Personalization of e-tivities using Web 2.0 tools and ELARS (E-learning Activities Recommender System)

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Abstract - This paper describes a collaborative learning process using Web 2.0 tools and ELARS (E-learning Activities Recommender System). The Web 2.0 approach stimulated the development of our own e-learning models that can be applied to different types of e-courses. Within the research project "E-learning Recommender System" a didactic model of using Web 2.0 tools in e-learning activities was developed. Combining LMS with Web 2.0 tools and using recommender system for personalization of activities make our courses at the Department of Informatics and Faculty of Teacher Education much more interested and challenged.

I. INTRODUCTION

New approaches in e-learning are based on teaching model using the constructivist theory of learning. This model is student-centred and it is using various Web 2.0 tools for collaboration, communication, sharing learning materials, tagging, etc. [8].

The learning process that includes social software in e-learning is called E-learning 2.0, due to Web 2.0 tools that are used to enhance the process of learning itself. Web 2.0 tools enable a shift from a distributive to a more collaborative mode in e-learning. In particular, the ease of use and simplicity of Web 2.0 technologies allow creating learning environments, which can realize activity-rich pedagogical models and facilitate students' development of competences [14].

Today students enter institution with some experience with Web 2.0 tools such as wikis, blogs, YouTube, Facebook, but they lack an awareness of how those tools can be used for learning [5]. Siemens and Matheos [15] suggested two trends in education: learners have freedom to access, create and recreate their learning content, and they have opportunities to interact outside of a learning system.

Student-centred didactical models presents the work in progress as part of the research project "E-learning Recommender System" with main goal to develop didactical models for realization of e-learning courses in Moodle based learning management system MudRi, supported by Web 2.0 tools and ELARS (E-learning Activities Recommender System). These courses will, besides the usual activities supported by LMS, include personal collaborative e-learning activities (e-tivities).

The second part of this paper describes the e-learning 2.0 process. The third part is explaining building parts of the model: e-tivities, Web 2.0 tools and ELARS recommender system. The fourth part gives overview of the "E-Learning Recommender System" project. The last part brings conclusions and future work plans.

II. E-LEARNING 2.0

While the first generation of e-learning has been oriented on distributing learning materials and modest communication between the participants of learning process, e-learning 2.0 includes changes that facilitate participation in learning as well as interaction and collaboration between students rather than continuous focus on subject matter knowledge.

E-learning 1.0 was based on the idea that teaching is transmissive task. Teacher present topics, distribute learning materials, and communicate with students about those learning materials. E-learing 2.0 emphasises the proactive role of the students. Learning is perceived as an interlinked social process, in which students use Web 2.0 tools to develop learning outcomes. They do not only use the already distributed learning materials, but also collaborate and extend their learning activities to open content on the internet [13, 14].

Many students did not traditionally participate in any decisions relating to their learning environment. E-learning 2.0 enables students to choose, create, share and publicize their learning materials [5]. Students are actually building their own personal learning environments not only with collecting (consuming) the learning materials but also with producing a significant amount of learning content [11].

While considering the pedagogical aspects of e-learning, it is necessary to include elements that comply

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with different theories of learning: behaviourism, cognitivism and constructivism. However, e-learning 2.0 promotes constructivism according to which students should be active participants who do not remember teaching materials literally, but create their own versions of the course content by exchanging views and opinions with their colleagues [6, 10]. The teacher is still an important participant of that process, although his/her main task is no longer transmitting the knowledge but guiding students in the process of acquiring knowledge [6].

The process of designing the e-learning 2.0 environments is grounded in socio-cultural learning, which is in a constant cognitive development with the power of dynamic social interaction. Cognitive learning focuses on learning processes and development trough creating, editing and remixing learning content socially and collaboratively [3].

From technological aspects, e-learning 2.0 can be supported with combination of functionalities of an LMS that are equal for all users, and appropriate third-party services available on the Web [6, 7]. Thus, the environment for e-learning 2.0 consists of a set of tools. Different students can use different tools and create their own personal learning environments (PLE) [6]. According to Attwell [1] and Costello and Shaw [4], PLE is not a specific tool, but rather a way of organizing resources. Although today Web 2.0 tools usually have a central place in PLEs, it can also be comprised of learning materials, peers, hardware, and other components that allow students to collect, process and share information and knowledge [8].

Today students need more than simply consuming the offered learning materials. They should be provided with challenging situations instead of ready-made instructions that are put in rigid and closed environments [16]. With PLE the learning outcomes change from knowledge acquisition to competence development, making students more motivated and satisfy.

III. USING WEB 2.0 TOOLS AND RECOMMENDER SYSTEM FOR E-TIVITIES

Didactical models developed during the research presented in this paper are in line with the e-learning 2.0 approach and are based on collaborative e-tivities. Web 2.0 tools enable realization of different e-tivities and therefore, represent one of the building parts of our didactical models. In addition, the personalization of e-tivities is achieved using the educational recommender system ELARS which extends the environment for e-learning.

A. E-tivities

An e-tivity is the interaction of a student with other students using specific tools [17]. It is achieved through completion of a task and oriented towards specific learning outcomes that should be achieved [8]. The components that constitute such activity are: the context within the activity occurs (the subject, the learning outcomes, and the environment within which the activity takes place), the pedagogy adopted (learning and teaching approaches) and the undertaken tasks. The task specifies the type of task, the resources (e.g. teaching and learning materials, tools), the interaction and roles of the participants involved (e.g. work in pairs or groups) [6].

Teacher, as an important participant of the e-learning process, designs a task. The task defines required learning materials, tools that can/should be used for e-tivity and mode of interaction between participants. For e-learning 2.0 more significant are e-tivities where the task is group-based and involves collaboration [6]. Besides defining a task, teacher should also support students during the e-tivity in order to encourage them for participation and collaboration with their peers.

B. Web 2.0 tools

Web 2.0 tools are shifting the e-learning process to personal learning environments (PLE) where students can organize and collect learning resources on their own way [1]. Depending on task, an e-tivity can be performed with one or more tools, which means that it is not necessary that all students use the same tools.

In the current stage of our research, developed didactical models include one of the nine Web 2.0 tools [8], described in the reminder of this section.

Blogger is a tool for publishing blogs. The characteristic of blog is commenting, tagging and linking. In the majority of blogs, visitors are allowed to write comments under each entry. This enables exchange of views between the author on the one hand and a group of people who all contribute by writing comments on the other. In order to facilitate subsequent retrieval of published records and searching similar content, records can be bookmarked by specifying keywords that categorizes the entry. Blogs can be individual or collaborative and connected in groups' topic. In e-learning environment, blogs can be used as a personal journal for learning. Students can independently express their opinions on learning materials as well as conclusions from learning.

Diigo is a tool for collecting and organizing bookmarks and other resources. In e-learning, it can be used for organizing and sharing favourite internet resources about learning topics. One of the goals is to create a common review on the teaching content.

Flickr is a tool for photo management and sharing. Some of the key elements of the Flickr are tags, common clustering and ranking of interesting facts. Students can store, organize and view photos within the group or individual e-tivities.

Google+ is a tool for social networking, sharing and communication. It can be used in e-learning with its *Circles* application that allows creating a group of users who can actively engage in the creation of content for the Web and participate in publishing and exchanging of learning materials working together. Furthermore, Google+ provides the tool called *Sparks*. This tool is looking for videos and articles that it considers interesting for the user. This service enables the teacher and students to monitor the current issues that can be applied in the

teaching process and update their knowledge of the potential new findings related to the topic.

Google Drive is a tool for creating and sharing documents (textual documents, spreadsheets, presentations, forms). Those applications allow students to create and edit documents online while collaborating with each other in real-time.

MindMeister is a tool for online mind mapping and brainstorming. A mind map is the most common teaching aid in all educational areas. During e-tivities, students can use this tool for presentations, for the purpose of allocating tasks, graphical explanation of concepts, for reviewing topics, to prepare for the assessment, the exchange of ideas and information and simultaneous work on the map.

SlideShare is a tool for sharing presentations. In e-learning, using this tool students can cooperate at the local level but also with a virtual community where they can make, share and collect teaching content.

Wikispaces is a tool for creating wikis. Wiki is very well suited to support collaborative online learning since it fosters collaborative writing. Therefore, it can be used in various forms to fit into e-tivities in which students need to summarize subject matter in a written form, present results of conducted WebQuest and similar.

YouTube is a tool for editing and sharing videos. As one of the most popular media tools YouTube has vast application in the teaching process. In e-learning environments, textual materials can be enhanced with animations and video content. In addition to the publication of teaching materials in videos, it can be used for displays of various examples, instructions, guest speakers recording, multimedia presentations, etc.

C. ELARS recommender system

Within this research a recommender system ELARS (E-Learning Activities Recommender System) was developed. It provides personalization in the context of collaborative e-tivities realized using Web 2.0 tools [7].

Recommender system is used in parallel to LMS and Web 2.0 tools [8]. Students use LMS to read previously prepared materials for learning, to get instructions, to communicate with each other and with the teachers and Web 2.0 tools to perform e-tivities. They use ELARS system, as a third component of the e-learning environment, to read recommendations before and during e-tivities.

Recommendations are generated based on several characteristics: student's learning styles, Web 2.0 tools preferences, knowledge level and activity level. Learning styles and tools preferences are collected explicitly using the feedback from users. Data regarding the other two characteristics are collected implicitly. Knowledge level is automatically calculated according to the results of (online) tests, while activity level is automatically estimated based on the data about students' interaction with the Web 2.0 tools. Activity level represent quantity and continuity of student's contributions relatively in respect to others students and group's contributions relatively in respect to other groups. The important part of our research are novel procedures for assessing student's (group's) activity level based on data collected from Web 2.0 tools.

Data regarding students' characteristics, including activity level, are used in recommendation rules in order to recommend possible students-collaborators, Web 2.0 tools or optional e-tivities, as well as to generate advices regarding participation in e-tivities [8].

IV. E-LEARNING RECOMMENDER SYSTEM PROJECT

Development of didactical models that can be applied to different types of e-courses was conducted within the research project "E-learning Recommender System".

A. Goals and Tasks

The purpose of the research was to improve the quality of higher education by introducing innovative computer technologies in the processes of teaching and learning and the promotion of new pedagogical approaches of e-learning 2.0 through the presentation of case studies.

The project included activities to meet specific objectives of the research:

- the development of algorithms and model of recommender system and its implementation
- the development of new models of learning based on collaborative learning and developed recommender system,
- the educational design with e-activities for different types of courses that will be realized in practice with the support of the recommender system,
- the designing the recommendations for the implementation of the developed didactical models and recommender system in the context of higher education.

B. Didactical models

Our didactical models are based on observing the process of e-learning as a sequence of (collaborative) e-tivities, on using Web 2.0 tools for their realization, and on using recommender system for personalization of e-learning process according to student's characteristics [8].

Research provides scientific innovation in the field of e-learning with technological and pedagogical aspects. The recommender system, as one of the main results of the project, was used to determine personalized recommendations for the students in performing a sequence of collaborative e-activities with the help of learning management system and Web 2.0 tools.

In this way, with a new approach to the use of computer technology to support education, research promotes new pedagogical approaches that emphasize the need for collaborative learning and are based on the performance of e-activities.

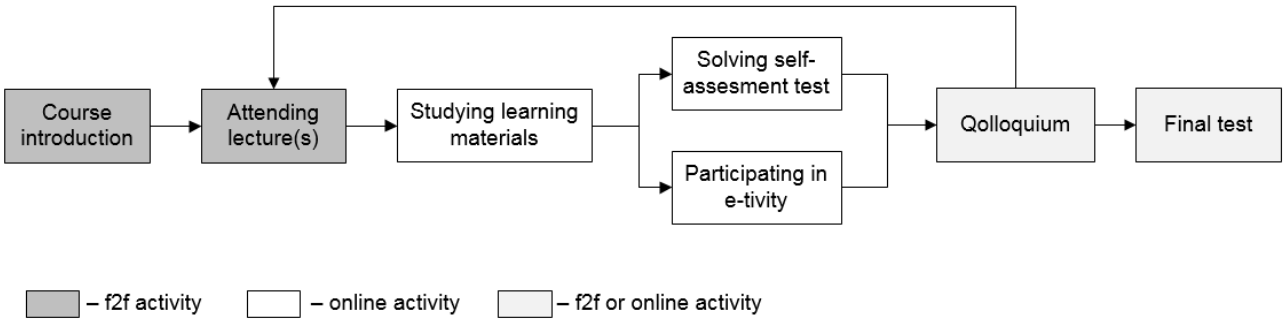

Figure 1. Course design by sequence of activities

It is expected that the application of the above mentioned learning model in practice result in increased performance and motivation of students which will be evaluated in the context of different types of e-courses that are conducted: face-to-face (f2f) courses with online available contents, mixed mode (blended learning) and fully online courses. For the purpose of the project some of e-learning courses in Moodle based LMS MudRi on University of Rijeka were adopted. The courses workflow includes individual and group-based e-tivities that are realized using Web 2.0 tools. The approach was used for two e-courses at the Department of Informatics ('Hypermedia in education' and 'Operational research') and currently is used for one e-course at the Faculty of Teacher Education ('Extracurricular informatics and technical activities'), University of Rijeka, Croatia.

During blended learning courses, a course introduction is followed by sequence of activities that are realized in f2f or online environment. These can, as shown in example presented on Fig. 1, include lectures in f2f environment in order to present subject matter to students. Students are usually required to study prepared learning materials that are available in LMS. Sometimes, students have opportunity to test their knowledge using online tests for self-assessment. In addition to self-assessment tests, e-tivities can also be used to ensure formative assessment before colloquiums. Depending on number of topics covered by the course, such sequence can be repeated. At the end, students' knowledge can be assessed using final test.

Personalization provided by the ELARS system is based on course learning design that describes the sequence of course activities. Between course activities, e-tivities (eLA) are the most important. Activities sequences can also contain f2f activities (FA), learning content activities (CA) and testing activities (TA). Besides that, it should be stressed out that planning e-tivities often requires planning additional e-tivities that are not directly oriented towards achievement of learning outcomes, but support the organization or personalization of e-tivities. Those are support activities (SA) and decision activities (DA).

ELARS system recommends collaborators if corresponding e-tivity is group-based. The system recommends the most appropriate tool for student or group to fulfil the aim of e-tivity if more than one tool is offered for its realization. Optional e-tivities are recommended when students are allowed to choose between several e-tivities and advice is offered during e-tivities, in order to encourage students to reach higher activity level. To enable this, the original recommendation model is developed.

Fig. 2 presents a didactic model with activities sequence that precedes the collaborative e-tivity personalized using ELARS recommender system. Before an e-tivity starts, students should get instructions with description of task they are supposed to do and other details relevant for the realization of the e-tivity (is it individual or group-based, duration, evaluation criteria, etc.). For that purpose, support activity is used.

In order to achieve personalization using recommendations, decision activities should be planned. If the e-tivity is group-based, collaborators recommendations are presented to students within corresponding decision activity in ELARS systems. Similarly, if there are several tools offered for the realization of the e-tivity, tools recommendations are presented. During e-tivity, additional support to students is provided in a form of advice regarding quantitative aspects of students' engagement. Therefore, students need to enter input data to the ELARS system in order to enable activity level calculation and advice generation. E-tivity can be followed by presentation of students' results in f2f environment.

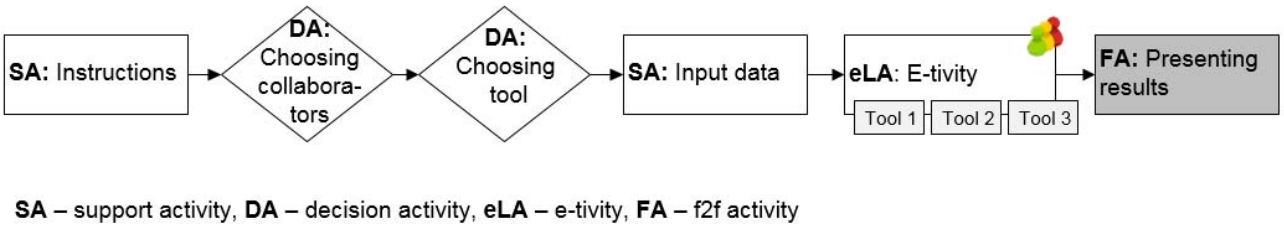

Figure 2. A didactic model of one e-tivity

C. Evaluation

The educational verification of e-learning model is in the progress, as well as the recommender system impact on student's performance in e-tivities.

We are now in stage of final evaluation that is conducted in order to determine the impact of the recommender system on student's performance during e-tivities and how collaboration affects the learning process itself. Before this final evaluation, several components were already tested. Selected Web 2.0 tools were previously used within e-learning courses. They found to be reliable, and that their performance matches the expectations and needs in practice [8]. Validation of the algorithms for assessing student's (group's) activity level was also conducted with aim to determine to what extent obtained values match the actual state [8].

Our goal is to determine whether proposed didactical models increase student's effectiveness and motivation for e-tivities included in e-courses. In addition, students' satisfaction with received recommendations will also be examined using questionnaires.

V. CONCLUSIONS

Development of didactical models described in this paper was enhanced with LMS, Web 2.0 tools and E-Learning Activities Recommender System - ELARS. Such e-learning environment is based on e-learning 2.0 approach that emphasize the need for including collaborative e-tivities in e-courses learning design.

Our future work will focus on creating didactical models for different types of higher education e-courses. In doing so, the extent of using f2f/online learning will be taken into account as well as number of students - a factor that could affect the realization of e-tivities. Since e-tivities included in the models are personalized with the ELARS recommender system further efforts will be made to improve the system. This include additional experiments to evaluate recommendation algorithms and making ELARS web application in line with the responsive web design, so it can be used on different devices, from desktop computer to smart phones. The recommender system will be open source coded and implemented to support large number of users via cloud service.

Project outcomes and results, including the examples of good practice, will be presented on the website. This will enable all interested parties to be acquainted with the developed models and facilitate their use in the broader academic community.

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