Joint Annotation and Knowledge Building in Collaborative E-Learning*

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Abstract: Tools to enable joint annotation help in collaborative knowledge building in e-learning. EDUCOSM is a system that offers two types of annotation, namely highlights and comments, on any Web-page that are visible to other learners immediately. The tool is built to enable straightforward interaction between the students and the material. Empirical data suggests that the concept of joint annotation can help in processing large amount of material by a large number of students.

Introduction

There has long been an interest in the field of human-computer interaction research to support people collaborating online (Mynatt et al. 1997). When talking about the on-line communities (Preece 2002; Preece and Maloney-Krichmar 2003), issues in the field include trust-building between community members by the increase of "karma", making community members aware of social relations in the community, for example, by visualizing them for the benefit of the community and matching people to form *ad hoc* communities or small groups from a pool of people that have had no previous contacts with each other (Kurhila 2003).

E-learning in higher education can have a spirit of on-line communities, when the tools used support collaboration so that everyone can benefit from everyone else. Critical issues such as the start and the nurturing of the community are simpler in higher education since students and courses in higher education are more goal-oriented than random self-evolving on-line communities.

The tools to support the interaction between people and the material are needed in e-learning as they are in on-line learning communities. The tools should be straightforward to use but powerful in a sense that they provide means to engage discussions tightly coupled to the context. EDUCOSM (Miettinen et al. 2003; Kurhila et al. 2003) is a tool offering easy-to-use publishing and joint annotation of arbitrary documents on the Web. This paper presents empirical data to support the concept of joint annotation as a primary way to communicate within a group of students in community-like collaborative e-learning, thus enabling the students to help each other in processing vast amount of materials.

System Description of EDUCOSM

Contemporary perspectives on education are based on the assumption that a learner is an active contributor in his or her individual learning process (Snow 1994). The EDUCOSM tool used as an e-learning course platform was designed to support these perspectives by offering an environment for collaborative knowledge building by joint annotation of resources. An important issue in the tool is the transparency that penetrates the operation of the tool altogether; everything is visible to everyone else

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present, so that the students can benefit from each other's actions. In a way, it is a form of *social navigation* (Munro et al. 1999, Dieberger 1999), where the actions of others guide the activity of others.

The first operation of the tool is the ability to bring arbitrary Web-documents to the course area, i.e. to build an open-ended common collection of resources together with the other students of the course. When a student finds an interesting document from the Web (while logged-in to the system), bringing the document into the course area requires right-clicking the mouse and selecting "Add to EDUCOSM" from a pop-up menu. The document is linked and routed through the proxy server so that there is no need to actually copy the document. From a user's point-of-view, the document is added to the collection of course resources, and is there for everyone to utilize.

The most essential operation of the tool is the *joint annotation* of any Web-page brought into the joint document pool. When a student is viewing a document, he or she can highlight or comment an arbitrary part of the text. The annotations are visible to all other users. In practice, highlighting is performed by selecting a part of the text with the mouse, right-clicking the mouse and selecting "Highlight" from the pop-up menu. When someone places the mouse pointer over a highlighted text, a tooltip is presented showing who has made the highlight (Figure 1). Similarly, a comment to a specific part of the text can be done by selecting the text fragment, right-clicking the mouse and selecting "Comment" from the pop-up menu. Another pop-up is opened where the user can enter the comment. The comment is visible as a tooltip (called *tooltip comments* from here on) to everyone who places the mouse pointer over the text with a comment (Figure 1).

It is important that the annotations are easy and straightforward to make to enable active joint processing of the material. However, when people are actively annotating documents, the documents can be flooded with highlights and comments. Therefore, EDUCOSM offers *filters* for viewing only the highlights and comments of the desired participants. Everyone can create as many filters as needed. The filters are created by selecting the desired participant names from a list. This way a student can e.g. read the document without any annotations, can filter out any annoying annotators, or can view only annotations from the student group he or she belongs to.

To enable longer and more structured discussions, every user can initiate a document-specific newsgroup-type hierarchical discussion. When a user is viewing a document that does not have an attached newsgroup, the user can start a discussion with a right mouse-click and selecting "Add newsgroup".

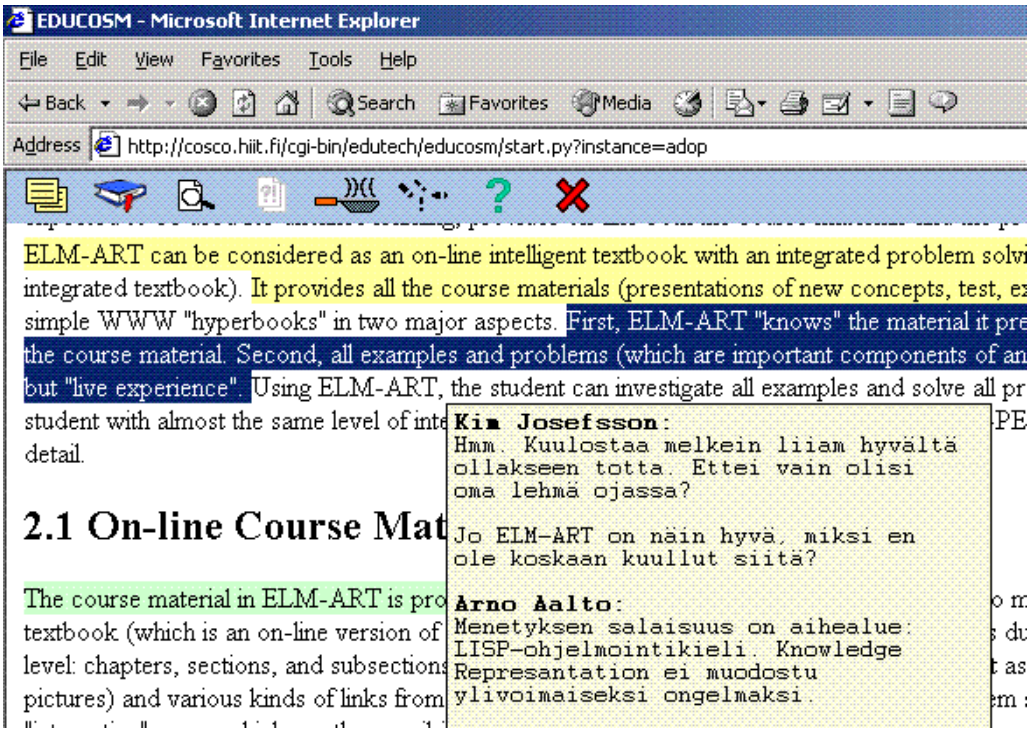

Figure 1:EDUCOSM in operation. Highlighted texts and comments in a tooltip visible.

Empirical evaluation

Study setting

The data set was collected during the Spring 2003 semester from a course entitled ”Computer Uses in Education” with a subtitle of “Web-based learning”. The course was given at the Department of Computer Science, University of Helsinki, Finland. The course was a web-based course without face-to-face meetings and the use of EDUCOSM was mandatory. Thirty-two students were active in the course. Some of the students were adult learners with varying backgrounds and degrees but most of them were Computer Science majors. The course lasted for nine weeks.

The format of the course was fairly unique compared to the other courses at the Department. The students had five reports to produce from various topics. Apart from the first and the last assignment, it was not allowed to produce the report alone. At least a working pair was required, and a group of three was recommended. Moreover, the groups were not allowed to stay the same during the course. The students were encouraged to publish draft versions of their reports so that other students could comment the reports so that the final version could be improved by the discussion around the reports. The teachers (one teacher and one teaching assistant) were deliberately passive and let the feedback from peers guide the process.

The students were expected to bring meaningful Web-pages like research articles or some other resources, called background articles, into EDUCOSM throughout the course. The idea was that the most meaningful resources would emerge as a result for joint annotation, and there would not be a need for everyone to go through every document. The transparency of every activity in the system was made explicit from the start: students’ annotations were not anonymous, and they were not able to erase their comments or highlights.

Results

The study concentrates on three different questions about joint annotation. The first is whether students prefer tooltip comments over the traditional newsgroup-type discussion boards. The second question is whether joint annotation helps in common knowledge building by reducing the time needed for subsequent readers to process the material. The third question is whether it is necessary to construct filters to avoid excessive annotation.

Table 1 shows the amount[1] of tooltip comments and newsgroup postings, revealing a clear preference on tooltip comments (Table 1). This supports the results interviewed in an earlier study (Miettinen et al. 2003).

Table 1: Tooltip comments vs newsgroup postings. Average, min and max figures are per student.

	Total	Average	Min	Max
Tooltip comments	1161	5,86	0	40
Newsgroup postings	96	0,48	0	18

Tables 2 and 3 show how many highlights and comments were made to the background articles and published reports by the first annotating person. The last column shows how much time subsequent readers invested into that particular document. The figures suggest that the first person to annotate used significantly more time on the document, thus paving the way for subsequent persons. In addition, the figures suggest that the students were more eager to comment on the reports produced by their peers than the background documents, but they highlighted the background documents more than the reports.

[1] The figures include some additional highlights and comments made by the teacher to demonstrate the system, but the effect of these additional annotations to the figures presented is minimal.

Table 2: First and subsequent users to annotate the background documents.

	Total	Avg.	Max
First one to highlight	633	2,54	40
First one to comment	107	0,42	12
First one, time used	2429	9,76	157
Subsequent users, time used (avg)	789	3,17	42,26

Table 3: First and subsequent users to annotate the reports produced by peers.

	Total	Avg.	Max
First one to highlight	257	1,3	15
First one to comment	248	1,25	19
First one, time used	2850	14,39	252
Subsequent users, time used (avg)	1322	6,68	28,84

The third question to study was the need of using filters to exclude annotators. The logged data shows that in addition to the two default filters provided (all annotation visible/no annotations visible), the students did not see a need to create too many additional filters. Thirty-two students created a total of 16 filters, ranging from 0 to 3 filters. The data also shows that all the course participants were fairly evenly excluded by the filters. One student was excluded by 10 filters, others were excluded less. Everyone was excluded at least by 2 filters. Students who were excluded the most were not the most active commentators or highlighters; instead, the quality of the comments made appeared to result in exclusion by filters.

Conclusions

The paper described EDUCOSM and presented the way it was used in a higher education setting. EDUCOSM provides the users with joint annotation. Meaningful discussions can be tied to a context, and important points can be highlighted easily. Empirical data gathered from the use suggests that the concept of joint annotation works as expected: a group of people can process information by helping each other to locate meaningful points in background documents, and commenting on each other's work to refine their final outcomes. The

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