Remote Topic Maps in Learning

Stian Lavik, Tommy W. Nordeng, Jarle R. Meløy, Tore Hoel

Cerpus AS
N-8432 Alsvåg
Norway
stian@cerpus.com
tommy@cerpus.com
jarle@cerpus.com

Oslo University College
P.O. Box 4, St. Olavspl., 0130 Oslo
tore.hoel@hio.no

Abstract

Topic Maps is becoming a recognized way of structuring and navigating knowledge. Since the digital world is moving towards a more and more service oriented reality, it is appropriate to focus on solutions for using topicmaps remotely as services. Two current cases for how this can be done is displayed here, both carried out by Cerpus AS, a small Norwegian company that works with topicmaps in the e-Learning domain. This is discussed in the light of topicmaps in a service-oriented architecture and along the axis of virtual learning environments (VLEs) and personal learning environments (PLEs). We conclude that using remote topicmaps is a viable road to travel in the learning domain, as well as in other domains.

1. Introduction

Topic Maps (ISO 13250) is on its way to consolidate its position as a powerful way to manage, structure and navigate knowledge [1]. The general idea behind topicmaps is to organize information by subjects and relation between subjects, and to use a knowledge layer to organize the information layer. This subject centricity is useful, it gives a proper focus: on the subject one are examining, not on files, formats, headlines or other meta information.

From a learning perspective the support for associative structures is interesting and useful. According to some knowledge theory, there are two basic building blocks in learning; concepts and propositions (the relation of two or more concepts into a meaningful unit, typically a semantic expression) [2]. Topics from Topic Maps correspond to concepts and associations correspond to propositions. Hence, according

to the theory of knowledge consisting of concepts and propositions, Topic Maps inherently supports the basics of learning. And to quote Dubai:

"Bodies of knowledge in general are associative systems. Associations are not only aids to understanding, they are also proven mnemonic devices: The richer the associative network, the higher the probability that the item will be stored and retrieved" [3].

One of the fascinating aspects of Topic Maps is the idea of using the domain knowledge itself to index domain information. If this is capitalized upon, we can experience a very rewarding way of modeling knowledge (and its relation to information); (most of) the metadata of the domain model can be built inside the domain model. This is especially interesting from the angle of learning. When it comes to learning it is crucial to relate new knowledge to existing knowledge. Ausubel claims that "the single most important factor influencing the learning process is what the learner already knows" [4]. And he expresses further in-depth theory that stresses the importance of this building of understanding by relating new knowledge to prior knowledge, not just merely memorizing information. So, it's a good idea to build metadata or context inside the domain model. To use Topic Maps in learning effectively, it is also necessary to have a Topic Maps based repository that lasts a long time, so that the learner can graft new knowledge into the knowledge base.

2. Virtual Communities

In light of the ongoing globalization and the "Internet wave", the rise of virtual communities seems natural and almost inevitable. An increasing number of communities are available, they be commercially, culturally, ideally motivated, or motivated based on beliefs or interest in a special domain. Some examples are Yahoo groups, flickr.com, youtube.com and lots of others.

Within the domain of learning, the virtual communities have been around for some time. In Norway there are currently two major vendors (Fronter and it's learning) of *Virtual Learning Environments* (VLE) (sometimes called *Learning Management Systems* (LMS)). There are also some open source solutions around, such as Sakai and Moodle.

Common for all the VLEs are that they mean to offer a complete environment that facilitates a range of pedagogical activities, and (not least) administration features to administrate the environments. They all have some way to model the everyday schooling, including users, subjects, classes, access control, etc. This is a top down perspective, and rather system centric. Still, it matches what most teachers probably expect of a learning environment, since it more or less reflects the working environments they are used to.

The *Personal Learning Environments* (PLE) have a different starting point than the VLEs; the main focus here is on the individual learner and his context. The learner himself configures his virtual learning environment (controls access levels, etc.). There is little or no course management here. Instead, one will typically find services the learner subscribes to (learning activity tools, RSS feeds, etc.), links to other

important resources, etc. Elgg is a good example of a PLE that has received much positive publicity lately [5].

As the learner is the center in the PLEs, there data will also live independently of what education institution the learner is enrolled at. The educational institutions are in general more toned down than in the VLEs. Metadata from the educational institutions (such as groups, classes, courses, terms, etc.) may serve as a mean or supportive structure in the PLE, but not as a framework that that dictates or limits the learners' own preferences in terms of structuring his learning and knowledge.

When it is the learner that decides what courses, methods and activities (maybe together with a supervisor) he will use to learn what he is supposed to learn, it is natural that he himself also decides what tools and services he will use to reach his goals. The digital learning environments are driven towards a more service-oriented architecture. Instead of the system (the digital learning environment) giving a set of predefined activities and resources, the learner himself can subscribe to services that support his own style of learning.

In Norway, the government has already established the first version of "Citizen portal" ("Min side"). This is meant as personal web page for each citizen of Norway where they can find personal information about and interact in relation to health services, taxation, etc. And we have launched the idea of "My learning portal" ("Min læringsside") as a web page to be a kind of "personal portal" for learning. If this site is to be anything like the described ideas, it will be more or less a hundred percent service-oriented. Each citizen would subscribe and unsubscribe to whatever services they want to in relation to their learning, and thereby create their own learning environment.

3. Service Oriented Architecture (SOA)

Within the XML community service oriented architecture (SOA) has been discussed and nourished for quite some time, and more and more websites/organizations offer web services to other websites/organizations and virtual communities. And along the lines of Web 2.0, web services and distribution of content is essential [6].

The growth of virtual communities displays an inherent need of thinking in terms of exchanging services and the growth of web services fuels virtual communities so they become more viable to attract users and to last.

SOA has a very simple basic philosophy. We acknowledge the fact that we cannot be experts in every field ourselves, so we ask the some experts to do the job for us [7]. We simply make the desired output available to our users.

As already mentioned, there exist a vast number of virtual communities and websites on the Internet and more and more of them offer services from other sites through web services (e.g. Amazon, eBay, Google, etc.). Many of them also offer web services themselves, to be used in other communities and applications.

3.1 Remote Topic Maps

Many learning applications and systems don't use Topic Maps, and they may not implement it in any near future. Still, we want to bring the power of Topic Maps into their domain, because we think building topicmaps is a good way of documenting acquired knowledge and building a deeper understanding of the knowledge domain.

The SOA way of building software has reached the Topic Map community. Ontopia has recently released the Topic Maps Remote Access Protocol (TMRAP) as "a web service interface for remotely accessing topicmaps" [8]. The reasoning behind TMRAP is exactly what it sounds like; to be able to interact with a topicmap remotely. The interface consists of a number of methods that can be applied to the topicmap remotely, and the output can then be used to one's liking.

4. Topicmap Server

In response to the demand for service-oriented architecture and on the basis on the belief in the Topic Maps technology, Cerpus built the Topicmap Server. Our goal was to develop technology for offering Topic Maps in external systems without having to implement topicmap engines in those systems. The Topicmap Server is a server to host topicmaps for various applications and systems that can be accessed and used via web services. Our customers will be organizations that want the power of topicmaps in their applications without implementing topicmap support themselves. The idea is that such organizations buy an account on the Topicmap Server and host their topicmap there, and then use the topicmap in their own application over web services (with TMRAP).

The Topicmap Server will have some editing applications for users to edit the topicmaps directly. And to regulate access between users, applications and topicmaps, the Topicmap Server has a managing application called TMBuilder Application (Topic Map Builder Application). The TMBuilder Application also handles web service requests from external systems.

The Topicmap Server can be used to serve external VLEs or PLEs, and it can empower those systems with support for Topic Maps. For example, a VLE could use a topicmap to index all the resources belonging to a given user and display the relation between his resources (associations in the topicmap) by fetching the necessary fragment of the topicmap from the Topicmap Server. Or, as we will see in a moment, topicmaps could be used to display the knowledge domain itself, organized by subjects and associations.

5. BrainBank Learning, Integration with Moodle

5.1 Background

One of our current tasks is the integration of BrainBank Learning and VLEs, represented by Moodle (Modular Object-Oriented Dynamic Learning Environment). From a BrainBank Learning perspective, Moodle is an interesting VLE to use as a case for this kind of integration. Firstly, Moodle has roots in the same learning philosophy as BrainBank Learning, namely constructivism [9, 10]. Secondly, Moodle is open source (and hence easy to deal with, business-wise).

BrainBank Learning and Moodle complement each other well. Moodle is a richly featured VLE, including features to support a typical school everyday (e.g. course management). BrainBank Learning is more focused on the individual learner and his learning process, with a clear emphasis on the bottom up perspective.

In addition to a genuine interest in integrating BrainBank Learning with VLEs, we are currently in working together with the County of Nordland (Nordland Fylkeskommune) in a project that is concerned with computer aided learning in schools. This project is a catalyzer for the integration work.

5.2 The integration

BrainBank Learning was designed to be a tool for meaningful learning [2] within a constructivist learning environment [11, 12, 13]. It is a web application for learning of concepts (their meaning) and context (how concepts relate). The core of the suite is BrainBank, the ontology of a topic map for acquired knowledge in a lifelong perspective. As the Topic Maps standard defines an effective way of representing information (through topics and associations etc.) [1], BBL uses Topic Maps technology to represent the data in the application. The application is installed on a central server, making users connect to the very same repository of data. This makes it easy for a learner to change schools (or even use BrainBank Learning after finished education) without loosing any data.

BrainBank Learning is mainly focused on aiding each user to build his own knowledge map (in the form of a topicmap), from a bottom up perspective. The focus is on the learner, and he can decide how to build his knowledge base himself. In this sense, BBL has more in common with PLEs than with VLEs.

Moodle calls itself “A Free, Open Source Course Management System for Online Learning”. Furthermore, Moodle is presented as a course management system (CMS) on the official website [14].

The architecture of Moodle strongly suggests that there is one installation per educational institution, even though you probably could combine several schools in one installation. (That would in any case be a bit limiting in terms of customization for each school.) This also implies that the expected time for data to live in Moodle is significantly shorter than for BrainBank. A given users data will live at the Moodle installation as long as the user is a student at that school. If he wants to carry it

further, it needs to be exported as a package, to be imported in another system later. This way of handling data is the general way of going about it in the VLE world, Moodle does not stand out from other VLEs in this matter.

Moodle's dictionary module and the BrainBank topicmap are natural connection points between BrainBank Learning and Moodle. By using the Moodles dictionary module learners can build their own dictionaries. The module also facilitates to use words from the dictionary as "hot words" in the rest of Moodle, which means that whenever a word that exists in the dictionary is used in another text in Moodle, Moodle automatically creates a link to the entry for that word in the dictionary.

We have created an updated version of the Moodle dictionary that contains functionality to connect every word in the dictionary to topics in BrainBank. If the topic does not exist in the users BrainBank, it will automatically be created. When a word is connected, there is a link that can take the user directly to the corresponding topic in BrainBank Learning. On the BrainBank Learning side, there will be created a resource to the given topic that represents the entry in the Moodle dictionary.

We have built a component in BrainBank Learning that will accept request from other applications over web services and use parameters from the request to perform operations within BBL. This is of such nature that it also opens up possibilities for easily integrating with other VLEs and PLEs in the future.

Obviously, there are limitations to the integration. For the integration to work, users must be users in BrainBank Learning as well as in Moodle.

It makes sense to apply topicmaps in such a context and to do it via BrainBank Learning, since BrainBank Learning is a learning application allowing learners to build their own topicmaps. Words can be linked to topics in BrainBank as resources and the knowledge map is enriched with associations etc. The integration amplifies the effect of the Moodle dictionary on one hand, and on the other it improves BrainBank Learnings connection to resources located externally and makes it more useful to the VLE as well as PLE community in general.

From a pedagogical point of view it makes perfect sense to tie the produced resources (in this case essays, WIKI pages, forum discussions, multiple choice tests, etc. in Moodle) stronger to the knowledge map (the learners' BrainBanks). As mentioned above, it is important to relate all new knowledge to prior knowledge. In this way, the learners' knowledge maps can play a key role in the production of learning resources in Moodle.

There are many other potential areas for integration, and there is also a great potential for improvement in today's model. For example, it would probably be useful if there were some kind synchronization between the topics in BrainBank and the Moodle dictionary, so that changes in one place automatically changed the data in the other repository.

Likewise, we see possibilities for extending the integration, such as using fragments of the learners' knowledge maps from BrainBank for navigation inside Moodle, etc. Still, the integration has begun, and the chosen approach seems like a useful place to start.

6. Conclusions

We see a clear potential for remote topicmaps in learning. The cases of the Topicmap Server and the integration of BrainBank Learning and Moodle display two ways of doing it. And most likely, there will emerge more and new ways of using topicmaps remotely in the near future.

In the case of BrainBank Learning and Moodle we use remote topicmaps to reach a specific goal, namely integrating the VLE Moodle with BrainBank Learning. In the case of Topicmap Server, the use of remote topicmaps is on a more general level, and we hope to see this generating new possibilities to use Topic Maps in learning.

To use topicmaps over web services seems to be a viable solution in the learning domain, and it fits with the development that is going towards PLEs, where the learner himself configures what services he wants and what suits his learning style.

References

1. Garshol L. M. & Moore G. (2005) *ISO/IEC 13250 Topic Maps: Topic Maps — Data Model*. http://www.isotopicmaps.org/sam/sam-model/. Accessed 30.05.2006.
2. D. P. Ausubel, Novak, J.D. & Haneisan, H. (1978) *Educational Psychology: A Cognitive View.* 2 edn, Holt, Rinehart and Winston.
3. Dubai, Y. (2002) *Memory from A to Z.* Oxford University Press.
4. Ausubel , D., (1968) *Educational psychology: A cognitive view (context)*. New York: Holt, Rinehart & Winston.
5. O'Hear, S. (2006, March 7th) *A space on the web that we control.* Article in The Guardian. http://education.guardian.co.uk/elearning/story/0,,1724614,00.html . Accessed 07.06.2006.
6. O'Reiily, T. (2005) *What Is Web 2.0 - Design Patterns and Business Models for the Next Generation of Software.* http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html Accessed 09.06.2006.
7. He, H. (2003) *What Is Service-Oriented Architecture?* http://www.xml.com/pub/a/ws/2003/09/30/soa.html . Accessed 07.06.2006.
8. Garshol, L. M. (2005) *TMRAP – Topic Maps Remote Access Protocol*. In: *Charting the Topic Maps Research and Applications Landscape: First International Workshop on Topic Map Research and Applications, TMRA 2005*. pp. 53 - 68. Ed. Maicher L. & Park J. Springer Berlin / Heidelberg. ISBN: 3-540-32527-1. http://dx.doi.org/10.1007/11676904_5 . Accessed 07.06.2006.
9. Moodle Documentation. http://docs.moodle.org/en/Philosophy. Accessed 30.05.2006.
10. Wikipedia: *Constructivism (learning theory)* http://en.wikipedia.org/wiki/Constructivism_%28learning_theory%29. Accessed 30.05.2006.
11. Lavik, S., Meløy, J. R. & Nordeng, T. W. (2004) BrainBank Learning - building personal topic maps as a strategy for learning. IN XML 2004 Washington, DChttp://www.idealliance.org/proceedings/xml04/papers/21/brainbank.pdf Accessed 30.05.2006.
12. B Wilson. (1996) *Constructivist learning environments: Case studies in instructional design*. New Jersey: Educational Technology Publications.

13. Jonassen, D.H & Rohrer-Murphy, L. (1999) *Activity theory as a framework for designing constructivist learning environments*, Educational Technology Research and Development. 47, 61-79.
14. Moodle - *A Free, Open Source Course Management System for Online Learning*. http://moodle.org. Accessed 30.05.2006.