MERGING WIKI AND ONTOLOGICAL APPROACH TO E-LEARNING PORTAL DESIGN

Tatiana Gavrilova, Vladimir Gorovoy, Elena Petrashen

Abstract: The paper presents an ontological approach towards e-learning portal development. Special stress is put on structuring procedure as it is the kernel of ontology development and on visual design as a powerful learning mindtool. We also describe the experience of ontology developing based on Knowledge Engineering educational course in St.Petersburg State Polytechnical University and "OntolingeWiki" tool for creating ontology-based e-learning portals.

Keywords: e-Learning, e-Learning Objects, Ontologies, Subject Domain, Wiki-technology

ACM Classification Keywords: I. Computing Methodologies - I.2 Artificial Intelligence - I.2.4 Knowledge Representation Formalisms and Methods

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Introduction

The development of information and communication technologies is becoming more and more intense and increasingly fast, so e-learning also needs to evolve, to find new solutions and to reach several goals. What are they? It has to be effective, well designed, not expensive, reusable, and fast in development. Society changes too: it becomes more and more visually dominated, parallel processing and multi-tasking are widely practiced, life is faster and more and more overloaded with information. Students think and process information differently from their predecessors [Prensky, 2001]. So, educative systems also need to become more up-to-date, flexible and adequate.

One of really interesting topics in e-learning nowadays is the convergence of knowledge management and technology enhanced learning towards the effectiveness in the design and exploitation of learning content. In the last years an intensive application of Semantic Web concepts and technologies seems to solve a lot of problems and concerns that existed earlier.

The importance of specification and structuring the content and its visual presentation – followed with such connected issues as design, adaptation and usability has been underestimated to a certain extent until recent times. The researchers often were far more concerned about how to educate (with methods of instruction or reasoning over the content) than how to present the object of the research (content specification and knowledge structure) [Ikeda et al., 1999]. When ontologies were being started to be used in educational systems its main advantage was considered the fact that it provides a common vocabulary, and an explication of what has been often left implicit. The systematization and structuring of knowledge becomes the backbone of the system.

And concepts and relations among them are like this specified and can be used as building blocks without really complex actions [Mizoguchi et al., 1997]. So the new approach in using ontologies in e-learning is more about constructing ontologies to form content and/or navigation system, improving navigation usability and level of knowledge acquisition. In recent years, there has been a growing interest in the development and use of domain ontologies, mainly motivated by the Semantic Web initiative [Woukeu et al., 2003].

In this paper we describe the experience of ontology developing for Knowledge Engineering courses based on educational course for undergraduate students of Saint-Petersburg State Polytechnic and Saint-Petersburg State Universities. It also seems important to specify why ontology-based conceptual domain modeling is so efficient for needs and purposes of e-learning using researches which have already been made and applying our own considerations. Next section gives details of goals we wanted to achieve while starting to develop the ontology. Then OntolingeWiki, ontology-based tool which takes advantage of both wiki-technology and ontologies for creating educational portals, is described. The paper is concluded with summary and future work discussion in the last section.

Ontology-based conceptual domain modeling and its efficacy

So why is structuring followed by visual presentation of course's structure so important and helpful?

- To share common understanding of the structure of information among people or software agents [Musen, 1992]
- To make domain assumptions explicit so that it would be possible to change these assumptions easily if knowledge about the domain changes.
- To separate domain knowledge from the operational knowledge [Noy, McGuinness, 2001]
- It's simpler and more effective to perceive and analyze domain knowledge when it's clearer how all small pieces of information connected between each another are. It can be compared with having a picture of a complete puzzle before and while inspecting each of the separated pieces. It's easy: we know how this piece is connected with others, what's pictured on it and how we can use it. But when the puzzle is undone and the only thing we know it's that this is a picture of a pretty princess, a lot of time can be spent while deciding whether that little blue piece is sky or princess's dress.
- Despite the fact that many IES (Intelligent Educational Systems) exist and keep being developed, knowledge reuse from one system to another is almost non-existent. Content-oriented view over the IES could facilitate knowledge sharing and reuse [Mizoguchi et al., 1997]. Therefore two of the most current research issues in the e-learning community are specifying reusable blocks of learning content and defining an abstract way for designing different units (e.g. lessons) [Knight, Gaševic, 2005].
- It also provides the ability to modify easily the course's structure for different educational purposes adapting to current needs. Just like when using Lego we can build castle for a knight and rose cottage for an old lady using the same blocks. So it will be possible to use different structures for a beginner/a professional, a third-grader/a Ph.D. etc.
- As two major problems of learning online are loss of overview due to low information density of the medium and short attention spans due to fast fatigue of perception structure and presentation of learning material it will be a lot more effective if it reflects the characteristics of hypermedia and the web [Psyché et al., 2004]
- The web itself is a very large scale hypertext information space where users can search and find information in different domains. But considering the constant increasing of resources on the Web getting an overview of all the available information relevant to their current needs and tasks becomes pretty much impossible. And if this user is not fully experienced in the knowledge domain as it happens in the majority of cases (if he/she was, why would he/she need to find this information?) he/she is not totally able to define for sure whether found content is entirely appropriate and useful for their cognitive state, tasks and level or accurate, conforming exactly to truth or to a up-to-date standard [Aroyo, Dicheva, 2004]. Within the class of Web-based educational systems, a major role in various instructional contexts play the Educational Information Systems that are aimed at providing intelligent, task-centered information support for solving

problems and performing learning tasks. And ontology is really good for maintaining functionality required for those ones [Psyché et al., 2004]

Knowledge Engineering Ontology Elaboration

Pedagogical and psychological construction and delivery of contents rather than the actual content are actually major key issues. If students also are interested in process, student performance is really likely to be up after being introduced to new ways of learning. The use of visual paradigm enables students to process and understand greater volume of information and visual form influences both analyzing and synthesizing procedures in ontology development process [Gavrilova, Puuronen, 2007]. This is why we've decided to make first a visual representation of the top level of ontology as a powerful mind tool in data structuring process [Gavrilova, 2007]. The developed ontology will be also used as a table of contents for educational system.

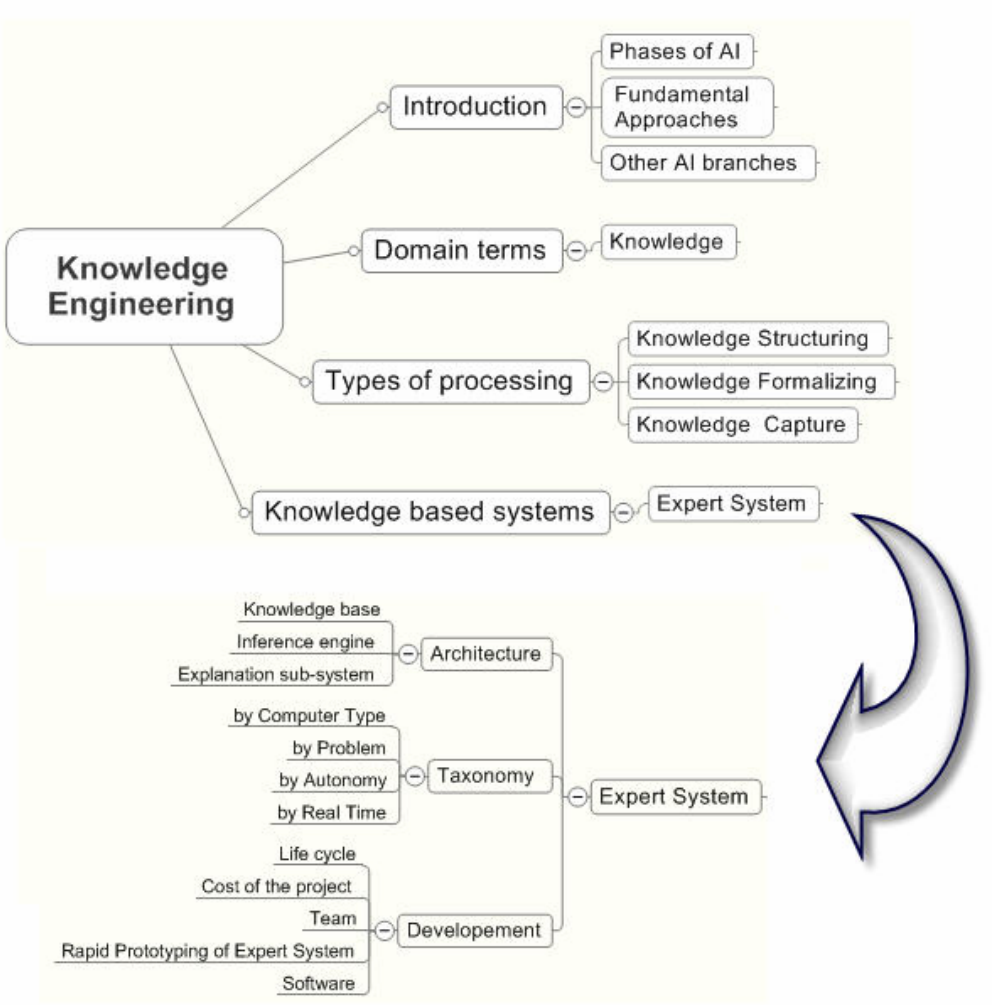

Fig.1 Top Levels of the Educational Ontology of Knowledge Engineering

As while developing learning design we should try to exclude excessiveness and contradictions and to avoid the ontology being too complex and big, we thought it would be reasonable to make it more scalable – e.g. when user chooses the leave of top level ontology it proves to be the root of another one (see Fig.1) – the screen is not overloaded so the information is perceivable yet all the advantages of using ontology are kept.

OntolingeWiki Tool

Wiki technology is a perfect base for on-line knowledge engineering. It supports collaboration, it's easy to add and modify information there. One of its other great advantages – nearly everyone can create, modify and delete the data (of course, now it's not exactly like that – access control lists permit to give different rights to different persons). But it not only an advantage, but a disadvantage too – after some time wiki-portal can become a mess of chaotically messed hypertext where it's not really easy to find and learn something. The solution is to use ontologies as a framework.

Thus, OntolingeWiki is a tool that takes advantage of both wiki-technology as a good environment for collaboration and ontologies as a tremendous tool for knowledge structuring. It can take any ontology saved in OWL format as an input and provide web-interface for ontology navigation with visualization based on hypergraph technology (http://hypergraph.sourceforge.net). Each concept of the ontology can be annotated with wiki-page created on demand (see http://ontowiki.org.ru:8180/ontolinge/dispatcher). OntolingeWiki was created on the base of Ontolinge-KAON system [Gorovoy, Gavrilova, 2007]

This technology can be used for creating ontology-based educational portals and was successfully leveraged in the design of the ontology-based content management system for the virtual exposition of the optical technologies museum in Saint-Petersburg State University of Information Technologies, Mechanics and Optics. Many electronic teaching materials such as presentations, animations or java-applets were united in the virtual exposition which introduces a visitor with optics according to the chosen ontology model.

Conclusion

As e-learning lacks teacher or tutor in a traditional way, knowledge structuring is really important for better understanding course ideas. And by using visual paradigm students can better understand and remember the course. It also permits to reuse knowledge units, expand and modify e-learning system, enables a shift away from the teacher-centric and curriculum-oriented course perspective towards a more learner-centric and interest-oriented approach. We consider OntolingeWiki tool a step forward in creating a useful technological environment for creating ontology-based educational portals supporting collaboration as it has advantages of both wiki technology ad ontological engineering.

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Authors' Information

Tatiana Gavrilova – Head of Information Technologies in Management Department; Saint-Petersburg State University, Graduate School of Management, Information Technologies for Management Dpt. 199004, Volkhovsky, per. 3, St. Petersburg, Russia; e-mail: tgavrilova@gsom.pu.ru

Vladimir Gorovoy – Researcher; Saint-Petersburg State University, Graduate School of Management, Information Technologies for Management Dpt. 199004, Volkhovsky, per. 3, St. Petersburg, Russia; e-mail: gorovoy@gsom.pu.ru

Elena Petrashen – Student; Saint-Petersburg State Polytechnic University, School of Information Technologies, Politechnicheskaya, 29, 195251, St. Petersburg, Russia; e-mail: elena.petrashen@gmail.com