Using Recommender System to motivate Electrical Engineering Course Students to use Web 2.0 tools in their learning process

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Abstract: *Students in technical disciplines sometimes through their formal education do not learn about Web 2.0 tools. During their learning process, these students either do not use Web 2.0 tools or use only their basic features. Research results have shown that the use of Web 2.0 tools in the learning process significantly increase student motivation. With the aim of motivating students to use Web 2.0 tools recommender systems can be used (we have used ELARS, recommender system developed at the Department of Informatics, University of Rijeka). Results of conducted research indicate that described approach could motivate students to use Web 2.0 tools to acquire new knowledge, but also that additional motivation is needed for students enrolled in courses that do not belong in the area of computer science.*

Key words: *Web 2.0 tools, e-learning, collaborative learning, recommender system, ELARS, PLE*

INTRODUCTION

Using recommendations in the decision-making process is one of the fundamental elements that people apply when making decisions [7]. The development of computers and the World Wide Web as well as increasing amount of information available today has consequently created a need for systems that can help users in finding meaningful and relevant information. In response to this need in the past two decades different recommender systems were developed, firstly for commercial purposes and later for helping users to find educational content during their on-line learning efforts [1], [2].

With the rise of Web 2.0, in which the focus from previously static content shifted towards the user in a way that enables users to independently influence the content through the creation, modification and upgrading, the possibility of using Web 2.0 tools for educational purposes has emerged [6]. One of the fundamental changes that followed was shifting focus from different systems developed to support e-learning (such as Learning Management Systems - LMS) toward the users of these systems, which are becoming a starting point for designing and organizing the process of e-learning. Today's users create personal learning environments (PLE) within which they combine materials from formal and informal sources and create new materials that future users can access and further develop and modify [9]. PLEs also include different tools, including Web 2.0 tools which became indispensable element in the today's learning process. Studies such as [6] have shown that the use of Web 2.0 tools in the learning process increase student motivation, and consequently leads to better results in their learning.

This paper presents a work in progress in the framework of the project " E-learning Recommender System" which aims to raise the quality of education by introducing innovative computer technologies for e-learning, teaching and the promotion of new pedagogical approaches through associated division of knowledge about practical applications. Our previous research have resulted in didactical models that include e-tivities supported by Web 2.0 tools and ELARS – E-Learning Recommender System [11]. Results of evaluation of those models have also shown that the use of Web 2.0 tools increase student motivation for learning. These results were obtained within blended learning courses that by their content belong to the computer science (Hypermedia in education [4], Multimedia systems [3], Operational research [5], Extracurricular informatics and technical activities [8]). The main focus of research presented in this article was to try to motivate students attending a course that does not incorporate computer science content to use Web 2.0 tools for learning.

The paper is organized as follows. The second part describes the conducted research, its parts and main objectives. Research results are shown in the third part of the paper, after which conclusions and future work goals are outlined.

DESCRIPTION OF CONDUCTED RESEARCH

In order to study the possibility of motivating students to use Web 2.0 tools in their learning process in cases when they doesn't study computer science as their major course, a new learning design was created for the course *Electrical Engineering 2*. Existing didactical models developed within the project "E-learning Recommender System" were adapted to the course context in a way that course learning design included one optional e-tivity supported with Web 2.0 tools and ELARS recommender system.

Participants included in the conducted research were students who attended the course *Electrical Engineering 2* during summer semester of the academic year 2015/2016 (N=20). The students were surveyed at the beginning of the course about their own experiences and it was established that they had none or very little previous experience with the use of Web 2.0 tools for learning. This was taken into account during course learning design development. In addition, during the course students received detailed instructions on how to use Web 2.0 tools and ELARS. Experiences of students in the use of Web 2.0 tools and ELARS were questioned through anonymous questionnaire (after they have passed the final exam). The questionnaire had 11 questions (shown in Table 1) and used Likert scale of attitudes (1 - strongly disagree, 5 - strongly agree). Of the total number of enrolled students 15 of them filled out this anonymous questionnaire (75%).

E-Learning Activities Recommender System (ELARS)

Learning design created for the course *Electrical Engineering 2* was implemented within educational recommender system ELARS. ELARS was developed at the Department of Informatics, University of Rijeka with the goal of personalization collaborative learning activities (or e-tivities [10]) that are performed using Web 2.0 tools. The system is used together with the chosen LMS and a set Web 2.0 tools. In ELARS students can find the expected learning outcomes for learning modules in which the course is divided, a workflow of activities included in the learning design of particular module as well as the information on the time period intended for start and completion of each activity. They can also examine received recommendations and choose among offered collaborators, Web 2.0 tools and optional e-tivities. The system monitors students activity during individual and group assignments and provides advice. Activity data is obtained through RSS channels or application programming interfaces (API) of different Web 2.0 tools. Based on the observed quantity and continuity in students work, ELARS compare students and groups results, and calculates their activity level in order to give them feedback and encourage them for further work [4], [5].

All types of recommendations available in the system are determined based on data from student and group models that are among the main components of the system. When students start to use the system, they enter data regarding their learning styles preferences (results of VARK questionnaire) and their preferences of different Web 2.0 tools. Using these information the system builds the initial model of each student. During the course, the student model is updated with information regarding knowledge and activity level. While activity level is automatically calculated according to the collected activity data, knowledge level is determined based on test results entered into the system by the teacher. Group model contains data regarding group activity level.

Electrical engineering Course and pedagogical basis

Course *Electrical Engineering 2* is part of the curriculum at the second year of university undergraduate study program: Polytechnics (single major) at the University of Rijeka. The course is given 4 ECTS and managed by one teacher. In terms of content, the course covers the area of electrical engineering related to alternating currents and voltages, the phenomena of electromagnetism and its application in practice. The course is designed in the form of face-to-face (f2f) classes in which the students are expected to

actively participate in analyzing and solving the presented problems in the field of electrical engineering. Based on the acquired theoretical knowledge, students are expected to gain the ability to use this knowledge in practical applications (in the computational analysis of electrical phenomena and later in the practical work in the laboratory). The course materials used in the classroom, as well as additional materials are available via LMS system MudRi – Moodle based system used at the University of Rijeka.

Regarding the grading components, students can collect up to 10 points on short tests during the *f2f* lectures and up to 60 points on three tests during the semester (20 points for each). When the semester ends, students should take the final exam and collect up to 30 points. After totalling all points earned, the final grade is given according to the following scale: A (80-100%), B (70-79.9%), C (60-69.9%), D (50-59.9%), E (40-49.9%). Students with less than 40 points fail and must retake the course.

The introduction of Web 2.0 tools in the Electrical engineering course

In order to motivate students to use Web 2.0 tools and Web 2.0 based e-learning, learning module *Web 2.0 assignment* was designed. After successful completion of the module, students are expected to be able to work independently and in a group, process selected topic of the course using available Web 2.0 tools, select the appropriate Web 2.0 tool to solve specific task and use Web 2.0 tools in the learning processes in other courses during their study. To facilitate the achievement of these learning outcomes, several optional e-tivities were designed in line with constructivism as a theory of learning. According to constructivism, students are expected to actively participate through the creation of their own version of the course content [10]. E-tivities were introduced to the course learning design to enable students to revise the course content (by rewriting topics from the field of electrical engineering) and expand their knowledge thus preparing for the final test. It was taken into account that Web 2.0 tools for designed e-tivities (Diigo, MindMeister, SlideShare and Wikispaces) are appropriate for the course content.

Activity workflow of the learning module *Web 2.0 assignment* is shown in Figure 1. After initial instructions, students had to chose partners to work with in a group by accepting the recommendations given by the ELARS system, or they could choose to ignore these recommendations and select collaborators using their own preferences. A list of potential students-collaborators was determined on the basis of similarities between students (data regarding their learning styles and final grades from the course *Electrical Engineering 1*). Each group then appointed a representative who, in agreement with other members, performed a selection of one of the offered optional e-tivities. To enable automatic activity level estimation, students also had to enter their user identities and feeds related to the corresponding tool and created content.

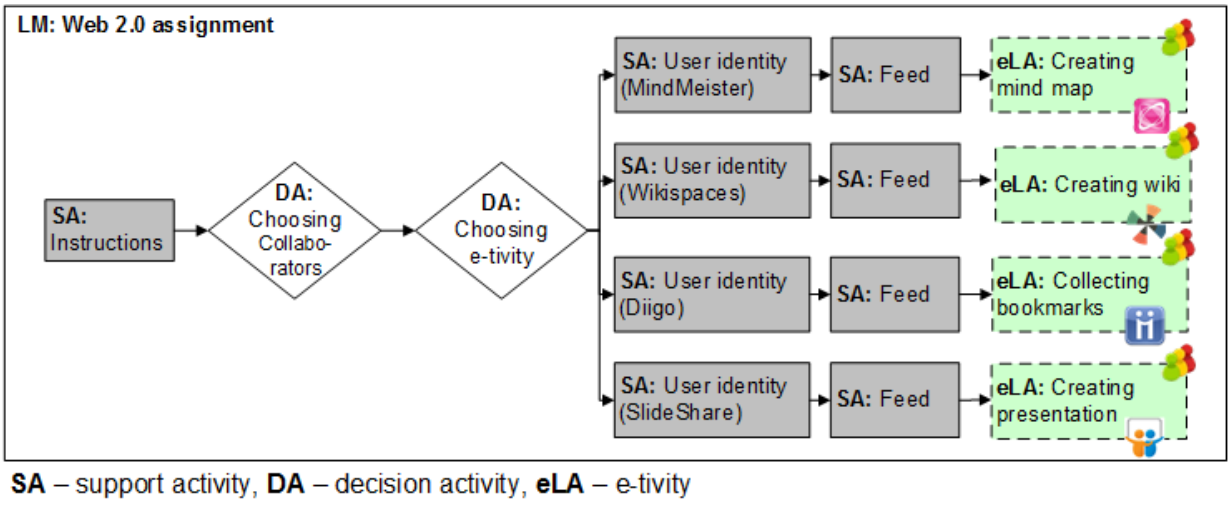

Figure 1 – Activity workflow of the *Web 2.0 assignment* learning module.

Within this new learning module, students had the opportunity to work in teams and experience problem solving and project-based learning. Project-based learning in the technical courses shares a great number of characteristics with the e-learning based on the technologies of Web 2.0 tools (such as creativity, collaboration, personalization, flexibility, etc.). In this way, the introduction of e-learning based on Web 2.0 tools and motivating students to incorporate it in their learning process is a logical upgrade of the learning process within the courses with technical content. The assignment became a part of the final exam. Students could gain up to 10 points depending of the quality/quantity of their contribution in chosen e-tivity and up to 20 points on written test.

RESEARCH RESULTS AND DISCUSSION

Results of the survey (mean value and standard deviation) are shown in Table 1. Although the number of students is relatively small and the results are not statistically significant, it is possible to identify trends and guidelines for the further research.

For *Web 2.0 assignment* students formed four groups of five students. Given that students were allowed to freely choose the collaborators to work with, and also to freely choose between four offered e-tivities they decided to select e-tivities that should be performed by SlideShare or Wikispaces (none of the groups chose the other two). Obviously, when choosing their choices were based on the Web 2.0 tools that were previously known to them. Their choices can be attributed to the lack of previous experience in the use of Web 2.0 tools for the e-learning activities, which is an indication that the additional motivation for students to use Web 2.0 tools is definitely needed.

During their work on the *Web 2.0 assignment*, it was observed that the part of the students had minor problems with meeting the formal procedures described to them (problems with entering correct user identities, tagging their works, etc.). These problems were solved during the process and did not impact the obtained results. The main problem which was observed was discontinuity in students work on the *Web 2.0 assignment.* The results of monitoring through ELARS showed that students have concentrated their work at the end of the time period assigned for the completion of the *Web 2.0 assignment* thus failing to use the entire available time. Possible explanation for that is in the way that students organize their own time dedicated to their studies (probably they were working on other assignments given to them in other courses). However, the trend of non-continuous work on assignments, and using only the end period of the available time interval for completing tasks is also observed in their other assignments (it can be concluded that this is their usual way of learning and completing assignments they are given).

From the results shown in Table 1 it can be observed that most of the students perceived their experience either as overall positive or overall negative. The distribution of responses indicates that almost equal number of students chose to agree or to disagree with the given statements. Questions in which students were in their answers virtually united are related to the possibility of allowed freedom (free choice of partners to work with, tasks and Web 2.0 tools) as well as automatic monitoring of their work in relation to their privacy. These results suggest that this is the part of the research that is well-designed and acceptable to the vast majority of students. On the other hand, since they have rated the given instructions about the system with average score of 3.07, it will certainly be necessary to improve these instructions for future generations of students.

Since the main objective of the study was to motivate students to use Web 2.0 tools in their learning process, and just on that answer students gave the lowest average grade of 2.93, it is interesting to look at their written comments to this question. A number of students highlighted that they would like to use Web 2.0 tools in the learning process but would like to have enough (prior) experience in using them as not to lose time to learning about them at the same time when they have to work on other assignment related to the course content. Therefore, further efforts should be taken to prepare students for using

Web 2.0 tools in the beginning of the learning processes. This should enable students to concentrate their work efforts on the content of the course and to use Web 2.0 tools as familiar tools intended to assist them in their learning process, thus not perceiving them as additional workload.

Web 2.0 assignment was graded as an independent part of the course activity. Average grade for all students were 85,00% with 65,00% of students achieving excellent (A) grade. Overall average grade for the course will be known at the end of academic year after all students pass their final exam (at the time of writing this paper, average grade is 2,82 for students that have finished this course).

Table 1 - Anonymous questionnaire results (N=15).

Question	Avg	StDev
Using Web 2.0 tools as part of the course is a positive learning experience	3,21	0,84
Given instructions for use of the ELARS are clear and understandable	3,36	1,05
ELARS system is easy to use	3,79	1,38
ELARS user interface is simple and functional	3,64	1,05
The method for determining my Web 2.0 tools preference is well designed	3,64	1,11
Recommending collaborators on the basis of the Initial test, VARK questionnaire and preferences of Web 2.0 tools is good	3,64	0,84
It is good to have the freedom to choose collaborators, topics and Web 2.0 tools for working on the *Web 2.0 assignment*	4,86	0,79
ELARS adequately helps in the selection of collaborators for working on the *Web 2.0 assignment*	3,43	1,13
ELARS appropriately encouraged me to actively participate in Web 2.0 activities	3,64	1,11
Using ELARS positively affected the level of my involvement in the development of *Web 2.0 assignment*	3,86	1,23
Automatic data collection of my activities does not violate my privacy	4,57	0,65
Automatic data collection influenced my motivation in making *Web 2.0 assignment*	3,79	1,17

CONCLUSIONS AND FUTURE WORK

This paper presents results of initial research in motivating students enrolled in non computer science courses to actively use Web 2.0 tools in their learning process. The results of a survey conducted before the implementation of the research revealed that students do not tend to use Web 2.0 tools for the purpose of their own education and that if they use them they do not use their advanced but only basic features. To carry out the research previously developed recommender system ELARS was used (system enables students to connect with their colleagues that are similar to them and monitor their work and progress learning environment while using Web 2.0 tools).

Given that the results obtained by conducted research are based on a small number of students they are statistically insignificant but they pointed to several main trends for further research. In addition to upgrading the supporting material in order to achieve better acceptance and ease of use by students, it is a problem of experiencing Web 2.0 tools by students as additional workload that we plan to focus our further research. Also, we will focus on the problem of non-continuous students work and ways in which the recommender system could be used to motivate students to work continuously in order to better organize their time devoted to learning and to achieve better overall learning results.

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