

Ontology in e-learning: a tool to increase efficiency*

Gyöngyi Bujdosó

Department of Computer Graphics and Library and Information Science
Faculty of Computer Science, University of Debrecen
e-mail: bujdoso@inf.unideb.hu

Abstract

More and more e-learning courses are offered for study at institutions as well as outside schools within the framework of lifelong and lifewide learning. Frequent attendance increases the requirements in e-learning systems. For example, people want to retrieve necessary data and information easier and faster, group information, or personalize the learning design of a given e-learning course. The standards (such as SCORM) for encoding references among content objects in e-learning materials do not support the new requirements. More general solutions should be found.

Applying ontologies for referencing learning content is a possible solution to satisfy several new requirements.

This presentation treats several new requirements arising from the frequent and long term usage of e-learning courses as well as the benefits of using ontologies for referencing learning contents.

Keywords: e-learning, ontology, ontologies and natural languages

MSC: 68T30, 68T35, 68T99

1. Introduction

More and more e-learning courses are offered for study at institutions as well as outside schools within the framework of lifelong and lifewide learning. Frequent attendance increases the requirements in e-learning systems. For example, people want to retrieve necessary data and information easier and faster, group information, or personalize the learning design of a given e-learning course. Fulfilling new requirements frequently need new solutions on the technical level of computer systems.

*The research was supported by the (Hungarian) National Office for Research and Technology (NKTH) under grant No. GVOP-3.2.2-2004-07-0021/3.0.

In general, leaning objects (LOs) – the smallest referable part of learning materials – are taken as separate conventional documents. For structuring, grouping and modeling learning objects, there are several standards such as ADL, CISCO RLO/RIO, SCORM. Reusing e.g. a part of a LO causes some problems if these traditional standards are used: the text should be copied into another LO that needs more attention and the maintenance of the learning material is much more difficult because of redundancy.

In the literature of e-learning, there are several definitions of learning object and learning design. In this paper we use the determinations applied by Duval ([3]) and Koper & Olivier ([8]):

Learning Object (LO) is any digital or non-digital entity, that can be used, re-used, or referenced during technology-supported learning.

Learning Design (LD) is an application of a pedagogical model for a specific learning objective, target group, context or knowledge domain.

2. New requirements and problems

First of all, it is worth looking into some new requirements which appear to increase convenience and efficiency ([1]) and which need new solutions and introduce new features into the e-learning systems:

- Printing highlighted/marked parts or our own notes
- Possibility of adding new information
- Grouping information
- Making personalized scenarios/LD by the user
- Increasing the efficiency of search
- Possibility of search related to the LD

Many questions arise immediately ([2]), for example:

- How can only certain parts of LOs be applied?
- How can a search be made more efficient?
- How can the user re-arrange LOs?
- How can the user personalize LD?
- Is the LD re-usable in other contexts? ([7])
- Can the learner extend the curriculum?
- Can the content be made visible from the outside of the course?
- Can we learn/search without dictionaries?

3. Ontologies in e-learning

Ontology could be a practical means for solving the problems referred to above. The ALOCoM, LOCO and LOCO-Cite ontology based framework could be a good base for solving many new problems.

3.1. Learning object content structure

ALoCoM (Component Architecture for Learning Object Model) (see e.g. [5, 6, 10]) is an ontology based platform that synthetizes the various content models. It helps to create the formal representation of LO content structure. It supports the formal definitions of the structure of LOS, so it is possible to access and re-use each component. Content Fragments (undividable texts, audio or video files, etc.), Content Objects and Learning Object can be referred. The ALOCoM ontology is divided into two ontologies ([7]):

- ALOCoM Content Structure: Enables a formal representation of LOS decomposed into components.
- ALOCoM Content Type: Defines the educational role of LOS and their components.

3.2. Learning design

LOCO (Learning Object Context Ontology) creates the formal representation of learning design. It is based on IMS Learning Design Information Model, i.e. it formally defines the concepts and the relationships of IMS-LD specification ([9]):

- Completeness (full description of the teaching-learning process)
- Pedagogical expressiveness
- Personalization
- Compatibility (with other standards and specifications)
- Reusability
- Formalization (formal language)
- Reproducibility

3.3. Learning object context

LOCO-Cite formalizes the concept of learning object context (see e.g. [5]). This ontology is a bridge between ALOCoM and LOCO. For binding these ontologies, it contains a LearningObjectContext class. Some properties for enabling formal representation of the context-related metadata of LO: isContextOf, usedInActivity, userRef.

4. Ontologies and natural languages

By using the ontology based framework detailed above we can tackle the problems represented by the first six questions in Section 2. Concerning the last two questions, this framework does not give any solution.

Ontologies use two languages, a natural and a formal language, where the natural language is English typically. Developing ontologies supposes that the domain experts who participate in developing the given ontology know both languages.

4.1. Verbalization

Performing a project of developing ontologies can be made easier by using verbalization, i.e. translating the conceptual model or ontology to a pseudo-natural language. For example, see the following formal expression:

$$\forall x \left(\text{Account}(x) \rightarrow \exists y, z (\text{Person}(y) \wedge \text{Company}(z) \wedge \text{OwnedBy}(x, y) \vee \text{OwnedBy}(x, z)) \right)$$

and its verbalization:

Each Account must be OwnedBy a Person or a Company, or both.

Verbalization can be automated by translator applications (see e.g. [4]) that needs templates for the languages we want to use. Templates for more languages should be developed.

4.2. Ontologies and dictionaries

Natural languages in ontologies can cause problems during developing them as well as when searching the keywords on the web.

During developing ontologies we have to think about which natural language we should use. If we use English, we can have trouble in translating all words for the domain experts. During searching on the web, users should know the adequate English terms they want to find. Here we propose some solutions:

a) Joining the ontologies to dictionaries. In this case some problems remain: there are no free dictionaries which contain all the words of all technical terms of each field and topic.

b) Making dictionaries for ontologies. In this solution there are problems by the different meanings of the same technical terms in different fields (see e.g. the meanings of *quad*).

c) Making dictionary ontologies. Maybe the biggest work but the best solution. An ontology which can bind the given natural language and the English version of the ontology could make visible the related contents of e-learning courses structured by ontologies from all over the world.

5. Conclusions

It is suggested that with the help of verbalization in various natural languages and the project of developing an ontological dictionary language problems should be eliminated. The former increases efficiency by developing ontologies whereas the latter makes searches easier and more conclusive. The visibility would be important in business, too, because the ontologies developed for e-learning courses could be useful e.g. in e-commerce.

Beyond the content ontologies are employed for handling learning objects and learning design. Using ontologies in preparing learning materials both knowledge sharing and retrieval becomes easier, more rapid and complete. It also means increased efficiency when complex searches take place, along the learning design, on the semantic web.

Acknowledgements. The author is grateful to Professor Katalin Bognár for her helpful comments and suggestions.

References

- [1] BUJDOSÓ, GY., Introducing cyber climate dimensions into designing e-learning systems, (2006), (submitted).
- [2] BUJDOSÓ, GY., New ideas in typographical knowledge management, Ph.D. Thesis, University of Debrecen, Faculty of Computer Science, (2007), (in Hungarian).
- [3] DUVAL, E., IEEE standard for learning object metadata, *Tech. Report 1484.12.1, IEEE Learning Technology Standards Committee*, (2002), <http://ltsc.ieee.org/wg12/>
- [4] JARRAR, M., KEET, M., DONGILLI, P., Multilingual verbalization of ORM conceptual models and axiomatized ontologies, *Tech. Report, Vrije Universiteit Brussel*, (2006).
- [5] JOVANOVIĆ, J., GASEVIĆ, D., BROOKS, C., KNIGHT, C., RICHARDS, G., MCCALLA, G., Ontologies to support learning design context, *Proc. of First European Conference on Technology Enhanced Learning (EC-TEL 2006, Oct. 1–4 2006)*.
- [6] JOVANOVIĆ, J., GASEVIĆ, D., VERBERT, K., DUVAL, E., Ontology of learning object content structure, *Proc. of 12th International Conference on Artificial Intelligence in Education (Amsterdam)*, (2005), 322–329.
- [7] KNIGHT, C., GAŠEVIĆ, D., RICHARDS, G., An ontology-based framework for bridging learning design and learning content, *Educational Technology & Society*, Vol. 9 (2006), 23–37, http://www.ifets.info/journals/9_1/4.pdf
- [8] KOPER, R., OLIVIER, B., Representing the learning design of units of learning, *Educational Technology & Society*, Vol. 7 (2004), 97–111.

- [9] KOPER, R., Current research in learning design, *Journal of Interactive Media in Education*, Vol. 9 (2006), 1–7.
- [10] VERBERT, K., JOVANOVIĆ, J., GAŠEVIĆ, D., DUVAL, E., Repurposing learning object components, On the Move to Meaningful Internet Systems 2005: OTM Workshops (R. Meersman et al., ed.), *Lecture Notes in Computer Science*, no. 3762, Springer Verlag, Berlin, Heidelberg, (2005), 1169–1178.

Gyöngyi Bujdosó

Faculty of Computer Science
University of Debrecen
H-4010 Debrecen, P.O. Box 12
Hungary