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EduWiki: A Knowledge Construction System for Collaborative Learning

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1. Introduction

Adoption of new technology or new method is likely to be slower in education than in other domains due to its character. Although collaborative learning that involves some tasks is commonly conducted, practice of distributed collaborative learning is not very common.

This paper presents a knowledge content construction system that can be applied to collaborative learning.

There are issues in Web-based distributed collaborative learning:

- While majority of the research on supporting distributed collaborative learning deals with discussion that is in the stage of information exchange in the process of collaborative learning, majority of actual learning involves tasks other than discussion (Inoue, 2005).
- There are fewer practices of distributed collaborative learning compared to those of face-to-face collaborative learning. Methodology of distributed collaborative learning is not well-known yet (Inoue, 2005).
- CSCL is theoretically based on social constructivism. It regards knowledge as one that emerges and appears through interaction with the world including other people, and acquisition of knowledge can be achieved by a learner to interpret knowledge after its emergence (Japanese Society for Educational Technology, 2000). People build up their own understanding with the help of the outside world (Shirouzu et al., 2002). It is important to provide such a world, or collaborative workspace, in distributed learning environment.

We have conducted practical research on the methodology and support tools of collaborative learning in higher education a few years motivated by these issues (Mishima et al., 2004a) (Mishima et al., 2004b) (Takayanagi et al., 2004). A text chat system was used for communication and a collaborative document editing system, a Wiki, was used for collaborative task in these practices of task-centric distributed collaborative learning. Research on a knowledge content construction system named "EduWiki" is based on this experience. Usability issue, content organization issue, and management issue are to be pointed out from these practices, and the "EduWiki" has been developed based on the issues.

The system is based on a Wiki, a Web-based collaborative document authoring system that has been widely used. Expansion of a Wiki has potential to produce a useful tool for content creation in collaborative learning.

The developed system has been then used in practical settings. Two experiments were conducted around the system use. They were to investigate 1) usability of the interface, and 2) content organization. The evaluation resulted in showing effectiveness of the developed system in these aspects.

In the following sections, more details of the system are described. Collaborative learning is explained in the section 2. Related research is summarized in the section 3. System requirements and design drawn from these requirements are described in the section 4. Evaluation of the EduWiki is described in the section 5. The section 6 concludes the paper.

2. Collaborative Learning

Major benefits of collaborative learning are known as: (Japanese Society for Educational Technology, 2000)

- To promote reorganization of knowledge and/or deeper understanding by externalizing a learner's ideas when exchanging ideas with other learners
- To promote reconsideration or refinement of a learner's ideas by knowing other learner's view or solution

Interaction with others can give a learner benefits that cannot be gained from individual learning.

A space for interaction with others is necessary to get the benefits of collaborative learning. A collaborative workspace can be the one. Besides the case that members of a group learn collaboratively, it promotes collaborative learning even when individual learners create their own interim documents, if a workspace is shared and thus a learner can glance those of other learners.

From these, a collaborative document authoring system Wiki can be a support tool of constructing knowledge content in collaborative learning.

3. Related Research

3.1 Distributed Collaborative Learning Support

Kotani et al. developed a discussion support system that shows participants' roles to activate discussions in real time (Kotani et al., 2004). Ogata & Yano developed "Sharlok" system that support starting discussion online by providing awareness of knowledge of others (Ogata & Yano, 1997). There are many other researches on online discussion in learning.

3.2 Wiki and Its Use for Learning

WikiWikiWeb, or Wiki, was originally developed by W. Cunningham. By a Wiki, a user can:

- Edit a Web page instantly through a common Web browser
- Write a formatted Web page by the Wiki description language that is easier than HTML
- Link Web pages easily

A variety of similar systems called "Wiki clone" have been developed because of these reasons. Some of these are Twiki (<http://twiki.org/>), which is made in Perl and has a lot of functions, and CoWeb, which is mentioned later. Among Wiki clones developed in Japan are Puki Wiki (<http://pukiwiki.sourceforge.jp/>) and FreeStyleWiki (<http://fswiki.poi.jp/>), whose functions are separated between basic and advanced for the convenience of developers. HashedWiki (<http://cake.dyndns.org/hashedwiki/>) can edit, add, delete, and move by a paragraph, not a page.

CoWeb that was developed at Georgia Institute of Technology is well known (Guzdial, 1998). More than 120 CoWeb sites were run and used by more than 1000 students in the year 2000 (Guzdial et al., 2000). Though CoWeb was widely applied for education, it does not have many functions specifically designed for learning.

Ito reported an example of using a common Wiki to share information in his laboratory (Ito, 2003). He raised issues on the lack of relation between the Wiki pages and accessibility to those pages. Yamashita reported a trial of using Wiki in his class (Yamashita, 2004). Eto developed a Wiki system that uses mailing list as the content of the Wiki (Eto et al., 2005).

Our system EduWiki is designed for educational use, and is focused on content organization of the system as well as its usability.

3.3 Other Related Systems

There are other content construction systems in distributed collaborative learning.

CMS(Content Management System) is a system to manage all the content the Web site has. XOOPS is one of the open-source CMSs. CMSs provide management functions to the content, but is different from EduWiki because they do not focus on collaborative learning. Also they do not pay much attention to self-organization of the content.

Blog system can be regarded as another content management system. Blog system keeps holding small articles organized in posted time and the category of content. Blog has function named "trackback" to tell the users when their articles are linked by other blog. Blog also has the function to sort articles by time, but organization of the articles is not focused.

LMS(Learning Management System) is a kind of CMS, in that its content is learning material. LMS also provides total control of learning activities including learners' management such as progress of each learner and score of examination. Generally, LMS supports functions to control learning and teaching materials, to estimate user's learning status, and make contents.

4. Design and Implementation of Wiki for Learning

We noticed a few issues concerning a Wiki through the practical research on distributed collaborative learning that is mentioned earlier.

- Relation between the pages is not well organized.
- It is not easy to reuse the created pages for later activity (another learning).

An interview to a teacher also revealed issues. They were the requirements that were summarized as:

- ・Usability
- ・Content construction
- ・Easy and secure operation

We have examined each of these three aspects, and have developed a new Wiki named EduWiki for collaborative learning.

4.1 Usability

Providing intuitive interface is important. It is also important to make learners aware of existing content and to provide easy access to it.

User interface was changed to cope with these requirements. EduWiki shows only necessary menu items at the side bar (Figure 1). A common Wikis place small menu items on the top of a page. They include unnecessary menu items (Figure 2). On the side bar is a page list that makes learners aware of all existing pages, while this list is one of the menu items in a common Wiki.

Fig. 1. Menu of the EduWiki

Fig. 2. Menu of the FreeStyleWiki

4.2 Content Construction

Functions to organize and reuse pages are needed. A common Wiki can use keyword. Expanding keyword function to organize content is expected. Increasing relations between pages helps organize them and provide opportunity of reuse.

According to this, EduWiki has functions as follows.

- ・ Keyword registration
- ・ Keyword organization by category
- ・ Automatic keyword linking
- ・ Keyword list
- ・ Keyword page

Any word in a Wiki page can be registered as a keyword by using easy notation (double parentheses; [[]]). A keyword page is prepared accordingly. The word in all other pages changes to the link to the keyword page. Category of the keyword can be set when editing the keyword page.

The keyword list on which category chooser is shows keywords depending on the selected category. All keywords are links to the keyword pages (Figure 3).

Fig. 3. Keyword list

Fig. 4. Keyword page

A keyword page has a list of the pages that include the keyword as well as description of the keyword (Figure 4).

4.3 Easy and Secure Operation

There should be variety in the form of learners groups and the way of learning. There would be a case where a learner belongs to multiple groups. There would be a case where learning activity takes place between schools. The system is desirable to cope with these varieties. A Wiki basically permits every user to change pages. This is not always desirable for learning activity. Identifying a user is sometimes needed. To reduce teacher's load, easy administration functions are necessary.

To cope with variety of collaborative learning, EduWiki has functions as follows.

- Flexible user group
- Permission of access by user group

A user can belong to more than one group. Permission of access can be set by group and by page. These functions enable even complicated collaborative learning.

To cope with the security issues, EduWiki has functions as follows.

- Providing ID and password to users for logging in
- Automatic signature on the edited part

To cope with administration requirements, user interface for administrator was changed, and bulk management function of users was added.

5. Evaluation

EduWiki was compared with FreeStyleWiki as one of the common Wikis. Two experiments were conducted. In the experiment 1, usability of EduWiki was examined whether EduWiki interface made its menu more intuitive and easier to operate than FreeStyleWiki. In the experiment 2, content made by EduWiki and by FreeStyleWiki was compared in terms of its organization.

5.1 Experiment 1

5.1.1 Method

Fifteen university students who were new to a Wiki engaged in the following two tasks with the EduWiki and a common Wiki (FreeStyleWiki3.5.5).

- Task 1: to make a new page that is identical with the indicated example page
- Task 2: to search the indicated page and edit as indicated

Half of the subjects used the EduWiki first and then used the common Wiki. The rest of the subjects used them in the reverse order. Task completion rate and time of the two tasks were compared between the Wikis.

5.1.2 Result

There was not difference between the EduWiki and the common Wiki in task completion rate (Table 1).

	EduWiki	FreeStyleWiki
Task 1	100	100
Task 2	80.0	86.7

Table 1. Task completion rate (Percentage of the subjects who completed the task) (%) N=15

	EduWiki	FreeStyleWiki	Significance level p
Task 1	176.2 (N=15)	194.9 (N=15)	0.68
Task 2	52.8 (N=8)	84.5 (N=6)	0.07

Table 2. Averaged task completion time (sec)

Chapter	1	2	3	4
Pages	39	46	31	51
Sections	3	4	3	4
Wiki	EduWiki	FSWiki	EduWiki	FSWiki
Subject A	x			x
Subject B	x	x		
Subject C	x	x		
Subject D		x	x	
Subject E			x	x
Subject F			x	x

Table 3. Member assignment and Wiki assignment for the study sessions

Then task completion time of the 2 tasks were compared (Table 2). The task completion time was shorter in EduWiki but was not significantly different between the Wikis in the Task 1. In the Task 2, Because both Wikis have a search window, some subjects used it instead of using the "page list". Only the data of the subjects who used the page list were used because search function was not the target of evaluation. The averaged task completion time of the EduWiki was shorter than that of the common Wiki.

5.2 Experiment 2

Organization of content was compared between the content made by EduWiki and the content made by FreeStyleWiki.

5.2.1 Method

The subjects were six lab members. They used Wikis in regular study sessions. They were not informed of this experiment. The topic of the study session was statistics. The textbook has 4 chapters. A chapter of the textbook was assigned to a group. The group made presentation material for the chapter and lectured to other members. The groups and the assignment were organized so that each member made presentation material twice, one by EduWiki and the other by FreeStyleWiki (Table 3).

Each chapter has about 30 - 50 pages and has 3 -4 sections. Difference between chapters is not significant.

Chapter	1	2	3	4
Number of Wiki pages	4	4	3	4
Number of keyword Wiki pages	31	2	3	3
Used Wiki	Edu	FS	Edu	FS

Table 4. Number of created Wiki pages

From	To	Edu	FS
Standard	Standard	0 (0.0)	3 (0.4)
Standard	Keyword	131 (18.7)	2 (0.3)
Keyrword	Standard	57 (1.7)	0 (0.0)
Keyword	Keyword	44 (1.3)	2 (0.4)
Total		232	7

Table 5. Number of links between Wiki pages (Averaged number of links for a page in parentheses)

Both Wikis were used through study sessions. That is, the users could read the content for the chapter 1 when they make content for chapter 3 because the content for chapter 1 was already made and was stored in EduWiki. The users could read the content for the chapter 2 when they make content for chapter 4 in the same way.

The subjects were instructed the use of EduWiki and FSWiki, and were instructed that every member should be involved in making content. The study session was held every week so that there was a week for making content for a chapter.

5.2.2 Result

Table 4 shows the number of created Wiki pages for each chapter.

The number of created Wiki pages was larger in EduWiki. Many of the pages were Wiki keyword pages for chapter 1. These keyword pages were also used in the content for chapter 3 because the created content was stored in the system.

Table 5 shows the number of links between Wiki pages. For example, there were 131 links from standard Wiki pages to keyword Wiki pages in total. Because there were 7 standard Wiki pages that were created in EduWiki, number of links for a page is 18.7 on average.

EduWiki has 2 kinds of pages that are standard pages and keyword pages. The content of a standard page can contain keywords. Each keyword has a keyword page that explains its meaning. A keyword page contains automatically generated links to standard pages where the keyword is used.

There was more averaged number of links in EduWiki except standard – standard link. This standard – standard links were made between pages whose content were in sequence. It was possible to be used for looking up related pages easier because a page list was not always shown in FSWiki. There were keyword – standard links in EduWiki but not in FSWiki. EduWiki has automatic linking function for this, while a user has to make the link manually considering content organization in FSWiki.

6. Conclusion

We have developed a knowledge construction system for collaborative learning. The system is based on the requirements of usability, contents construction, and easy and secure operation. The content is organized mainly by keywords.

A collaborative document authoring system Wiki has been used in the practice of distributed collaborative learning, but has not been newly developed for collaborative learning as have been done in this paper. Evaluation through experimental uses suggested usefulness of the system.

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