CKBLS: An Interactive System for Collaborative Knowledge Building and Learning

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Abstract: - In this paper, I review some current technologies and software used in collaborative knowledge building and learning in general and then discuss the interactive system I designed to facilitate collaborative knowledge building and learning in tertiary education. This system is used in conjunction with a wireless intelligent personal electronic response system in the classroom. Contributors and learners are also able to access this system remotely.

Key-Words: - knowledge bases, collaborative knowledge building, collaborative learning, tertiary education

1 Introduction

Collaborative knowledge building resulting in the creation of knowledge bases that can be easily interrogated to provide valid answers to questions from students is a challenging task. This challenge is even greater in a field such as computing where progress is fast and change happens so often. In the first part of this paper, I review some current technologies and software tools, such as wikis, used in collaborative knowledge building and learning in general. I then discuss the interactive system designed to facilitate collaborative knowledge building and learning at the university level. I also provide some details of the wireless intelligent personal electronic response system used in conjunction with this system in the classroom and how the collaborative knowledge building and learning system can also be accessed remotely.

2 Collaborative Knowledge Building and Learning

Most humans living in the twenty-first century, process, in one day, more information than the Neanderthals would have processed in a lifetime. Yet, we face problems trying to get our students to acquire the knowledge that they set out to do and paid fees to do so. These problems multiply further in classes with students with multiple diversities.

Many experts in education suggest collaborative knowledge building as one tool that may be used to help students learn.

Interaction is recognized as a very important social element of deep and effective Learning [1].

This “interaction can happen between learner and content (hypertext, simulation), learner and instructor (computer mediated communication) and finally between learner and learner (collaborative learning)” [2].

Collaborative knowledge building is also very useful to all of us, the general population, with Wikipedia, probably being the best known, and most used tool [3].

3 A Major Tool

3.1 Wiki

Wiki is a server software tool that enables users to create and edit web content using browsers such as Mozilla Firefox and Internet Explorer. It has a simple syntax for creating new pages and cross links between pages.

A single page in a wiki is a wiki page. The entire collection of wiki pages with hyperlinks is referred to as the wiki.

As anyone can edit the content on a public wiki site it is easy for users to unintentionally or deliberately, add false or misleading information. According to Lars Aronsson, a data systems specialist, “Most people, when they first learn about the wiki concept, assume that a website that can be edited by anybody would soon be rendered useless by destructive input. It sounds like offering free spray cans next to a grey concrete wall. The only likely outcome would be ugly graffiti and simple tagging, and many artistic efforts would not be long lived. Still, it seems to work very well.” [4].
3.1.1 Wikipedia
Wikipedia is a free, very successful and well-known online-encyclopedia that is available in many languages. Knowledge on Wikipedia is constructed in a collaborative manner. Wikipedia is a very open wiki where anyone can edit the content. This openness has enabled it to continue to grow at an amazing rate. It was launched in 2001.

In six years it has over nine million articles in more than 250 languages [5]. Although some people continue to argue, and everyone agrees, that some of the information contained in Wikipedia may not be reliable, Wikipedia has become a rich source of information for most people around the world.

3.1.2 Citizendium
A project that initially forked out from Wikipedia and initiated by one of the co-founders of Wikipedia, Larry Sanger is the Citizendium [6]. Sanger said in an October 17, 2006, press release that Citizendium "will soon attempt to unseat Wikipedia as the go-to destination for general information online" [7].

The aim to provide highly reliable information, has limited the number of contributors and this has resulted in Citizen's Compendium having only around 4200 articles in one language, compared to the nine million on Wikipedia in more than 250 languages [5, 7].

3.1.3 Semantic wiki
“A semantic wiki is a wiki that has an underlying model of the knowledge described in its pages. Regular wikis have structured text and untyped hyperlinks ….. Semantic wikis allow the ability to capture or identify further information about the pages (metadata) and their relations.” [8]

The major goal of the semantic web is the creation of machine readable representations of meaning that make the web more intelligent and responsive [9].

3.1.4 Problems with Metadata
Although some progress has been made in certain domains, by formalizing domain-specific ontologies, such as the ones produced by the Gene Ontology Consortium [10], and much work has been done using semantic wikis [11, 12], the problems using metadata remain unsolved to a large extent [13].

4 Other Tools in Current Use
Several other tools exist that have specific uses in collaborative knowledge building and learning and fast and efficient sharing of knowledge. These are often called social software and include discussion boards, blogs, podcasts and RSS feeds.

4.1 Discussion Boards
These are ideal for topics that require, and attract different viewpoints and debate and where a consensus may be attempted as the final outcome.

However, these can often attract many postings, and when they do so, become difficult to read. Important information may be submerged in a lot of chatter.

Discussion boards are available in commercial software such as Blackboard [14]. In Moodle, a free, open source software, similar to Blackboard, the equivalent is called a discussion forum [15].

4.2 Blogs
These, sometimes called weblogs, (blog is an abbreviation of web log) are mostly used as individual members’ journals to which others may add comments, when permitted. These have limited value in collaborative knowledge building and learning.

4.3 Podcasts and RSS Feeds
These are useful tools with limited value in knowledge building and learning.

5 Applications in Tertiary Education
Several interesting projects have been completed using wikis and modified wikis in tertiary education. One of these, BauWiki, for use in the teaching of structural concrete (lectures) is described by Ebner et.al. in [2].

Another, QBLS (Question Based learning System), for use in the teaching of Java programming (laboratory classes) is described by Dehors and Faron-Zucker in [16].

The third project we consider “discusses the potential use of wiki as an environment for the formation of student models during distance education sessions” [17].

Another interesting paper presents a number of ideas on using wiki as a tool in teaching software engineering [18].

5.1 BauWiki
In their paper, the authors describe BauWiki, giving their reasons for choosing TWiki as the base platform, from amongst the 200 or so wiki systems that were then available. Latest information on TWiki is available on [19].
The authors of the BauWiki encouraged their students to collect, collate and prepare relevant learning resources for the whole learning community on a collaborative basis and allowed the individual students to bring this material to the exams [2].

The authors found that they could not replicate the level of contribution experienced by the German Wikipedia, even though the number of registered users grew at a rate comparable to that of the German Wikipedia [20].

“Almost none of the students edited articles during a period of three months.”[2].

Their findings are in agreement with my views that, most students in this era, a. need to have an immediate outcome (an incentive) in the form of a grade, for them to put in some effort, b. do not find the idea of putting in some effort to create something in a collaborative manner for the benefit of everyone, readily acceptable, and, c. usually like to consume the provided leaning content and not contribute to its creation on a voluntary basis.

The authors views are also in agreement with my views, and experience, that for any collaborative knowledge building and learning system to be successful in a teaching institution, a. the system should have a minimal mass of relevant articles readily available to shorten the “lurking-phase”, and that, b. “In the early stages only a tiny linear growth of articles, produced by a very small group of contributors, can be expected.” [2].

5.2 Comparing with Wikipedia
It should be noted that Wikipedia now has an exponential growth as has the body of total knowledge available to the human race. Wikis used in universities are never likely to match the same rate of growth.

5.3 QBLS: A Semantic Web Based Learning System
In this paper, the authors describe how, the teachers collaboratively write laboratory classes, in the BlueJ programming environment, using a wiki, and how they “collaboratively add links towards QBLS using a macro.” [16].

The findings of these authors are also in agreement with my experience that students, a. only look for what is relevant to solve their current problem(s), b. expect the availability of relevant resources online, and, c. engage in distant on-line learning, from home, or other suitable location, such as their workplace, “even when having face to face courses in a regular location”[16].

5.4 Student Modeling
Student models may be thought of as representing “student understanding of the material to be taught with the purpose to make hypotheses about student's misconceptions and suboptimal performance strategies” [21].

According to Greer [22], “a student model may be:

a. An abstract representation of the learner.
b. Teacher's conceptualization of a learner.
c. System’s beliefs about the learner.
d. System's beliefs about the learner's beliefs and skills.
e. It may include the history of learner actions as raw data.
f. Interpretations of raw data.
g. Explanations of behavior.”

Tsinakos [17] argues that the, “issue of collaboration among tutors in order to form student models leads to wiki environment as a potential collaborative tool in their hands.”

5.5 Teaching Software Engineering
Parker and Chao list a number of software development activities in which wikis were used by students in a software engineering course [18]. These activities include, a. maintaining group diaries of individual and team activities, b. project planning, c. requirements management, d. project tracking and reports, e. test case management, f. defect tracking, g. client notes, and, h. developing user documentation.

6 My System
Having considered using wikis, semantic wikis, discussion boards, blogs and QBLS, the semantic web based learning system, and other web technologies discussed in the last few sections I decided to build my own system to facilitate collaborative knowledge building and learning, in my courses.
Building an independent system not only gave me the flexibility to include the features needed to make it a very useful one, but also made it easier for me to integrate it with the wireless intelligent personal electronic response system built by me earlier. Details of this system may be found in [23].

6.1 Design Considerations
I took the following into consideration in designing the system:

a. the system providing reliable information and at the same time giving all users the ability to contribute freely. This is taking the main difference between Wikipedia and Citizendium and putting the best of both together.

b. being able to build the validated part of the knowledge base on an evolutionary fashion. This is similar to the idea used by both Wikipedia and Citizendium, except that my knowledge base is structured differently.

c. being able to use the knowledge base to answer questions posed in certain pre-defined formats. This is so as to provide answers especially in situations such as when the students are doing something practical and need help to be able to continue. The system needs to be more intelligent than Wikipedia and other social software.

d. providing enough initial validated information so users will continue to use the system, and not write the system off as a useless resource after their first visit. This will also minimize the ‘lurking-period’ identified by Ebner et.al. [2].

e. providing incentives for people who provide valuable contribution. This is to encourage people to not only use the system as a resource, but also to actively participate in the collaborative knowledge building and learning process. Providing incentives overcomes some of the reluctance identified by Ebner et.al. [2].

f. the users of the system being able to switch domains, thus enabling the use of the system in other subject areas.

g. the system having the ability to be integrated with the WIPER system.

h. the system being able to be produced using the agile system development methodology.

i. the system having the capacity to form models of student understanding.

j. the system having the capacity to provide appropriate ‘hints’ to the students.

6.2 Implementation
Initially my system was provided with a body of encapsulated current knowledge built into it by the subject expert (in this case, the lecturer). This knowledge base could be edited by only the expert, thus making the information adequately reliable. Thus the system was made immediately useful for all users including the passive users who use it solely as a source of information.

The knowledge was encapsulated in a way that it is easy to query it using simple questions such as “What is a …?”, “How do I …?” and “What should I do if I get the message …. when I ….?”

Students are allowed to add new knowledge in an area separate from that of the validated area. All users are able to view the content in both areas at any time. This is like putting together Wikipedia and Citizendium, taking the best of both.

All users are also allowed to ask questions, respond to others’ questions, make suggestions and initiate new threads as on discussion boards, in a fully open, un-moderated part of the system.

Selected pieces of new knowledge are then encapsulated, in the correct format, and added to the validated area by the experts.

6.3 A Pictorial View of My System

Fig. 1 A Pictorial View of the System
7 Some Details of the Implementation
The system is implemented in Linux with much of the code written as shell scripts. The knowledge bases contain chunks of knowledge in text files, picture files, sound files and video files.

As the system is a skeleton system into which knowledge bases can easily be added and removed, it is highly versatile. Although it was developed primarily to help in teaching courses in computing where the knowledge itself is changing all the time, its skeleton nature makes it easy to switch domains giving it the ability to be used in collaborative knowledge building and leaning in almost any area, during lectures and tutorials, in both physical and virtual classrooms, in synchronous mode as well as in asynchronous mode.

8 Integrating with WIPER
A wireless intelligent personal electronic system was earlier developed by me for use in the classroom. Details of this may be found on [23]. This system was integrated with the current version of the CKBLS and the resultant system is shown in Fig. 2.

8.1 Benefits of Integration
The WIPER system has engines for not only sorting and answering questions from users but also gives the expert users the ability to compose entire lectures or presentations by simply putting together chunks of knowledge contained in the knowledge base. These lectures may also be delivered automatically, remotely, or using one of the humanoid robots available to the system.

9 Conclusion
In this paper, I identified some of the tools and technologies used in collaborative knowledge building and learning, and their limitations. I then gave some details of a system that I developed to facilitate collaborative knowledge building and learning amongst my students, at the tertiary level. The techniques used are successful within specific domains and very useful, especially in domains where the knowledge itself is changing.

References:


