Evaluating the Role of a Shared Document-based Annotation Tool in Learner-centered Collaborative Learning

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Abstract

This study presents a shared document-based annotation tool, EDUCOSM. Usefulness of the system is empirically evaluated in a real-life collaborative learning context. Relationships between learner's self-rated use of learning strategies, cognitive outcomes, and completion of various tasks in the system are investigated. An empirical study (n=31) was conducted in order to investigate various dependencies between variables from pre-course self-rated questionnaire, system log file data collected during the course and post-course e-mail survey.

1. Introduction

The purpose of this study is to empirically evaluate the usefulness of a shared document-based annotation tool, EDUCOSM [4] in real-life collaborative learning situations. Furthermore, we investigate how learner's self-rated use of learning strategies is related to cognitive learning outcomes (final examination of the course) and completion of various tasks in the system (i.e., on-line group formation and peer-to-peer annotation of the course material).

2. Theoretical framework

2.1. Shared Annotation

There exists a large research body studying both personal and collaborative annotations in various domains. Previous research [7] has shown that annotations made in books are useful to subsequent readers. We categorize annotation systems into two main groups: Document-centered and discussion-centered. Discussion-centered systems providing tools to browse and annotate discussion messages and threads are out of the scope of this paper. Next we discuss about non-commercial document-centered systems where learners are able to annotate web-based documents.

The first generation of annotation tools such as ComMentor [13] and Group Annotation Transducer [15] required installation of platform-specific client-side software. The second generation allowed annotation of any document on the Web. Systems like CoNote [2] showed annotations embedded in the document, at the nearby position that they were made.

We see two problems with the first and second-generation annotation tools: First, annotations are separated from the context visually by placing them into different browser frame or window, and second, annotations are not embedded in the document at the exact position that they were made.

Some of the third generation creditable annotation systems, such as Kukakuka [17], concentrated on design for artifact-centered discourse, ignoring the first issue of annotation context. We agree that there is no problem with long and threaded newsgroup discussion-like annotations, but we argue that simple one or two word comments should be placed in the context that elicited them. In the EDUCOSM system, user made annotations are shown in small *tool tips* that pop up on top of annotated area. Background color of the area indicates the type of annotation: straw-colored stands for highlighting and light green stands for comment.

The second problem was answered by some of the third generation of annotation tools, such as CritLink [18] and Annotation Engine [16]. Both systems allow embedded annotations, but CritLink places markers around annotated text phrase indicating exact sphere of influence, as Annotation Engine generates just one pointer for each annotation. Both systems allow anyone to add annotations to any document on the Web. EDUCOSM continues this development process introducing numerous intuitive features such as document highlighting and commenting with a right-click of the mouse after selecting a desired text area.

2.2. Collaborative Learner-centered Learning

Throughout the 1990's student-centered learning environments and computer-mediated communication systems such as problem-based, project-based, cognitive apprenticeships, constructivist learning environments, and goal-based scenarios, have rather focused on the affordances they provide learners for effecting their way of learning and thinking, than transmitting information from teachers to learners [5].

Student-centered learning is supported theoretically by various overlapping pedagogical concepts such as self-directed learning [1], student-centered instruction or learning [3], active learning [12], vicarious learning [6] and cooperative learning [3]. For example, self-directed learning involves dimensions of process and product referring to four related phenomena: personal autonomy, self-management, learner-control and autodidaxy [1]. All these dimensions are present in the process of student-centered learning where the locus of control is shifted from teacher to the learner who has now a greater responsibility for her own learning.

3. EDUCOSM system

The EDUCOSM system consists of a set of tools (i.e., “Search”, “Newsgroups” and “Filters”) for asynchronous collaborative knowledge construction. The system appears to the user as a button bar at the top of the browser window and a custom popup menu that is available on any page being accessed through the system (Figure 1). The button bar is used for navigating between the various views, including desktop, search and filter creation views, which are described below. Functions for handling individual documents are located in the popup menu. They allow the students to add new material to the system and create annotations and newsgroups.

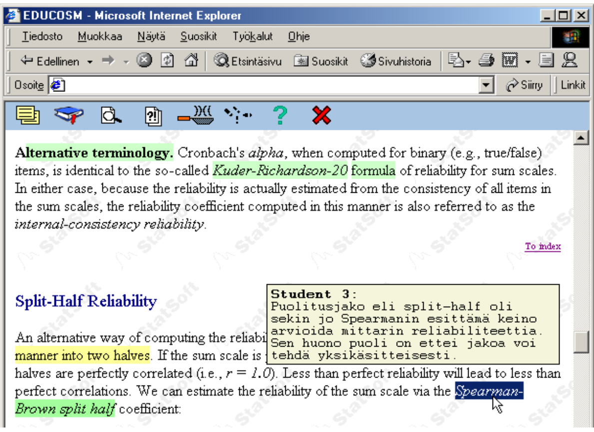

Figure 1. User interface showing a comment.

The idea of learner-centered collaborative learning in the context of this study is that learners are expected to take responsibility for their own learning: The instructor gives an orientation to the topic through theoretical face-to-face lectures. She also gives few pointers to selected on-line resources. The system provides tools to process information and collaborate with peer learners.

4. Method

Information about student’s use of strategic skills in learning was collected with a self-rated on-line questionnaire system, EDUFORM [10], in the beginning of a web-based university-level statistics course in Fall 2002.

The response options varied in a five-point Likert-scale from “1-Completely Disagree” to “5-Completely Agree”. The sample consisted of 26 female and 5 male Finnish vocational education in-service teachers (n=31) taking their post-graduate degree. The respondents’ age ranged between 21 and 51 years.

The questionnaire [14] contains three dimensions of professional learning: motivation, learning strategies and social abilities. In this paper we investigate the 16 items measuring learning strategies (listed in Table 1).

Table 1. Initial statistics of the learning strategy category.

Proposition	Mean (S.D.)
1. I use the time for studying efficiently.	3.8(0.9)
2. I set goals for learning in order to direct the course of my studies.	3.6(1.0)
3. I work hard in order to pass my courses even if I did not like all the readings and exercises.	3.9(0.9)
4. I learn best through practice.	4.1(1.0)
5. Before reading a new text I first glance it through and see how it is outlined.	4.1(0.6)
6. During work practice I ask myself questions and ponder on the relation between theory and work experience.	3.9(1.0)
7. I seldom have time to go through notes and review literature before an exam.	3.4(1.3)
8. I learn most from practical training.	3.8(1.1)
9. I try to elaborate on my own thoughts based on what I have been taught.	3.8(0.8)
10. I want to receive performance-related feedback from my teachers.	3.8(1.0)
11. I study new topics rather by reading than by listening to a well-disposed presentation about it.	2.2(1.0)
12. From a study material, I remember best the pictures and graphical presentations.	3.5(1.1)
13. I study, experiment and solve problems rather on my own than in a group.	2.7(1.2)
14. I like tasks for which there are no model solutions.	3.6(1.0)
15. I want to be sure that my answer is correct, before I answer a question from the teacher.	2.4(1.0)
16. I like study situations, in which the students do the same tasks simultaneously.	2.6(1.3)

The category [11,14,8] has three parts. First part, learning methods, consists of four sections: 1.1 metacognition in learning (items 1, 2, 5, 9), 1.2 metacognition in practice (items 6, 10), 1.3 learning by doing (items 4, 8), and 1.4 resource management (items

3, 7). Second part, sense perception, has four sections: 2.1 visual and verbal (item 11), 2.2 visual and nonverbal (item 11 reversed), 2.3 auditory and verbal (item 11), and 2.4 kinesthetic and tactile (items 4, 3). Third part, information processing, has two sections: 3.1 impulsive (items 11, 12), and 3.2 reflective (items 13, 14).

User log from EDUCOSM was recorded during the course from September 27 to October 26, 2002. The data file contains parameter values for numerous user activities, for example, individual time spent annotating and reading documents, number of highlightings, comments and newsgroup messages.

An email survey consisting of ten open propositions was conducted three weeks after the course in November 2002. In this study we analyze the items measuring users experiences and expectations towards computer supported education.

After two face-to-face sessions covering selected theoretical issues, following two weeks were solely peer-based distance learning in the system. During this time, learners were expected to (1) form a group of two, and (2) annotate by highlighting and commenting an on-line document.

Group mate was selected anonymously amongst the other available learners with a special tool. The only personal information provided in the dynamic selection process was the learning strategy profile presented for each learner. In addition, the group mean was reported for each dimension to help decision-making process.

Each group worked anonymously on a different document that course lecturer had brought into the system. The learning task had following phases: (1) establishing a newsgroup for the document, (2) highlighting and (3) annotating the relevant issues in the document, and (4) discussing about the document with peer learner in the newsgroup.

Final examination measuring subject-related (i.e. statistical topics) cognitive outcomes was conducted in the end of the course.

5. Results

Statistical analysis was conducted with Bayesian network classification [9] due to small sample size and the fact that we could not guarantee neither multivariate normality assumption nor equal sample sizes or variances within groups.

Course lecturer evaluated quality of annotations made by the students in the EDUCOSM system individually on a scale from 0 to 3 after the course. The new variable, “annotation quality”, was the grouping variable (four groups) in the classification procedure where group membership was predicted with gender, self-rated learning strategies, and learner’s actions in the system. The results with 74% classification accuracy show that the quality of annotations was rated higher for male than for female students. Results indicate that auditory and verbally (item 12) oriented students’ who like to have practical training from teacher (item 8) and like to “ask themselves questions and ponder on the relation between theory and work experience” (item 6) generated lower quality annotations compared to those who spend the most time (total time) in the system and “tried to elaborate their own thoughts based on what they have been taught” (item 9).

The individual score of the final examination, “cognitive outcome”, was the classifying variable in the second model with gender, self-rated learning strategies, and learner’s actions in the system as predictors. The results with 63% classification accuracy show that students who are auditory and verbally (item 12) oriented, need teacher’s feedback (item 10) and like to learn from practical training (item 8), scored lowest on the final examination.

Open e-mail survey responses were coded manually by course lecturer into three categories: disagree, agree, strongly agree. Results showed that all the respondents strongly agreed when asked “if the system brought added value to the learning process” and “if it changed their studying habits favorably”, when compared to the traditional university lectures. Further, all the respondents strongly agreed when asked “if they would recommend the system for other courses”. One of the most interesting finding was that both self-made highlightings and comments were experienced to be more useful for the learning process than those made by other learners. Another interesting result was that the respondents made no distinction between anonymous and full name annotations (Table 2.)

Table 2. Preliminary results of the e-mail survey coded into three categories

Proposition	Disagree N (%)	Agree N (%)	Strongly agree N (%)
1. The study process in the system has added value when compared to traditional studying.	-(-)	-(-)	11(100)
2. The use of the system changes my studying process when compared to my previous studies.	-(-)	5(45)	6(55)
3. The system would be useful with other courses.	-(-)	1(9)	9(82)
4. The self-made highlightings promoted my learning.	-(-)	5(45)	6(55)
5. The highlightings made by other learners promoted my learning.	2(18)	6(55)	3(27)
6. The self-made comments promoted my learning.	-(-)	2(18)	9(82)
7. The comments made by other learners promoted my learning.	-(-)	8(73)	3(27)

6. Concluding remarks

A shared document-based annotation tool was presented and its usefulness in real-life web-based university-level statistics course was empirically evaluated. The process of employing adult learner's self-rated motivation, learning strategies, and social ability profile into collaborative learning tasks of an on-line learning environment was investigated.

The overall results indicated that those learners who are willing to do real work with the tools provided by the system, and are able to elaborate what they are doing, produce both highest quality annotations and learning outcomes. Other findings need further investigation. First, impulsive students produced higher-level annotations and scored better in the final examination. Second, visually (but not verbally) oriented students produced higher-level annotations compared to other groups separated by sense perception. Third, students who like to have guidance from teacher or tutor did not do in their studies as well as their more autonomous peers.

This real-life use of the system convinced us that shared document-based annotation promisingly supports learner-centered collaborative learning. However, further studies are needed to investigate possible distractive effects of peer-to-peer annotation to individual learning processes as self-made highlightings and comments were experienced to be more useful than those made by other learners. Generalizibility of the results is limited due to small sample size.

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