Collaborative e-learning environments enhanced by wiki technologies

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ABSTRACT

E-learning environments have met rapid technological advancements in the previous years. Nevertheless, current e-learning techniques do not adequately support student interaction and collaboration, resulting in decreased student progress and motivation. In this paper, a blended technique combining collaborative forums and wiki technologies is proposed. Through collaborative forums, students discuss course related topics assigned by the tutors to produce new educational material. This material is then stored in the wiki platform for further use. The proposed technique was applied on an e-learning course provided by the National Technical University of Athens and its effectiveness was evaluated using student activity data and questionnaire analysis. Results showed that the technique adequately supported teamwork, increasing student motivation and progress while simultaneously producing satisfactory level educational material.

Categories and Subject Descriptors

K.3.1 [**Computer Uses in Education**]: Collaborative learning, Computer-assisted instruction, Computer-managed instruction and Distance learning.

General Terms

Measurement, Human Factors

Keywords

e-learning, collaborative learning, wikis.

1. INTRODUCTION

Recent advancements in the field of e-learning have resulted in sophisticated learning environments that support students in various educational aspects. Current research focuses not only on improving those environments in terms of technology but also on adapting the most successful techniques of classical education to the e-learning process. Collaborative learning has been found [2, 9, 12, and 13] to increase student motivation and enhance their performance. Through collaboration, students become actively engaged in the learning process, exchange ideas and produce knowledge, helping other students to better understand the learning material.

In contrast to classical education, typical e-learning environments lack face-to-face interaction between students. Therefore, the introduction and adaptation of collaborative techniques in these environments is especially necessary. Successful design of e-collaboration will help students feel less isolated and become part of the virtual course community, resulting in better educational performance, motivation and persistence in the course.

Moreover, collaboration between users is also introduced through Web 2.0 technologies, such as blogs, wikis and social-networking sites, as a powerful means of maximizing collective knowledge through user interaction. E-learning courses are delivered through web interfaces and can, therefore, be enhanced by these Web 2.0 technologies to increase student interaction and sustain the educational material produced.

This paper presents a blended technique which supports teamwork through collaboration forums and wikis. More specifically, students are distributed into collaborative forums to better support teamwork. This teamwork results in the production of new educational material under the tutor supervision. The wiki technologies are then used as a means to store and maintain the information produced. The design, implementation and results of this approach are evaluated in terms of system utilization and student progress achieved.

The rest of this paper is structured as follows: Section 2 introduces the theoretical background and related work of this study. In section 3 the educational framework and system structure upon which the proposed technique is based, is presented. Section 4 evaluates the results of the proposed technique. In section 5 a brief discussion regarding the produced results is carried out. Finally, section 6 concludes the study.

2. RELATED WORK

Collaboration in e-learning environments has been examined in various studies. In [1] various technologies that should be further studied to benefit e-collaboration are discussed. The implementation of a web-based collaborative e-learning environment is presented in [4]. For this purpose, factor analysis on student questionnaire answers is used to extract student aspects which are important in developing effective collaborative environments. Recent advancements of e-learning, including the introduction of e-collaboration, and their adoption from tutors and students are discussed in [3]. An examination on how gender, internet experience and computer self-efficacy influence students'

use of collaborative e-learning technologies, is conducted in [8]. Furthermore, perceived usefulness is estimated, and the role of gender is studied to find that it plays no role in the acceptance of collaborative technologies. The combination of virtual reality and collaborative learning systems is used to enhance user interaction and satisfaction towards an e-learning course in [6].

The implementation of Wiki technologies in e-learning environments has been less researched by current literature. Quality feedback from students that used a wiki platform was extracted in [10] leading to the result that overall rating of the wiki usage is satisfactory. The integration of wikis into an e-classroom was investigated in [11]. This study also provides a prototypical extension to the MediaWiki platform called Context Bar.

3. SYSTEM STRUCTURE

3.1 Educational Framework

The course upon which this study is based is an introductory e-learning course on Web Design provided by the Multimedia Technology Laboratory of the National Technical University of Athens [5]. The course consists of seven educational sections and its duration is one semester. During the first six sections the educational material is delivered to the students and discussed with the tutors through forums. Students' progress is assessed through multiple choice tests and projects. The last section assesses student understanding of the total course material through a final multiple choice test and a project. To successfully complete the course, students are required to achieve an average grade of at least 60%. As soon as the e-learning course ends, participating students are asked to fill in a questionnaire regarding their perceived effectiveness of the proposed technique. The data used in this study were extracted from the Fall 2007 course, which consisted of 26 students. The e-learning course is based on the Moodle open source LMS platform [7]. Additionally, the course is supported by a Wiki platform [15]. This platform is, according to the laboratory policy, publicly accessible but maintained exclusively by students and tutors.

3.2 Technique implementation

Besides general purpose forums, where students can pose questions regarding the educational material, a special purpose forum is included in each educational section called "*collaborative forum*". Its goal is to actively engage students in the learning process, motivating them to research over a specific topic and discuss their findings with their classmates.

Firstly, students are divided by the tutors into discussion groups. The nature of collaborative forums used is closely related to brainstorming activities as described in [14]. The aforementioned study results that the optimal size of each brainstorming group should not exceed 10 students. Thus, based on the number of the participating students in the e-learning course under study, three groups of 8-9 learners were created for each section.

To ensure that every group has similar participation levels, a participation index is computed for every student and used to allocate students into homogeneous groups. This index is defined as follows:

$$SP_{n,i} = \frac{p_{n-1,i}}{\sum_{j=1}^{k} p_{n-1,j}} + \frac{h_{n-1,i}}{\sum_{j=1}^{k} h_{n-1,j}} , \ 2 \leq n \leq 6 \text{ and } 1 \leq i \leq k$$

where $SP_{n,i}$ is the student participation index, $p_{n,i}$ refers to the number of posts in a collaborative forum and $h_{n,i}$ is the total activity recorded for the nth course section and the ith student. Finally, k is the number of the total participating students.

The SP_n vector is calculated at the beginning of every educational section. Then, according to their SP value order, three sets of students are created namely the upper, middle and lower third. Next, each set is randomly distributed to the three collaborative groups, a process which leads to homogeneous groups.

After that, a current research topic related to the course is assigned to each group by the instructors. From each group, a student is randomly selected and assigned the role of the group coordinator. This person is responsible for identifying and distributing the necessary workload to the students of the group. Then, the group members discuss the assigned topic, present their findings and propose solutions. As soon as the section deadline expires, the coordinating student collects group answers to compose a summary of the group's findings. Since these findings will be used as future educational material, the instructor proposes certain improvements to the final group answer. Then, the coordinating student incorporates the tutor suggestions to the final group conclusion and uploads it to the wiki platform.

The wiki platform is a collection of all collaborative group answers organized by theme. It is a collective knowledge database to be used as a reference by all e-learning students, including those who will take the course in the future. Figure 1 depicts the aforementioned process. In this figure, "C" represents the coordinating student and "S" the participating students.
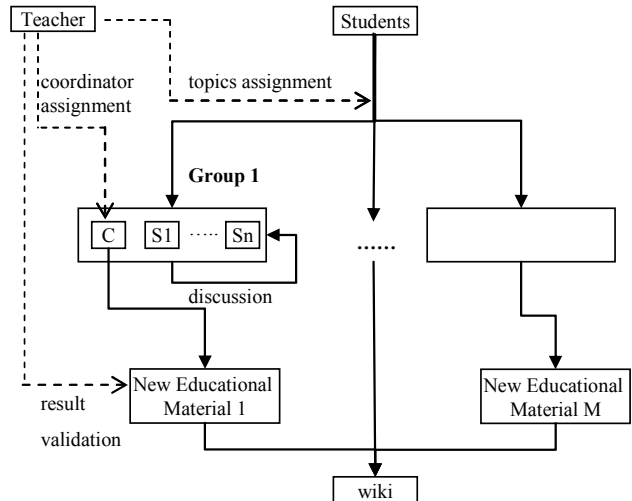

Figure 1. The proposed technique.

4. RESULTS

4.1 System Evaluation

In this section the experimental results of the proposed technique are presented and evaluated.

Figure 2 illustrates the system utilization per educational section. The left vertical axis corresponds to the total collaborative forum posts and participating students per section, whereas the right vertical axis depicts the average posts per student. As one may observe, the number of posts is higher during the first two sections, then it is stabilized in the middle of the course and decreases in the last section. This is mainly explained by the fact that more students tend to actively participate in the first sections. As the course advances, some students drop out thus lowering the number of participants. The decline of participation in the last section is mainly due to the fact that students tend to focus more on completing their final assignment and less on the collaborative process. However, it can be observed that the average number of posts per student increases during the course, indicating that the collaboration between persistent students is reinforced.
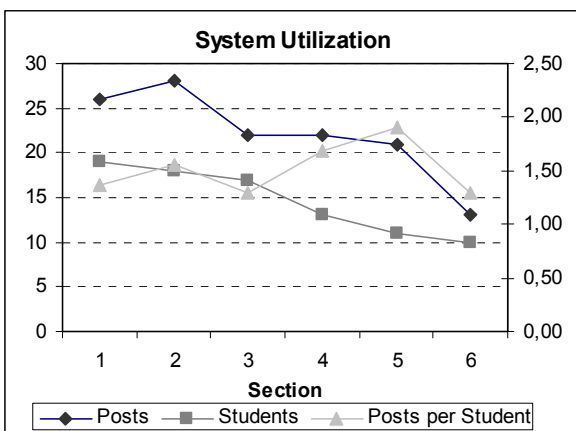

Figure 2. System Utilization

The next step is to evaluate the contribution of collaborative forums on student progress. Figure 3 presents the relation between the average number of student posts in these forums and their average grades in the assignments and multiple choice tests. Two distinct sets of students can be observed. The first set (Group A) corresponds to the more participating students and the second (Group B) to the less actively participating ones.
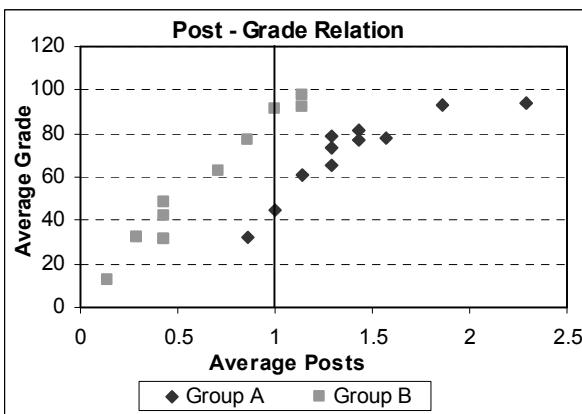

Figure 3. Relation between student progress and participation in collaborative forums

Table 1 presents the differences of the two groups in terms of progress. The group of the more participating students actively engage themselves into the collaboration forums with an average of 1.4 posts per forum which is approximately 3 times higher than the 0.49 average posts per forum that the group of less participating students has. Moreover, the average grade achieved by the more participating learners is significantly higher (71%) than that of the less participating students (46%).

Table 1. Group A and Group B comparison

	Group A	Group B
Average grade	71%	46%
Average posts per forum	1.4	0.49

In figure 3, one may observe that there is a significant difference between the progress of those that continuously participate in the collaborative forums, having at least one post per forum, and those that do not. According to table 2, students with more than one post per forum tend to perform better, achieving an average of 79%, in contradiction to the 34% grade achieved by the students with less than one post per forum. Additionally, the majority of the students that continuously participated in the collaborative forums successfully completed the course, achieving an average grade higher than 60%. On the other hand, students that do not regularly participate in the collaborative forums tend to fail the course.

Table 2. Comparison of regular and non regular participants

	Less than 1 posts per forum	More than 1 posts per forum
Average grade	34%	79%
Grade > 60%	2	12
Grade < 60%	11	1
Total students	13	13

To sum up, according to the experimental results, students that regularly participate in the collaborative forums tend to perform better and complete the course compared to those that do not actively participate.

4.2 Questionnaire Analysis

This section presents an analysis of the questionnaire that e-learning students filled in after the course completion. This questionnaire was designed to evaluate the perceived student effectiveness of the collaborative forum and wiki technologies. More specifically, students were asked to evaluate the proposed techniques answering to the questions presented in table 3. Furthermore, table 3 shows the student characteristic that each question intends to evaluate.

Table 3. Student Questionnaire

Question	Student characteristic evaluated
Collaborative Forum Evaluation	
The collaboration with my classmates increased my motivation and interest in attending the course	Motivation
Communicating with my classmates through collaborative forums helped me feel less	Inclusion to the Student

isolated and more part of the community.	Community
The new educational material produced by collaborative forums is of adequate quality.	Produced Educational Material Quality
Before contributing to the forum, I took into consideration previous student opinions.	Teamwork
Wiki Platform Evaluation	
The wiki platform is useful and informative.	Wiki Usefulness

Figure 4 presents student answers to the questionnaire. Generally students have a positive attitude towards both the collaborative forums and the wiki platform. More specifically, almost 90% of the students felt more motivated using the aforementioned technologies and 80% felt less isolated and part of the student team. Student opinions towards the new educational material produced by collaborative forums vary from neutral to satisfactory. Moreover, almost all students collaborated with their classmates to reach to the group findings. Finally, as far as the wiki platform is concerned, the majority of the students found it useful and informative.
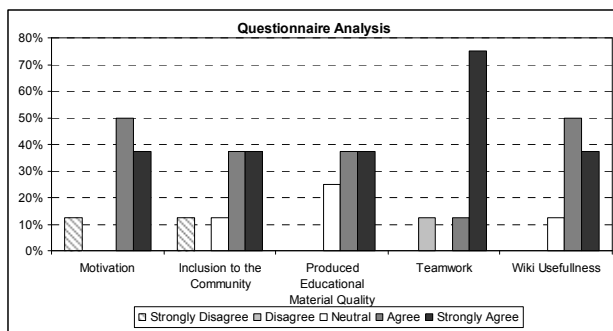

Figure 4. Questionnaire Analysis

5. DISCUSSION

The proposed technique combines collaborative methods and wiki technologies to enhance student interaction and preserve collective knowledge. Based on this technique, student participation is better coordinated and more closely monitored than simple wiki contributions, thus achieving better participation levels. Moreover, since students create their final answer through discussion, rather than simply contributing to other classmates' previous work, learners are not only motivated, but also feel part of the e-learning community.

Another advantage of the blended collaboration method refers to the validity of the information published on the wiki platform. In traditional wiki environments, the validation process is effective due to the large number of participants. However, in an educational wiki maintained only by a limited number of e-learning participants, the validation and correction process relies greatly on the teacher, thus increasing his workload. On the contrary, using the proposed technique, the information uploaded to the wiki has already been extensively discussed and corrected by the students and their coordinating peers, throughout the collaboration process. Additionally, the responsibility for the

validation of the information is distributed to both the students and the instructor leading to the creation of new educational material with minimal workload.

Additionally, the wiki platform supplements student collaboration by collecting and presenting structured educational material created by the students. Collective knowledge is thus not lost but instead it is constantly enriched with up-to-date material. The wiki platform also serves as a link available to e-learning students who have already completed the course but would like to continue contributing and be informed about current research issues in the field.

Therefore, the technique proposed can be beneficial to both students and instructors. Students collaborate with each other to perform research on a specific issue, actively involving themselves in the learning process and achieving better educational results. Tutors on the other hand, are also aided since much of the new educational material is produced by the students, therefore reducing their workload.

6. CONCLUSION

This paper introduces a blended technique based on collaborative forums and wiki technologies to enhance interaction between e-learning students and preserve the knowledge they produce. According to this technique, students are allocated into smaller groups and a research topic is assigned to them. Then, the members of each group exchange ideas and opinions to reach to a final answer which will result in new educational material. Their findings are then uploaded into the wiki platform, creating collective and continuously upgradable course-related knowledge.

The proposed technique was evaluated using both explicit and implicit methods. The explicit method involved inquiring students about their perceived effectiveness of the technique. The questionnaire analysis showed that students provided positive feedback towards the techniques. The implicit method evaluated the effectiveness of the technique using various student characteristics, including the number of posts, total student activity in the course and average grades. According to the produced results, the majority of students that actively participated in the collaborative forums achieves higher grades and completes the course, while less participating students tend to fail.

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