Effectiveness of a framed wiki-based learning activity in the context of HCI education

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Abstract— In this paper, the effectiveness of a framed wiki-based learning activity is investigated. A one-group pretest-posttest study was conducted towards this aim. The study involved 36 first year university students of a Greek Education Department using wikis to learn basic aspects and implications of usability evaluation in the frame of a first year course entitled “Introduction to Web Science”. Analysis of the results showed significant improvement in learning outcomes, in particular for students with low initial performance. The average students’ questionnaire score jumped from 35.2% to 54.9%. In addition, a positive attitude towards using wikis in their project was expressed by the students. The design of the activity, the context of the study as well as the results obtained are discussed in detail.

Web 2.0; wikis; activity design; hei education; project based learning; collaborative learning; learning outcome

I. INTRODUCTION

During the recent years, a considerable interest in using Web 2.0 technologies in education is observed. In general, the term Web 2.0 is associated with websites that are collaboratively produced by their users, in contrast to websites in which users are passive recipients of the content that was created for them. An important advantage of using Web 2.0 technologies is the ascertainment that they constitute a fertile ground for building project-based learning activities [1]. Among them, wikis seem to offer the most dynamic collaboration possibilities [2]. A wiki typically offers the ability to freely edit a website, providing features to add and modify pages as well as to integrate hypertext, images, video, etc. [3]. The adopted interaction model is similar to that of a rich text editor coupled with features of collaboration awareness.

The open nature of the wiki technology creates significant opportunities for learning [4, 5]. However, this advantage can at the same time be a major obstacle if the context and objectives of the activity are not well defined and/or not effectively communicated to the participants [6]. A wiki, by its very nature, facilitates quick content and organization deployment, which in turn increases the possibility of introducing inaccurate or unreliable information, or quoting unsubstantiated opinions. Nevertheless, all the participants of a wiki have the opportunity to edit and improve the provided content. This process of study, identification and correction of content through a process of reflection provides the opportunity for educational approaches compatible with socio-cultural views of learning [7].

As it is the case with other technologies used in education, there is often an implicit perception that wikis can by themselves benefit the educational process without addressing the challenges related to their appropriate integration in the educational context. However, preliminary results, suggest that social, organizational and cultural aspects of the learning context are important factors for the effective use of wikis in educational practice, and not the intermediary technology itself [8]. The open nature of the wiki technology and the dynamic form of collaboration poses the need for coordination among members in order to optimize cooperation with emphasis on learning rather than manipulating the environment [2]. In addition, only few studies so far provide rigorous results on the effectiveness of learning activities mediated by wikis [5, 9].

The aim of the research presented in this paper is to investigate the effect of a framed, rigorously designed wiki-based activity on the learning outcome. The design of the activity was based on the framework proposed by West and West [2]. The implementation of the activity took place in an academic course of a Greek Social Sciences Department. The goal of the designed activity was to teach basic aspects and implications of usability evaluation in the frame of a first year course entitled “Introduction to Web Science”. A one-group pretest-posttest study design was used to investigate the extent of students’ knowledge and understanding before and after their involvement in the activity. Towards this end, a test comprising 35 multiple-choice questions with four answer options was designed. This test was completed online both before and after the wiki-mediated activity.

The topic of the wiki-based learning activity was selected because it is both a notable session of the course’s overall outline, and it addresses a variety of educational, technological, psychological, social and business aspects of website design. Thus, it provides a fertile ground for critical thinking, argumentation and problem solving. While it is generally accepted that the fundamental usability judgment criterion should be the effective use of a system by real users, there is still a considerable use of usability evaluation methods based on experts’ opinion [10, 11]. These methods are typically considered as discount usability techniques and can have a formative character, because they can be applied by experts that often emulate the expected typical use during

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initial stages of an iterative design cycle. Such discount usability evaluation methods are particularly popular in Web development and various (semi)automated usability evaluation tools have been proposed in the literature [12]. The most popular expert-based usability method is Heuristic Evaluation. The latter involves a small set of usability specialists who examine the interface and judge its compliance with recognized usability principles (the “heuristics”). The goal is the identification of any usability issues to be addressed as part of an iterative design process. The expected amount of the total usability issues which could be unveiled using the heuristic evaluation method is related with the evaluators' expertise. However, even regular users with some education and practice could effectively use the method [13]. As a result, one may argue that heuristic evaluation serves as an excellent educational tool to introduce students to the concept of usability evaluation.

The rest of the paper is organized as follows: Initially, the research methodology, the profile of the participants and the design of the activity are presented. Subsequently, the research results are presented focusing on learning outcome as assessed by an appropriately designed knowledge acquisition questionnaire which was completed before and after the wiki-mediated activity.

II. METHODOLOGY

The goal of this study was threefold. First, to study the students’ learning gain after the wiki-based activity. Second, to investigate whether the students with lower pre-test score were benefited from the activity at least to the same extent as students with higher pre-test score. Third, to investigate the effect of the students’ role, while carrying out the activity, on their learning performance. As described in more detail below, students were divided into groups of four members and each one had a specific role in the group such as collector, coordinator, editor and verifier [2].

A. Research method

A one-group pretest–posttest design was adopted [14]. A questionnaire was used as a data collection technique which was completed by the students at the beginning and the end of the wiki-based learning activity. The questionnaire included both demographic and knowledge acquisition questions. The former were completed only before the wiki-mediated activity and collected personal information regarding ICT, Internet, wikis usage and adoption. The knowledge acquisition questions addressed basic aspects and implications of usability evaluation in general and heuristic evaluation in particular. This set of questions was completed both before and after the wiki-mediated activity and was used as an instrument of students’ learning assessment. The students did not know that they would be asked to complete the questionnaire at the beginning or the end of the activity.

B. Procedure and participants

Thirty-six first year university students, 35 female, 1 male, aged 18-24 (mean=19.36, sd=1.18) participated in the study. Six more students who participated in the study did not respond to the assessment questionnaire (either the pre-test or the post-test), and they were excluded from the analysis. Participants were attending a non-compulsory academic course entitled “Introduction to Web Science”, offered in the second semester in the Department of Education and Early Childhood Education at the University of Patras. The study took place from 3/5/2011 to 20/5/2011, a period during which the students had to complete the activity. Participation in the activity was compulsory and was one of the four required mini-projects given to the students in the context of the laboratory part of the course.

The procedure of the study was the following: First, an instruction on the wiki’s basic functionality was given to the students. Subsequently, a compulsory assignment was presented to them in the form of a wiki, initiated by the researchers. The wiki presented the learning objectives, detailed and organized instructions to carry out the assignment, evaluation criteria and supporting material in the form of references and hyperlinks. The students were divided into nine groups comprising four members each. They were allowed to freely form their groups without any restrictions. Each team member had a specific role in the group such as collector, coordinator, editor and verifier [2].

C. Research materials

The wikispaces service (www.wikispaces.com) was used both for the activity announcement, as well as the platform provided to the students to construct their wiki. Survey Monkey (www.surveymonkey.com), an online surveys service, was used to create and distribute the questionnaires of the study. The collected data were organized and analyzed using Excel 2007 and SPSS v17.0. The initial presentation of the activity to the students, the students’ presentation of their wikis and the completion of the questionnaires took place at the computer lab of the Department. All materials used were presented in students’ first language which was Greek.

D. Description of the activity

The design of the activity was based on the framework proposed by [2] who identify the following critical factors to add context to the wiki environment: a) establish a purpose for the wiki project, b) define and classify the learning goals of the wiki project, c) design a rich context and problem that support the achievement of the purpose and goals, d) prepare students for work in the new environment, e) promote a collaborative process through which active, social learning can take place ([2], p. 22). The students had to study and present the most widely adopted usability evaluation techniques and include basic definitions about human computer interaction, user interface design, etc. In addition, they had to delineate the process required to carry out a heuristic evaluation. Finally, they had to cooperatively evaluate the departments’ web site (www.ecedu.upatras.gr) using the heuristic rules [10, 11]. Learning was expected to be achieved by engaging the students into five processes: information seeking and retrieval, web site evaluation, argumentation development.
and refinement to support their thesis, cooperation among members, and their involvement with the wiki editing process. The assignment was presented to the students through a wiki, which was constructed by the researchers (available at http://web-usability.wikispaces.com, Figure 1). The wiki included the objectives of the assignment, its structure, detailed implementation instructions, the expected learning outcome, the evaluation criteria and representative support material.

The topic was selected for the following reasons: First, students should be able to understand the impact and importance of usability evaluation of any interactive software application in general, and of educational tools in particular [15, 16]. In addition, the topic helps students to deeply understand a variety of educational, technological, psychological, social and business aspects of Human–Web interaction. Finally, it is a notable session of the course’s overall outline.

The students had to create their own wiki, in which they would develop the theme of the assignment. In order to better support and align the process of organizing their wiki content and to organize and structure their arguments, an exemplary wiki was constructed by the researchers. In this wiki, the topics that they should cover were presented, organized into subsections with a short description for each one. For each topic, an indicative outline and specific arguments were given to the students to develop. However, the context was not restrictive and the students were encouraged to use additional arguments.

For each topic and sub-topic, supporting material and references were given to the students, mainly in the form of hyperlinks (Figure 1). The students had to search for information on these topics and seek additional materials. The use of additional material was not only desirable, but also a discrete evaluation criterion. The other criteria were text relevance, text clarity, argument originality and reasoning, compliance to the provided structure and format guidelines, material appropriateness and richness and appropriate use of references. All the evaluation criteria were communicated to the students and were included in the wiki. In addition, it was stressed that usage of other’s work should follow specific rules since the open nature of Web 2.0 tools could lead to inappropriate use of content from other sources [2, 17]. For this reason, students were instructed on how they should use and cite other sources. Furthermore, they were informed that they could only use freely available media or media under a creative common license.

Each team member had a specific role in carrying out the work [2]. The first role was that of the "Collector", who had the responsibility to obtain appropriate material relevant to the subject undertaken by the team. The second role was that of the "Coordinator", who was responsible to organize the collected material, to check its consistency and relatedness with the objectives of the project, and to coordinate the discussion on the evaluation of the website using the heuristic rules. The "Editor" was responsible to compose the list of the basic arguments according to the objectives of the scenario. The "Verifier" was responsible to check the contents of the work for its completeness, structure and compliance with the objectives of the project. However, all students were allowed to participate and contribute in every aspect of the collaboration process. After the completion of the activity they discussed and reflected upon their overall project experience with the rest of the class.

III. RESULTS

Most of the students (35/36) reported that they have Internet connection at home and use it mainly on a daily basis (27/36) or several times per week (6/36). Their dominant online activity is information retrieval, followed by email and instant messaging. Concerning their wiki experience, many of them (23/36) reported that they had previously used wikis (except Wikipedia).
The knowledge assessment questionnaire included 35 questions. The maximum score improvement found for a single question was 550.0%. In contrast, an average decrease of 29.2% in the success rates was observed for six questions. The average students’ test performance jumped from 35.2% (SD = 4.63, minimum 14.3%, maximum 54.3%) to 54.0% (SD = 4.61, minimum 17.1%, maximum 82.9%). This difference was found very significant; Wilcoxon matched-pairs signed ranks, p<0.0001. It should be also noted that for 8/36 students, a decline in test performance was observed. The latter, possibly suggests a low involvement in the activity. However, the remaining students (28/36, 77.8%) improved their performance by at least 10%, while 20/36 (55.6%) students improved their test score by at least 50%. The highest score improvement observed was 65.7 percentage points (from 14.3% to 80.0%, see also Figure 2).

The data also suggest that students with lower pre-test performance showed a higher improvement, compared to the students with higher initial performance whose improvement was lower (or marginally negative). In specific, the 18 students with the lowest initial test scores showed an average improvement of 29.4 percentage points, while the 18 students with the highest initial scores improved by 8.4 percentage points (Figure 2). Furthermore, a strong negative correlation between students’ post-test improvement and their pre-test performance was found; Pearson’s r=-0.586, p<0.001. This observed pattern of learning gain seems of particular interest and is compatible with the results obtained from another activity in a similar context [18]. However, additional studies are required to identify the specific reasons; if this kind of cooperation was beneficial for the students with lower initial performance, or whether the specific activity did not offer sufficient learning opportunities for the students with relatively high initial performance.

Table I presents the mean pre-test score, post-test score and learning gain per student’s role. An one-way ANOVA did not unveil any significant effect of the student’s role on the learning gain; F(3,32)=0.732, p=0.541. This finding suggests that the wiki-mediated activity benefited students regardless of the role they selected themselves.

Finally, students reported positive attitudes towards the wiki-mediated activity while presenting their work and reflecting upon their experience with the rest of the class. Beyond their notable learning gains they also reported that the activity helped them to acquire better writing, group process and self-organization skills. Furthermore, they managed to balance between members’ different views, criticism, modifications and suggestions and create effective channels of collaboration.

### TABLE I. DESCRIPTIVE STATISTICS PER STUDENT ROLE

<table>
<thead>
<tr>
<th>Student Role</th>
<th>Mean Pre-test score</th>
<th>Mean Post-test score</th>
<th>Mean Learning Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Editor</td>
<td>40.0%</td>
<td>49.6%</td>
<td>9.6%</td>
</tr>
<tr>
<td>Verifier</td>
<td>35.6%</td>
<td>52.4%</td>
<td>16.8%</td>
</tr>
<tr>
<td>Collector</td>
<td>33.4%</td>
<td>56.3%</td>
<td>22.9%</td>
</tr>
<tr>
<td>Organizer</td>
<td>32.4%</td>
<td>57.1%</td>
<td>24.8%</td>
</tr>
</tbody>
</table>

### IV. CONCLUSION

In this paper, the results of a study investigating the effectiveness of a wiki-mediated learning activity were presented. The evaluation was carried out using a one-group pretest–posttest design. Students worked in freely-formed groups of four persons. Each student had a specific role as a member of the group, which was self-selected among four options: collector, organizer, editor and verifier [2].

Analysis of the results showed a significant improvement in learning outcomes, in particular for students with low initial performance. In specific, the average students’ knowledge acquisition questionnaire score jumped from 35.2% to 54.0% and a strong negative correlation between students’ post-test improvement and their pre-test performance was found (Pearson’s r=-0.585, p<0.001). No significant learning gain differences between the four different students’ roles were found. All in all, the results

![Figure 2. Students’ learning gain. Data were sorted according to their pre-test score.](image-url)
suggest that a properly designed, framed wiki-based activity could substantially facilitate students to achieve high levels of learning. In addition, students reported positive attitudes towards the wiki-mediated activity, stating that it supported the improvement of their writing, self-organization, collaboration and argumentation skills.

However, the study is not without limitations. The results obtained do not explain how the students have benefited from their involvement in the activity. Moreover, it is not known to what extent the students were improved in other non-cognitive aspects considered important to complete a wiki project, such as self-organization, collaboration, attitudes towards technology and openness [19]. In addition, other future research goals constitute the design of additional wiki-based activities in a variety of educational settings as well as to investigate the learners’ behavioral intention to use wiki technology using technology acceptance models [20]. The relation between the observed students’ activity and the learning outcome [21, 22, 23] will be also examined.

REFERENCES


