Collaborative Learning in AHyCo Online Learning System

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Abstract. *This paper presents a model for online collaborative learning to be used with the AHyCo - an adaptive Web-based learning management system. Our approach to collaborative learning and asynchronous communication using AHyCo subsystem for organizing learning groups and forum is described.*

Keywords. online collaborative learning, computer mediated communication, forum, group forming

1. Introduction

The use of information and communication technology (ICT) in education has a long history of at least 35 years [12]. During that period it has been given various names, including programmed instruction, Computer Aided Instruction (CAI), Computer Aided Learning (CAL), Computer Based Training (CBT), Intelligent Tutoring Systems (ITS), Web-based training (WBT), online learning, and e-learning [9, 12].

Some previously used methods are now replaced with learning systems that utilize interactive learning and teaching using hypermedia (WWW), and computer-mediated communication (CMC) via Internet. The common approach in all these methods is the use of educational software or software for learning, called courseware.

Online learning could be defined as a learning environment that relies on the Internet/WWW as the primary delivery mode of communication and presentation. The students acquire knowledge via the Internet, without the need to be physically present within the learning environment [9].

Despite of the advantages introduced by online learning, some problems related to the use of such learning systems emerge as well. One of the major pitfalls that generally occur in online learning is that providing information to students, mostly in the form of hypermedia courseware, is just the same thing as teaching [6]. Nowadays it is well known that each student is supposed to individually analyze and transform gathered information into knowledge. One of the major problems of online education is high students' drop out rate. According to [11], up to 35% of enrolled students drop out of distance learning classes. In order to reduce this number, educational strategy must change. Online students' drop out rate may be decreased by focusing less on content delivery and more on the learning process [14]. One of the reasons for large drop out rate in online learning is the lack of social interaction. Many online courses encourage interaction between students and content (e.g. by using hypermedia and online tests) and some interaction between students and a tutor (e.g. via e-mail), but little or no interaction between students. This is the main reason why the role of CMC in online learning systems should be emphasized [4, 13, 16].

The research results at Croatian institutions of higher education have as well shown that students' satisfaction with online courses increases only when both quality online materials and well prepared tutors leading the course are present [15]. Quality design of an online course is not a simple conversion of an equivalent face-to-face course in a way that it provides students with access to online information and tests [9,

10]. These courses should use asynchronous CMC and collaborative activities to motivate students to participate more. The role of a tutor is to encourage students in online activities, particularly in the early stages of communication and collaboration [5, 13, 14].

2. Collaborative online learning

Collaborative learning is an approach to learning in which students of different abilities and interests work together in small groups in order to solve a problem or complete a project. It involves group activities and active participation, interaction and communication on the part of both students and teachers [11].

The instructor organizes a class into groups and assigns specific tasks or projects to each group. Group members ought to have well-established "ground rules" that describe how will they interact and work together as a learning community.

Before the group work starts, the teacher should present students with their assignments, responsibilities, regulations for group work and rules for evaluation of assignments. Group work is organized into several stages: initial stage of forming groups, distribution of group tasks or assignments, autonomous group work on assignments, presentation of results to the teacher and other groups, evaluation of group work and assignments' results.

The critical point in the beginning of group work deals with group forming. Groups could be formed according to the several criteria such as students' prior achievement or knowledge, levels of preparation, work habits and gender [5]. Very often, homogenous groups are formed in a way that well-prepared students are placed in groups with other well-prepared students.

During the group work on assignment, members support each other and focus on their task. The crucial part in this stage is a well established communication between the group members [11].

The last stage is evaluation which includes students' reflection on their task as well as a task completion check. This allows students to reflect on their own problem solving process: what did and what did not work well in the group and how could the group learning process be improved.

ICT can be used to facilitate collaborative learning. Specially, CMC gives students an opportunity to work on collaborative projects in an online learning environment [4, 9, 16]. On the other hand, teachers need to pay special attention to students in online collaborative learning, because of physical and psychological separation between them [11]. This could be best accomplished by using various forms of asynchronous CMC.

3. Learning and Communication using AHyCo system

3.1. Adaptive Hypermedia Courseware

AHyCo (Adaptive Hypermedia Courseware) is a LMS (Learning management system) for development and distribution of adaptive Web-based courseware [1]. AHyCo consists of a domain model, which describes the structure of the learning domain as a set of concepts linked together with prerequisite relationships, a student model encompassing student's knowledge of learning concepts and an adaptive model which contains rules for adaptation [7].

The domain model has a two-level structure and consists of concepts that can be seen as elementary pieces of knowledge for a given learning domain [7]. The first domain level in AHyCo can be presented as a graph with nodes corresponding to the concepts in prerequisite relationships. For example, $C_i \ll C_j$ means "concept C_i should be learned before concept C_j". AHyCo distinguishes between two types of concepts or graph nodes: lessons C_i and tests T_j. Tests contain questions about the domain lessons.

To split the domain into more manageable units, the concepts are grouped into modules M_k. Therefore, the second level of the domain model is a directed graph that represents the course a student has enrolled to [8]. Each module consists of various numbers of lessons and tests.

For representing the student's knowledge, AHyCo uses a two-level student model, which is a variant of the overlay model [3]. The first level estimates students' knowledge k_i about the lesson C_i and the second level estimates the knowledge km_k about the module M_k.

The adaptation model consists of adaptation rules that define how are the domain model and the student model combined together to support adaptive navigation. Students can freely follow hyperlinks within a module, while the list of offered hyperlinks is dynamically produced according to the tests' results. Navigation within

a course is restricted and depends on the student's knowledge value km_k.

Each module M_k has one final test T_f and several mini-tests or quizzes T_j. Assessment model uses mini-tests or quizzes T_j to check students' knowledge and to update the student model (values k_i and km_k) while he/she navigates through the module. To enter to another module, successful completion of the final test is required ($km_k > lm_k$, where lm_k is the minimal acceptable knowledge level for module defined by the teacher-author).

AHyCo is composed of two environments: an authoring environment and a learning environment. The authoring environment is used by teachers to define adaptive courseware materials (lessons, tests, etc.) in various learning domains. The Web-based learning environment [1] allows a student to log in and study the automatically generated courseware, which can dynamically adapt according to his/her success in acquiring knowledge.

3.2 Online Collaboration and Communication in AHyCo

AHyCo, as a learning management system, has an ambition of integrating various collaborative and group oriented interactive modules to enhance its own educational capabilities.

Communication is particularly important in collaborative learning, because learning and successful group work can only occur through continuous exchange of ideas between students within a group and between students and tutor [11, 16]. The appropriate form for both ways of communication is an asynchronous CMC, especially the forum.

The main advantage of asynchronous over synchronous CMC in online learning is participation at "anyplace and anytime". Furthermore, each participant has enough time to think about conversations and to make thoughtful contributions. A record of the interaction is kept and can be reused by both the students and teachers [12].

Therefore, integrating support for discussion groups and, on top of it, various forms of communication has emerged for AHyCo as well. At this point AHyCo's database layer and data access layer are expanded in order to provide collaborative support. AHyCo has been upgraded in three main directions in order to support collaborative work and make it as easy and as natural as possible.

1. Adaptive group formation

AHyCo is capable of dividing students into groups. It considers various factors in order to establish a functional and pleasant learning environment.

The student model in AHyCo is now expanded to support collaborative work as well. The student's knowledge levels k_i about the lesson C_i and km_k about the module are used to divide the students into groups depending on their learning success.

Moreover, the knowledge level doesn't have to be the one and the only criteria by which the groups are formed. AHyCo enables teachers to interfere with system's logic and override its decisions through some of the following parameters:

- Grades from previous courses – students can be divided into units which will be led by the best of them or, alternatively, will consist of students with similar previous success.
- Group's size – since the size dramatically influences the quality of learning within groups, this feature is used to prevent overpopulating some groups while leaving others almost empty. The optimal number of students for a small closed group is 4 to 5 [11].
- Student's personal data – students' sex, ages, social background, etc. can also be a factor when deciding how student learning groups will be populated.
- Teacher's personal opinion – knowing students in person can also be a valuable criterion in achieving optimal working surroundings.

2. Collaborative support and communication

Multi threaded discussion forum is integrated into AHyCo [1], allowing students to share information and experience with other students and teachers.

Forum (Fig.1 & Fig. 2) provides many-to-many or group-oriented approaches. One student posts a question or an opinion and the others read it and attach replies. This is a continuous process and the sequence of posts (or a thread) can go on for an indefinite period of time[9].

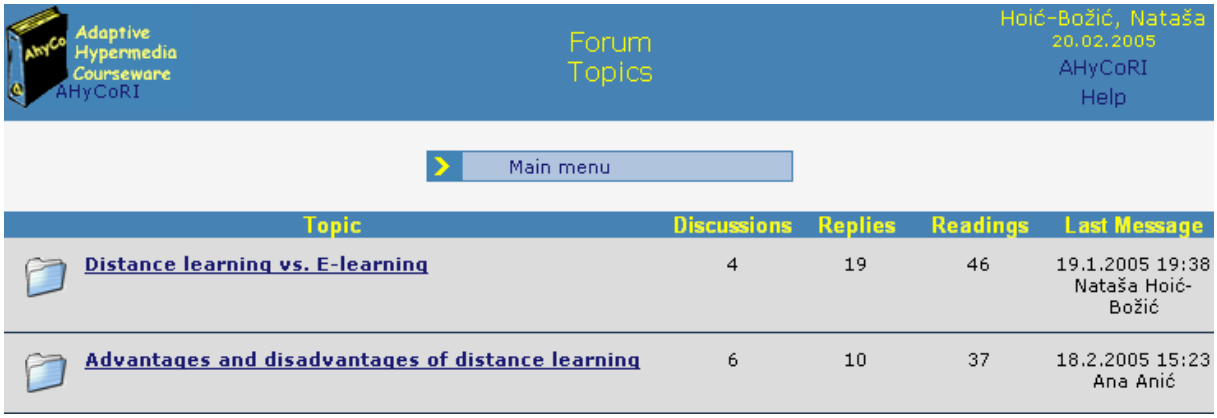

Figure 1. The *Topics* Web page

The forum has advantages over some other many-to-many asynchronous forms such as newsgroups [12]. AHyCo's forum is efficiently integrated into the existing user interface. It is implemented as a set of Web pages so that students navigate and post forum messages more easily.

Students can participate in discussions depending on groups they are enrolled in. Furthermore, discussions are classified as private or public. Private discussions are reserved only for members of certain groups, or students enrolled to courses related to certain groups.

The role of the teacher is to monitor interactions, encourage students in communication and provide feedback on their questions about content or collaborative work [11, 16]. In addition to that, teachers are responsible for creating forum's discussion groups and discussion themes as well as connecting them with existing system's infrastructure.

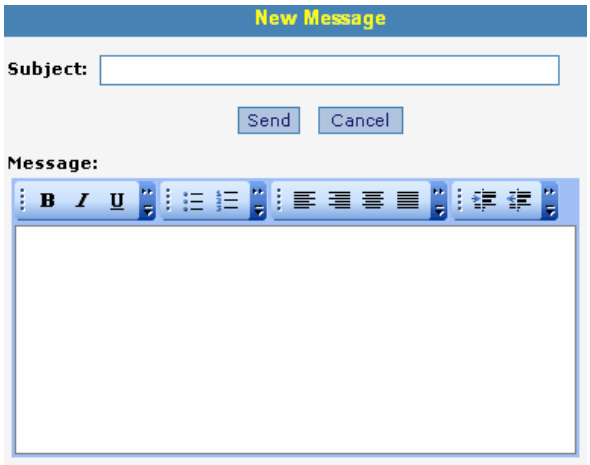

Figure 2. The *New Message* Web page

3. Various means of exchanging messages and files

AHyCo entices its users to upload and download files which are logically stored within groups of their interest. In addition to that, individual communication can be achieved through an internal messaging system.

Internal messaging system is another form of asynchronous communication used in AHyCo. It was chosen because it gives students an opportunity to communicate individually without pressure. Messages are classified as read and unread and are archived to achieve better organization and overview.

3.3 Future development

Although AHyCo's collaborative subsystem has reached a level which satisfies its current users (both teachers and students), many further enhancements are planned in order to make it even more attractive:

- Synchronous whiteboard and chat – these very popular means of communication will be incorporated into AHyCo to extend its interactivity.
- Adaptive regrouping based on students' knowledge level – with this feature AHyCo will be able to monitor students' progress and adaptively regroup students. New groups will reflect current knowledge levels changes in a way that parameters set by teacher allow.
- Group to group grading and evaluation – inter-group progress evaluation will not only be an assessment tool but will also serve to teach objectivity and cooperation.
- Progress supervision and deadline monitoring – the aim of this feature is to help

teachers when dealing with large number of students and deadlines for multiple tasks. Its main purpose is to track students' progress and help manage various activities and events.

3.4 Using AHyCo System for Learning

AHyCo is currently being used for teaching students at the Department of Computer Science, Faculty of Philosophy, University of Rijeka (approximately 20 students of Information Science). Courseware has been generated for a part of the course "Teaching Methods in Information Science" [8] since we utilize a mixed model of face-to-face and online learning with prevailing face-to-face part.

Learning activities supported by AHyCo have been extended and enhanced since this academic year. Major changes deal with introduction of online collaborative learning and online asynchronous communication between students. Until this academic year collaborative work was realized in a classical classroom environment.

The main activities for the course are:

1. *Presenting theoretical knowledge about course's content* - This activity is mostly implemented as f2f lecturing in a class (about 70% of subject matter) and partly by using AHyCo. The number of AHyCo's modules will be enlarged gradually. Eventually, each course topic will be presented as an AHyCo module.
2. *Students' seminar papers* – Students are required to write short papers which deal with course content individually or in groups. These papers are then uploaded to be evaluated by teacher using AHyCo's online testing subsystem. Some of them are presented and discussed on AHyCo's forum.
3. *Online discussion* - It requires that students make regular posts in AHyCo's forum. They comment on and generate ideas with other students and teachers. Topics of discussions are linked with the concepts introduced in course's modules. The online discussion is moderated by teachers who decide whether a discussion should be private (available to selected students) or public (available to all of them).
4. *Development of WWW courseware* – Students choose a topic for the courseware development. They have to explore classical literature or the Internet in order to prepare the content which should be designed in the form of WWW application and published on the Web server. Students work in groups of 3 to 5 managed by AHyCo's group forming subsystem. Courseware is evaluated both by teacher and students from the other groups (peer-evaluated).
5. *Courseware reflection* - A group of students present their WWW courseware and a brief summary of the courseware development process. Each member of the group produces a brief written summary about his/her role within the group and experiences in the project. A student analyzes the courseware and describes what he/she learned from developing it. Each group evaluates the other groups' courseware according to the defined set of criteria regarding implementation and quality of multimedia and courseware elements, quality of the content (subject matter presented in courseware) and quality of design: graphical, interface and navigation design.

Quality learning environments in general, and especially quality online learning environments, should be based on multiple theories of learning [10]. According to these assumptions, in our online learning system AHyCo the combination of three learning paradigms is used: behaviourism, cognitivism, and constructivism [2]. A few years ago the prevailing paradigm was behaviourism since AHyCo was used only for online learning and testing.

Cognitivistic paradigm promotes students' individual differences and motivation for learning. Therefore, students express their own opinions while discussing in forum, choose the topic for the WWW courseware and reflect on their work. An important element of cognitivistic approach is that students apply, analyze, synthesize, and evaluate examples in order to produce their seminar papers and courseware.

According to the constructivism, learning should be an active and interactive process [13, 16]. In the context of a course, students interact online with teachers, other students and the content throughout AHyCo. These activities allow students to acquire their knowledge by learning from AHyCo's online modules, discussing online with other students and teacher and reflecting on their seminars. Collaborative and cooperative learning are encouraged by working in groups.

5. Conclusions and Future Plans

In this paper the use of AHyCo system for online collaborative learning is presented. AHyCo is currently being used in teaching "Teaching Methods in Information Science" course by utilizing a mixed model of face-to-face and online learning. Our approach to the collaborative learning and asynchronous communication using AHyCo subsystem for organizing learning groups and forum has been described.

Currently, we are working on further development of the subsystem for organizing learning groups and CMC. This includes tools for synchronous communication (chat, whiteboard), and tools for the improvement of group work (adaptive regrouping, progress supervision, grading and evaluation).

In order to explore students' attitude concerning online collaborative learning approach, the questionnaire will be conducted in the end of the academic year. Depending on the questionnaire results (students' acceptance of online collaborative environment), further improvements of both AHyCo and course's methodology will be made.

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