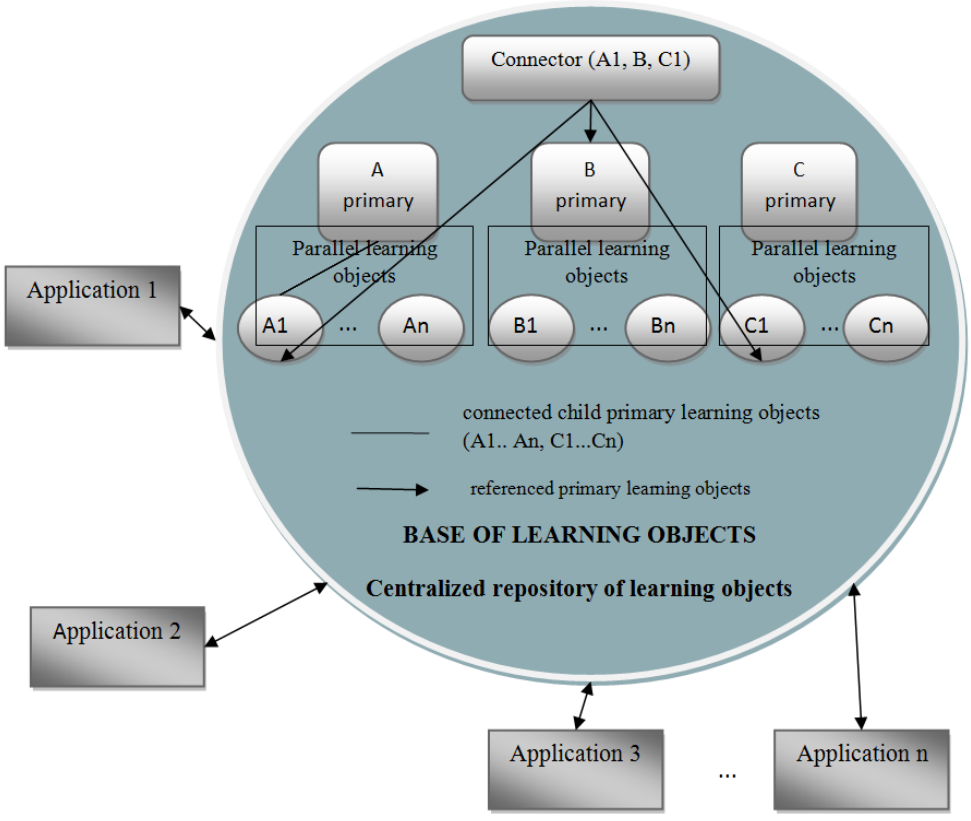

Fig. 1. Learning object repository based on three levels of learning objects

VII. CONCLUSION

In this paper we attempted to provide new concept of storing and designing learning objects in order to facilitate work with digital learning content.

Design of learning objects is based on components of learning objects. With standardized and classified components of objects it is possible to define a design of learning objects that is compatible with as many as possible learning platforms and technologies. The classification of learning objects may serve for different intentions, but the main purpose of classification is to establish some kinds of criteria that are fundamental in the search of learning objects.

The work presented by the paper has presented a recommendation for learning objects design and concept of centralized learning object repository. In the first part it is presented an overview of learning object problem with definition and standards. In second part we recommended a solution for designing learning objects and storing in centralized repository. Focus of this work is on need for categorization of learning objects as well as standardization and centralization.

As result, standardized design of objects, as well as centralized repository of learning objects, ensures quality during the process of creating and using learning objects and has potential to increase the educational experience. Our future work will be focused on detailed clarification of importance of using learning object centralization and more complex classificatory frameworks.

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