SEMANTIC WIKI–BASED COLLABORATIVE E-LEARNING SYSTEM

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ABSTRACT

“Collaborative learning” is an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together. Comparing to the other learning environments, wikis stand out as natural tools for facilitating and supporting the activities of a learning community, both during the official course period and afterward. The goal of this paper is to examine how wikis that use Semantic Web technologies can be used in the development of collaborative e-Learning system and to propose the architecture of such system.

INTRODUCTION

'Wiki' can be defined as follows: a website that allows the easy creation and editing of any number of interlinked web pages via a web browser using a simplified mark-up language or a WYSIWYG (What You See Is What You Get) text editor (see Figure 1). Wikis store all previous versions of each page, including the author, date, and time of particular change.

It is a common misconception among people unfamiliar with wikis that Wikipedia is a typical wiki; however, there are important differences. First, Wikipedia is an online encyclopedia. Wikis’ developers may decide not to follow this kind of model. Second, even though Wikipedia started as an open-to-all wiki, after some time it limited its access, but it remains substantially open. Third, and most important, Wikipedia should be acknowledged as much a knowledge creation methodology as a wiki (Cummings, 2008).

Wikis are very well suited for collaborative activities like learning and knowledge exchange. Mader came to conclusion that the main difference between the wiki and more traditional content management or knowledge management systems is structure (Mader, 2008). He states, “… The wiki starts off with the minimum possible structure and grows a custom structure based on how each person, team, or project uses it."

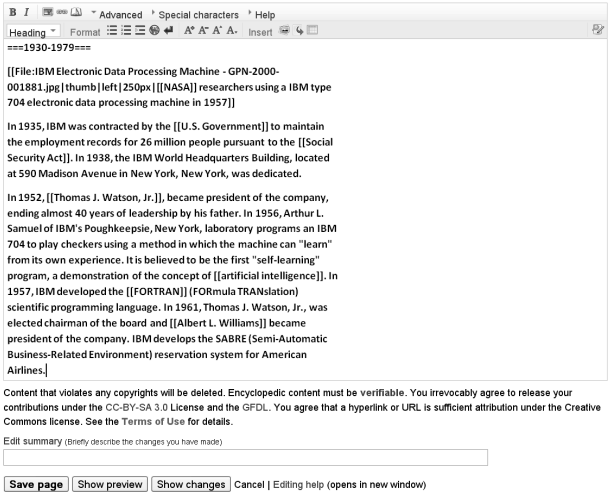


Figure 1. Wiki page editing example.

Appropriately designed and maintained wikis can extend beyond one class or even one purpose. Therefore, wikis can give students the sense of contributing to a large and growing projects, joining the efforts of participants in a given course or topic of study.

The goal of this paper is to examine how wikis that use Semantic Web technologies (for example, IkeWiki or Semantic MediaWiki) can be used in the development of collaborative e-Learning system and to propose the architecture of such system.

WIKI-BASED COLLABORATIVE E-LEARNING

“Collaborative learning” is an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together. Usually, students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. Collaborative learning activities vary widely, but most center on students’ exploration or application of the course material, not simply the teacher’s presentation or explication of it (Smith and MacGregor, 1992).

Collaborative learning facilitates education, research, social cohesion, and psychological stability; thereby, increasing self-esteem, reducing anxiety, encouraging understanding of diversity, fostering relationships, stimulating critical thinking, increases student retention, and encourages group learning (Panitz, 1997).

It is important to distinguish between collaboration and cooperation, as quite often these terms are confused. Henri and Rigault (1996) identify cooperative tasks as those that are divided up and completed individually. Division of labor, task specialization, and individual responsibility for part of the final product are characteristics of cooperative learning. Roschelle and Teasley (1995) describe collaboration as "a coordinated synchronous activity that is the result of a continued attempt to construct and maintain a shared concept of a problem". Schrage (1990) defines collaboration as a "process of shared creation: two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on their own. Collaboration creates a shared meaning about a process, a product, or event". This is the reason why no formal roles are assigned in collaborative groups.

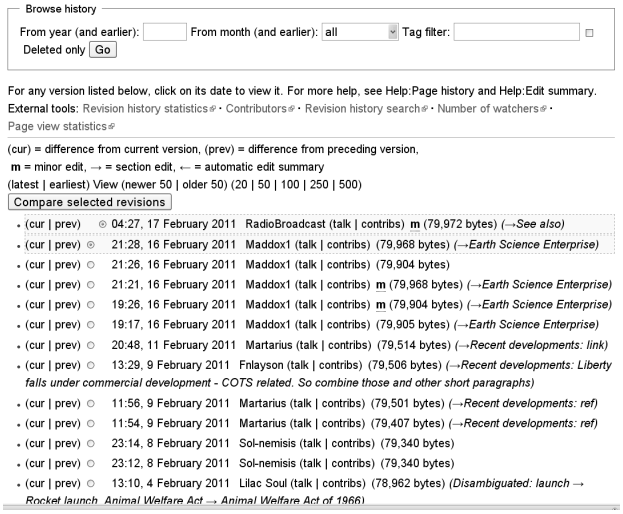
Collaborative learning theory has special educational applicability in an online environment. Online environments avoid some of the problems that occur during collaborative learning in face-to-face classroom environments. Many of the collaboration techniques used in the classroom can be even more effective online; thereby, providing greater student engagement and better student learning.

According to Klemm (2005), Internet-based collaborative learning is most effective when the following conditions are met:
1. Group tasks are clearly defined in the form of an expected result;
2. Group tasks require generation of some kind of intellectual product, which is group graded;
3. Group members use the formalisms of collaborative learning to finish task and produce the results;
4. Teachers and students have access to the environments that provide shared use of documents and organization of conferences.

One of the important problems with collaborative e-Learning and e-Learning in general is to convince teachers of the value of online e-Learning and to train the so-called technophobes so that they would feel comfortable using these technologies.

Comparing to the other learning environments, wikis stand out as natural tools for facilitating and supporting the activities of a learning community, both during the official course period and afterward.

Most wiki environments provide history and rollback mechanisms that keeps previous versions of pages (see Figure 2). These mechanisms allow to see who made the changes and, if necessary, to revert them or to compare different versions of a page. Rollback doesn't prevent the changes from occurring in the first place; however, it also doesn't put any restraints on how the students can express their creativity. Still, it is important to keep the limitations of this approach in mind if you are working with a big group.


Browse history

From year (and earlier): From month (and earlier): all Tag filter:

Deleted only Go

For any version listed below, click on its date to view it. For more help, see Help:Page history and Help:Edit summary.

External tools: Revision history statistics · Contributors · Revision history search · Number of watchers · Page view statistics

(cur) = difference from current version, (prev) = difference from preceding version,

m = minor edit, → = section edit, ← = automatic edit summary

(latest | earliest) View (newer 50 | older 50) (20 | 50 | 100 | 250 | 500)

Compare selected revisions

- (cur | prev) 04:27, 17 February 2011 RadioBroadcast (talk | contribs) m (79,972 bytes) (→See also)
- (cur | prev) 21:28, 16 February 2011 Maddox1 (talk | contribs) (79,968 bytes) (→Earth Science Enterprise)
- (cur | prev) 21:26, 16 February 2011 Maddox1 (talk | contribs) (79,904 bytes)
- (cur | prev) 21:21, 16 February 2011 Maddox1 (talk | contribs) m (79,968 bytes) (→Earth Science Enterprise)
- (cur | prev) 19:26, 16 February 2011 Maddox1 (talk | contribs) m (79,904 bytes) (→Earth Science Enterprise)
- (cur | prev) 19:17, 16 February 2011 Maddox1 (talk | contribs) (79,905 bytes) (→Earth Science Enterprise)
- (cur | prev) 20:48, 11 February 2011 Martarius (talk | contribs) (79,514 bytes) (→Recent developments: link)
- (cur | prev) 13:29, 9 February 2011 Fnlayson (talk | contribs) (79,506 bytes) (→Recent developments: Liberty falls under commercial development - COTS related. So combine those and other short paragraphs)
- (cur | prev) 11:56, 9 February 2011 Martarius (talk | contribs) (79,501 bytes) (→Recent developments: ref)
- (cur | prev) 11:54, 9 February 2011 Martarius (talk | contribs) (79,407 bytes) (→Recent developments: ref)
- (cur | prev) 23:14, 8 February 2011 Sol-nemisis (talk | contribs) (79,340 bytes)
- (cur | prev) 23:12, 8 February 2011 Sol-nemisis (talk | contribs) (79,340 bytes)
- (cur | prev) 13:10, 4 February 2011 Lilac Soul (talk | contribs) (78,962 bytes) (Disambiguated: launch → Rocket launch, Animal Welfare Act → Animal Welfare Act of 1966)

Figure 2. Revision history of NASA page on Wikipedia.

In author's experience wiki has been used to coordinate the development of extremely large and complex software project (overall, more than 8 million lines of code to maintain and upgrade). Wiki has become a necessity due to the take-over of the correlated project and a large increase in size of the developer team, which currently includes more than 30 members.
Wiki (slightly modified version of DokuWiki) is used to train the new joiners and to effectively exchange knowledge among project team members. Attracted by the ease of use and familiar interface, even the new joiners started to fill and update the wiki right after a short general introduction. The page locking mechanism is used to protect certain pages (like schedule or some other formal page) from being modified or deleted by system users.

It is interesting that, after a while, many of the developers have started to use wiki as their main source of information. Some of them were motivated by the practicality of the information in the wiki. Indeed, it is easier to find information on the specific topic (FreeBSD–based operating system for 3G routers) in the wiki that was written and edited by experienced people than to sort through piles of unrelated information.

SEMANTIC WEB TECHNOLOGIES

The Semantic Web is an extension of the current Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation (Berners-Lee, Hendler, & Lasilla, 2001). It is a web of data that can be processed directly and indirectly by machines. The Semantic Web is based on the idea of having data on the Web defined and linked in a way that it can be used by machines not just for display purposes, but for automation, integration, and reuse of data across various applications.

Semantic Web technologies can be used in a variety of application areas; for example: in data integration, whereby data in various locations and various formats can be integrated in one, seamless application; in cataloging for describing the content and content relationships available at a particular Web site, page, or digital library; by intelligent software agents to facilitate knowledge sharing and exchange; in content rating; in describing collections of pages that represent a single logical "document"; for describing intellectual property rights of Web pages (see, eg, the Creative Commons), and in many others (W3C, 2009).

Semantic wikis are traditional wiki systems empowered with Semantic Web technologies like RDF, OWL, SPARQL, etc. The main goal of semantic wiki is to create a wiki with data in structured, machine-processable format. This is usually achieved by annotating the existing content with symbolic information that describes its meaning. For example, a link from White House to Pennsylvania Avenue NW, Washington, D.C., could be annotated with "located at".

Depending on the semantic annotations, wiki can change the way the content is presented to the users. These context-aware presentation features can include (but not limited to) formatted display of information derived from the underlying knowledge base, change of page style to make it more convenient for users to perform their actions (for example, to provide printer-friendly versions of the related pages), display of semantically related information in the current page (for example, in the "See also" section), etc.

Semantic Web technologies make it possible to implement semantic search mechanism that can improve search accuracy by understanding searcher's intentions and the contextual meaning of terms. The search engines can look for pages that refer to a precise concept in an ontology instead of collecting all pages in which certain, generally ambiguous, keywords occur. In this way, differences in terminology between Web pages and the queries can be overcome (Antoniou and van Harmelen, 2008).

Inference engines, or reasoners, are software tools that derive new facts or associations from the available information. Therefore, making it possible to create new knowledge based on the existing information. Reasoners create models of the information and relationships to draw logical conclusions based on these models. For example, using OWL (Web Ontology Language), it is possible to make inferences based on the associations represented in the models, which primarily means inferring transitive relationships (Cardoso and Sheth, 2006).

Use of the Semantic Web standards (RDF, OWL, etc) makes it easier to exchange data with other application and to re-use existing data in the other projects. This approach helps to avoid many data conversion-related problems and is especially important for projects that will produce data with long-term importance.

Currently, there is a number of semantic wikis that could be used as the basis of the e-Learning system. Some of the most popular semantic wiki applications are:

- Semantic MediaWiki - is an extension to MediaWiki (a wiki software that runs all the projects of the Wikimedia Foundation, including Wikipedia, Wiktionary, and Wikinews), that allows users to add semantic annotations to the wiki pages (Semantic MediaWiki, 2011). Semantic MediaWiki, just like MediaWiki, is written in PHP (PHP: Hypertext Preprocessor) programming language.
- IkeWiki – is a semantic wiki developed by SalzburgResearch that allows users to annotate pages and links between pages with semantic annotations. IkeWiki makes full use of Semantic Web technologies like RDF(S) and OWL using the Jena RDF store, and is implemented as an AJAX-based Rich Internet Application, based on the Dojo Toolkit.
- OntoWiki – is a semantic wiki from Universität Leipzig. Besides providing the opportunity to annotate text-based Wiki pages with a special syntax (as suggested by text-based semantic wiki approaches), Onto Wiki uses RDF to represent information. For human users, Onto Wiki makes it possible to create different views on data (for example, tabular representations or maps). For machine consumption it supports various RDF serializations as well as RDFa, Linked Data and SPARQL interfaces.

PROPOSED E-LEARNING SYSTEMS ARCHITECTURE

Existing knowledge bases contain the enormous amount of information on different subjects; thus, it is necessary to provide the possibility to import data stored in the common formats. Importers for the specific formats could be implemented as pluggable modules. Plug-ins can also be written by the third-party developers and added to the system when necessary.

The proposed collaborative e-Learning system should be able to integrate multiple semantic wikis. This is necessary because single e-Learning system can be used for multiple courses or projects; therefore, each course or project may require its own wiki. To improve system usability and students productivity a system could include Single Sign-On (SSN) mechanism. This mechanism allows users to log in once and get access to all (sub-)systems without being prompted to log in again to each of them.

Social networks have recently attracted huge interest and according to the latest Nielsen Online reports now they are even more popular than email (Guardian, 2009). Hence, one of the important features of the proposed collaborative e-Learning system should be the built-in rich social network. This addition should allow group members to easily organize face-to-face communications and real-time discussions for the whole group. FOAF technology support would make it possible for users to import the existing profiles and also to re-use the created profiles in the other projects with support of FOAF.

Blogging has become an integral part of the social Internet; therefore, it is necessary to let students express their personal opinions in the blogs. Other students could not only read those blogs but also leave comments regarding some of the described issues or proposed ideas.

Thus, social networks and blogs can help students to develop the bonds and trust with team (or course) members and improve team relationships. Use of these social tools helps to supplement face-to-face encounters.

To reduce the possibility of interference between different learning groups and copying of other groups' work, it is necessary to implement an access control system. This system should allow the administrator (who most likely is also the teacher) to modify project status. For example, if a project is public, everyone has at least read-only access to the information within this project, but in close/private projects only group members and teacher have the access to the information.

Once a group finishes the task (completes the project), project status can be changed from close to public; thereby, making it possible for other students to use the information from particular wiki in their studies. Depending on the purpose and type of project, it can be provided as read-only or as free for all to edit.

Designing e-Learning system for children usually requires additional effort from the developers because differences between kids and adults should be taken into consideration. Kids like to compete; therefore, in case of e-Learning system designed for children and kids, instructors can effectively use rank systems (similar to those used in games) to reward kids for their participation and effort. To make rank system (and e-Learning system) more appealing to kids, it is advisable to use visually attractive (again, for kids) and distinctive badges for each rank or level. This approach is quite similar to giving golden stars to active kids in classroom. Also, similar strategies are effectively used to attract video game players and to prolong their interest (ChicagoNow, 2010). Figure 3 depicts the examples of the badges from video games.

Figure 3. Examples of badges from video games.

Of course, rank or level systems can also be used to assign duties for the particular groups of students. For example, all students with rank Analyst will perform the gathering and analysis of statistical data. This approach makes it is possible to simultaneously assign duties for members of each group in the course; thereby, helping instructor and reducing overhead.

CONCLUSIONS

As collaborative learning and e-Learning are becoming more popular and demanded, it is necessary to develop a system that would satisfy all needs of instructors and students. Thanks to its ease of use and high elasticity, wiki can be effectively used as the basis of the collaborative e-Learning system. However, to improve this system, it is important to provide additional functionality. Features like built-in social network, personal blog, single sign-on, access control for particular content of the wiki, and others, can turn wiki-based collaborative e-Learning into highly effective replacement of traditional face-to-face learning approach.

Semantic Web technologies can be used to advance the existing wiki systems and to implement new features. Some of the advantages the Semantic Web technologies can bring are the following: improved search accuracy (especially important for large projects), context-aware presentations, easier data integration, an ability to make inference on the existing data to create new knowledge. The Semantic Web technologies provide an opportunity to create machine-processable data that can be easier reused in other projects. This is especially important for data with long-term importance.

The future plans of the author include the development of the collaborative e-Learning system on the basis of the existing semantic wiki and improvement of this system.

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BIOGRAPHY

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